Initial Environmental Examination

Project Number: 38272-044
October 2021

India: Uttarakhand Integrated and Resilient Urban Development Project – Development of Water Supply, Sewerage and Storm Water Drainage System at Banjarawala - Package 2 (Part A)

Package UIRUDP: WS&S-DDN-02

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CURRENCY EQUIVALENTS

(as of 21 October 2021)

Currency unit	–	Indian rupee (₹)
₹1.00	=	$0.0133
$1.00	=	₹74.82

ABBREVIATIONS

ACM	–	Asbestos containing Material
ADB	–	Asian Development Bank
ASI	–	Archaeological Survey of India
BOCW	–	Building and Other Construction Workers
BOD	–	Biological Oxygen Demand
CAMP	–	Comprehensive Asbestos Management Plan
CAPP	–	Community awareness & Public Participation
CGWB	–	Central Ground Water Board
CI	–	Cast Iron
CLC	–	City Level Committee
CPCB	–	Central Pollution Control Board
CPHEEO	–	Central Public Health and Environmental Engineering Organization
CTE	–	Consent to Establish
CTO	–	Consent to Operate
DBO	–	Design-Build-Operate
DBOC	–	Design-Build-Operate Contractor
DI	–	Ductile Iron
DPR	–	Detailed Project Report
DSC	–	Design and Supervision Consultant
DWC	–	Double Walled Corrugated (Pipe)
EHS	–	Environmental Health and Safety
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan
ESMC	–	Environmental & Social Management Cell
FAO	–	Food and Agricultural Organization
FCO	–	Fertilizer Control Ordinance
FSSM	–	Fecal Sludge and Septage Management
GOI	–	Government of India
GOU	–	Government of Uttarakhand
GLSR	–	Ground Level Service Reservoir
IA	–	Implementing Agency
IEE	–	Initial Environmental Examination
IFC	–	International Finance Corporation
IPMC	–	Investment Program Management Consultant
IPMU	–	Investment Program Management Unit
ISPS	–	Intermediate Sewage Pumping Station
JNNURM	–	Jawaharlal Nehru National Urban Renewal Mission
LPCD	–	Litres per Capita per Day
LSGD	–	Local Self Government Department
MCFT	–	Million Cubic Feet
MCM	–	Million Cubic Meter
MLD	–	Million Litres per Day

MOEF&CC	–	Ministry of Environment, Forest and Climate Change
NGO	–	Non-Governmental Organization
NGT	–	National Green Tribunal
NHAI	–	National Highways Authority of India
NOC	–	No Objection Certificate
OHSR	–	Overhead Service Reservoir
O & M	–	Operation and Maintenance
OD	–	Outer Diameter
PHED	–	Public Health Engineering Department
PIU	–	Project Implementation Unit
PMU	–	Project Management Unit
PMDSC	–	Project Management and Design and Supervision Consultant
PWD	–	Public Works Department
RCC	–	Reinforced Cement Concrete
REA	–	Rapid Environmental Assessment
RoW	–	Right of Way
SCADA	–	Supervisory Control and Data Acquisition
SIP	–	Service Improvement Plan
SBR	–	Sequential Batch Reactor
SEIAA	–	State Environmental Impact Assessment Authority
SPS	–	Safeguard Policy Statement, 2009
STP	–	Sewage Treatment Plant
SWM	–	Solid Waste Management
TOR	–	Terms of Reference
UDD	–	Urban Development Department
UEPPCB	–	Uttarakhand Environmental Protection & Pollution Control Board
UJS	–	Uttarakhand Jal Sansthan
ULB	–	Urban Local Body
UPJN	–	Uttarakhand Pay Jal Nigam
UUSDIP	–	Uttarakhand Urban Section Development Investment Program
WHO	–	World Health Organization

WEIGHTS AND MEASURES

^{o}C	degree centigrade
dB	Decibels
dia	diameter
kg	kilo gram
Kl	kilolitre
km	kilometre
kmph	kilometre per hour
ha	hectare
HP	Horse Power
LPCD	litres per capita per day
lps	litres per second
m	meter
m^3	cubic meter
mg	milligram
mm	millimetre
mcm	million cubic meter

sq.km	square kilometre

NOTE

In this report, "$" refers to United States dollars.

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EXECUTIVE SUMMARY

The proposed Uttarakhand Integrated and Resilient Urban Development Project (UIRUDP) aims to improve universal and equitable access to safe and affordable drinking water, and access to adequate and equitable sanitation and hygiene for all ending open defecation. The outcome of the project is reliability and efficiency of water supply and sanitation services in Dehradun and Nainital enhanced. The Department of Urban Development (UDD), Government of Uttarakhand is the Executing Agency (EA) and Uttarakhand Urban Sector Development Agency (UUSDA) is the Implementing Agency for the UIRUDP. The project has the following four outputs:

(i) **Output 1:** Water supply system and service in Dehradun improved.
(ii) **Output 2:** Integrated sanitation systems and drainage enhanced in Dehradun and Nainital.
(iii) **Output 3:** Computerized maintenance and management systems (CMMS) for water and sanitation developed and implemented in Dehradun and Nainital.
(iv) **Output 4:** Project management, institutional capacity and knowledge strengthened.

Dehradun, the capital of Uttarakhand, is the most populous city in the state and experiencing unprecedented urban sprawl. City limits were expended in 2018 from 64.6 square kilometer (km^2) to 196.48 km^2, over 3 times. Municipal wards increased from 61 to 100, and zones increased from 6 to10 Zones, and the population from 569,578 (2011) to 803,983 (2018). Nainital is the judicial capital of Uttarakhand. Set in a valley of steep mountains around Naini Lake, it is a highly popular hill station and tourist destination in India. Estimated population of Nainital (2020) is about 60,000, increased by 50% from 41,377 in 2011.

Under outputs 1 and 2, it is proposed to improve water supply, sewerage, sanitation, and storm water drainage in some newly added wards in Zone 1, Zone 7 and Zone 8 of Dehradun. Works are organized into 5 contract packages – 1 each in Zone 1 and Zone 8, and 3 in Zone 7. Sewerage works proposed in Nainital, proposed sewerage works are organized into a single contract package. All the packages will be implemented under design-build-operate (DBO).

In Dehradun City. Dehradun city is divided into ten (10) sewerage zones. Zone 1 to 6 cover the old municipal areas, and zone 7 to 10 cover added areas. In Zone 7, in southern periphery it is proposed to improve water supply, sanitation, sewerage, and drainage infrastructure in Kedarpur, Banjarawala and Mothrowala wards. These works in Zone 7 are divided into three DBO contract packages: (i) Banjarawala Package 1 – covering part of ward 85 (Mothrowala), (ii) Banjarwala Package 2 – covering part of ward 83 (Kedarpur) and ward 85 (Mothrowala), and (iii) Banjarawala Package 3 – covering part of ward 83 (Kedarpur) and ward 84 (Banjarawala). All the three packages include water supply, sewerage and sanitation, in respective areas, the Package 1 additionally include a sewage treatment plant (STP) that will serve all the areas covered in 3 packages. This IEE is prepared for Package 2.

Existing infrastructure status. Piped water supply system is available in Package 2 area (spread over 3.59 km^2), and service is provided intermittently at a rate of around 110 liters per capita per day (lpcd), for about 4 to 6 hours a day, which is below the water supply norms. Groundwater is the source of water. Existing pipelines (cast iron, galvanized iron, and PVC) are old, laid more than 25 years back, and have high leakages. There is no sewerage system, most of the households depend on septic tanks. Effluent from septic tanks and sullage is let off into open drains which collect in low lying areas and natural drains and ends up in Bindal River in the outskirts of the town. Although there are roadside drains in some parts, there is no planned or proper storm water drainage system. Most of the existing drains are in poor condition and are

filled with garbage, debris and silt. In the absence of sewerage system, the sewage is being discharged into roadside drains resulting in water pollution. The existing water supply, sewerage and drainage system in the subproject area is inadequate. In the absence of basic infrastructure facilities, the people of Package 2 subproject area of Dehradun are facing unhealthy and unhygienic conditions, therefore, public representatives are also demanding safe and improved water and sewerage system along with drainage system on priority basis.

Proposed subproject. It is proposed to improve water supply, sewerage and storm water drainage systems in the subproject area to meet the present and growing demand and improve the service levels. Under water supply, it is proposed to develop additional water source (tube wells), treatment, pumping, and distribution facilities to provide 3.87 MLD of water to meet ultimate design year (2051) demand. Sewerage system will be provided in a combination of underground sewerage system and FSSM system. It is estimated that 3.19 MLD of sewage (2051) will be generated in the subproject area, collected via sewer network, and will be conveyed to proposed 11 MLD STP to be developed under package 1 of this project. FSSM system will be in areas that are not fully developed at present and/or not feasible to provide sewer system (Dandi Village, Vishnupuram Colony, Shvkunj Colony and Mahalakshmi Pruam Colony). An estimated 1.46 KLD of septage is generated from the FSSM, which will be disposed at existing Kargi STP, developed under the previous ADB funded Uttarakhand Urban Sector Development Investment Program (UUSDIP). Under the storm water drainage, new storm water drains with covers will be constructed alongside secondary municipal roads to collect, transport, and discharge the runoff safely during the rains. Proposed subproject components are:

(i) Water supply. (a) installation of tube wells (3 nos), (b) disinfection (chlorination) unit at the outlet of each tube well, (c) construction of two over-head tanks (OHT) of 650 kilo liter (kl) and 800 kl capacity, (d) installation of 60 kilometer (km) water supply network (100 - 450 mm diameter), (e) 1,950 new house service connections, (f) rehabilitation of existing tube wells and OHT, and (g) SCADA and GIS systems

(ii) Sewerage. (a) installation of 45 km sewers (44 km, 225 - 355 mm diameter, and around 1 km 350-700 mm diameter) including 1,950 manholes, (b) 1,650 household sewer connections, and (c) FSSM system – septic tanks and mobile tankers with suction and discharge arrangements for collection from septic tanks and convey to Kargi STP

(iii) Storm water drainage. (a) installation of 30 km drains with precast covers (reinforced cement concrete, RCC), and (b) development of 10 groundwater recharge pits, and 2 rainwater harvesting structures,

Screening and categorization. ADB requires consideration of environmental issues in all aspects of the Bank's operations, and the requirements for Environmental Assessment are described in ADB's SPS (2009). The potential environmental impacts of the subproject have been assessed using ADB Rapid Environmental Assessment (REA) Checklist. The proposed project is not likely to have any significant adverse environmental impacts that are irreversible, diverse, or unprecedented. Potential impacts are mostly site-specific and in most cases mitigation measures can be designed with uncomplicated measures commonly used at construction sites and known to civil works contractors. Therefore, the project is classified as Environmental Category "B" per ADB SPS and mandated preparing Initial Environmental Examination (IEE) Report. Per the Government of India regulations, this subproject does not fall under the ambit of Environmental

Impact Assessment (EIA) Notification, 2006, and therefore do not require an EIA study or Environmental Clearance (EC) from state- or central level agencies.

Description of the Environment. Dehradun City is situated in the Doon Valley on the foothills of Himalayas, at an average elevation of 640 m above the mean sea level. This subproject area (Banjarawala Package 2) is located in southern outskirts of the city's newly expanded municipal area, comprising municipal wards of 83 (Kedarpur) and 85 (Mothrowala). Rispana River flows through subproject area and meets Bindal River. Subproject area is predominantly plain and surrounded by hilly forested areas in the south, southeast and west. There are few low-lying pockets. Area is sloping towards south and west, and ultimately drains into Bindal River. Climate of Dehradun is humid subtropical. City experiences heavy to moderate rains, and average annual rainfall is 2073 mm, mostly occurs in southwest monsoon season of June to September. Subproject locations are mostly along the roads and small parcel of vacant land in this developing urban peripheral area, where there are no remaining natural habitats. Hilly and dense forested areas (eg Lachchiwala Range) are situated outside the municipal area towards south. The closest protected area is Rajaji National Park, situated about 3-4 km southwest. There are no forest or protected areas within the subproject area, and it does not fall under any buffer or eco sensitive zone. Screening via Integrated Biodiversity Assessment Tool (IBAT) indicate presence of various protected areas and key biodiversity areas within 50 km radial distance; however, none are located close to the subproject area. There are no notable or notified historical, archeological or heritage sites or places. Tube wells and OHTs are proposed in the existing water supply campuses. Sites are vacant, no notable vegetation.

Potential Environmental Impacts and Mitigation Measures. Draft IEE identifies negative impacts in relation to location, design, construction and operation of the improved infrastructure. The project is unlikely to cause significant adverse impacts that are irreversible, diverse or unprecedented because: (i) proposed components will involve construction works with minimal impacts and it is very much localized. (ii) project area is mostly urban and peri urban nature, and (iii) predicted impacts are site-specific and likely to be associated with the construction process. Environmental impacts as being due to the project design or location are not significant. Various measures are included in site planning and preliminary design. Groundwater availability is good and as per the Central Groundwater Board (CGWB), the area is considered "safe" for abstracting and utilizing groundwater. Further groundwater studies will be conducted by Contractor during the detailed design to confirm source sustainability. Water quality is also good and can be safely utilized for drinking after disinfection. Water quality tests will be conducted and ensured that quality meets drinking water standards, The collected sewage from the subproject area will be conveyed to STP of 11 MLD capacity proposed under Banjarawala package 1 of this project. Location of septic tanks will be finalized during the detailed design, and these will be constructed as water sealed to avoid any leaching and contamination of groundwater. Collected septage will be transported to existing and operational 68 MLD Kargi STP. Preliminary environmental audit indicates compliance with statutory requirements.

Construction will have adverse, but temporary, impacts arising mainly from the disturbance to residents, businesses and traffic due to construction work; safety risk to workers and community, dust and noise, public and nearby buildings due to deep trench excavations in the road; access impediment to houses and business, disposal of large quantities of construction waste etc. These are all general impacts of construction in urban areas and there are well developed methods of mitigation that are suggested in the EMP. At main roads and river/stream crossings, and for laying sewers more than 6 m deep will be done via trenchless method to minimize impacts. Once the water supply, sewerage/septage and storm water drainage system is operating, the facilities will operate with routine maintenance, which should not affect the environment. Improved system

operation will comply with the operation and maintenance manual and standard operating procedures to be developed by the contractor.

Environmental Management Plan (EMP). An Environmental Management Plan (EMP) has been developed to provide mitigation measures to reduce all negative impacts to acceptable levels, along with the delegation of responsibility to appropriate agency. Various design related measures are already included in the project preliminary design, which will be further fine-tuned as required during detailed design. For construction, the EMP includes mitigation measures such as (i) proper planning of construction works, especially linear works, to minimize the public inconvenience; (ii) barricading, dust suppression and control measures; (iii) traffic management measures for works along the roads and for hauling activities; (iv) provision of walkways and planks over trenches to ensure access will not be impeded; (v) occupation and community health and safety including COVID-19 health and safety measures and (vi) finding beneficial use of excavated materials to extent possible to reduce the disposal quantity. EMP will guide the environmentally-sound construction of the subproject. EMP includes a monitoring program to measure the effectiveness of EMP implementation and include observations on- and off-site, document checks, and interviews with workers and beneficiaries.

This draft IEE and the corresponding EMP will be included in the bidding and contract documents, which will be updated during the detailed design. The contractor will be required to submit to PIU/PMU, for review and approval, a site-specific environmental management plan (SEMP). No works will be allowed to commence until SEMP is approved. A copy of the EMP/approved SEMP will be kept on site during the construction period at all times. EMP will also ensure efficient lines of communication between PIU/ULB, PMU, consultants and contractor. Non-compliance with, or any deviation from, the conditions set out in this document shall constitute a failure in compliance.

To monitor the operation stage performance, there will also be longer-term surveys to monitor quality of supplied water, implement regular monitoring of the sewerage and drainage system in order to ensure that it is functioning well along with the project agency responsible for such actions, form part of the Environmental Management Plan. A CRVA study is being done for the project and its recommendations shall be included in the project design.

Consultation, Disclosure and Grievance Redress. The stakeholders were involved in developing the IEE through discussions on-site and a public consultation workshop at city level, after which views expressed were incorporated into the IEE and in the planning and development of the project. Apart from on-site public consultations, a stakeholder meeting was held and CLC has appreciated and approved the subproject. The IEE will be disclosed on ADB and UUSDA websites. The consultation process will be continued and expanded during project implementation to ensure that stakeholders are fully engaged in the project. A grievance redress mechanism (GRM), described in IEE, will ensure public grievances are addressed timely.

Implementation Arrangements. UUSDA will establish a Project Management Unit (PMU) in Dehradun and two Project Implementation Units (PIUs) in Dehradun and Nainital. PMU is headed by Program Director (PD) will implement the project. PD is supported by two Additional Program Directors (APD) for technical and administration. A Deputy Project Director (DPD 1) under APD (Technical) will be the focal person for safeguards and GESI implementation and compliance with ADB SPS and will be assisted by a Social Development and Gender Officer (SDGO), an Environmental Officer (EO) and an Information, Education and Communication (IEC) Officer. PIUs, headed by a Project Managers, will be responsible for day-to-day implementation and supervision. A Junior Engineer in each PIU will be designated Assistant Environmental

Officer. PMU and PIUs will be supported by Project Management and Design Supervision Consultant (PMDSC) team in supervision, monitoring and overseeing implementation, policy reforms, and safeguards. Two Environmental Experts in PMDSC will support PMU and PIUs in preparation, implementation and monitoring of all environmental safeguards tasks, and ensure compliance with ADB SPS. Contractors will appoint Environment, Health and Safety (EHS) supervisors to ensure EMP implementation and reporting.

Monitoring and Reporting. The PMU, PIU and consultants will be responsible for monitoring and reporting. During construction, results from internal monitoring by the DBO contractor will be reflected in their monthly EMP implementation reports to the PIU. PIU with the assistance of PMDSC, will monitor the compliance of contractor, prepare a quarterly environmental monitoring report (QEMR) and submit to PMU. The PMU will oversee the implementation and compliance and will submit Semi-Annual Environmental Monitoring Reports (SEMR) to ADB for review and approval. ADB will post the environmental monitoring reports on its website. Monitoring reports will also be posted UUSDA websites.

Conclusions and Recommendations. The subproject is therefore unlikely to cause significant adverse impacts. The potential impacts that are associated with design, construction and operation can be mitigated or minimized to acceptable levels through proper engineering design and by implementing recommended mitigation measures and procedures of EMP. Based on the findings of the IEE, there are no significant impacts and the classification of the subproject as Category “B” is confirmed, and no further study, such as an EIA, is required. To comply with government regulations, subproject require permission to withdraw groundwater and other permissions related to construction. These shall be obtained.

Following **recommendations** applicable to the subproject to ensure no significant impacts:

-
- Include this draft IEE, prepared based on the preliminary designs, in DBO bid and contract documents, and specify that this draft will be superseded by the updated/final IEE based on detailed design after contract award
- Conduct groundwater studies during detailed design and confirm source sustainability
- Follow suggested measures in locating and designing septic tanks to avoid nuisance and water contamination
- Conduct detailed assessment of treatment septage at existing Kargi STP during detailed desgn, and confirm co-treatment efficiency and meeting disposal standards
- Update this IEE during the detailed design, and submit to ADB for approval
- Provide updated IEE and EMP to the contractor for implementation
- Obtain necessary permissions, and consents prior award of contract or start of construction as applicable, and include conditions, if any, in the updated IEE and EMP
- Do not commence works until all preconstruction requirements are met, including: (i) this IEE is updated and approved by ADB, (ii) contractor appointed EHS supervisor, and prepared SEMP and health and safety plan including COVID-19 health & safety plan, and approved by PIU/PMU, (iii) contractor complied with government regulations, and (iv) GRM is established and operationalized.
- During implementation, ensure that EMP / SEMP is implemented as envisaged via regular supervision, monitoring, and timely reporting as indicated in the IEE
- Ensure COVID-19 appropriate behavior and compliance with protocols in implementation per the applicable government regulations and relevant guidelines published by WHO, ILO, ADB etc.,
- Continue consultations with stakeholders, and redress grievances effectively and timely

I. INTRODUCTION

A. Project Background

1. The proposed Uttarakhand Integrated and Resilient Urban Development Project aims to improve universal and equitable access to safe and affordable drinking water, and access to adequate and equitable sanitation and hygiene for all ending open defecation. The outcome of the project is reliability and efficiency of water supply and sanitation services in Dehradun and Nainital enhanced. The project has four major outputs as follows:

2. **Output 1: Water supply system and service in Dehradun improved.** The project will construct around 136 kilometer (km) of water supply networks in newly added wards in South Dehradun, to close the gap of water supply infrastructure. The project will ensure reliable and quality water supply services with a standard norm of 135 liter per capita per day (lpcd); 24 hours a day and 7 days a week (24/7) supply. Around 5,400 household connections will be provided by 2028 with water meters that would allow volumetric billing. Non-revenue water (NRW) in the project area will be reduced from 45–50% to at most 25%, which is higher than the Uttarakhand performance standards. The improved water service will benefit around 40,000 population including about 4,000 urban poor and vulnerable people by 2028.

3. **Output 2: Integrated sanitation systems and drainage enhanced in Dehradun and Nainital.** The project will construct (i) two sewage treatment plants (STPs) with a total treatment capacity of 29 million liters per day (MLD); (ii) around 256 km of sewer networks; (iii) at least 117 km of stormwater drainage networks factoring potential climate risks; and (iv) around 17,410 household sewer connections in Dehradun. This output will benefit about 138,000 population, including around 15,000 urban poor and vulnerable people by 2028. The project will collect, transport, and treat fecal sludge and septage at a proposed STP equipped with a septage cotreatment unit. Combining a centralized sewerage system with decentralized septage management solutions, the project will establish a cost-effective integrated sanitation system in Dehradun. In Nainital, which has 100% sewerage system, the project will (i) replace around 4 km of aging STP1 (17 MLD) trunk and outfall sewers with leaks; and (ii) construct a new STP with a treatment capacity of 17 MLD and 5 prefabricated compact STPs with advanced moving bed biofilm reactor technology, which will have at least 20 kiloliter per day capacity each.

4. Once household are connected to the new centralized sewer system, existing household and community level soak pits in the project areas that would be no longer in use. These soak pits after cleaning and connecting with rainwater capturing system can be re-utilized as groundwater recharge pits. This soak pit reutilization idea introduced by UUSDA will be first kind in India, which is an innovative solution to enhance flood-resilience.

5. With an objective to increase access to quality & affordable sanitation and hygiene services enhancing city-wide sanitation service provision to residents and visitors, UUSDA proposed 20 mobile toilet buses for pilot testing under the UIRUDP. Bus mobile toilets are created by refurbishing and converting old transport buses into integrated sanitation treatment facility. During this pilot period, 10 bus mobile toilets are decorated as pink for female-only: and the other 10 buses as blue for male-only. Such clear segregation would give more comfort with gendersensitive design and safety to women to exercise their sanitation activities. Pink Bus Mobile Toilets will be equipped with spaces for feminine sanitation and hygiene practices. Enhanced use of hygienic and safe sanitation services through pink bus mobile toilets will influence behavior of women towards healthy sanitation practices and hence contribute to positive

health outcomes. Blue bus mobile toilets will also have similar inclusive design features to accommodate men with special and/or other needs.

6. **Output 3: Computerized maintenance and management systems (CMMS) for water and sanitation developed and implemented in Dehradun and Nainital**. To advance the O&M performance and asset management of WSS in Dehradun and Nainital, the project will procure, install, and implement city-wide CMMS for WSS schemes. Using the internet of things, this information and communication technology (ICT)-based platform will communicate with supervisory control and data acquisition (SCADA) and geographical information system (GIS) to provide real-time data and information. It will also provide a range of functions, including but not limited to the following: (i) present and record operation status; (ii) schedule and track inspections; (iii) plan, implement, and report the results of preventive maintenance; (iv) manage fixed assets across multiple sites; (v) manage inventory, work orders and contract managements; and (vi) provide customer services, which include the establishment of consumer data management system with disaggregated data by sex, age, and other social dimension.[1] The detailed program functions for CMMS will be determined through the customized design based on the WSS system needs and WSS governance structure in Dehradun and Nainital.

7. **Output 4: Project management, institutional capacity and knowledge strengthened**. This output includes a range of activities such as: (i) enhancing project and contract management of UIRUDP through hands-on implementation support and skills training for project management unit (PMU) and project implementation units (PIUs) at Dehradun and Nainital; (ii) developing robust WSS O&M manuals, which will be aligned with the national WSS manuals [2] and customized to the WSS system, governance structure, and specific conditions and needs in the project cities; (iii) providing training and implementation support on the WSS O&M manuals and CMMS use to UUSDA, UJN, UJS, and project ULBs; (iv) strengthening institutional capacities of UUSDA, project ULBs, and the wards members at project ULBs on WSS tariff re-structing to enhance the sustainability,[3] green and resilient urban planning for livable and prosperous cities, ecosystem-based adaptation (EBA) measures, integrated water management, intelligent and sustainable WSS operation and management, and gender equality and social inclusion (GESI) issues in urban systems and services; (v) executing community awareness, participation, and behavior changes programs on water conservation, public health and hygiene practices, waste reduction, and making safe, clean, and healthy community environments; and (iv) implementing the GESI action plan, which will be further developed during the project preparation.

8. This IEE focuses on one of the subprojects under output 1 and 2, which is the development of water supply, sanitation and drainage systems in newly-added wards through the 2018 re-boundary arrangements located in the southern periphery of Dehradun (Zone 7) comprising part of ward numbers 83 (Kedarpur) and 85 (Mothrowala).

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[1] 'Internet of things' describes the network of physical objects— "things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.

[2] GOI, Ministry of Housing and Urban Affairs, Central Public Health & Environmental Engineering Organisation (CPHEEO). (i) Manual on Operation and Maintenance of Water Supply System – 2005; (ii) Manual on Sewerage and Sewage Treatment Systems – 2013 Part B O&M and Part C Management; and (iii) Manual on Storm Water Drainage Systems – 2019 Part B O&M and Part C Management. (accessed 18 September 2020).

[3] The World Bank has an ongoing project in Uttarakhand to support institutional strengthening of ULBs' public financial management and revenue management systems, which would have positive impacts on the financial sustainability of the water supply and sanitation systems and other urban services. To avoid any duplicated efforts, the project team will closely monitor and communicate with the World Bank. If any gaps are identified, the project team will design specific activities to support the project UBLs. (World Bank. 2019. Uttarakhand Public Financial Management (PFM) Strengthening Project.)

B. Purpose of Initial Environmental Examination Report

9. 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 SPS 2009. The potential environmental impacts of the subproject have been assessed using ADB rapid environmental assessment (REA) checklist for water supply, sewerage works and storm water drainage systems (Appendix 1A, IB & 1C). 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 (IEE0 has been prepared in accordance with ADB SPS, 2019 requirements for environment **Category B** projects.

10. The entire subproject is located in Zone 7 which consists of Kedarpur, Banjarawala and Mothrowala wards and is divided into three work packages. Development of water supply, sewerage and storm water drainage system of Banjarawala Package 2, comprising part of ward numbers 83 (Kedarpur) and 85 (Mothrowala) in Dehradun is proposed for implementation under the design-build-operate (DBO) modality, where the design is carried out by the selected bidder based on the feasibility and preliminary project reports prepared prior to bidding. Thus, this IEE is based on the preliminary project report prepared by Uttarakhand Urban Sector Development Agency (UUSDA). The IEE is based mainly 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 is an integral part of the IEE.

11. This IEE will be updated and finalized during detailed design stage to reflect change in scope of works, change in location of component and change in cost due to addition or subtraction of components which can change the environmental impacts. The revised IEE shall supersede the earlier version of IEE and shall be contractually applicable to the contractor after approval from PMU and ADB.

12. The implementation of the subprojects will be governed by Government of India (GoI) and the state of Uttarakhand and other applicable environmental acts, rules, regulations, and standards. Environmental safeguards will be followed in accordance with the ADB SPS 2009. During the design, construction, and operation of the project the borrower/client will apply pollution prevention and control technologies and practices consistent with ADB SPS, 2009 and international good practice, as reflected in internationally recognized standards.

C. Report Structure

13. The report has been structured in compliance with ADB SPS, 2009 and contains the following ten (10) sections including the executive summary at the beginning of the report:

14. **Executive Summary**. This section describes concisely the critical facts, significant findings, and recommended actions.

(i) **Introduction.** Presents a brief overview of the assignment along with its background, objectives, scope of work and methodology etc.

(ii) **Description of the Project.** This section describes the proposed project; its major components; and its geographic, ecological, social, and temporal context, including any associated facility required by and for the project.

(iii) **Analysis of Alternative.** Analyzes the environmental situation "With and Without project".

(iv) **Policy, Legal, and Administrative Framework.** This section discusses the national and local legal and institutional framework within which the environmental assessment is carried out. It also identifies project-relevant international environmental agreements to which the country is a party.

(v) **Description of the Environment.** This section describes relevant physical, biological, and socioeconomic conditions within the study area. It also looks at current and proposed development activities within the project's area of influence, including those not directly connected to the project. It indicates the accuracy, reliability, and sources of the data.

(vi) **Anticipated Environmental Impacts and Mitigation Measures.** This section predicts and assesses the project's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic (including occupational health and safety, community health and safety, vulnerable groups and gender issues, and impacts on livelihoods through environmental media, and physical cultural resources in the project's area of influence, in quantitative terms to the extent possible; identifies mitigation measures and any residual negative impacts that cannot be mitigated; explores opportunities for enhancement; identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions and specifies topics that do not require further attention; and examines global, trans boundary, and cumulative impacts as appropriate.

(vii) **Public Consultation and Information Disclosure.** This section (i) describes the process undertaken during project design and preparation for engaging stakeholders, including information disclosure and consultation with affected people and other stakeholders; (ii) summarizes comments and concerns received from affected people and other stakeholders and how these comments have been addressed in project design and mitigation measures, with special attention paid to the needs and concerns of vulnerable groups, including women, the poor, and Indigenous Peoples; and (iii) describes the planned information disclosure measures (including the type of information to be disseminated and the method of dissemination) and the process for carrying out consultation with affected people and facilitating their participation during project implementation.

(viii) **Grievance Redress Mechanism.** This section describes the grievance redress framework (both informal and formal channels), setting out the time frame and mechanisms for resolving complaints about environmental performance.

(ix) **Environmental Management Plan**. This section deals with the set of mitigation and management measures to be taken during project implementation to avoid, reduce, mitigate, or compensate for adverse environmental impacts (in that order of priority). It may include multiple management plans and actions (mitigation, monitoring and performance indicators). Outlines the environmental monitoring program and reporting system including the cost of implementing the EMP.

(x) **Conclusion and Recommendations.** Presents the conclusion and recommendations of the IEE study.

II. DESCRIPTION OF THE PROJECT

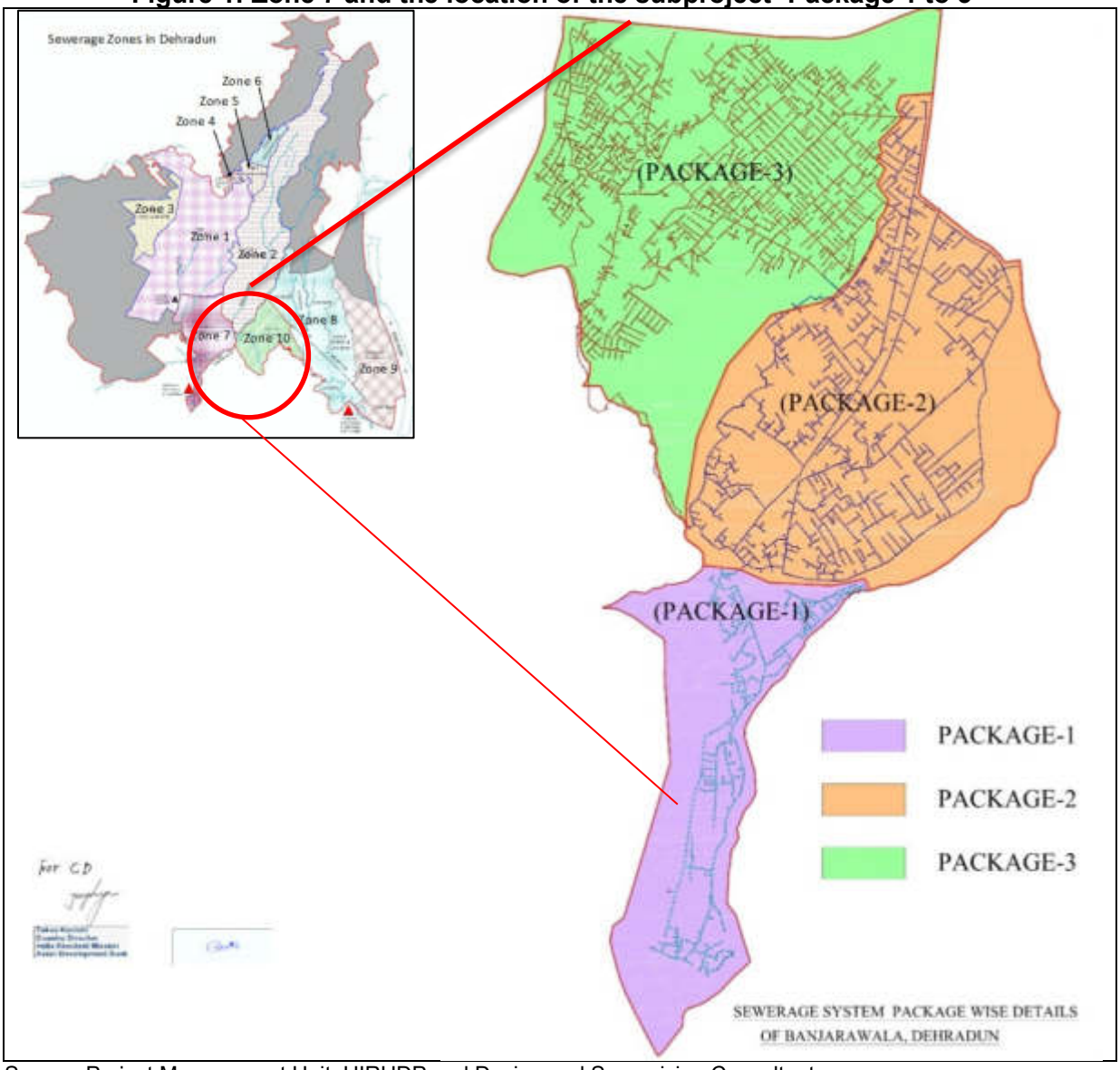
A. Dehradun and Subproject Location

15. Dehradun is the winter capital and most populous city in the State of Uttarakhand. Dehradun experienced fast growing peri-urban areas with huge influx of urban migrants and carried out re-boundary mission. As a result, Dehradun has expanded to 300% in area (196.48 sq.km) and increased by 141% in population (803,983 in 2018) living in 100 wards. The subproject of establishing water supply and sanitation and drainage systems is located in Southern part of newly expanded Dehradun, Zone 7, which consists of Kedarpur, Banjarawala and Mothrowala wards. There will be three work packages based on topography and hydrology

16. **Figure 1**), i.e. (i) Banjarawala Package 1 comprising part of ward number 85 (Mothrowala), Package 2 comprising part of ward numbers 83 (Kedarpur) and 85 (Mothrowala) and Banjarawala Package 3 comprising part of ward numbers 83 (Kedarpur) and 84 (Banjarawala).

17. The subproject covers Package 2 and the main components of this subproject includes: (i) Installation of three deep tube wells with 1000 liters per minute (lpm), 1500 lpm and 1500 lpm capacity with disinfection treatment in form of chlorination units will be provided at the outlet of the tube well [based on the projection of population increase the water demand of the area is estimated as 1.45 MLD (base year 2021), 2.66 MLD (intermediate year 2036) and 3.87 MLD (ultimate design year 2051)], (ii) construction of two over-head tanks with 650 kilo liter (kl) and 800 kl capacity; (iii) installation of 60 kilometer (km) of water supply network (59 km ductile iron pipe Class K7 (DI-K7) and 1 km DI-K9 pipes with diameter ranging from 100 mm to 450 mm) with 1950 new house service connections; (iv) installation of 45 km of sewer pipes (44 km of high-density polyethylene (HDPE) pipe of diameter 225 mm to 355 mm and around 1 km of DI-K7 pipe of 350 mm to 700 mm diameter) and around 1650 household sewer connections (v) a total of 1,950 manholes, including 1,150 brick masonry circular manholes; 620 in-situ RCC circular manholes; and around 180 precast RCC manholes, ,(vi) installation of 30 km storm water drainage system with precast RCC covers, (vii) development of 10 nos Groundwater Recharge pits and 2 nos Rainwater Harvesting structures, (viii) Fecal Sludge and Septage Management (FSSM) system , (viii) Rehabilitation of .Tube wells and OHT (viii) SCADA and GIS system.

Figure 1: Zone 7 and the location of the subproject- Package 1 to 3



Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

B. Water Supply System in Banjarawala Package-2

18. The water supply service area under this package is part of ward number 85. Currently, there is existing water supply in the area but its pipeline network (CI, GI and PVC) is more than 25 years old with the average supply level of around 110 lpcd for 4 to 6 hours per day, not meeting the performance standard. The source of existing water supply system is ground water. Ground water is being extracted through three tube wells. There are three associated pump houses and three existing overhead tanks having 250 kl, 900 kl and 1000 kl capacity. One set of tube well, pumps and OHT is located in Udham Singh Park (under proposed district metering area (DMA) 6), another set is physically located under proposed DMA 3 (near PNB ATM) that falls under Banjarawala package 3. The tubewell, pumps and OHT in Bengali Kothi will continue supplying water to package 2 area till the time new sustem is commissioned.

19. Since the existing water supply system is insufficient to accommodate growing population in the area, new source, disinfection (chlorination) system and pipeline network have been included in the scope of this project. The design of water supply system has been done on DMA basis. DMAs 4, 5 and 6 falls under the scope of Package 2. The proposed tube wells and OHT details are as follows:

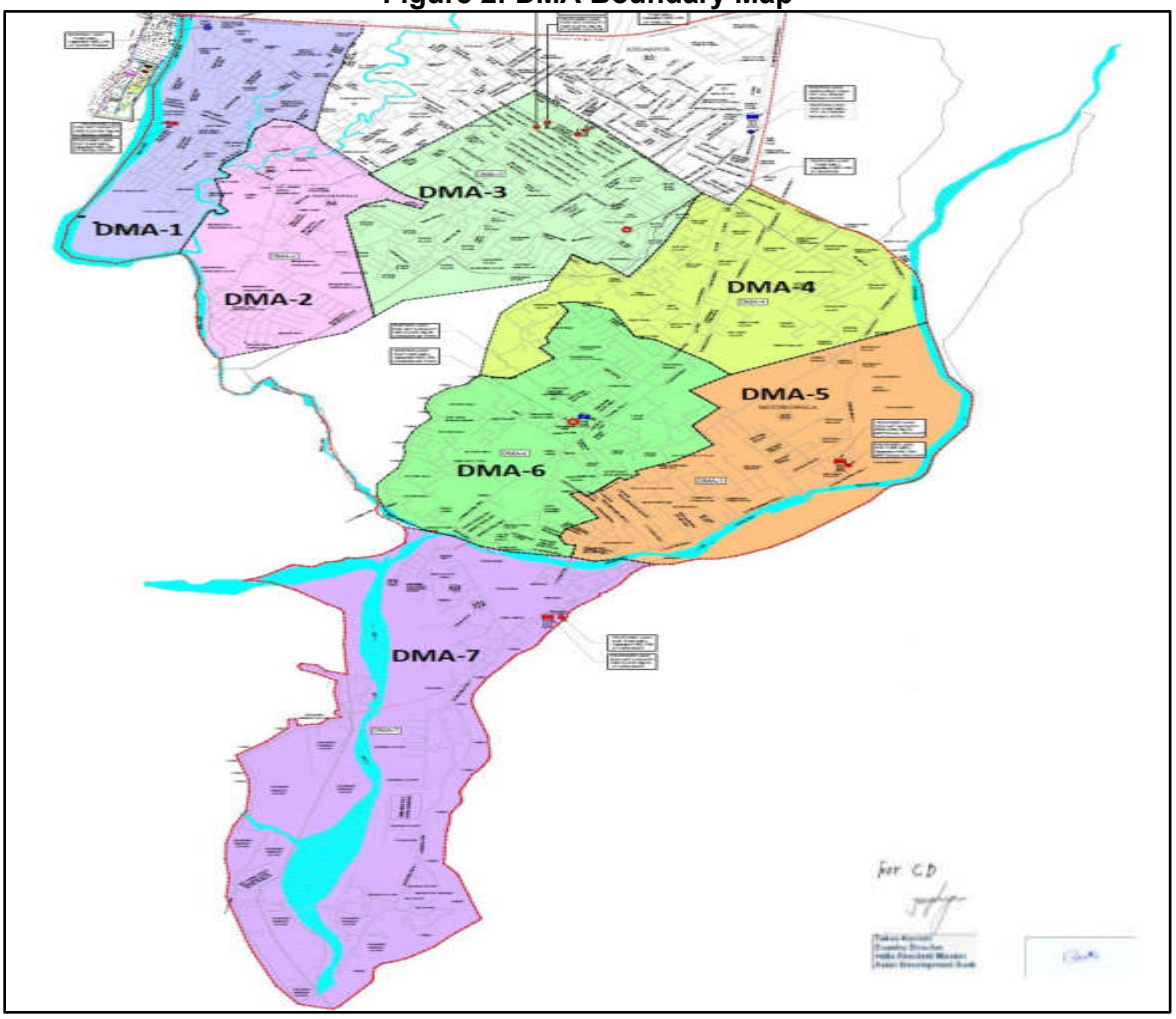
Table 1: The Existing and Proposed Tube wells and OHT details

District Metering Area (**DMA)**	**Existing Structure**	**Proposed Structure**
4[4]	Tube well (500 lpm)- - near PNB ATM (will be retained after rehabilitation) Overhead tank (250 kl) - near PNB ATM (to be dismantled)	TW – 1500 lpm near PNB ATM OHT- 800 kl near PNB ATM (Co-ordinates:30°16'58.17"N, 78° 01'56.87"E)
5	Tube well – discard- Bengali Kothi Overhead tank (900 kl)- discard- - Bengali Kothi	TW – 1000 lpm- Geetanjali Enclave OHT- 650 kl- Near Geetanjali Enclave (Co-ordinates: 30°15'52.15" N, 78°02'35.15" E)
6	Tube well (700 lpm) - near Nagar Nigam office, Mothorwala will be retained Existing OHT near Nagar Nigam office, Mothorwala (1000 kl)- to be retained after rehabilitation	TW – 1500 lpm near Nagar Nigam office (Co-ordinates: 30°16'3.83"N, 78°02'2.21"E)
4,5,6	Water supply distribution networks	Installation of New water supply network of 60 km (distribution networks of 59 km with ductile iron pipe Class K7 (DI-K7) and rising main or network of 1 km of DI-K9 pipes with diameter ranging from 100 mm to 450 mm). Groundwater from tube wells will be collected in OHTs and the disinfection treatment in form of chlorination unit will be provided at the outlet of the tube well.

Source: a detailed project report on Banjarawala.2021

[4] Physical location of existing and proposed structures is in DMA 3

Figure 2: DMA Boundary Map



Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

20. District Metering Area DMA at entry point will be provided with SCADA operated control valve with actuators, a bulk flow meter (Electromagnetic type), Pressure transmitter, residual chlorine indicator, Each DMA will have at least two Critical Measurement Points (CMPs) in each section of DMA (Area in command of one OHT) for continuous logging of pressure, and the CMPs shall be such that they should be at the highest and farthest points from the OHT.

21. Per capita water supply rate of 135 liters per day (LPD) is considered as per the CPHEEO norms. Table 2 shows the projection of population increase for entire contributing area in base year of 2021, intermediate year 2036 and ultimate design year of 2051, which are 9426 in 2021, 17282 in 2036 and 25139 in 2051. Based on the projection of population increase the water demand of the area is estimated as 1.45 MLD (base year 2021), 2.66 MLD (intermediate year 2036) and 3.87 MLD (ultimate design year 2051). The present service area i.e. Banjarawala Package 2 in Dehradhun falls in Raipur block which is categorized as **SAFE** as per the categorization adopted by the CGWB and leaving a large scope for further development of the resource for domestic, industrial, agricultural and other uses. Groundwater quality is fit for drinking; therefore, only disinfection is proposed prior to supply. Groundwater from tube wells will be collected in OHTs and the disinfection treatment in form of chlorination unit will be provided at the outlet of the tube well.

Table 2: Details of Population & Water Demand in Banjarawala Package 2

Ward	2011 population (from contributing area)	Projected Population (including 10% floating population)			Water Demand (MLD)		
		Base Year (2021)	Intermediate Year (2036)	Ultimate Year (2051)	Base Year (2021)	Intermediate Year (2036)	Ultimate Year (2051)
85	3875	9426	17282	25139	1.45	2.66	3.87

Source: Data from UUSDA

22. **Construction of Overhead Tanks (OHTs).** Construction of 800 kilo liter (kl) OHT near Punjab National Bank (PNB) automated teller machine (ATM) at Mothrowala will be done at an existing OHT (of 250 kl capacity) location. The old OHT will be dismantled and the new 800 kl OHT will be constructed; no additional impact on structures is anticipated at the site. The land is under ownership of Uttarakhand Jal Sansthan (UJS). The other 650 kl OHT will be constructed at Geetanjali Enclave; the proposed land for the OHT is under the ownership of Dehradun Nagar Nigam (DNN). The land parcel identified for OHT at Geetanjali Enclave (for DMA 5) is vacant and free of encumbrances. UUSDA shall obtain no objection certificate from UJS and DNN for construction of the OHTs and include the same in the IEE before award of the contract. Summary of OHT lands are provided in Table 3.

Table 3: Details of OHTs to be constructed under Package 2

Sl.No.	DMA	OHT Capacity (kl)	Location Name	Land Area Required (sq.m)	Ownership
1	4	800	PNB ATM, Mothrowala	1050	UJS
2	5	650	Geetanjali Enclave	461	Dehradun Nagar Nigam

Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

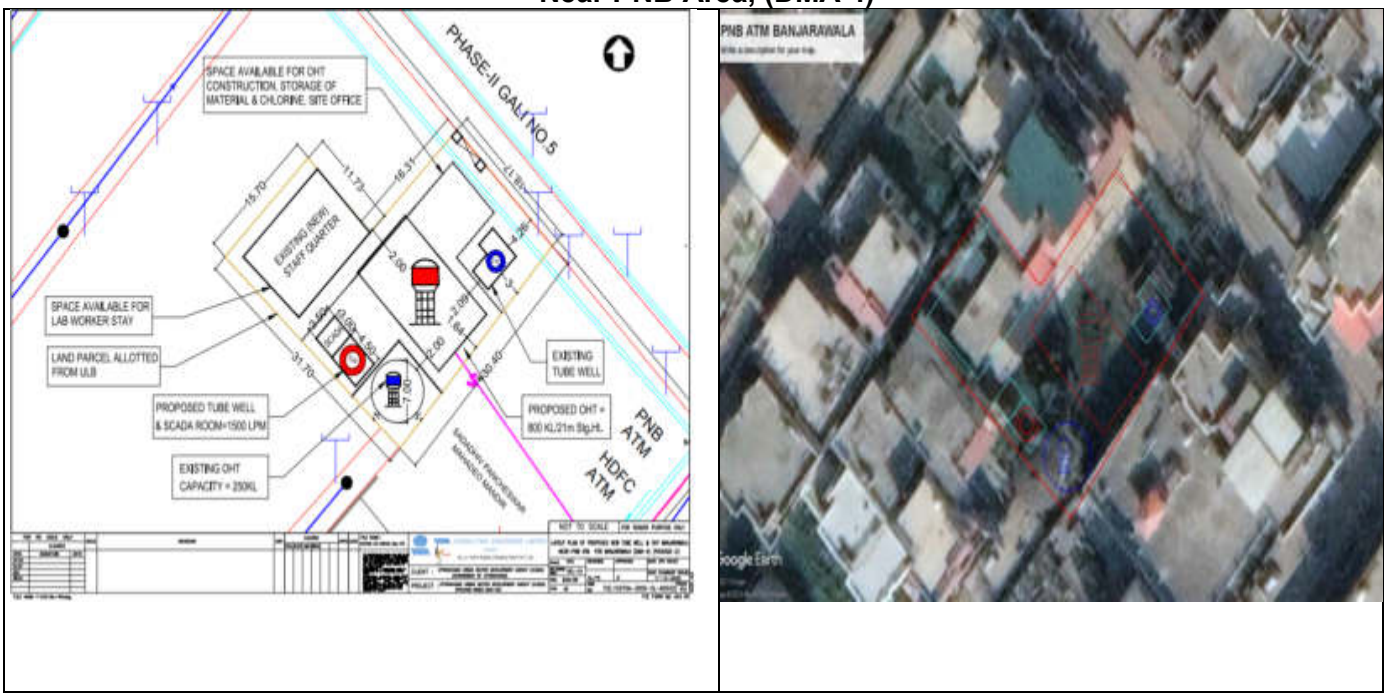
23. **Installation of Deep Tube Wells.** Three deep tube wells will be installed as water source for the DMA 4, 5 and 6. The tube wells will be installed at same locations where the two new OHTs will be constructed for DMA 4 (near PNB ATM, Mothrowala) and 5 (at Geetanjali Enclave) and the third tube well at the existing OHT location at Mothrowala for DMA 6. As mentioned, that land is under the ownership of UJS and DNN, no land will be acquired for the installation of tube wells at all three locations and no structures will be impacted. UUSDA has already applied to Central Groundwater Board (CGWB) for permission to withdrawal of groundwater (Appendix 8). Due to COVID pandemic situation the process is getting delayed but before the award of contract the necessary permission should be appended in the IEE report. Summary of OHT lands are provided in Table 3A Google Earth image of OHT and tube well locations for DMA 4, 5 and 6 are given in Figure 3A, Figure 3B and Figure 4 respectively.

Table 3A: Details of Tube Wells to be constructed under Package 2

Sl.No.	DMA	Tube well Capacity (lpm)	Location Name	Land Area Required (sq.m)	Ownership
1	4	1500	PNB ATM, Mothrowala	1050	UJS
2	5	1000	Geetanjali Enclave	461	Dehradun Nagar Nigam
3	6	1500	Near Nagar Nigam office, Mothorwala	850	Dehradun Nagar Nigam

Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

Figure 3A: Layout Drawing of Proposed OHT and Tube well and Google Earth Image at Near PNB Area, (DMA 4)

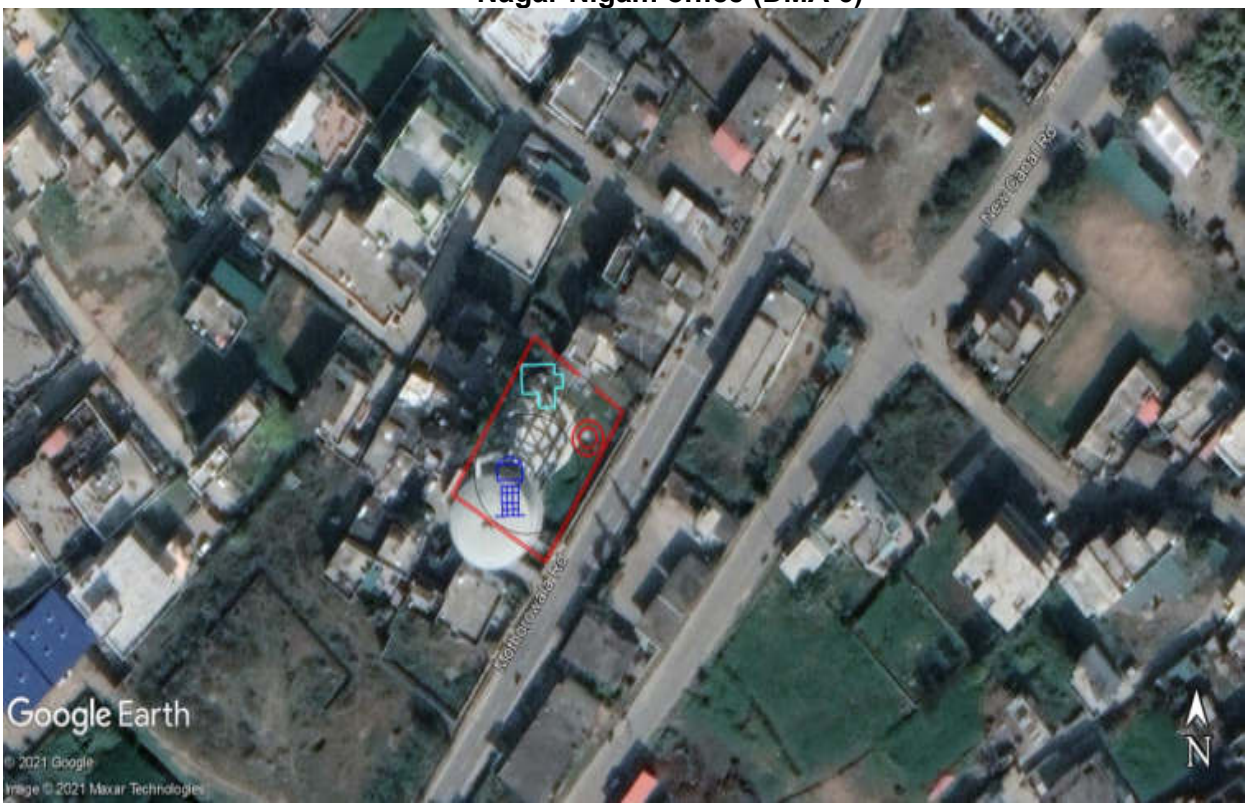


Source: Project Management Unit, UIRUDP and Design and Supervision Consultant

Figure 3B: Google Earth Image of Proposed OHT and Tube well locations at Geetanjali Enclave (DMA 4)

Source: Project Management Unit, UIRUDP and Design and Supervision Consultant

Figure 4: Google Earth Image of Tube well and OHT Location at Mothrowala, near Nagar Nigam office (DMA 6)



Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

24. **Laying of Water Supply Pipeline.** In the entire project area, 60 km new water supply pipelines (distribution network of 59 km with ductile iron pipe Class K7 (DI-K7) and rising main or feeder main network of 1 km of DI-K9 pipes with diameter ranging from 100 mm to 450 mm) will be laid and new house service connections (the targeted household service connections are 1950) will be provided from the newly laid main. The new service connections shall replace the old service connections at the entry point to the houses and all house connections meters will be having Automatic Meter Reading (AMR) technology. Most of the existing pipelines shall be left buried as it is. If the existing water pipes are in the same lining of new water supply pipes, a contractor through a detailed survey will establish the requirement of old pipes removal for giving way to new pipelines. Those pipes shall be removed and disposed in a controlled manner so as not to harm the environment. No. AC pipes are there in the existing facilities which may create hazardous conditions for the workers and surrounding community.

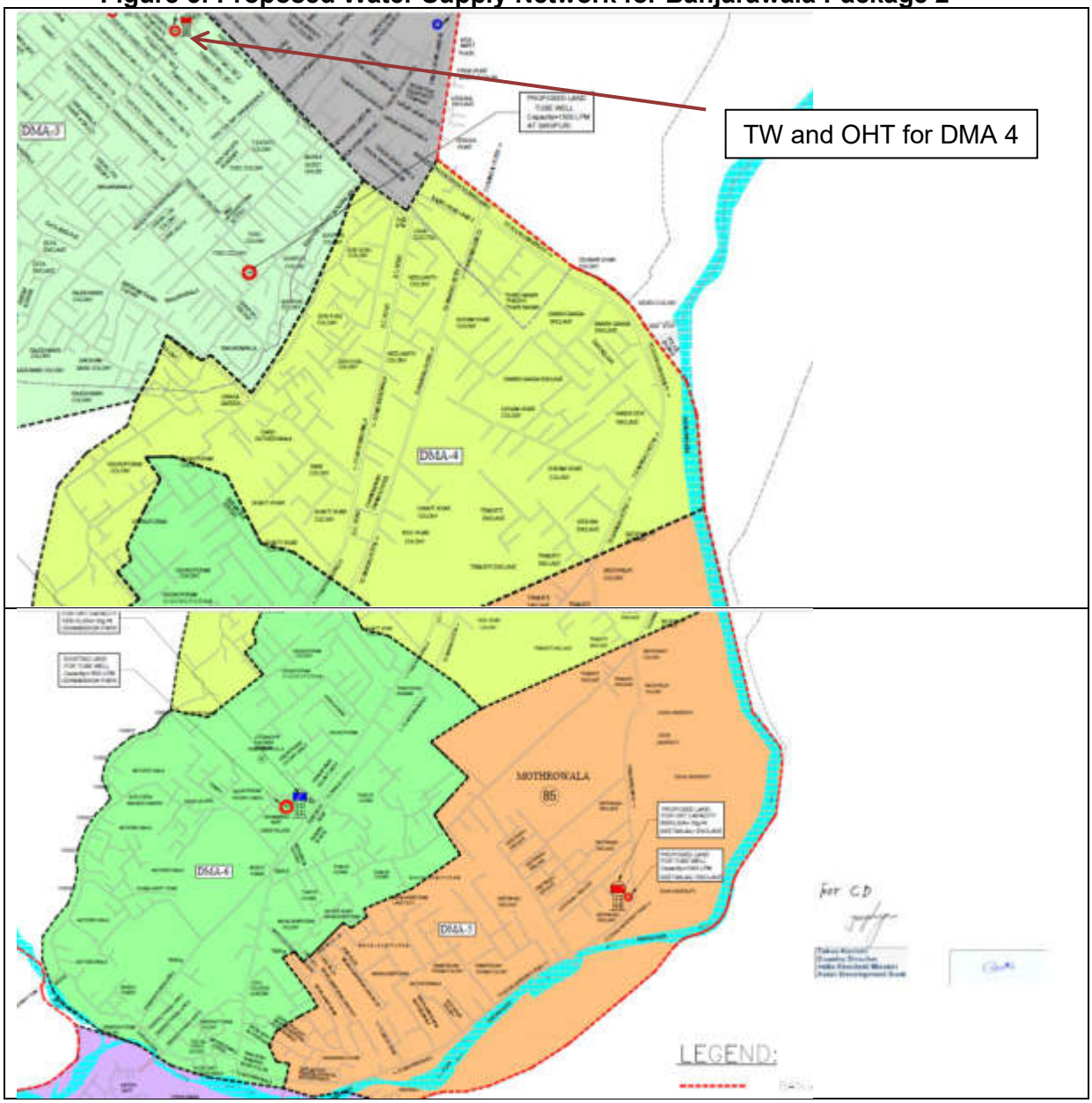
25. Water supply pipelines will be laid at a depth of 1m within the RoW of Dehradun Nagar Nigam (DNN) and PWD roads. PMU UIRUDP shall obtain ‘no objection’ or approval from DNN and PWD (owner of the roads) for laying of water supply pipelines before start of civil work. The NOC will be appended to the updated IEE report. Summary of the proposed water supply network is given in Table 4.

Table 4: Summary of Proposed Water Supply Network, Banjarawala Package 2

Sl. No.	Name of Major Road	Length (KM)	Category Low/Medium/ High Density	Width (M)	Dia of Major Proposed Pipe (mm)	Proposed Trench Width (M)	Ownership of Road
1	Link Roads in Neelkanth Colony	60	Medium	3 to 7 meters	100 to 200	1	DNN
2	Shivam Vihar		Medium		100	0.5	DNN
3	Mahalaxipuram		High		100	0.5	DNN
4	Geetanjali Enclave		Medium		100	0.5	DNN
5	Ramkrishna Puram Colony		Medium		100	0.5	DNN
6	Swarna Ganga Enclave		Medium		100	0.5	DNN
7	Tihari Nagar		Medium		100	0.5	DNN
8	Vishnupuram		Medium		100 & 125	0.5 to 0.75	DNN
9	Trimurti		Medium		100	0.5	DNN
10	Shakti Vihar,		Medium	7	100	0.5	DNN
11	Dhaba Cant.		Medium	7	100	0.5	DNN
12	Nanda Devi Enclave,		Medium	7	100	0.5	DNN
13	Doon University Road		Medium	6.50	125 to 250	1 to 1.2	PWD
14	New Canal Road		Medium	6.97	100	0.5	PWD
15	Mothorowala Road		Medium	7.21	100 to 250	0.5 to 1.20	PWD

Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

Figure 5: Proposed Water Supply Network for Banjarawala Package 2



Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

26. During the design and construction period of 42 months, the contractor will have the responsibility of maintaining the existing water supply levels and provide good quality water to consumers at least for the duration and adequate pressure being maintained presently.

27. The successful implementation of the project will result in better control over the NRW management, improved monitoring system and overall demand management along with energy reduction. The benefits arising from the water supply subproject include: (i) increased availability of potable water at appropriate pressure to all households; (ii) reduced time and costs in accessing alternative sources of water. (iii) better public health particularly reduction in waterborne and infectious diseases.

C. Sewerage System in Banjarawala Package-2

28. Currently, there is no sewerage system provided in the subproject area, which is around 359 Hectare (Ha) comprising of part of municipal ward numbers 83 and 85 (Table 5). It has been proposed that sewage collected from Package 2 along with Package 1 and 3 will also be carried to proposed sewerage treatment plant (STP) in Indrapuri Farm, Daudwala of Mothrowala ward which is proposed to be constructed under Banjarawala Package 1.

Table 5: Areas Covered Under Package 2

Sr. No	Ward Name	Ward No.	Total ward area (Ha)	Area considered under this subproject (Ha)	Ward coverage
1	Kedarpur	83	137	22	16%
2	Mothrowala	85	586	337	58%

Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

29. The STP will have a total of 11 MLD treatment capacity based on sequential batch reactor (SBR) process The sewage from all three packages, comprising of wards 83, 84 and 85, will be carried to this sewage treatment plant Table 6 shows the projection of population increase for the entire contributing area of Package 1, 2 & 3 in base year of 2021, intermediate year 2036 and ultimate design year of 2051, are 41,426 in 2021, 71,266 in 2036 and 1.01,105 in 2051. Based on the projection of population increase, it has been estimated that the contributing area will have 4.42 million liters per day (MLD), 7.61 MLD & 10.80 MLD of wastewater during the base, Intermediate & ultimate years respectively.

Table 6: Details of Sewerage Generation in Banjarawla work packages 1, 2 and 3

Package	Projected Population (including 10% floating population)			Sewage generation (MLD)		
	Base Year (2021)	Intermediate Year (2036)	Ultimate Year (2051)	Base Year (2021)	Intermediate Year (2036)	Ultimate Year (2051)
Package-1	4949	9074	13199	0.53	0.97	1.41
Package-2	11548	20704	29860	1.23	2.21	3.19
Package-3	24929	41488	58046	2.66	4.43	6.20
TOTAL	**41426**	**71266**	**101105**	**4.42**	**7.61**	**10.80**

Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

30. The projection of population increase for contributing area of Package 2, (part of wards 83 and 85) is 11,548 in 2021, 20,704 in 2036 and 29,860 in 2051 (Table 6). Considering the projection of population increase, it has been estimated that the contributing area will have 1.23 million liters per day (MLD), 2.21 MLD & 3.19 MLD capacity of treating wastewater during the base, Intermediate & ultimate years respectively.

D. SCADA and GIS System

31. GIS data of all the assets created under the subproject will be created. The three-dimensional position (x,y,z) of all point and line assets constructed under this subproject, including

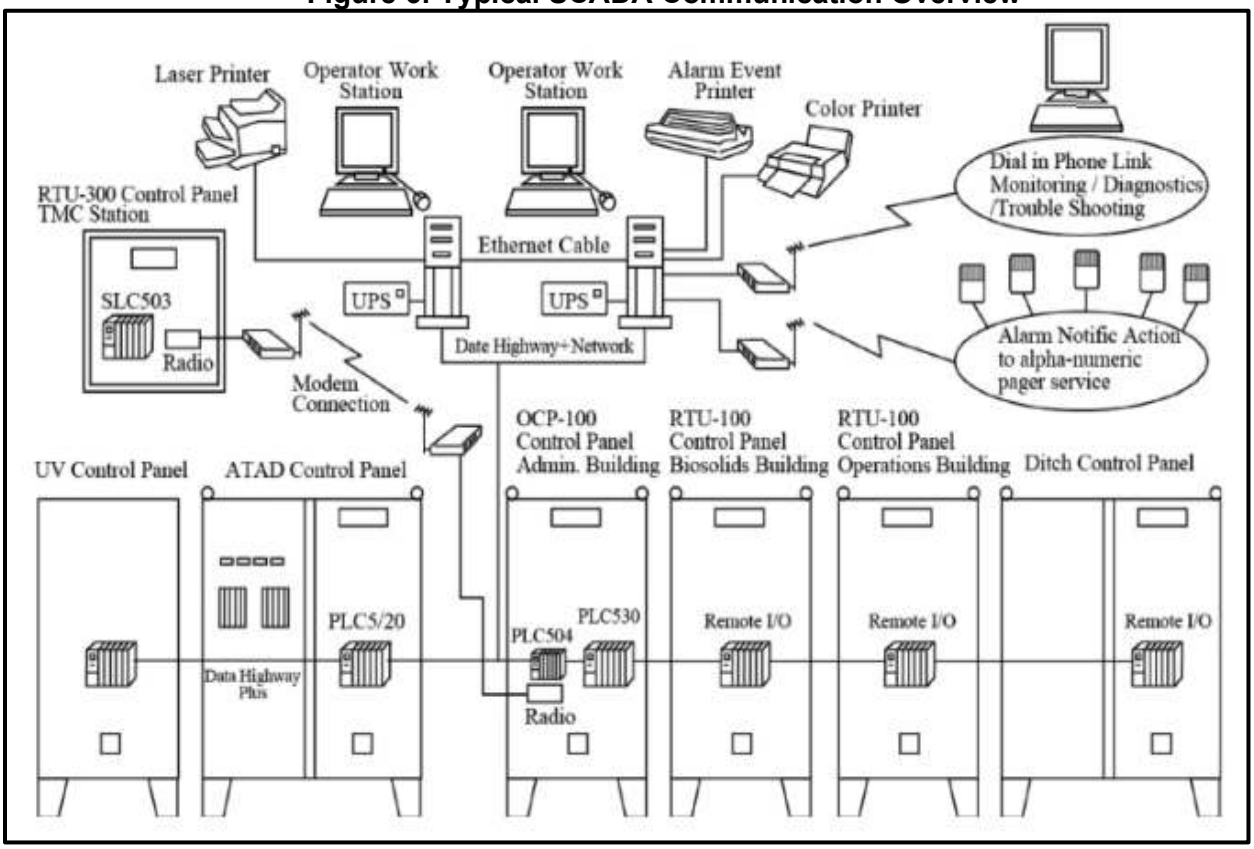
tube well, overhead tank, water pipe network, consumer connections, sewers, manholes, property chambers, house service connections, pumping station, STP, valves, pumps, and septic tanks will be surveyed. Nodes shall be created to clearly delineate different pipe sections in terms of material and diameter and to allow for future development of a hydraulic model in the GIS platform. Point and line data (i.e., the pipeline) will be consistent with the attributes of the existing Survey of India GIS and new attributes pertaining to non-survey data, e.g., pump make and model, images and/or plans will be added.

32. The GIS data will be linked to web-based interface/ dashboard to Supervisory Control and Data Acquisition (SCADA) for control and monitoring. SCADA presents the data as a viewable and controllable system on the screen of a computer. The data thus collected is stored and analysed for better real time process control. It assists plant operating personnel by monitoring and announcing abnormal conditions and failure of equipment and allows the operators to perform calculations based on the sensor inputs. Daily, weekly and monthly reports can be prepared using the stored data. A typical SCADA is shown in **Figure** .

33. Signals generated by various sensors and instruments are transmitted from the sensor to a control panel or computer system, which allows operators to inspect many process variables simultaneously. A Programmable Logic Controller (PLC) is electronic equipment that senses inputs and takes the decision to change outputs according to the set rules stored in the memory. Link systems with PLC are used for transmitting the signal, with which analogue signal is converted to digital signal and transmitted via coaxial cables or optical fibres.

34. The GIS and SCADA will be developed in a compatible environment so that it is aligned to city-wide CMMS. During operation and maintenance, the status of assets, inspection details and inventory etc. will be managed through these linkages to CMMS. The GIS system will be providing real time information for CMMS on ever increasing consumer details.

Figure 6: Typical SCADA Communication Overview[5]



Source: Central Public Health and Environmental Engineering Organization, Ministry of Urban Development of India

E. Sewer Network

35. The subproject will install a total of around 45 km sewer pipes, including 44 km of high-density polyethylene (HDPE) pipe of diameter 225 mm to 355 mm and around 1.41 km of DI-K7 pipe of 350 mm to 700 mm diameter which are proposed within the boundaries (RoW) of government roads and are assessed to not have any involuntary land acquisition impact. The roads through which the trunk sewer pipelines will be laid are under the ownership of Public Works Department (PWD) and the sewer network under Dehradun Nagar Nigam (DNN) (Table 7). UUSDA will obtain 'no objection' or approval from PWD and DNN (that are owners of the public roads) before start of civil work; the NOCs will be appended to the updated IEE report.

36. The wastewater collection system will mainly rely on gravity pipes and will discharge into the STP. The network will be of the conventional gravity collection type, starting from service connections to gravity sewers conveying the sewage to discharge into the trunk sewer leading to the STP.

37. The sewer system is designed as a separate sewer system that carries only the domestic/municipal wastewater and will not mix with a storm water drainage systems No industrial wastewater will be allowed into the sewers. Sewers will be laid underground in the roads and streets. While water pipes are/will be located on one or either side of the roads, the sewers will

[5] Source: Chapter 6, Part B Operation and Maintenance, Manual on Sewerage and Sewage Treatment Systems, Central Public Health and Environmental Engineering Organization, Ministry of Urban Development, India

be laid in the middle of the road to avoid any disturbing the water pipes. In the areas of water body crossing, main road crossings or deep cuttings (above 6-7 m depth), the sewers (around 3.5 km) will be laid by trenchless method. The nominal diameter of the casing pipes would be kept sufficiently large to permit easy withdrawal of the carrier pipe. The pit locations for trenchless pipeline laying will be identified by the design build and operate Contractor (DBO) on finalization of detail design, following which detail measurement survey (DMS) will be conducted.

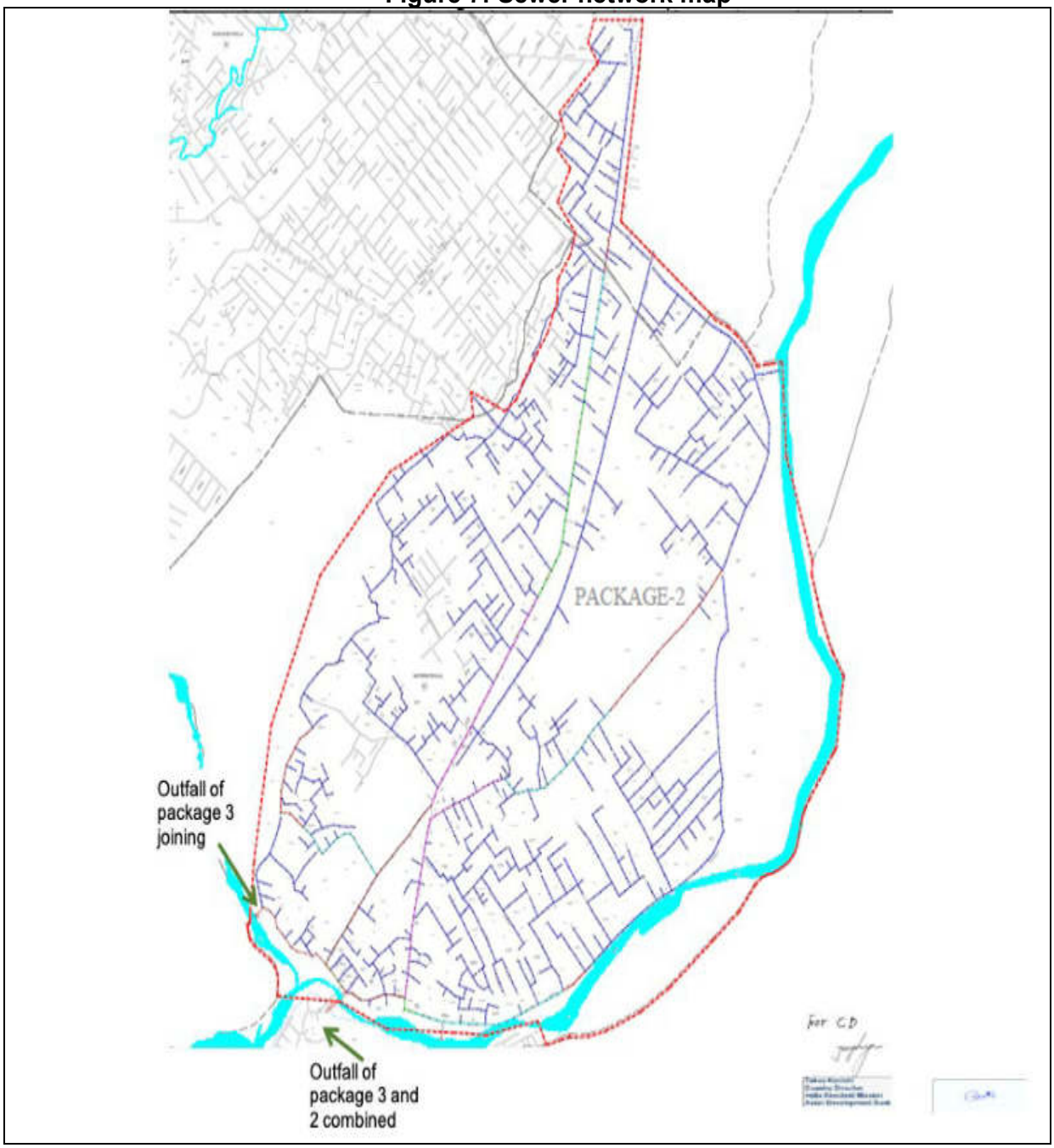
38. It may be noted that sewer pipelines will be laid at a depth of 1 to 6m, as per topography on the same roads along which water supply pipelines will be laid. The sewer pipelines will be laid along the center of the road and water pipelines along any one side of the road. Civil works for laying of both the water supply and sewer pipelines will be done simultaneously to reduce the impact duration. The visual screening conducted confirmed that there are no permanent/semi-permanent structures and common property resources on the pipe/drain RoW. It will impact mobile vendors, roadside temporary shops which are anticipated to face temporary income loss during the construction period at Doon University Road and Mothrowala Bridge. The resettlement plan assessed these impacts and provided mitigation/compensatory measures for the assessed impact of the project activities.

Table 7: Road Width-wise Diameter of Sewer Pipelines to be laid

Sl. No.	Name of Major Road	Length (KM)	Category Low/Medium/ High Density	Road Width (M)	Dia of Major Proposed Pipe (mm)	Proposed Trench Width (M)	Ownership of Road
1	Link Roads in Neelkanth Colony	45	Medium	3 to 7 meters	225 to 335	1 to 1.5	DNN
2	Shivam Vihar		Medium		225 to 335	1 to 1.5	DNN
3	Mahalaxipuram		High		225 to 335	1 to 1.5	DNN
4	Geetanjali Enclave		Medium		225 to 335	1 to 1.5	DNN
5	Ramakrishna Colony		Medium		225 to 335	1 to 1.5	DNN
6	Swarna Ganga Enclave		Medium		225 to 335	1 to 1.5	DNN
7	Tihari Nagar		Medium		225 to 335	1 to 1.5	DNN
8	Vishnupuram		Medium		225 to 335	1 to 1.5	DNN
9	Trimurti Enclave		Medium		225 to 335	1 to 1.5	DNN
10	Shakti Vihar		Medium	7	350 -700	2 to 3	DNN
11	Dhaba Cant.		Medium	7	350 -700	2 to 3	DNN
12	Nanda Devi Enclave		Medium	7	350 to 700	2 to 3	DNN
13	Doon University road		Medium	6.50	225 to 315	1 to 1.4	PWD
14	New Canal Road		Medium	6.97	225	1 to 1.25	PWD
15	Mothorowala Road		Medium	7.21	225 to 355	1 to 1.5	PWD

Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

Figure 7: Sewer network map



Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

39. **Construction of Manholes:** A total of 1,950 **manholes**, including 1,150 brick masonry circular manholes; 620 in-situ RCC circular manholes; and around 180 precast RCC manholes based on the assessment of subsoil condition and traffic loads, will be constructed at an interval of 24 m distance well within the ROW of government roads along the sewer network.

40. Around 1650 **household sewer connections** will be also installed, which include around 1520 connected to sewer system and 130 connected to community septic tanks. House connections will be provided through a chamber constructed inside the property line and another

chamber outside the property line. Chambers are to be connected with manholes in the main sewer line below the roads by means of unplasticized polyvinyl chloride (uPVC) pipe stiffness (SN) 4 of 110 mm or 160 mm outside diameter (OD).

F. Fecal Sludge and Septage Management (FSSM) System

41. Septage is the settled solid matter in semi-solid condition usually a mixture of solids and water settled at the bottom of septic tank. It has an offensive odour, appearance and is high in organics and pathogenic microorganisms. A FSSM system will be provided to collect fecal sludge and septage in low lying and/or low dense areas of Package 2, e.g., Dandi Village, Vishnupuram Colony, Shvkunj Colony and Mahalakshmi Pruam Colony that are not techno-economically feasible to connect to sewerage system. This facility is expected to cover a population of 1350 in the base year 2021 and 4450 at the ultimate design year 2051 under Septage management for Banjarawala Package 2 (Table 7A).

Table 7A: Population Covered under Septage Management for Banjarawala Package 2

Subproject Package	Projected Population for Septage Management (including Floating Population @10%)			No. of required Septic tanks and Soak pits		
	Base Year (2021)	Intermediate Year (2026)	Ultimate Year (2051)	Base Year (2021)	Intermediate Year (2036)	Ultimate Year (2051)
Banjarawala Package-2	1350	2500	4450	20 Users - 6 50 Users - 3 100 Users - 0	20 Users - 10 50 Users - 4 100 Users - 1	20 Users - 12 50 Users - 9 100 Users - 2

Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

42. The collected Septage from Banjarawala (Package-1, 2 & 3) will be transported to 68 MLD Kargi STP which is equipped with septage co-treatment facility. At present, the Kargi STP is under utilized receiving only 12 to 15 MLD sewage against the 68 MLD design capacity and only 130 KLD of FSS is presently being disposed at Kargi STP for treatment (NIUA 2021).

43. . Based on the projection of population increase, it has been estimated that the contributing areas of all three Packages (part of wards 83,84 and 85) will generate septage of 1.77 kilo liters per day (KLD), 3.13 KLD & 4.75 KLD during the base (2021), intermediate (2036) & ultimate (2051) years respectively (Table 7B). Contributing area of Package 2 (part of ward nos. 83 and 85) will have 0.44 KLD, 0.82 KLD & 1.46 KLD of septage during the base, Intermediate & ultimate years respectively (Table 7B).

Table 7B: Details of Septage Generation in Banjarawla work packages 1, 2 and 3

Banjarawala Package	Projected Population for Septage Management (including Floating Population @10%)			Septage Generation (at the rate of 120 Liters per capita per Annum as per BIS) (in Kilo Liters/Day)		
	Base Year (2021)	Intermediate Year (2036)	Ultimate Year (2051)	Base Year (2021)	Intermediate Year (2036)	Ultimate Year (2051)
Package-1	1465	2686	3907	0.48	0.88	1.28
Package-2	1350	2500	4450	0.44	0.82	1.46
Package-3	2598	4348	6100	0.85	1.42	2.00
Total	**5413**	**9534**	**14457**	**1.77**	**3.13**	**4.75**

Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

44. Collection of sewage and sullage from individual households will be by 110 mm dia uPVC pipes and conveyance will be through sewers laid on road to community septic tank (150 mm dia UPVC pipe). The location and number of proposed septic tanks and soak pits will be decided during the detailed engineering design based on the results of topography surveys and consumer survey depending upon the households and population in the area during service improvement plan (SIP) by the contractor. Specific septic tank locations should be selected based on careful consideration on possible contamination of groundwater and surfacewater sources, odors, and other possible negative impacts on the environment and the relevant communities. Septage from the septic tanks will be regularly removed using trunks/sewer suction machines. Treated and clarified effluent from the top of sept tank will be discharged into soak pits, which will be constructed with porous material and covered, that allow water slowly to percolate into the ground. Proposed FSSM concept is depicted in Figure 8A.

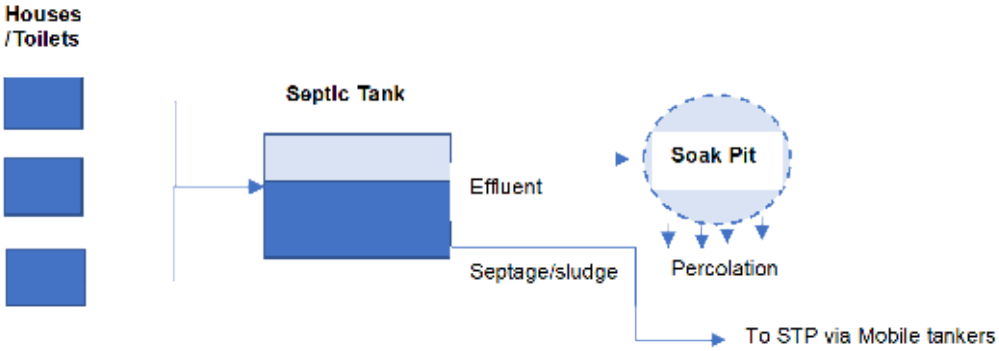
45. Septage generation rates vary widely from place to place depending on practices of septic tank use, number of users, water used for flushing, and the frequency of cleaning the septage. For estimation of septage flow, 1/3 volume of septic tank is estimated as septage for the treatment. The sludge removal will be through vacuum tankers, which is the most satisfactory method of sludge removal. Though de-sludging frequencies vary, it is generally recommended to de-sludge tanks once every two to three years, or when the tank becomes one third full. In this subproject area, once in a year sludge removal frequency is considered. Small scale vacuum sewer cleaning machines with 2,000-liter capacity will be used, which can easily access narrow roads. De-sludging of septage from household pits/ septic tanks will be done through mobile tankers with suction and discharge arrangements that will be procured for the project, transported and discharge to STP to co-treat the septage within STP.

46. The space for septage facility would include a septage holding tank for co-treatment, mixers and pumps accommodated in STP plant. Under septage management, septic tanks and soak pits are proposed (individual and community based) and pipe inside the properties for connecting connection chamber and property connection chamber outside property. This also includes the pipeline on road and connection up to community septic tanks. Location for the proposed community-based septic tanks and soak pits will be updated to this IEE document on design finalization and detail measurement surveys (DMS) along with Google earth maps.

Figure 8: Google Earth Map Showing Septage Areas under Banjarawala Package 2

Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

Figure 8A: Proposed FSSM System Concept



G. Storm water Drainage System

47. A total of 30 km storm water drains with precast RCC covers will be constructed alongside the roads in identified roads (Figure 9A & 9B) to facilitate smooth draining of storm water coming on the roads so that surface runoff generated during rainy season is properly collected, transported and discharged to the nearest water body (river).

48. Storm water drains will be constructed on both sides of the existing roads. Drains will be constructed within RoW of public roads under the ownership of Nagar Nigam; it is proposed to be constructed on the secondary municipal roads where there is no involuntary resettlement impacts assessed. Constructions of drains are part of the road reconstruction work, making the sides of road in slope to accommodate rain flowing down to the existing drainage systems. The drains will

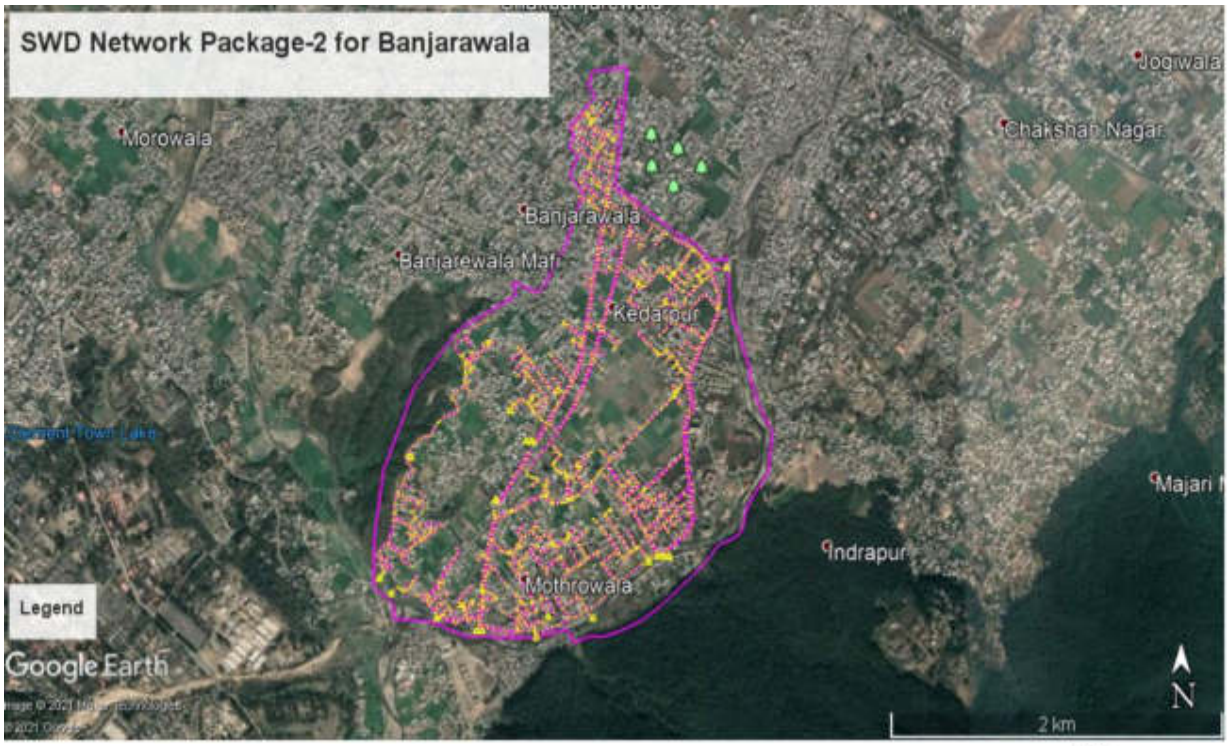
be constructed on roads that are under the ownership of DNN (Table 8). PMU, UIRUDP will obtain NOC from the Dehradun Nagar Nigam for the civil works prior to start of work and the same will be appended to the updated IEE report.

Table 8: Summary of Storm water Drains

Sl. No.	Name of Major Road	Length (KM)	Category Low/Medium/ High Density	Road Width (M)	Dia of drain (M^2)	Proposed Trench Width (M)	Ownership of Road
1	Link Roads in Neelkanth Colony,		Medium	3 to 7	0.25 x 0.4	1.0	DNN
2	Shivam Vihar.	30	Medium		0.25 x 0.4	1.0	DNN
3	Mahalaxipuram,		High		0.25 x 0.4	1.0	DNN
4	Geetanjali Enclave,		Medium		0.25 x 0.4	1.0	DNN
5	Ramkrishan Puram Colony		Medium		0.25 x 0.4	1.0	DNN
6	Swarna Ganga Enclave,		Medium		0.25 x 0.4	1.0	DNN
7	Tihari Nagar,		Medium		0.25 x 0.4	1.0	DNN
8	Vishnupuram,		Medium		0.25 x 0.4	1.0	DNN
9	Trimurti Enclave,		Medium		0.25 x 0.4	1.0	DNN
10	Shakti Vihar,		Medium	7	0.25 x 0.4	1.0	DNN
11	Dhaba Cant.		Medium	7	0.25 x 0.4	0.5	DNN
12	Nanda Devi Enclave,		Medium	7	0.25 X0.4	0.5	DNN

Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

Figure 9A: Google Earth Map of Storm Water Drains for Banjarawala Package 2



Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

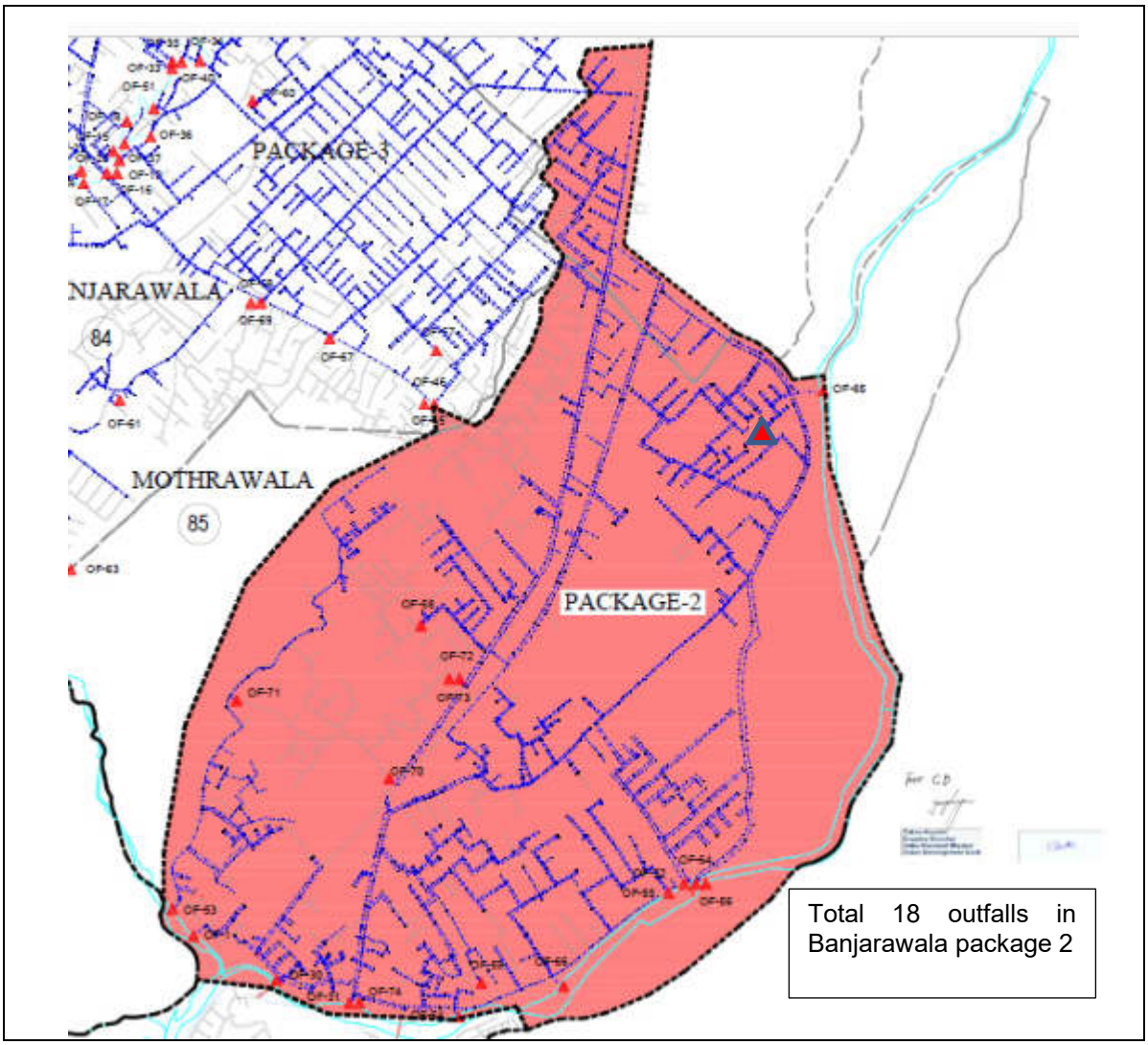
49. A total of 18 outfalls have been envisaged in the project area. Outfall structures shall be constructed at the end of storm water drains that discharge to nallah (a small stream/river) and major water body to reduce the velocity and prevent erosion. It shall be ensured that outfall structure invert level shall be above high flood level of the receiving water body. The discharge will be done to following *nallahs* and rivers: *nala* at Mothrowala area, nala at inter colony road, *nalas* near Mahalakshmipuram, Vishnupuram and to Ripsana and Bindal rivers (Table 9, Figure 9B)**.** All these *nalas* or drains ultimately join Ripsana River which in turn joins River Ganga. For discharge of storm water and construction of outfall structures, UIRUDP will obtain approval or NOC from Department of Irrigation, Government of Uttarakhand and Dehradun Nagar Nigam. The NOCs will be appended to the updated IEE report. Photographs of *nalas* (natural drains) are provided in Appendix 3.

Table 9: Proposed Outfalls under Banjarawala Package 2

Sl.No.	Name of Drain/Nala/ Rivulet /River Canal*	Number of Drainage Outfall points	Ownership
1	Ripsana River	10	Department of Irrigation, Government of Uttarakhand
2	Bindal River	2	
3	Nala near Vishnupuran inter	3	DNN
4	Nala near Mothrowala road	2	DNN
5	Nala near Mahalakshmipuram	1	DNN
	Total	**18**	

Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

Figure 9B: Proposed Storm water drains and Outfall map in Banjarawala Package 2



Source: Project Management Unit, UIRUDP and Design and Supervision Consultant

H. Climate Adaptation Measures

50. Groundwater Recharge pits and Rainwater Harvesting Structures will be developed and installed in the Banjarawala Package 2 project area. For Banjarawala Package 2, a total of 10 groundwater recharge pits along the primary and secondary existing natural drainage channels will be created. Two Rainwater harvesting structures will be constructed in two public parks under this Package 2, for which 10 sq.m area is required for each structure (Table 10).

51. A total of 10 groundwater recharge pits along the primary and secondary existing natural drainage channels will be created and 05 sq.m area is required for each recharge pits. Table 10 and 11 summarizes the locations of rainwater harvesting structures and groundwater recharge pits respectively. UUSDA will obtain NOCs from the Department of Education, Government of Uttarakhand, and Nagar Nigam Dehradun for construction of groundwater recharge pits.

Table 10: Locations of Rainwater Harvesting Structures under Package 2

S. No.	Subzone *	Location Name	Area Required (m^2)	Ownership of Land	Land use	NOC Status
1.	Zone -7	Near Veer Sahid Park, Mothrowala Road N 15.958, E 1.945	10	Dehradun Nagar Nigam	Park	Process initiated, yet to be availed
2.	Zone -7	Public Park, Doon University Road N 16.249, E 2.614	10	Dehradun Nagar Nigam	Park	Process initiated, yet to be availed

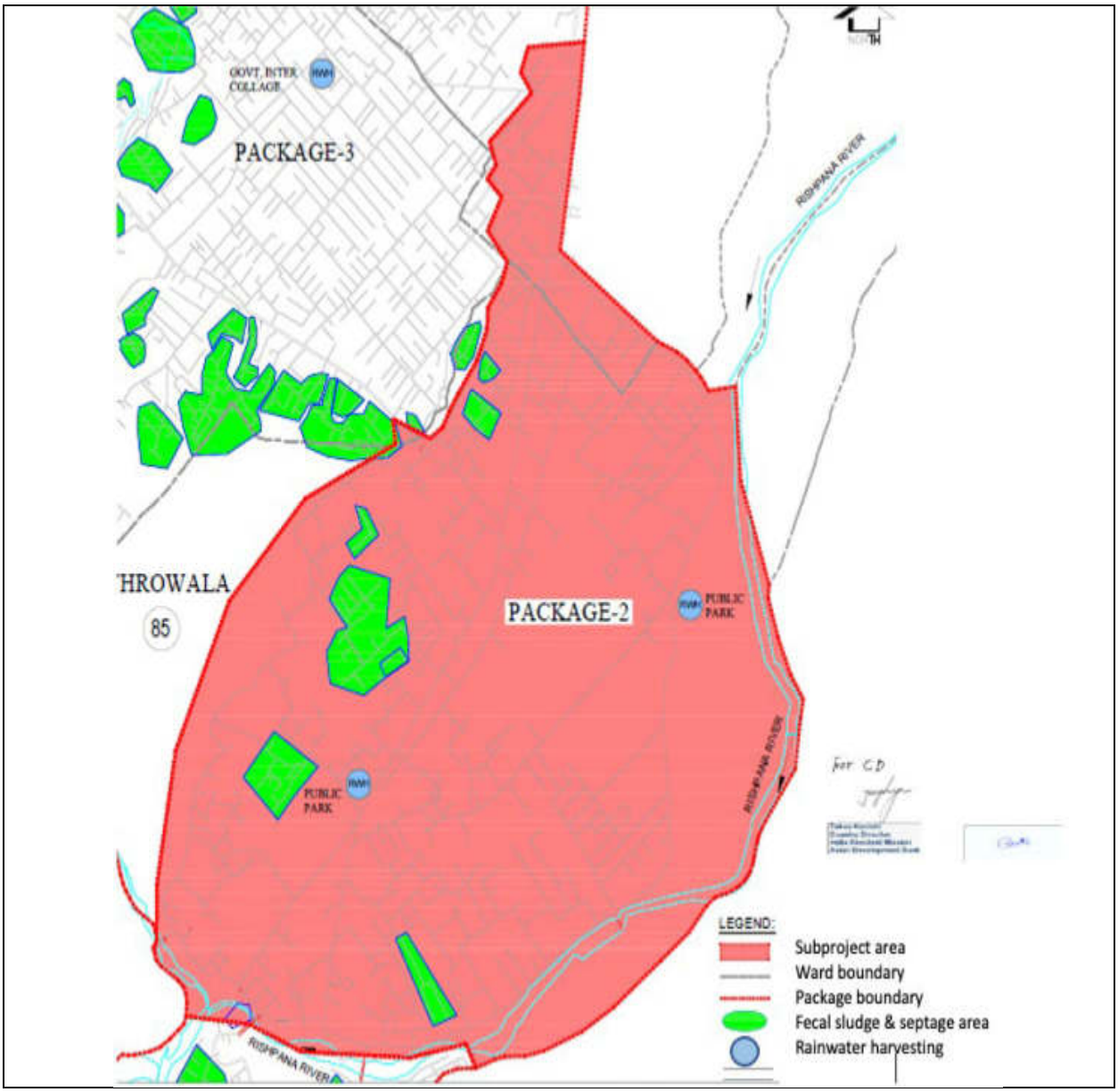
*as per Dehradun sewerage master plan
Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

Table 11: Groundwater Recharge Pits under Package 2

S. No.	Subzone *	Location Name	Area Required (m^2)	Ownership of Land	Land use	NOC Status
1.	Zone -7	Shaheed Udham Singh Park	5	DNN Dehradun Nagar Nigam	Park	Process initiated, yet to be availed
2.	Zone -7	Panchayat Bhavan Mothorowala	5	Dehradun Nagar Nigam	Park	Process initiated, yet to be availed
3	Zone -7	Near Sri Indresh Hospital	5	Dehradun Nagar Nigam	Park	Process initiated, yet to be availed
4	Zone -7	Near Cricket Ground	5	Dehradun Nagar Nigam	Park	Process initiated, yet to be availed
5	Zone -7	Doon University gate entry side	5	Dehradun Nagar Nigam	Park	Process initiated, yet to be availed
6	Zone -7	Geetanjali Enclave street side road	5	Dehradun Nagar Nigam	Park	Process initiated, yet to be availed
7	Zone -7	Shivam Vihar street side road	5	Dehradun Nagar Nigam	Park	Process initiated, yet to be availed
8	Zone -7	Vishnupuram street side road	5	Dehradun Nagar Nigam	Park	Process initiated, yet to be availed
9	Zone -7	Swarn Ganga Enclave street side road	5	Dehradun Nagar Nigam	Park	Process initiated, yet to be availed
10	Zone -7	Trimurti Enclave, street side road	5	Dehradun Nagar Nigam	Park	Process initiated, yet to be availed

*as per Dehradun sewerage master plan. Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

Figure 10: Septage Management Area and Rainwater Harvesting Structures



Source: Project Management Unit, UIRUDP and Design and Supervision Consultant

I. Proposed Subproject Components

52. Subprojects are proposed for implementation under Design-Build-Operate (DBO) modality, wherein which the successful bidder will design the water supply , sewerage and storm water drainage system and components (based on the feasibility / preliminary design / standards / guidelines provided in the bid document),construct, commission, and operate for 5 years, after which it will be transferred to Nagar Nigam. Therefore, at this stage, subproject is designed only in outline, and the details of components of the subproject provided in the table 5 below are as finalized at this stage based on the preliminary designs and as included in the bid documents. This IEE is based on the subprojects and components detailed in below and the IEE will be further updated during the detailed design phase. Table 11A shows the nature and size of the various components of the Water supply, Sewerage and Storm water drainage system.

Table 11 A: Proposed Subproject Components of Banjarawala Package 2

Infrastructure	Function	Description	Location
Water Supply			
Tube Wells	Abstract groundwater	**New** • 3 nos. • Drilling new tube wells, fixing pipes, casing, pumping equipment • Depth: 90-130 m • diameter of tube wells: 8-10” • Submersible pumps **Rehabilitation** • 2 tube wells • Replacement of pipes, pumps, valves, all electro-mechanical items etc., • Depth of the tube wells will not be increased	**New :** Three deep tube wells will be installed as water source for the DMA 4, 5 and 6. At all three locations land is under the ownership of UJS and DNN, no land will be acquired for the installation of tube wells • TW – 1500 lpm near PNB ATM, Mothorowala • (Co-ordinates:30°16’58.17”N, 78° 01’56.87”E) • TW – 1000 lpm - Geetanjali Enclave (Co-ordinates: 30°15’52.15” N, 78°02’35.15” E) • TW – 1500 lpm near Nagar Nigam office, Mothorowala (Co-ordinates: 30°16’3.83”N, 78°02’2.21”E) **Rehabilitation** Tube well (500 lpm)- - near PNB ATM, Mothorowala Tube well (700 lpm) - near Nagar Nigam office, Both the tube wells will be retained to supply water in the current service areas during construction period.
Overhead tanks (OHTs)	Store clear water for supply	**New:** **2 nos. with following capacity** • 800 kl near PNB ATM • 600 kl Near Geetanjali Enclave ▪ **Rehabilitation:** Existing Overhead tank (1000 kl) near Nagar Nigam office, Mothorwala to be retained and will be rehabilitated as	The new OHTs will be constructed at same locations where the two new tube wells will be constructed for DMA 4 (near PNB ATM, Mothrowala) and DMA 5 (at Geetanjali Enclave). The existing OHT at Mothrowala near Nagar Nigam office for DMA 6 will be rehabilated. At all three locations land is under the ownership of UJS and DNN

Infrastructure	Function	Description	Location
		required including: civil repairs, replacement of electromechanical items, and provision of SCADA	
Pump houses	To provide adequate pressure in water supply system to transmit water to overhead tanks for gravity supply Each tube well will be enclosed in the pumping station (PS) for protecting the equipment, piping, instrumentation and electrical panels from weathering and to have control over operation of tube well	**New: 3 nos.** Pump rooms with all mechanical and electrical equipment **Rehabilitation :** Two existing pump houses near PNB ATM and near Nagar Nigam office, Mothorwala will be rehabilitated as required including: civil repairs, replacement of electro-mechanical items, The instrumentations and SCADA arrangement will also be provided based of requirement and intended propose	**New:** • near PNB ATM, Mothorowala • Geetanjali Enclave • near Nagar Nigam office, Mothorowala
The rising main	The rising main is proposed for transferring water from pumping station into Overhead tank	**New** Rising main length of 1 km DI-K9 pipes with 100- 450 mm diameter	Pipes will be laid underground.

Infrastructure	Function	Description	Location
Chlorinator system	Post chlorination / disinfection of water prior to supply.	***New:*** 3 nos. Groundwater from tube wells will be collected in OHTs and the disinfection treatment in form of chlorination unit will be provided at the outlet of the tube well prior to supply	1. Near PNB ATM, Mothrowala) 2. Near Geetanjali Enclave). 3. Mothrowala near Nagar Nigam office for DMA 6 will be rehabilated.
Distribution network	To distribute water to consumers	***New water supply network*** : 59 km ductile iron pipe Class K7 (DI-K7) pipes with 100- 450 mm diameter	Pipes will be laid underground along the public roads/streets covering entire area of the town; No AC pipes are in the existing system
Bulk Flow Water Meters	Monitor water flow in the improved network	New As per the requirement to be finalized during the detailed design	Fixed at strategic locations in network as per the design., bulk meters will be fixed with the pipe section
Consumer connection with Automatic Meter Reading (AMR)	Provide water to consumers and measure water usage.	**New** Consumer connection with meters . • 1,950 water connections	Water delivery pipe (PE of dia 20 - 25 mm) will be connected to distribution lines and meters will be attached to the delivery pipe at each house with a meter chamber. All properties will have dedicated house connections with individual AMR meters.
Establishment of Customer Service Centres (CSC), meter testing room, Office room and GIS infrastructure will be common for water supply & sewerage system	Consumer relations and SCADA system control for entire water supply and sewerage system	**New:** **Customer Service Centres (CSC)** : - Two nos (Common for water supply and sewerage) **Central Control Centre (CCC)** : 1no	Will be constricted on government owned lands
Sewerage			
Sewage collection network including house connections	It has been proposed that sewage collected from Package 2 (part of municipal ward numbers 83 and 85) will be carried to proposed	**New** **A. Total 45 km sewer pipes** • 44 km of high-	Sewers will be laid underground in the roads and internal streets in the town. Sewers will be laid in the center of the road at a depth of 1 to 6m as per topography. The existing/proposed water pipes

Infrastructure	Function	Description	Location
	sewerage treatment plant (STP) at Indrapuri Farm, Daudwala which is proposed to be constructed under Banjarawala package 1. The wastewater collection system will mainly rely on gravity pipes and will discharge into the STP. The network will be of the conventional gravity collection type, starting from service connections to gravity sewers conveying the sewage to discharge into the trunk sewer leading to the STP	density polyethylene (HDPE) pipe of diameter 225 mm to 355 mm ● 1 km of DI-K7 pipe of 350 mm to 700 mm diameter **B. 1,950 numbers Manholes** **C. House sewer connections** up to Property Chamber (1650 numbers) by means of un-plasticized polyvinyl chloride (uPVC) pipe stiffness(SN)4 of 110 mm or 160 mm outside diameter (OD).	are/will be located on one or either side of the roads, and therefore sewers will be laid in the center without distributing the water pipes.. In the areas of water body crossing, main road crossings or deep cuttings (above 6-7 m depth), the sewers (around 3.5 km) will be laid by trenchless method. The nominal diameter of the casing pipes would be kept sufficiently large to permit easy withdrawal of the carrier pipe. The pit locations for trenchless pipeline laying will be identified by the design build and operate Contractor (DBO) on finalization of detail design, Based on the assessment of subsoil condition and traffic loads, **Manholes** will be installed along the sewer network. 53. House connections will be provided through a chamber constructed inside the property line and another chamber outside the property line. Chambers are to be connected with manholes in the main sewer line below the roads by means of unplasticized polyvinyl chloride (uPVC) pipe stiffness (SN)4 of 110 mm or 160 mm outside diameter (OD).
Fecal Sludge and Septage Management (FSSM) System			
Truck mounted mobile desludging equipment	Desludging of septage from household pits/ septic tanks, transportation and discharge to STP to co-treat the septage within STP	Mobile tankers with suction and discharge arrangements – number of tankers to be procured will be estimated during the detailed design	A FSSM system will be provided to collect fecal sludge and septage in low lying and/or low dense areas that are not techno-economically feasible to connect to sewerage system e.g. Dandi Village, Vishnupuram colony, Shvkunj Colony and Mahalakshmi Pruam Colony . This facility is expected to cover a population of 1350 in the base year 2021 and 4450 at the ultimate design year 2051 under Septage management for Banjarawala Package 2. The collected Septage from Banjarawala (Package-1, 2 & 3) comprising parts of municipal ward numbers 83, 84 and 85 will be transported to 68 MLD Kargi STP which is already equipped with septage co-
Septic tanks		Septic tanks are proposed for individual households for 5 and 10 users. Community-based septic tanks are proposed for 20/50/100 households.	

Infrastructure	Function	Description	Location
			treatment facility. At present, the Kargi STP under utilized receiving only 12 to 15 MLD sewage against the 68 MLD design capacity. The location for proposed community-based septic tanks and soak pits will be decided during the detailed engineering design based on the results of topography surveys and consumer survey depending upon the households and population in the area during SIP by the contractor
Storm Water Drainage System			
Storm Water Drainage System	**Storm water drains** will be constructed to facilitate smooth draining of storm water coming on the roads so that surface runoff generated during rainy season is properly collected, transported and discharged to the nearest water body (river). **Outfall structures** shall be constructed at the end of storm water drains that discharge to nallah (a small stream/river) and major water body to reduce the velocity and prevent erosion.	***New*** • A total of 30 km storm water drains with precast RCC covers • A total of 18 outfalls structures	Storm water drains will be constructed on both sides of the existing roads. Drains will be constructed within RoW of public roads under the ownership of Nagar Nigam; it is proposed to be constructed on the secondary municipal roads . The discharge will be done to following *nalas* and rivers : *nala* at Mothrowala area, nala at inter colony road, *nalas* near Mahalakshmipuram, Vishnupuram and to Ripsana and Bindal rivers. All these *nalas* or drains ultimately join Ripsana River which in turn joins River Ganga

Infrastructure	Function	Description	Location
Groundwater Recharge pits and Rainwater Harvesting Structures	Rainwater harvesting is the technique of collection and storage of rainwater at surface or in sub-surface aquifers, before it is lost as surface run-off. The augmented resource can be harvested in the time of need. Water collected from the rainwater harvesting structures shall be used for non-potable purposes such as in toilet flushing, gardening etc.,. Artificial recharge is substantially beneficial, as this will help store the surplus rainwater in the form of ground water and in turn arrest the decline of water level and degradation of the quality. All the same it is ecofriendly.	***New:*** • Two rainwater harvesting structures (Area required: 10 m^2) • Design will adopt principles and guidelines from good practice sourcebooks such as from the Water Sanitation and Hygiene Institute (WASH) and the African Development Bank.[6] • 10 groundwater recharge pits (Area required: 5 m^2) •	Two Rainwater harvesting structures will be constructed in Public Parks. These are under the ownership of Dehradun Nagar Nigam (DNN). • Near Veer Sahid Park, Mothrowala Road (N 15.958, E 1.945) • Public Park, Doon University Road (N 16.249, E 2.614) 10 groundwater recharge pits along the primary and secondary existing natural drainage channels are proposed

J. Subproject Benefits

54. The citizens of ward numbers 83 (Kedarpur) and 85 (Mothrowala) under Package 2 within Nagar Nigam Dehradun will be the major beneficiaries of the improved water supply, sewerage and storm water drainage systems. The subproject is primarily designed to improve environmental quality and living conditions of service area through provision of water supply and sewerage. The benefits arising from this subproject include: (i) increased availability of potable water at appropriate pressure to all households including urban poor; (ii) reduced time and costs in accessing alternative sources of water. (iii) better public health particularly reduction in waterborne and infectious diseases; (iv) reduced risk of groundwater contamination; (v) reduced risk of contamination of treated water supplies; and (vi) improvement in quality of water bodies due to disposal of treated effluent meeting disposal standards.

[6] WASH Institute's *A Practical Guide on Roof top Rain Water Harvesting*, and the African Development Bank's *Assessment of Best Practises and Experience in Water Harvesting Rainwater Harvesting Handbook.*

K. Energy Efficiency Measures included in the subproject

55. The subprojects in the project areas of Dehradun are designed with utmost consideration to energy efficiency. Gravity flow systems have been adopted.

56. To make the project energy efficient, as part of this project, energy efficiency measures are required to be included in the design of the projects. Accordingly, energy efficiency measures are being considered and incorporated into the subproject designs where appropriate. Energy efficient, high performance motors and transformers shall be provided for optimum utilization of energy during construction and operation of the project.

57. Component of luminaries shall be 'energy efficient low loss' type. Low power consuming CFL (Compact Fluorescent Lamp) /LED (Light-emitting Diode) type of luminaries shall be used for office/ all indoor areas except pump house area. HPSV or HPMV luminaries shall be used for pump house area and other outdoor areas. Street/ area lighting shall be of LED type and controlled by time switch/ photocell for automatic switching of luminaries. Solar type streetlights shall be installed where feasible in the project. Specification of solar lighting shall be as per Ministry of New and Renewable Energy. Fixtures shall be energy efficient and ballast shall be electronic low loss type.

58. Supervisory Control and Data Acquisition (SCADA) has been proposed for entire system of sewerage works. SCADA shall support and include a multi-level real-time auditing and advising of energy optimization process and Real-time process performance software. The key benefits of a performance auditing system would be a more energy efficient plant, improved reliability and safety, and increased profitability.

L. Implementation Schedule

59. After the completion feasibility study /preliminary designs, bids will be invited in June 2021 for the subprojects to be implemented under the DBO (design-build-operate) modality. Bids will be awarded in December 2021. Successful bidder then will carry out detailed designs and construction is will take about 42 months after the award of works. After completion of construction and commissioning, scheme will be operated by DBO contractor for 5 years, and after which the operation and maintenance will be carried out by Nagar Nigam Dehradun.

III. ANALYSIS OF ALTERNATIVES

60. The subproject is located in Zone 7, which is divided into three work packages based on topography and hydrology. This subproject covers package 2 and the main components of subproject are water, sanitation and drainage systems The ADB SPS requires an analysis of project alternatives to determine the best method of achieving project objectives (collecting and disposing the human waste generated, in Package 2 in Banjarawala at Dehradun town) while minimizing environmental impacts. Alternative analysis provides opportunity to integrate environmental considerations into early stages of project (i.e., pre-feasibility or feasibility study), so that adverse environmental impacts can be avoided or minimized by various alternatives. It also provides opportunity to study various options vis a vis costs, provides a logical base, via transparent process, assist in decision making, gaining public support and ultimately in project approvals and timely implementation.

61. The proposed water supply subproject components in Package 2 include source augmentation to provide adequate water, water conveyance, treatment, storage and distribution.

Similarly, the sewerage component includes sewage collection network, transmission, treatment and treated wastewater reuse and disposal. Descriptions of various alternatives considered for critical components such as water source, location of Tube well and OHTs, water and sewer pipe laying etc. are presented in the following Table 12.

Table 12: Analysis of Alternatives

1.	**Project Need – No Project Alternative**
Type of alternative	**'No project' / 'with project' alternative**
Description of alternatives	**<u>No project alternative</u>** The subproject area, which is around 359 Hectare (Ha) comprising of part of municipal ward numbers 83 (Kedarpura) and 85 (Mothrowala) located in Banjarawal area of Dehradhun city. The water supply system under this package is proposed in part of ward number 85 (Mothrowala) with the 2011 Census population of 3875. Water supply in ward 83 has been provided by some other government program recently. Currently, there is existing water supply in the ward number 85 (Mothrowala) area but its pipeline network (CI, GI and PVC) is more than 25 years old with the average supply level of around 110 lpcd for 4 to 6 hours per day, not meeting the performance standard. The source of existing water supply system is ground water which is being extracted through two tube wells. The sub-project area is newly incorporated/merged into Dehradun Municipal Corporation. Currently, there is no sewerage system provided in the subproject area, comprising of part of municipal ward numbers 83(Kedarpur) and 85 (Mothrowala). In most of the areas, sewage from the individual septic tanks exit/seep/flow/overflow directly into the nearby storm water drains. Effluent from septic tanks is also being discharged into the roadside drains. Open defecation is not uncommon. There are no soak pits, and the effluent discharge into open drains. The untreated / partially treated sewage flow in the open drains through habitation areas and discharged into rivers/streams. Presently there is no proper storm water drainage system. To make matters worse, sewage from the septic tanks constructed as part of individual houses is flowing into these drains and some of the major nalas passing through this sub project area are in dilapidated condition and are choked by garbage and debris Living conditions due to absence of proper water supply, sewerage and drainage system are poor, unhealthy, and unhygienic. Lack of infrastructure is also causing environmental pollution, overall poor quality of life. Poor environmental quality affects the urban poor more. The project intends to provide following benefits to the people residing in the sub-project area, and the "no project" alternative will deprive people of these benefits: • increased availability of potable water at appropriate pressure to all households including urban poor; • reduced time and costs in accessing alternative sources of water. • better public health particularly reduction in waterborne and infectious diseases; • reduced risk of groundwater contamination through appropriate sewer collection and treatment; • reduced risk of contamination of treated water supplies; and, • improvement in quality of water bodies due to disposal of treated effluent meeting

	disposal standards • newly constructed drainage systems will cater to not only runoff from roads but also the runoff of complete catchment area, which is causing flooding and overflow in the current scenario **<u>With project alternative</u>** The proposed subprojects will support the ongoing efforts of the Government of Uttarakhand towards improving water supply and sewerage systems. Since the existing water supply system is insufficient to accommodate growing population in the area, rehabilitation of existing sources, construction of new source (Tube wells), OHTs and water supply pipeline network have been included in the scope of this project. The project will also expand the sewerage network; improve storm water drainage systems in the project area. The project is expected to increase operational efficiency, improve service delivery, and result in a positive impact on health and quality of life for the residents of project towns in the state. With the implementation of Package 2, people will have convenient access to reliable and adequate safe and potable water supply, improved drainage and sewerage system. The sewerage system will remove the human waste from their homes safely and quickly As a result, good hygiene and sanitation practices will be promoted and there will be reduced health and safety risks. Similarly the proposed water supply subproject include source augmentation to provide adequate water, water conveyance, treatment, storage and distribution The project is expected to increase operational efficiency, improve service delivery, and result in a positive impact on health and quality of life for the residents of project area.. Overall, the **'with project alternative'** will bring about improved public health and living environment that will contribute to improved quality of life in service area. Improved sanitation and water supply system will create an enabling environment for local economic development and improved social services that communities within the sphere of influence of the municipality will benefit from; thus, contributing to the overall economic development of the region.
Selected Alternative	"Without" subprojects would yield the town to be continuously under-serviced that puts the health of the general public at an increasing risk and could potentially worsen the living environment. This 'no project' scenario would impede further social and economic development of the district and the defer commitments to improve the proportion of the population with sustainable access to clean water and basic sanitation. Given the large-scale benefits to the population and environment, 'with project' alternative is considered appropriate
2	**Alternative source of water**
Type of alternative	'Water source'
Description of alternatives	• Groundwater. • Surface water. • Combined ground and surface source

	Presently, the water supply of Dehradun is dependent on tube wells and mini tube wells yielding 142 MLD and surface water to the extent of 36 MLD. The existing water supply system in Dehradun city, which is more than 30 years old, consists of three sub systems viz. North zone, South zone and Pithuwala zone. The North zone is supplied mostly with surface water sources, and south (where subproject is located) and Pithuwala zones are supplied with ground water from tube wells located at various places in the city. All water supply scheme of the city is implemented by Uttarakhand Pey Jal Nigam (UPJN) and maintained by Uttarakhand Jal Sansthan (UJS). There are about 140 tube wells in the urban area of Dehradun city and these tube wells are being used for the drinking water supply to the residents of Dehradun. In addition to the tube wells, the surface sources of drinking water are Bandal River, Massi and Sikar water falls. The water from the above surface water sources is being brought through gravity pipelines to the Water Treatment Plants at Shanshahi Ashram (14 MLD), and Dilaram Bazar (21 MLD). Surface based Piped water supply is very unevenly distributed among different user groups, geographical areas and times of the year. The Government of Uttarakhand (GoU) aims at improving the drinking water supply status in terms of quantity and quality, as well as in identifying the need to develop and utilize its groundwater resource to the best extent. Accordingly, the GoU has launched its Uttarakhand Urban Sector Development Investment Program (UUSDIP), partly financed by the Asian Development Bank (ADB), which includes a phased scheme for developing the basic infrastructure facilities in its major urban centres including its capital, Dehradun. As part of this process, GoU has planned to augment the water supply system of Dehradun through installation of new groundwater sources through a sustainable scheme. During enquiry from various organizations including UPJN/UJS, it was informed that the ground water table at southern part of Dehradun is good and depletion is not a cause of concern as the annual recharging is adequate.
Selected Alternative	**Selected source** is Groundwater as no other sources were considered Three deep tube wells will be installed as water source with 1000 liters per minute (lpm), 1500 lpm and 1500 lpm capacities. Based on proposed water supply rate of 135 lpcd for service area of Banjarawala Package 2, the total raw water demand is estimated as 1.45 MLD (base year 2021), 2.66 MLD (intermediate year 2031) and 3.87 MLD (ultimate design year 2051). The present service area i.e. Package 2 of Banjarawala falls in Raipur block in Dehradhun district which is categorized as **SAFE** as per the categorization adopted by the CGWB and leaving a large scope for further development of the resource for domestic, industrial, agricultural and other uses. Groundwater quality is fit for drinking; therefore, only disinfection is proposed prior to supply. The Ground Water Depth, in the southern most part where the subproject is proposed ranges between 5 and 10 mbgl (metre below ground level). During the interaction with officials at Jal Sansthan, it was understood that the average depth of these wells ranges between 70 and 120 m and the average yield is about 1500 litres per minute (LPM). The average diameter of tube wells constructed by Jal Sansthan is 8 – 10 inches. As per the available information, the cumulative discharge of the above tube wells is 185 million liters per day (MLD). A hydrogeological investigation was carried out for constructing a tube well at Mothronwala, Dehradun district, for Uttarakhand Jal Sansthan (UJS) which is about 2.5 km from the

	proposed Tube well site near Nagar Nigam office at Mothorowala.(ward 85) shows that Groundwater occurs under unconfined condition and water levels are generally in the range of 25 to 30 m below ground level in the area. Groundwater development in and around the study area is moderately low. The aquifers are composed mainly of sand, gravel and boulder. A tubewell was drilled down to a depth of 130 m and saturated water bearing horizons from 57-60, 75-87 91-96 and 119-123 were tapped for the construction of a production well. The Static Water Level of this tubewell was measured to be 28.5 m and the discharge of the ground water abstraction structure is measured to be 2000 lpm for a moderate drawdown. It can be concluded that tube well constructed to the recommended depth of 130m will give a sustainable discharge of 1500 to 1800liters per minutes (lpm) to enjoy sustaining yields and long pumping hours @20 hours per day. The average diameter of tube wells constructed by Jal Nigam is 8 – 10". Ground water quality in the area is reported chemically suitable for drinking purposes. Hence only Groundwater as a sustainable source was considered by the UUSDA,
3	**Project Locations**
Description of alternatives	**Location of Deep Tube wells. Pumping Stations and OHTs**: Location selection is guided by technical feasibility, and easy approach. The locations will be fine-tuned during the detailed design following the detailed site surveys and investigations. One of the main criteria is to locate tube wells where there is adequate / proposed yield is available till ultimate design period. All the tube well and OHTs are proposed on Government land free from enchorochments. Land acquisition is not envisaged for the proposed two OHTs under package 2. Construction of 800 kilo liter (kl) OHT near Punjab National Bank (PNB) automated teller machine (ATM) at Mothrowala will be done at an existing OHT (of 250 kl capacity) location. The old OHT will be dismantled and the new 800 kl OHT will be constructed; no additional impact on structures is anticipated at the site. The land is under ownership of Uttarakhand Jal Sansthan (UJS). The other 650 kl OHT will be constructed at Geetanjali Enclave; the proposed land for the OHT is under the ownership of Dehradun Nagar Nigam (DNN). The land parcel identified for OHT at Geetanjali Enclave is vacant and free of encumbrances. Three deep tube wells will be installed as water source at same locations where the two new OHTs will be constructed (near Punjab National Bank (PNB) ATM at Mothrowala and Geetanjali Enclave) and another one at the existing OHT location at Mothrowala near Nagar Nigam office. As mentioned, that land is under the ownership of UJS and DNN hence no land will be acquired for the installation of tube wells at all three locations and no structures will be impacted at PNB ATM and Mothrowala location. **Water distribution and sewer lines.** Sewer and water supply pipes will be laid underground and are proposed along the roads/streets in the town within the road right of way (ROW). While water pipes are/will be located on one or either side of the roads, the sewers will be laid in the middle of the road to avoid disturbing the water pipes. In the areas of water body crossing, main road crossings or deep cuttings (above 6-7 m depth), the sewers will be laid by trenchless method. The nominal diameter of the casing pipes would be kept sufficiently large to permit easy withdrawal of the carrier pipe. **Storm water drains** will be constructed alongside the roads in identified roads to facilitate smooth draining of storm water and Outfall structures shall be constructed at the end of storm water drains that discharge to nallah (a small stream/river) and major water bodies.

	There are no eco-sensitive or protected areas within or close to proposed project activity areas. No wildlife is also reported in the project town. During water supply and sewer pipe laying works tree cutting is not envisaged as per design. **Fecal Sludge and Septage Management (FSSM) System.** A FSSM system will be provided to collect fecal sludge and septage in low lying and/or low dense areas of Package 2, e.g. Dandi Village, Vishnupuram Colony, Shvkunj Colony and Mahalakshmi Pruam Colony that are not techno-economically feasible to connect to sewerage system. This facility is expected to cover a population of 1350 in the base year 2021 and 4450 at the ultimate design year 2051 under Septage management for Banjarawala Package 2. The location and number of proposed septic tanks and soak pits will be decided during the detailed engineering design based on the results of topography surveys and consumer survey depending upon the households and population in the area during SIP by the contractor. Specific septic tank locations should be selected based oncareful consideration on possible contamination of groundwater and surfacewater sources , odors, and other possible negative impacts on the environment and the relevant communities. The collected Septage from Banjarawala (Package-1, 2 & 3) comprising parts of municipal ward numbers 83, 84 and 85 will be transported to 68 MLD Kargi STP which is already equipped with septage co-treatment facility and only 130 KLD of FSS is presently being disposed at Kargi STP for treatment (NIUA 2021). **Groundwater Recharge pits and Rainwater Harvesting Structures**. In Banjarawala Package 2 a total of 10 groundwater recharge pits along the primary and secondary existing natural drainage channels will be created and 05 sq.m areas is required for each recharge pits. Two Rainwater harvesting structures will be constructed in Public Parks under this package 2 and 10 sq.m area is required for each structure. All the lands are under the ownership of Dehradun Nagar Nigam

IV. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. ADB Safeguard Policy Statement, 2009

62. ADB SPS requires that during the design, construction and operation of the project necessary compliance to all applicable laws and international conventions / treaties along with pollution prevention and control technologies and practices consistent with international good practice, are ensured.

63. **Screening and Categorization with that of ADB SPS 2009.** ADB uses a classification system to reflect the significance of a project's potential environmental impacts. A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence. Each proposed project is scrutinized as to its type, location, scale, and sensitivity and the magnitude of its potential environmental impacts. Projects are assigned to one of the following four categories:

(i) **Category A**. A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA) is required.

(ii) **Category B**. A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These

impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for Category A projects. An initial environmental examination (IEE) is required.

(iii) **Category C**. A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.

(iv) **Category FI**. A proposed project is classified as category FI if it involves investment of ADB funds to or through a FI.

64. The environmental impacts of Banjarawala Package 2 water supply and sewerage subproject have been identified and assessed as part of the planning and design process. An environmental assessment using ADB's Rapid Environmental Assessment Checklists for Water supply, Sewerage works and SWD system (Appendix 1A. IB & 1C) were conducted, and results of the assessments show that the subproject is unlikely to cause significant adverse impacts. Thus, this IEE has been prepared in accordance with ADB SPS's requirements for environment Category B projects.

65. **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. The EMP shall include the proposed mitigation measures, environmental monitoring and reporting requirements, emergency response procedures, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators.

66. **Environmental Audit of Existing Facilities.** ADB SPS requires that relevant external experts perform an environmental audit, if a subproject involves facilities and/or business activities that already exist or are under construction, ito determine the existence of any areas where such project may cause or is causing environmental risks or impacts, and identify and plan appropriate measures to address outstanding environmental issues. If the project does not foresee any new major expansion, the audit constitutes the environmental assessment for the project.

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

(i) Final or updated IEE upon receipt; and

(iii) Environmental monitoring reports submitted by the Project Management Unit (PMU) during project implementation upon receipt.

68. **Consultation and Participation.** ADB SPS requires borrowers to conduct meaningful consultation[7] with affected people and other concerned stakeholders, including civil society, and

[7] Per ADB SPS, 2009, meaningful consultation means a process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;1 (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues

facilitate their informed participation. The consultation process and its results are to be documented and reflected in the environmental assessment report.

69. **Grievance Redress Mechanism.** ADB SPS requires borrowers to establish a mechanism to receive and facilitate resolution of affected people's concerns, complaints, and grievances about the subproject's performance. The grievance mechanism shall be scaled to the risks and adverse impacts of the subproject.

70. **Monitoring and Reporting.** Borrower shall monitor measure and document the implementation progress of the EMP. If necessary, the borrower shall identify the necessary corrective actions, and reflect them in a corrective action plan. Borrower shall prepare and submit to ADB semi-annual environmental monitoring reports that describe progress with implementation of the EMP and compliance issues and corrective actions, if any. For subprojects likely to have significant adverse environmental impacts during operation, reporting will continue at the minimum on an annual basis until ADB issues a project completion report.

71. **Unanticipated Environmental Impacts.** Where unanticipated environmental impacts become apparent during subproject implementation, ADB SPS requires the borrower to update the environmental assessment and EMP or prepare a new environmental assessment and EMP to assess the potential impacts, evaluate the alternatives, and outline mitigation measures and resources to address those impacts.

72. **Occupational Health and Safety.** ADB SPS requires the borrower8to ensure that workers9 are provided with a safe and healthy working environment, taking into account risks inherent to the sector and specific classes of hazards in the subproject work areas, including physical, chemical, biological, and radiological hazards. Borrower shall take steps to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work, including: (i) identifying and minimizing, so far as reasonably practicable, the causes of potential hazards to workers; (ii) providing preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; (iii) providing appropriate equipment to minimize risks and requiring and enforcing its use; (iv) training workers and providing them with appropriate incentives to use and comply with health and safety procedures and protective equipment; (v) documenting and reporting occupational accidents, diseases, and incidents; and (vi) having emergency prevention, preparedness, and response arrangements in place.

73. **Community Health and Safety.** ADB SPS requires the borrower to identify and assess risks to, and potential impacts on, the safety of affected communities during the design, construction, operation, and decommissioning of the subproject, and shall establish preventive measures and plans to address them in a manner commensurate with the identified risks and impacts. The borrower shall ensure to apply preventive and protective measures for both occupational and community health and safety consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. PMU shall also adhere to necessary protocols in response to emerging infectious diseases such as the corona virus disease (COVID-19) consistent with the guidelines of relevant government healthcare agencies and the World Health Organization.

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[8] In case where responsibility is delegated to subproject contractors during construction phase, borrower shall ensure that the responsibilities on occupational health and safety are included in the contract documents

[9] Including non-employee workers engaged by the borrower/client through contractors or other intermediaries to work on project sites or perform work directly related to the project's core functions.

74. **Physical Cultural Resources.** Borrower is responsible for siting and designing the subproject to avoid significant damage to physical cultural resources. ADB SPS requires that such resources likely to be affected by the subproject are identified, and qualified and experienced experts assess the subproject's potential impacts on these resources using field-based surveys as an integral part of the environmental assessment process. When the proposed location of a subproject component is in areas where physical cultural resources are expected to be found as determined during the environmental assessment process, chance finds procedures shall be included in the EMP.

75. **ADB SPS International Best Practice Requirements.** ADB SPS requires that, during the design, construction, and operation of the project, the executing agency shall apply pollution prevention and control technologies and practices that are consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. (IFC's General EHS Guidelines[10] and Sector Specific (Water and Sanitation) Guidelines[11)]. These standards contain performance levels and measures that are normally acceptable and applicable to projects. 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.

76. **Bidding and Contract Documents**. This IEE report, which contains the EMP, shall be included in bidding and contract documents and verified by PMU. The PMU shall also ensure that bidding and contract documents include specific provisions requiring contractors to (i) comply with all other conditions required by ADB,21 and (ii) to submit to PMU, for review and approval, a site specific environmental management plan (SEMP), 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 EMP; and (iv) budget for SEMP implementation, among others as may be required. No works can commence prior to approval of SEMP. A copy of the EMP and/or approved SEMP will be kept on site during the construction period at all times. Non-compliance with, or any deviation from, the conditions set out in the EMP and/or SEMP constitutes a failure in compliance and shall require corrective actions.

77. **Conditions for Award of Contract and Commencement of Work**. PMU shall not award any works contract under the subproject until (i) relevant provisions from the EMP are incorporated into the works contract; (ii) this IEE report is updated to reflect subproject's final detailed design and PMU has obtained ADB's clearance of such updated IEE report; and (iii) other necessary permits from relevant government agencies have been obtained. For "design, build, and operate" type contracts, PMU shall ensure no works for a subproject which involves environmental impacts shall commence until (i) relevant provisions from the EMP are incorporated into the works contract; and (ii) this IEE report is updated to reflect subproject's detailed design and PMU has obtained ADB's clearance for such updated IEE.

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[10] World Bank Group, 2007. Environmental, Health and Safety General Guidelines, Washington, DC.
[11] World Bank Group, 2007, Environmental, Health and Safety Guidelines for Water and Sanitation, Washington, DC.

B. National and State Laws

78. The implementation of the subprojects will be governed by Government of India and State of Uttarakhand and other applicable environmental acts, rules, regulations, and standards. These regulations impose restrictions on the activities to minimize or mitigate likely impacts on the environment. It is the responsibility of the project executing and implementing agencies to ensure subprojects are consistent with the legal framework, whether applicable international, national, state or municipal or local. Key standards include those related to drinking water quality, air quality, effluent discharge, and protected areas. Compliance is required in all stages of the subprojects including design, construction, and operation and maintenance.

79. **Environmental assessment.** The Government of India 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.

80. None of the components of this water supply and sewerage system subproject falls under the ambit of the EIA Notification 2006, and therefore EIA Study or environmental clearance (EC) is not required for the subproject.

81. **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 13.

Table 13: Applicable Environmental Regulations

Law	Description	Requirement	Relevance to Project Phase
EIA Notification	Projects indicated in the schedule of this notification requires EIA study and environmental clearance.	None of the components of this subproject falls under the ambit of the notification; no EIA study or environmental clearance required.	-
National Environment Policy (NEP), 2006	NEP is a comprehensive guiding document in India for all environmental conservation programs and legislations by Central, State and Local Government. The dominant theme of this policy is to promote betterment of livelihoods without compromising or degrading the environmental resources. The policy also advocates collaboration method of different stakeholders to harness potential resources and strengthen environmental management.	UUDP should adhere to NEP conservation of environmental resources and abatement of pollution.	All phases of project
Water (Prevention and Control of Pollution) Act of 1974, Rules of 1975, and amendments (1987)	Act was enacted to provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water, by Central and State Pollution Control Boards and for conferring on and assigning to CPCB/SPCBs powers and functions relating to water pollution control. Control of water pollution is achieved through administering conditions imposed in consent issued under provision of the Water (Prevention and Control of Pollution) Act of 1974. These conditions regulate the quantity and quantity of effluent, the location of discharge and the frequency of monitoring of effluents. Any component of the subproject having the potential to generate sewage or trade effluent will come under its purview. Such projects have to obtain Consent to establish (CTE) under Section 25 of the Act from Uttrakhand Pollution Control Board (UEPPCB) before starting implementation and Consent to Operate (CTO) before commissioning.	Proposed STP under Package 1 will require CTE (prior to start of construction works) and CTO (prior to start of operation) from Uttrakhand Pollution Control Board (UEPPCB) All relevant forms, prescribed fees and procedures to obtain the CTE and CTO can be found in the UEPPCB website. (http://ueppcb.uk.gov.in)	Operation
Air (Prevention and Control of Pollution) Act of 1981, Rules of 1982 and amendments.	This Act was enacted to achieve prevention, control and abatement of air pollution activities by assigning regulatory powers to Central and State boards for all such functions. The Act also establishes ambient air quality standards. The projects having potential to emit air pollutants into the atmosphere have to obtain CFE and CFO under Section 21 of	The following will require CFE and CFO from UEPPCB: (i) Diesel generators); (ii) Batching Plant hot mix plants; and (iii) stone crushers, if installed for construction.	Construction and operation

Law	Description	Requirement	Relevance to Project Phase
	the Act from UEPPCB. The occupier of the project/facility has the responsibility to adopt necessary air pollution control measures for abating air pollution.	All relevant forms, prescribed fees and procedures to obtain the CFE and CFO can be found in the UEPPCB website (http://ueppcb.uk.gov.in) If ready mix concrete and hot mix bitumen is procured from third party, contractor to ensure that the plants, from where material is being purchased is having CTE/CTO and copy should be collected from third party and submitted in PIU	
Ground Water (Regulation, Development and Management) Act 2005	An act to regulate and control the development and management of ground water and matters connected therewith or incidental thereto.	Applicable for new tube wells	Pre-construction
Biodiversity Act of 2002	This Act primarily addresses access to genetic resources and associated knowledge by foreign individuals, institutions or companies, to ensure equitable sharing of benefits arising out of the use of these resources and knowledge to the country and the people.	Not Applicable	-
Wildlife Protection Act, 1972 and amendment 1991	This overarching Act provides protection to wild animals, birds, plants and matters connected with habitat protection, processes to declare protected areas, regulation of wildlife trade, constitution of state and national board for wildlife, zoo authority, tiger conservation authority, penalty clauses and other important regulations.	Not applicable – none of the project components are located in or near protected areas. .	Construction
The Forest (Conservation) Act, 1980	The Forest (Conservation) Act prohibits the use of forest land for non-forest purposes without the approval of Ministry of Environment Forests and Climate Change (MoEF&CC), Government of India	Not applicable; none of the components of the subproject are located in forest.	Construction
Environmental (Protection) Act, 1986 amended in 1991 and the following rules/notifications:	This is an “umbrella” legislation that empowers the Central Government to take all necessary measures to protect and improve the quality of the environment and prevent, control and abate environmental pollution. Empowers central government to enact various rules to regulate	There are rules / notifications that have been brought out under this Act, which are relevant to UUSDA, and are listed below	Construction and operation

Law	Description	Requirement	Relevance to Project Phase
	environmental pollution, including standards for quality of air, water, noise, soil; discharge standards or allowable concentration limits for environmental pollutants, handling of hazardous substances, locating/prohibiting industries, etc.,		
Environmental Standards (ambient and discharge).	Emissions and discharges from the facilities to be created or refurbished or augmented shall comply with the notified standards	Appendix 2 provides applicable standards for ambient air quality, emission limits and emission stack height requirements for diesel generators Appendix 3 provides STP discharge standards	Construction and operation
Doon Valley Notification vide Notification number S.O 102 (E), dated 1st February 1989 and subsequent amendments under 3(2)(v) of Environment (Protection) Act, 1986, and Rule 5(3)(d) of Environment (Protection) Rules, 1986	MOEF&CC has imposed restrictions on restricting location of industries, mining operations and other development activities in the Doon Valley in erstwhile Uttar Pradesh (now Uttarakhand) keeping in view of the environmental impacts in the region. This notification states that "The obnoxious and hazardous industries are those using inflammable, explosive, corrosive or toxic substances. are prohibited".	Not Applicable The proposed project do not have any usage of obnoxious or hazardous substances will be categorised as Green. Also, the sewerage treatment plant will overall improve the water quality of the surrounding area.	
Noise Pollution (Regulation and Control) Rules, 2000 amended up to 2010.	Rule 3 of the Act specifies ambient air quality standards in respect of noise for different areas/zones.	Appendix 4 provides applicable noise standards, and noise limits for diesel generators	Construction and operation
Solid Waste Management Rules 2016	Responsibility of Solid Waste Generator: (i) segregate and store the waste generated in three separate streams namely bio-degradable, non- biodegradable and domestic hazardous wastes in suitable bins and handover segregated wastes to authorized waste pickers or waste collectors as per the direction or notification by the local authorities from time to time; (ii) store separately construction and demolition waste, as and	Contractor to follow all the rules during construction works	Construction and operation

Law	Description	Requirement	Relevance to Project Phase
	when generated, in his own premises and shall dispose off as per the Construction and Demolition Waste Management Rules, 2016; (iii) No waste generator shall throw, burn or burry the solid waste generated by him, on streets, open public spaces outside his premises or in the drain or water bodies.		
Construction and Demolition Waste Management Rules 2016	Every waste generator shall segregate construction and demolition waste and deposit at collection centre or handover it to the authorized processing facilities Shall ensure that there is no littering or deposition so as to prevent obstruction to the traffic or the public or drains Large generators (who generate more than 20 tons or more in one day or 300 tons per project in a month) shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition or remodeling work, Large generators shall have environment management plan to address the likely environmental issues from construction, demolition, storage, transportation process and disposal / reuse of C and D Waste. Large generators shall segregate the waste into four streams such as concrete, soil, steel, wood and plastics, bricks and mortar, Large generators shall pay relevant charges for collection, transportation, processing and disposal as notified by the concerned authorities;	Construction waste shall be collected at stockpile area for 8-10 days and will be sent to disposal site. Disposal site shall be identified and allotted by Municipal Council after mobilization of contractor (during SIP period) and can't be mentioned at this time. Contractor to follow all the rules during construction works. Sludge or any material if classified as hazardous waste / material is to be handled and disposed according to this Rules Excerpts from C and D Rules are provided in Appendix 5.	Construction
Hazardous and Other Wastes (Management and Trans boundary Movement) Rules, 2016,	Responsibilities of the occupier for management of hazardous and other wastes.- (1) For the management of hazardous and other wastes, an occupier shall follow the following steps, namely:- (a) prevention; (b) minimization; (c) reuse, (d) recycling; (e) recovery, utilization including co-processing; (f) safe disposal. (2) The occupier shall be responsible for safe and environmentally sound management of hazardous and other wastes. (3) The hazardous and other wastes generated in the establishment of an occupier shall be sent or sold to an authorized actual user or shall be disposed of in an authorized disposal facility. (4) The hazardous and other wastes shall be transported from an occupier's establishment to an authorized actual user or to an authorized disposal facility in accordance	Contractor to comply all the requirements of this Act, if there are any hazardous wastes are generated, handled or managed during construction and operation works. However, it is unlikely that it will involve any hazardous waste. Sludge generated from STP, if the incoming sewage mixes with industrial wastewater, there is a possibility of STP sludge classified as hazardous waste.	Construction and operation

Law	Description	Requirement	Relevance to Project Phase
	with the provisions of these rules. (5) The occupier who intends to get its hazardous and other wastes treated and disposed of by the operator of a treatment, storage and disposal facility shall give to the operator of that facility, such specific information as may be needed for safe storage and disposal. (6) The occupier shall take all the steps while managing hazardous and other wastes to- 6 (a) contain contaminants and prevent accidents and limit their consequences on human beings and the environment; and (b) provide persons working in the site with appropriate training, equipment and the information necessary to ensure their safety.	Proper measures will be included to avoid mixing of industrial wastewater into sewage.	
Wetlands (Conservation and Management) Rules, 2017	The Rules specify activities which are harmful and prohibited in the wetlands such as industrialization, construction, dumping of untreated waste and effluents, and reclamation. The Central Government may permit any of the prohibited activities on the recommendation of Central Wetlands Regulatory Authority.	Not applicable as subprojects components are not located in or near to designated wetland area.	
Ancient Monuments and Archaeological Sites and Remains Act, 1958 and Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010.	The Act designates areas within 100 meters (m) of the "protected monument/area" as "prohibited area" and beyond that up to 200 m as "regulated area" respectively. No "construction" is permitted in the "prohibited area" and any construction activity in the "regulated area" requires prior permission of the Archaeological Survey of India (ASI).	Not applicable - there are no protected monuments / places of archeological / historical places in or near the project areas of Dehradun In case of chance finds, the contractor/ PIU will be required to follow a protocol as defined in the Environmental Management Plan (EMP)	Construction
The Building and Other Construction Workers (BOCW) Act 1996 and the Uttaranchal Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Rules, 2005.	Labour Department, Government. of Uttarakhand adopted proactive approach and initiated necessary steps to implement the provisions of the BOCW Act through the Uttaranchal Building And Other Construction Workers (Regulation Of Employment And Conditions Of Service) Rules, 2005. Further, Uttarakhand Government constituted the Building and Other Construction Workers Welfare Board (Board) in October 2005 to carry out welfare schemes for construction workers. As per the provision of the BOCW Act, Cess Act and Uttarakhand Rules, establishments which had employed on any day of the	Contractors are required to follow all the provisions of BOCW Act. Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 (BOCW Act) and Building And Other Construction Workers' Welfare Cess Act, 1996 (Cess Act) was passed to address the	Construction

Law	Description	Requirement	Relevance to Project Phase
	preceding twelve months, 10 or more building workers in any building or other construction work are required to pay cess at the rate of 1% of the total cost of construction incurred by an employer. The cess so collected is required to be spent for the welfare of building and other construction workers.	concerns regarding safety, health & welfare of larger number of labour force employed in the building and other constructions sector.	
Contract Labor (Regulation and Abolition) Act, 1970; The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979	Provides for 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. 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.,	Applicable to all construction works in the project Principle employer (UUSDA) to obtain Certificate of Registration from Department of Labour, as principle employer Contractor to obtain license from designated labor officer Contractor shall register with Labor Department, if Inter-state migrant workmen are engaged Adequate and appropriate amenities and facilities shall be provided to workers including housing, medical aid, traveling expenses from home and back, etc., Appendix 6 provides applicable labor laws including amendments issued from time to time applicable to establishments engaged in construction of civil works.	Construction and operation
The Child Labour (Prohibition and Regulation) Act, 1986	Prohibits employment of children below 14 years of age in certain occupations and processes Employment of child labor is prohibited in building and construction Industry.	No child labour shall be employed	Construction and operation
Minimum Wages Act, 1948	Minimum wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of buildings, roads and runways are	Applicable to all construction works in the project All construction workers should	Construction and operation

Law	Description	Requirement	Relevance to Project Phase
	scheduled employment.	be paid not less than the prescribed minimum wage	
Workmen Compensation Act, 1923	Provides for compensation in case of injury by accident arising out of and during the course of employment.	Compensation for workers in case of injury by accident	Construction and operation
Equal Remuneration Act, 1979	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.	Equal wages for work of equal nature to male and female workers	Construction and operation
The Indian Forest Amendment) Act ,2002	This Act makes the basis for declaration of Reserved Forests, constitution of village forest committees, management of reserved forests and penalties and procedures.	Not applicable; none of the components / pipeline alignment are in forest areas.	Construction
IS 11768: 1986/2005: Recommendations for disposal of asbestos waste material	The standard emphasis that every employer who undertakes work which is liable to generates asbestos containing waste, shall undertake adequate steps to prevent and /or reduce the generation of airborne dust during handling, storing,	The crux is waste avoidance: the practice inculcated should focus the on minimal waste generation. Waste Collection: In the project circumstance, the waste is referred to the damaged powered asbestos which will be collected in the Permissible plastic bags to be disposed to the nearest TSDF facilities.	Construction
International Conventions and Treaties			
Ramsar Convention, 1971	The Ramsar Convention is an intergovernmental treaty that provides the framework for national action and international co-operation for the conservation and wise use of wetlands and their resources. India is one of the signatories to the treaty. The Ramsar convention made it mandatory for the signatory countries to include wetland conservation in their national land use plans.	There are no Ramsar sites in or near project area. Not applicable to this project	-
Convention on International Trade in	India is a signatory of this convention which aims to control international commercial trade in endangered species	Not applicable in this project as no endangered species of wild	-

Law	Description	Requirement	Relevance to Project Phase
Endangered Species of Wild Fauna and Flora (CITES), 1973		fauna and flora is found in project town.	
Montreal Protocol 1992	India is a signatory of this convention which aims to reduction in the consumption and production of ozone-depleting substances (ODS), while recognizing differences in a nation's responsibilities. Ozone depleting substances are divided in two groups Chlorofluorocarbons (CFCs) and Hydro chlorofluorocarbon carbons (HCFCs)	Not applicable in this project as no ODS are involved in construction works	-
Basel Convention on Trans-boundary Movement of Hazardous Wastes, 1989	India is a signatory of this convention which aims to reduce trans-boundary movement and creation of hazardous wastes	Contractor to follow the provisions of Hazardous Waste Rules 2016 for storage, handling, transport and disposal of any hazardous waste emerged during construction works Under this Convention, asbestos or asbestos waste in the form of dust and fibers is classified as hazardous waste.	-
Convention on Migratory Species of Wild Animals (CMS), 1979 (Bonn convention)	CMS, also known as Bonn convention, was adopted in 1979 and entered into force on 1 November 1983, which recognizes that states must be the protectors of migratory species that live within or pass through their national jurisdictions, and aims to conserve terrestrial, marine and avian migratory species throughout their ranges. Migratory species threatened with extinction are listed on Appendix 8 of the Convention. CMS Parties strive towards strictly protecting these species, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them. Migratory species that need or would significantly benefit from international cooperation are listed in Appendix 8, and CMS encourages the Range States to conclude global or regional agreements.	Not applicable to this project as no migratory species of wild animals are reported in the project areas.	-

82. **Clearances / permissions to be obtained prior to start of construction.** Table 14 shows the list of clearances/permissions required for project construction. This list is indicative, and the contractor should ascertain the requirements prior to start of the construction and obtain all necessary clearances/permission prior to start of construction.

Table 14: Clearances and Permissions required for Construction Activities

S. No	Construction Activity	Statute under which Clearance is Required	Implementation	Supervision
1	Ground Water Abstraction	Permissions from Central Ground Water Board Authority under Section 4 of the Environmental Protection Act (EPA) (1986).	PIU	PIU and PMU
2	Tree Cutting	State forest department	PIU	PIU and PMU
3	Hot mix plants, Crushers and Batching plants	Consent to establish and consent to operate under Air Act, 1981 from UEPPCB	DBO Contractor	PIU
4	Storage, handling and transport of hazardous materials	Hazardous Wastes (Management and Handling) Rules. 2016; Manufacturing, Storage and Import of Hazardous Chemicals Rules, 1989 from UEPPCB	DBO Contractor	PIU
5	Material Sourcing- Approval for sourcing stones and sand from quarries and sand mining and borrow areas	Permission from District Collector/ State Department of Mining	DBO Contractor	PIU
6	New quarries and borrow areas	Environmental clearance under EIA Notification 2006	DBO Contractor	PIU
7	Temporary traffic diversion measures	District traffic police	DBO Contractor	PIU
8	Road cutting for Sewer and water pipe laying works	Nagar Nigam and PWD	PIU	PMU
10	Construction Waste and Demolition Debris Management	Approval from Nagar Nigam for disposal site is required per Construction and Demolition Waste Management Rules 2016	DBO Contractor	PIU
11	Labour License	Labour Commissioner, Government of Uttarakhand	DBO Contractor	PIU
12	Use of Vehicles and Equipment- Pollution Under Control (PUC) Certificate	Motor Vehicle Rules, 1989	DBO Contractor	PIU

83. PMU will be overall responsible for supervision in getting all clearances and provide details to ADB through semi-annual report. PMU will ensure all necessary regulatory clearances and approvals are obtained prior to commencement of works. Respective PIUs, with support of project consultants and contractors, are responsible for obtaining the clearances/permits and ensuring conditions/specifications/provisions are incorporated in the subproject design, costs, and implementation. The PIUs shall report to PMU the status of compliance to clearances/permits as part of the regular progress reporting.

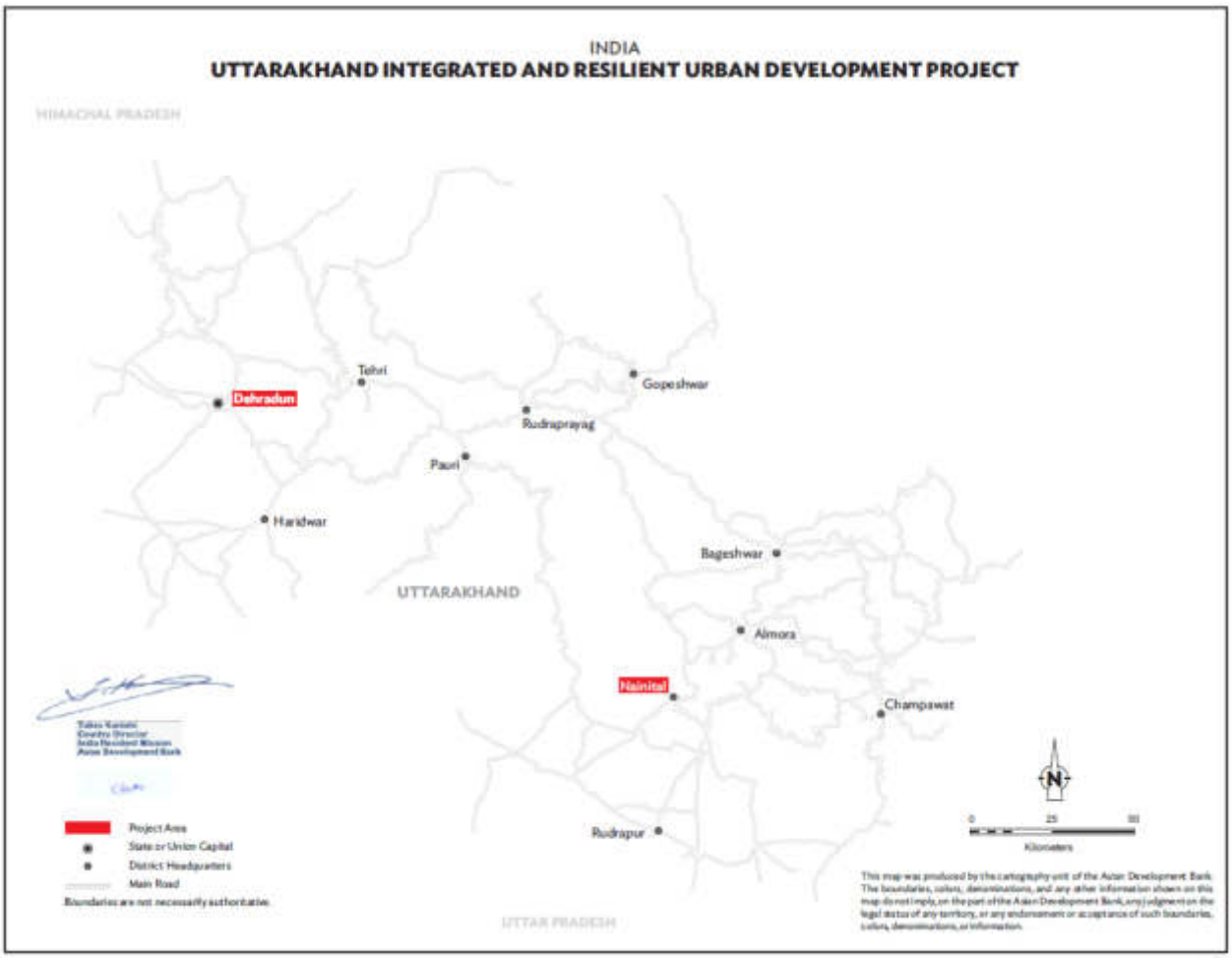
V. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

1. Location, Area and Connectivity

84. **State Uttarakhand**: Situated in the foothills of Himalayan Mountain ranges, Uttarakhand is one of the hilly states in India. It is in the northern part of India and spans at about 301 kilometers in the east to west direction, and 255 kilometers from north to south. It covers an area of 53,483 square kilometers and is at the elevation range of 210 to 7817 meters above sea level (masl). Uttarakhand is constituted of 13 districts falling in two major administrative units, i.e., Garhwal in the northwest portion, and Kumaon in the southeast portion. Dehradun is in Garhwal division, while Nainital, is in Kumaon division.

Figure 11: Uttarakhand State and Its Districts



85. Due to the fragile eco-system and geo-dynamic terrain, Uttarakhand state is highly vulnerable to natural disasters like earthquakes, landslides, forest fires, and cloud burst etc. According to hazard zoning in the Vulnerability Atlas of India, the whole of Uttarakhand falls under “very high” to “high” category earthquake zone. The problems of landslides, subsidence, and erosion are quite common in the hilly regions of the state due to combination of several factors

like geological movements, structure, lithology, water seepage, soil cover, vegetal cover, weather, and climatic changes.

86. **District Dehradun** is situated in NW corner of Uttarakhand state and extends from Latitude 29^0 58' N to 31^0 02' 30"N and Longitude 77^0 34' 45" E to 78^0 18'30" E. The total area of Dehradun district is 3088 km^2 with an average elevation of approximately 447 metres (1,467 ft) above sea level. It falls in Survey of India Toposheets Nos. 53 E, F, G, J and K. The district is bounded by Uttarkashi district on the north, Tehri Garhwal and Pauri Garhwal districts on the east and Saharnpur district (UP) on the south. Its western boundary adjoins Sirmour district of Himachal Pradesh are separated by Rivers Tons and Yamuna. The district comprises of six tehsils, namely Dehradun, Chakrata, Vikasnagar, Kalsi, Tiuni and Rishikesh. Further, it is divided into six developmental blocks, viz: Chakrata, Kalsi, Vikasnagar, Sahaspur, Raipur and Doiwala. There are seventeen towns and 764 villages in this district. Main languages spoken in the city are Hindi, Garhwali, Kumaoni, Jaunsari, and Nepali. Its geomorphological and meteorological characteristics, makes it prone to a number of natural hazards. Beside earthquake, the city is frequently devastated by landslides, cloudbursts, flash-floods, cold waves and hailstorms.

87. **Dehradun City**. Located in the north-western part of Uttarakhand at $30^0$11'24"N latitude and $78^0$02'24"E longitude. Dehradun is the capital and most populous city in the Indian state of Uttarakhand. It is located in the Doon valley on the foothills of the Himalayas nestled between the river Ganges on the east and the river Yamuna on the west. The city is noted for its picturesque landscape and slightly milder climate and provides a gateway to the surrounding region. It is well connected and in proximity to Himalayan tourist destinations such as Mussoorie, and Auli and the Hindu holy cities of Haridwar and Rishikesh along with the Himalayan pilgrimage circuit of Chota Char Dham. Dehradun is also known for its Basmati rice and bakery products.

88. **Dehradun** is the administrative headquarters of the eponymous district. Part of the Garhwal region, it lies along National Highway 7 with the distance of 236 kilometres (147 mi) north of India's capital New Delhi and is served by Dehradun railway station and Jolly Grant Airport. Dehradun is governed by the Dehradun Municipal Corporation (DMC).

89. Dehradun experienced fast growing peri-urban areas with huge influx of urban migrants and carried out re-boundary mission. As a result, Dehradun has expanded to 300% in area (196.48 km) and increased by 141% in population (803,983 in 2018) living in 100 wards. The subproject of establishing water supply and sanitation systems is located in Southern part of newly expanded Dehradun, Zone 7, which consists of Kedarpur, Banjarawala and Mothrowala wards. This subproject is divided into three work packages based on topography and hydrology.

90. **The service area proposed under Banjarawala Package 2** subproject is located in southern part of newly expanded Dehradun city which consists parts of ward nos 83 (Kedarpur) and 85 (Mothrowala) consisting of Mahalaxmipuram, Shivumvihar colony, Gitanjali enclave, vishnupuram colony, trimuti, suvarnaganga enclave, shaki vihar colony, shiv kunj colony, Ramkrishna puram colony Sangrash vihar, Dandi village etc. Mothrowala is surrounded by Banjarawala on the north-west, Kedarpur on the north, Defence Colony on the east, Nawada on the south-east, Bindal River on the west and the Lachhiwala Range on the south. Rispana River flows through it to meet River Bindal towards its west boundary.

91. Until 2017, above mentioned areas were outside the limits of Dehradun Municipal Corporation (DMC). After the 2018 re-boundary mission of Dehradun city, these areas have now become part of the DMC and as such are now part of Dehradun city (refer Figure 1 in Section II). These newly merged areas and its infrastructures are mainly designed for serving rural

population. However, due to proximity of State highway and Dehradun urban areas, these areas have been drastically developed and now these have been part of Dehradun Nagar Nigam.

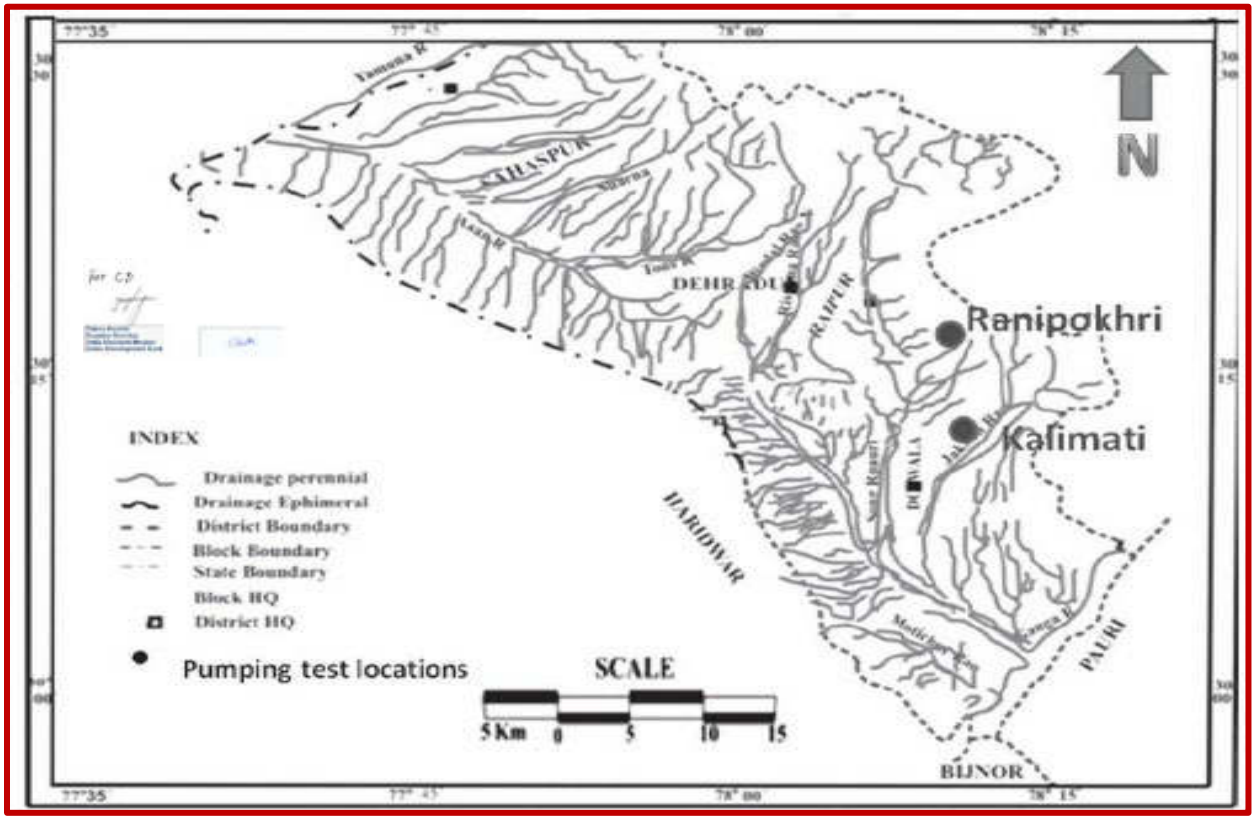
92. **Topography, Drainage, Soils and Geology**. Dehradun falls in Sub-Himalayan physiographic zone of Uttarakhand State. The physiography possesses least of Himalayan features, and consists of two sub-zones, the Shivaliks - the youngest of the Himalayan ranges and the Doon (flat longitudinal structural valleys) to the north of Shivaliks. The Shivaliks extend in a narrow varying width of 6 to 30 km with altitudes of 300 to 1000 m. The Doon Valley has the Himalayas to its north, the Shivalik range to its south, the sacred river Ganga to its east and the river Yamuna to its west.

93. **Dehradun City** is surrounded by dense hilly forests. The altitude of the City ranges from 1000 m in the north hilly region to 600 m in the south, with an average altitude of 640 m. It slopes north to south and is dissected by numerous seasonal streams, locally known as Khalas. City drainage is borne by the Bindal and Rispana Rivers. The direction of flow of streams in the eastern part is north to south (Bindal River) and in western part it is north to southwest (Rispana River).

94. **Drainage.** Dehradun district is drained by Ganga, Yamuna and their tributaries. The two basins are separated by a ridge starting from Mussoorie and passing through Dehradun. The easterly flowing rivers join River Ganga and the westerly flowing rivers join River Yamuna. The Asan, the Suswa, the Bandal and the Rispana are noteworthy amongst these. The Asan, the Suswa, the Bandal and the Rispana are noteworthy amongst these. The Asan river flows westerly while the remaining rivers i.e., the Suswa, Bandal and Rispana flow southeasterly to join the Song river which is a tributary of River Ganga. The Dehradun City is surrounded by River Song in the east and River Tons in the west.

95. Due to hilly terrain Dehradun City has a natural drainage pattern with sufficient gradients to drain off storm water easily in to the two main natural drainage channels i.e. rivers Bindal and Rispana. Asan, Tons and Duchene rivers discharges in these two rivers directly or through their tributaries. The slope of both the main rivers i.e. Riana and Bindal is from North to South.

Figure 12: Drainage Map of Doon Valley indicating major Rivers and its Tributaries

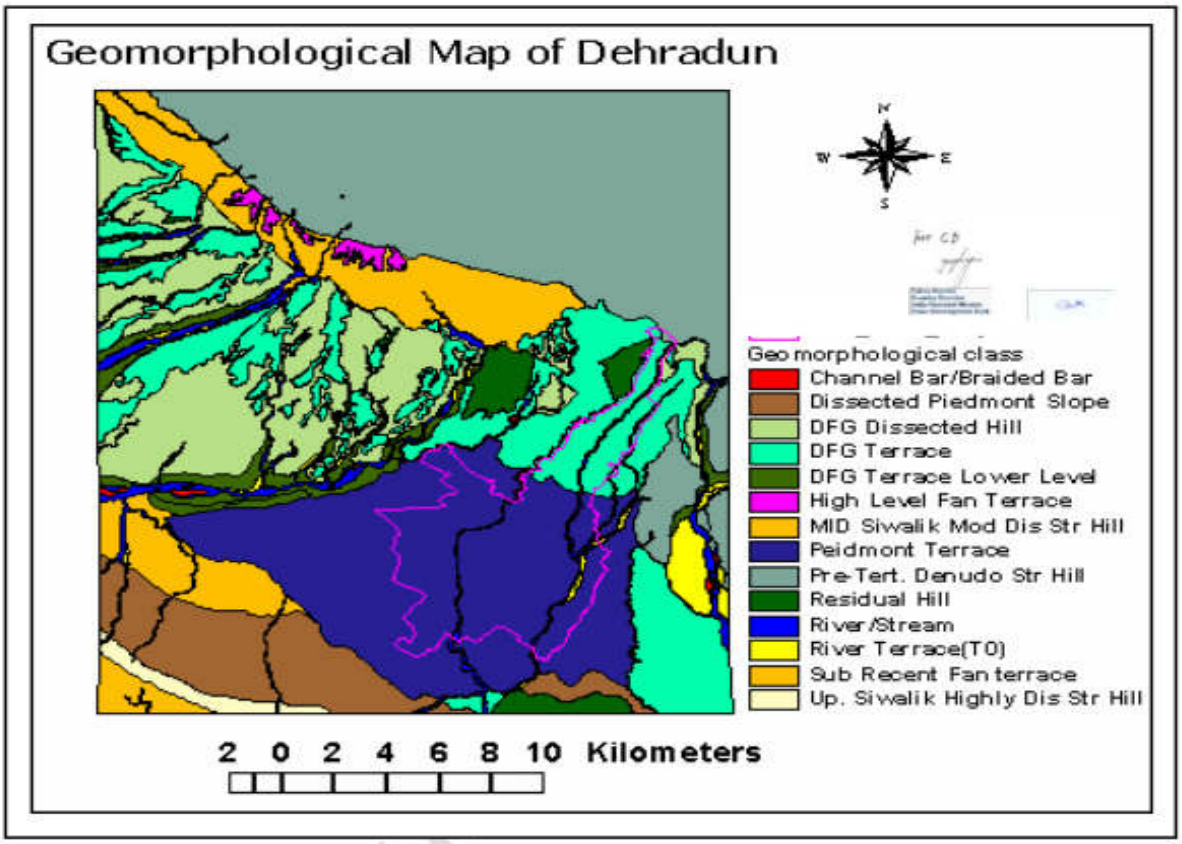


Source: Central Groundwater Board

96. **Geomorphology: Doon valley** is the largest intermontane synclinal longitudinal valley in the sub Himalayan region. Many rivers such as Ganga, Yamuna, Sitla Rao, Jhakan Rao, Suswa and Asan contributed in the formation of local landforms of the valley. For different type of formations there is change in drainage pattern, as in the pre tertiary formations drainage pattern is dendritic and trellis, in the Siwaliks it is sub-parallel and dendritic whereas in the recent formations it is parallel and sinuous. Geomorphologically the landforms in the area are formed due to erosion, deposition and tectonic activity. (Figure 13):

97. Broadly the main geomorphological units are can be categorized into Pre tertiary of the Lesser Himalaya, the Siwaliks and the Doon fan gravels. The pre tertiary hills form the most elevated landforms of the valley in the form of Mussorrie Range, with elevation up to 2000 m. The Siwaliks are exposed both in the northern and the southern part of the valley in the form of dissected structural hill at elevation of 600 to 700 m in the south and about 900 m in the north. Majority portion of the Dehradun city is covered by gravely material brought down by the streams from both the northern and southern hills. They are deposited in the form of fans popularly known as Doon Fans.

Figure 13: Geomorphological Map of Dehradun



98. **The project area is part of Dehradun** is surrounded by dense hilly forests. The topography of the area is mostly undulating and barren lands. Settlements are mainly on the plain lands, adjoining agricultural activities. The average altitude of the project area is about 630 m.

99. The project area is part of the Bindal River catchment, It slopes north to south and is dissected by numerous seasonal streams, locally known as Nallahs e.g *nala* at Mothrowala area, nala at inter colony road, *nalas* near Mahalakshmipuram and Vishnupuram**.** All these *nalas* or drains ultimately joins Bindal which inturn joins River Rispana. The direction of flow of streams in the eastern part is north to south (Bindal River) and in western part it is north to southwest (Rispana River).

100. **Soil Types.** The nature and soil type play an important role in agriculture and have direct relation with groundwater recharge. Physiography, climate, drainage and geology of the area are the factors responsible for the nature and type of soil and soil cover. The soil type also depends upon the slope and rate of erosion. The soil types of district Dehradun classified by Central Groundwater Board (CGWB) are given in Table 15.

Table 15: Soil Types of District Dehradun

Physiography	Characteristics	Taxonomic Classification
Mountains	Moderately deep, well-drained, thermic coarse loamy soils on steep slopes, strong, stoniness, associated	Loamy skeletal, District Eutrochrepts, Fine loamy lithic and

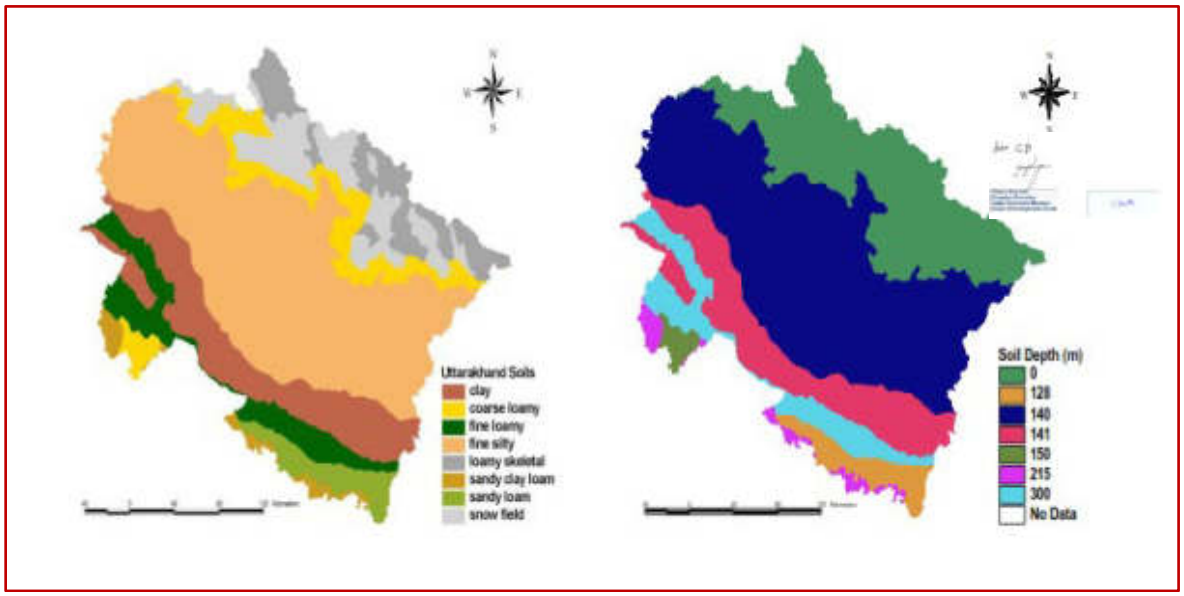
Physiography	Characteristics	Taxonomic Classification
	with shallow excessively drained, loamy skeletal soil.	typic Hapludolls - Loamy skeletal typic Udrothants
Soils on Upper piedmont plains	Deep, well-drained, coarse loamy cover, fragmental soils on heavy gentle slope with loamy surface and slight erosion	Udifluventic Ustochrept
	Associated with excessively drained soils with loamy surface and slight to moderate erosion	Typic Ustipsamments
	Deep, well- drained, fine to coarse loamy surface and slight to moderate erosion	Udic Ustorchrepts
Soil on Lower piedmont plains	Deep, well- drained, coarse loamy cover over fragmental soils on nearly level plains with loamy surface.	Udifluventic Ustochrepts
	Associated with deep, well drained, fine loamy soil with loamy surface.	Udic Ustochrepts
	Deep, well drained, fine silty soil on very gentle slopes with loamy surface and slight erosion	Udic Haplustolls
	Deep, well drained, fine to coarse loamy surface and slight to moderate erosion, silty soil with loamy surface	Udic Ustochrepts

Source: CGWB 2011

101. On the basis of soil texture, the National Bureau of Soil Survey & Land Use Planning (NBSS&LUP) has divided the soils of Uttarakhand into eight different categories, namely sandy loam, sandy clay loam. Fine loam, fine silt, clay, coarse loam, loamy skeletal and snow field (Figure 14).

102. **The Soils of Dehradun City** are alluvial, riverine, and non-calcareous to moderate calcareous soils, which have been carved out by the fast-flowing rivers draining the Himalayas. Limited distribution of red soil is also found in some places. Forest soils, which occur under coniferous and deciduous forest, are found rich in organic matter. Mountain /hill soils are the collective terminology used for various types of soils occurring at very high elevations, under a wide range of forest types trees. All the hill ranges around Dehradun (except the Sivaliks) are rich in limestone reserves. Soil texture varies from sandy loam to clayey loam. Soil pH is slightly higher in the restored sites in comparison to the natural area, which favors the increased availability of nutrient elements. The soil color varies according to profile but generally color was observed dark brown to olive brown (Kumar, 1997).

Figure 14: Uttarakhand Soils and Soil Depth Mapping by NBSS & LUP



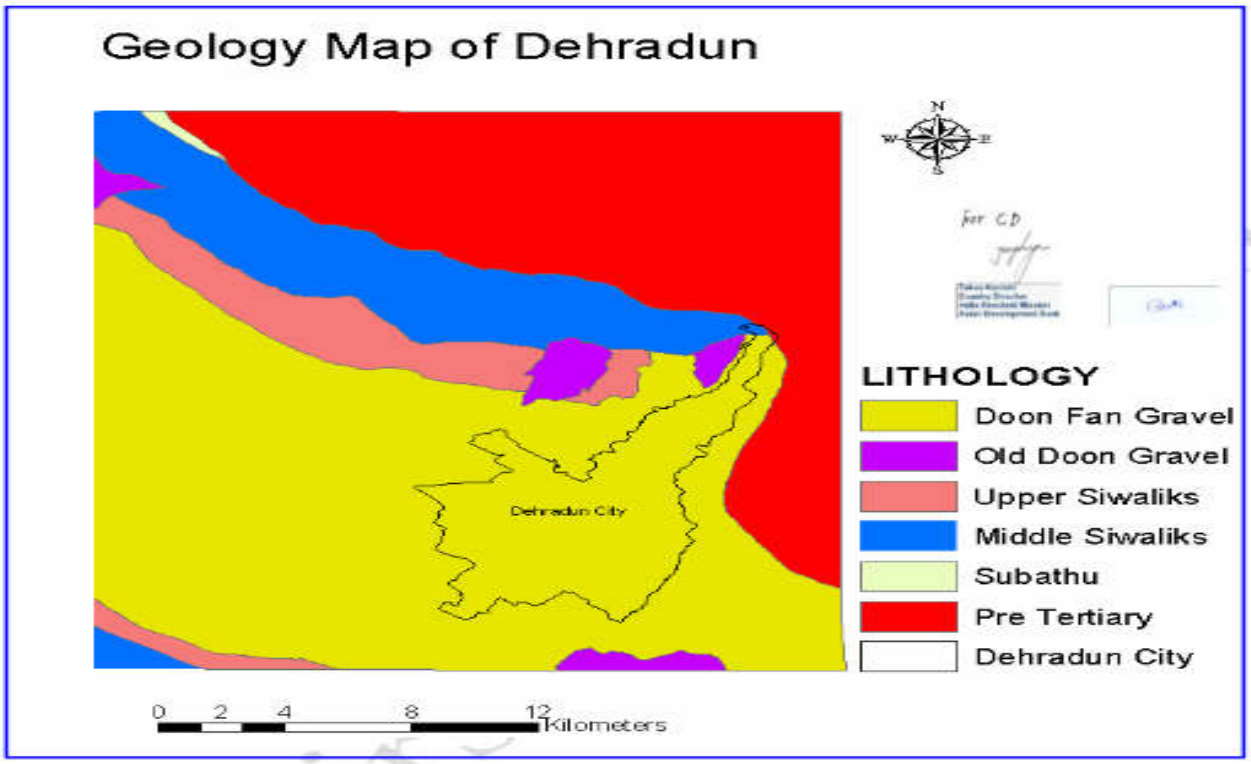
Source: NBSS & LUP

103. **The Soils of project area** are mainly alluvial, riverine, and limited distribution of red soil is also found in some places. Forest soils are rich in organic matter. Soil texture varies from sandy loam to clayey loam. Soil pH is slightly alkaline which favors the increased availability of nutrient elements. The soil color varies according to profile but is generally dark (NBSS & LUP).

104. **Geology.** Dehradun valley was formed as an intermontane valley between lesser Himalaya in the north and the Siwaliks in the south. The present Doon valley is developed in two phases. In the first phase, around 18 million years ago there was an upliftment in the Himalaya around the Main Boundary Thrust (MBT) that raised the Mussorie Range and the Lower Himalaya. It resulted in the formation of a synclinal depression known as Doon Syncline, in which the eroded sediments of the uplifted part were deposited and this continued for the long period. In the second phase, around 0.5 million years ago another tectonic event uplifted the Siwalik Range strata along the Himalayan Frontal Thrust (HFT) and the Doon valley came into existence. There are two transverse faults, Ganga tear fault in the east and Yamuna tear fault in the west limits the boundary of the valley towards east and west respectively

105. Geologically Dehradun valley is a synclinal trough within the Shiwaliks formation. The young formations in the region are the river terraces formed by Doon gravels (Figure 15). The limits of syncline consist of middle and upper Shiwaliks rocks followed by the northerly dipping pre-tertiary formations of lesser Himalaya in north. On all these older formations are deposited the Pleistocene and recent sediments, the Doon gravels. Outer fringe of lesser Himalaya of Garhwal is rich in its mineral deposits especially for rock phosphate and lime. Mussoorie hills and Dehradun valley have huge deposits of phosphorite. This mineralization is confined to the Krol and Tal formation and found in association with chert and black shales.

Figure 15: Geological map of Dehradun



Reference: Geological map of Dehradun based on satellite imagery interpretation of LISS III and available literature and geological maps (After Nossin 1971; Rupke, 1974; Raiverman et al., 1984; Thakur, 1995).

106. **Geology of the project area**. The area falls in the intermontane Doon Valley and is underlain by Recent to Sub Recent Doon Gravels, which lie over the Upper Siwalik Sediments. The Doon Gravel has been broadly divided in Older Doon Gravel and Younger Doon Gravel. The Older Doon Gravel consists partly of crushed Upper Siwalik cobbles, angular pebbles of quartzites, slates and shales while the younger Doon Gravels are characterized by very large boulders in the alluvial fans and debris flow deposits and consists of moderately sorted mixture of clay, sand, gravels and boulders. The major part of Doon Valley and the area under study is occupied by the Younger Doon Gravel except isolated occurrences of Siwaliks and older sediments.[12]

107. **Natural Hazards :** Due to the fragile eco-system and geo-dynamic terrain, Uttarakhand State is highly vulnerable to natural disasters like earthquakes, landslides, forest fires, and cloud burst etc. According to hazard zoning in the Vulnerability Atlas of India, the whole of Uttarakhand falls under “very high” (Zone V) to “high” (Zone IV) category earthquake zone. The problems of landslides, subsidence, and erosion are quite common in the hilly regions of the state due to combination of several factors like geological movements, structure, lithology, water seepage, soil cover, vegetal cover, weather, and climatic changes..

108. **Seismic Hazard:** According to the Global Seismic Hazard Map Data (GSHAP), the state of Uttarakhand falls in a region of “high” to “very high” seismic hazard. As per seismic zonation

[12] Report on the Feasibility for Constructing a tubewell at Mothronwala, Dehradun district, uttarakhand prepared for Uttarakhand Jal Sansthan, Dehradun ,2013

map of India published by the Bureau of Indian Standards (IS- 2002), Uttarakhand falls in Zones IV & V where the maximum intensities are expected. The city of Dehradun lies in Zone IV.

2. Climatic and Rainfall

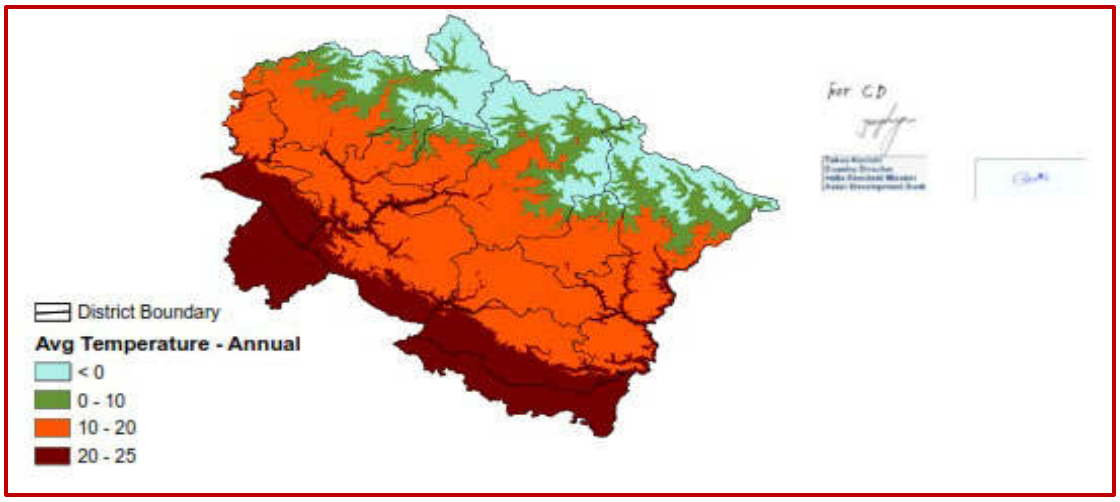
109. The district has within its limits lofty peaks of the Outer Himalayas as well as the Doon valley with climatic conditions nearly similar to those in the plains. The temperature depends on the elevation. The climate of the district, in general, is temperate. In the hilly regions, the summer is pleasant but in the Doon Valley, the heat is often intense. The temperature drops below freezing point not only at high altitudes but also even at places like Dehradun during the winters, when the higher peaks are under snow.

110. The climate of Dehradun is humid subtropical. It varies greatly from tropical to severe cold depending upon the altitude of the area. The city being hilly, temperature variations due to difference in elevation are considerable. In the hilly regions, the summer is pleasant. But in the Doon, the heat is often intense and summer temperatures can reach up to 44 ^{O}C for a few days and a hot wind called loo blows over North India. The winter, from November to February, is cold, and temperatures touches near freezing occasionally. The months of December and January are the coldest due to winter rains, coinciding with snow-fall in the nearby mountains ranges (maximum and minimum winter temperature is 23.4°C and 5.2°C respectively). Overall the winters are dry. The spring, lasting from March to April, is very pleasant.

Figure 16: Overall Climatic Condition in Uttarakhand

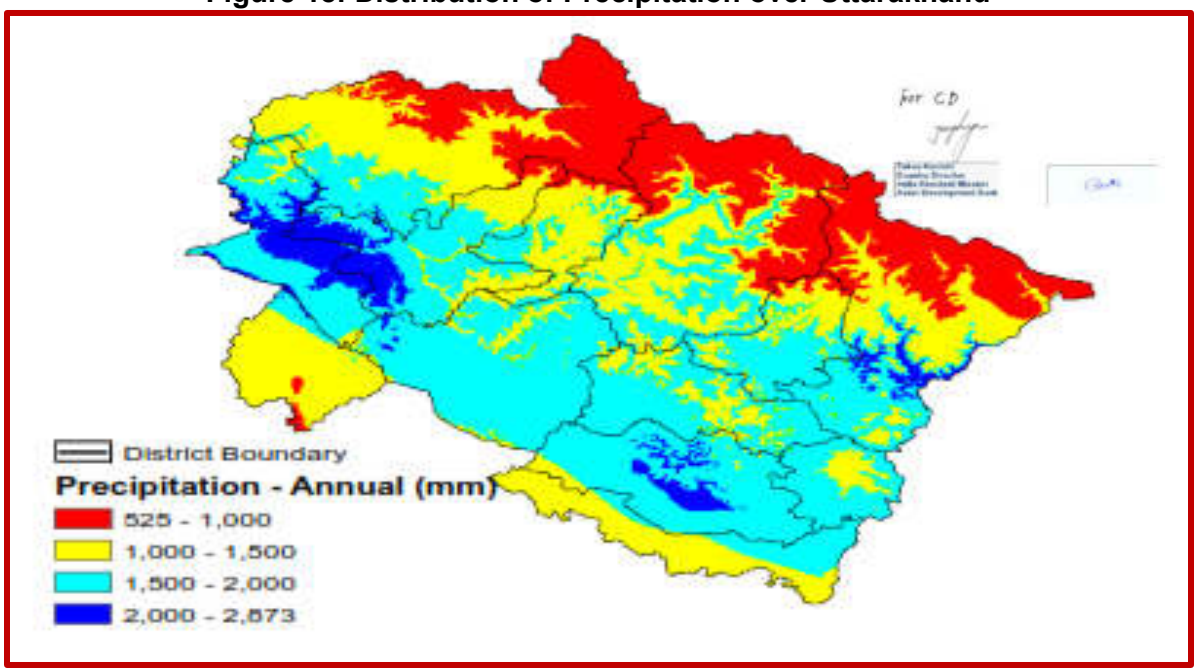
Source: The Uttarakhand Action Plan on Climate Change (UAPCC)

Figure 17: Temperature Regimes in Uttarakhand



Source: The Uttarakhand Action Plan on Climate Change (UAPCC)

Figure 18: Distribution of Precipitation over Uttarakhand



Source: The Uttarakhand Action Plan on Climate Change (UAPCC)

111. **Climatic data** (Table 16). has been collected from Indian Meteorological Department (IMD) for Dehradun city for a period of 25 years (from 1993 to 2017) the monsoon months, particularly July and early August are extremely humid. The annual average rainfall (AAR) of Dehradun is 2051 mm, of which about 62% is concentrated in the months of July and August (Figure 19). During the monsoon season, there is often heavy and protracted rainfall. Agriculture benefits from fertile alluvial soil, adequate drainage and plentiful rain.

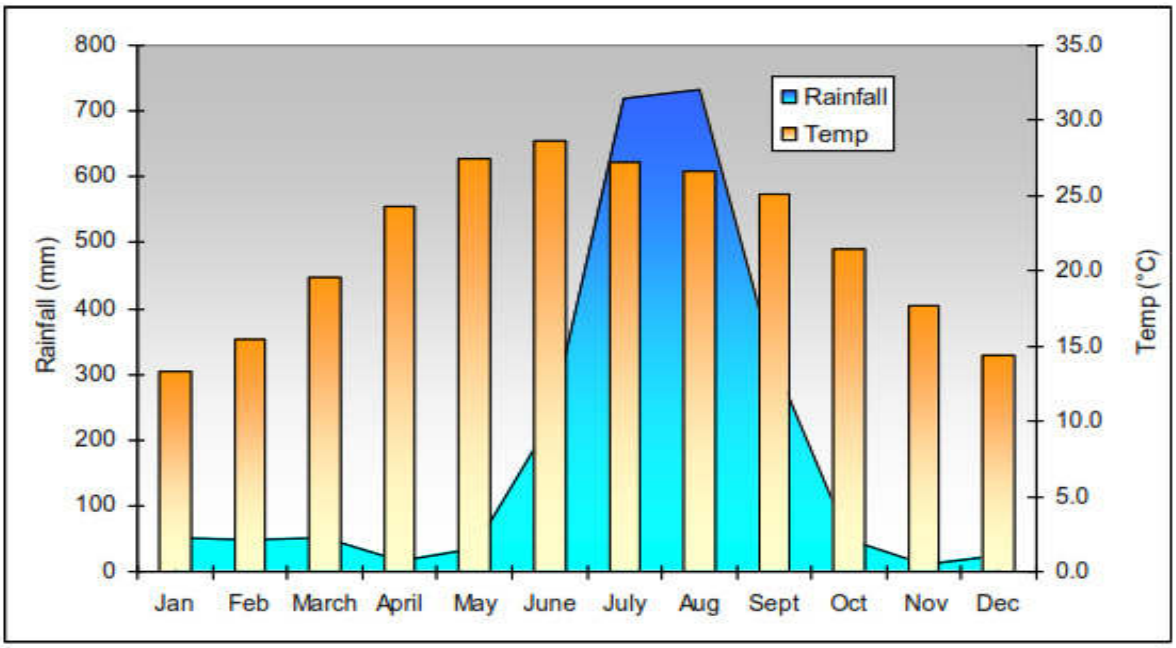
Table 16: Climatic data for Dehradun (1993 to 2017)

Month	Rainfall (mm)	Relative Humidity (%)	Temprature		
			Maximum	Minimum	Average
January	46.9	91	19.3	3.6	10.9
February	54.9	83	22.4	5.6	13.3

March	52.4	69	26.2	9.1	17.5
April	21.2	53	32	13.3	22.7
May	54.2	49	35.3	16.8	25.4
June	230.2	65	34.4	29.4	27.1
July	630.7	86	30.5	22.6	25.1
August	627.4	89	29.7	22.3	25.3
September	261.4	83	29.8	19.7	24.2
October	32	74	28.5	13.3	20.5
November	10.9	82	24.8	7.6	15.7
December	2.8	89	21.9	4	12
Annual Average	**2051.4**	**76**	**27.8**	**13.3**	**20**

Source: Indian Meteorological Department (IMD)

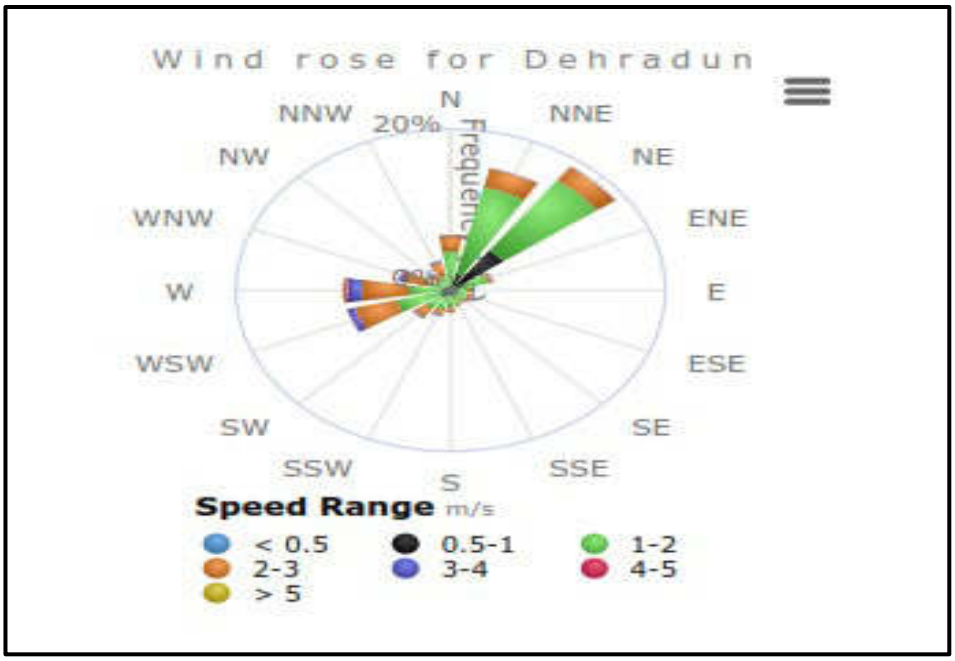
Figure 19: Climate chart showing the monthly rainfall and temperatures of Dehradun City



Source: Indian Meteorological Department (IMD)

112. The average wind speed in Dehradun is 1.7 m/s with the maximum wind speed of around 5 m/s. Wind rose of Dehradun shows (Figure 20) that predominantly wind blow from the NE - about 19.78% of all wind directions. The selected coordinates i.e., lat 30°19'0"N, lon: 78°1'0"E is found within the limit of Dehradun of Dehradun district, in the state Uttarakhand, India.

Figure 20: The Annual Wind Rose Diagram



{Location coordinates: lat 30°19'0"N, long: 78°1'0"E within the limit of Dehradun City}

3. Surface Water

The Dehradun city area is drained by several rivers / small rivulets and minor streams belonging to Yamuna and Ganga river systems. The Asan, the Suswa, the Bindal and the Rispana are amongst these. The Asan river flows westerly while the remaining rivers i.e, the Suswa, Bindal and Rispana flow southeasterly to join the Song river which is a tributary of River Ganga (Figure 30).. Seasonal rivers of Bindal and the Rispana have considerable flow during the monsoon. In the rest of the year these rivers mostly remain dry or carry wastewater. No water quality data of these rivers are available.

113. Due to hilly terrain, Dehradun has a natural drainage pattern with sufficient gradients to drain off storm water easily into the two main natural drainage, streams i.e., rivers Bindal and Rispana. The slope of both the main rivers i.e., Rispana and Bindal is from North to South. There are 8 nos. of drainage basins covering the town are (i) Bindal Basin;(ii) Bindal Sub Basin No.1; (iii) Bindal Sub Basin No.2;(iv) Bindal Sub Basin No.3;(v) Rispana Basin;(vi) Asan River Basin;(vii) Dulhani River Basin and (viii) Tons River Basin.

114. River Bindal and Rispana rivers flows with municipal drains from the eastern part of Dehradun city and joins the river Suswa at Mothrawala (Figure 21). As stated above, river Suswa receives copious volume of municipal wastewater through Rispana and Bindal rivers. As such no industrial wastewater drain into rivers Rispana and Bindal, however possibilities of wastewater from automobile service centres, unorganized commercial activities etc. cannot be ignored. Water quality characteristics of **river Suswa** at Mothrawala (downstream of Dehradun) and **River Ganga** after confluence of River Song near Satyanarayan Temple D/S Raiwala, Dehradun**, Uttarakhand** by the UEPPBC for the year 2019 and 2020 are given in Table 17 A-B and 18 A-B. The results shows pollution load in the river water. Therefore, the action plan for prevention and control of pollution of river Suswa in order to meet water quality criteria of Class-B should be adopted (Ref: Table 2 of Appendix 2).

115. **The Project area** has a natural drainage pattern with sufficient gradients to drain off storm water easily into the Bindal river. Drainage is borne by the Bindal and Rispana Rivers. The direction of flow of streams in the eastern part is from north to south (Bindal River) and in western part it is north to southwest (Rispana River). Proposed service area under the subproject is part of the Bindal River catchment, which drains out the water from Suswa and Song river into Ganga river. The Bindal is one of the very important seasonal river of Dehradun as it serves as a valve to disperse rainwater of Dehradun during the times of heavy rainfall... The Bindal like the Rispana is one of the tributaries of the Ganga River and thus, in needs to be taken care of to save the ecosystem of Dehradun and further to keep the Ganga unpolluted.

Figure 21: Google image of river Ganga and Song and its Contributing Suswa- Rispana and Bindal River

Table 17A: Water Quality of River Suswa at Mothrawala (Downstream of Mothrawala), Dehradun, Uttarakhand, 2019

Month	pH	BOD (mg/L)	COD (mg/L)	Temp (◦C)	DO (mg/L)	Alkalinity as CaCo3(mg/L)	Chloride (mg/L)	Calcium as Ca (mg/L)	Magnesium as Mg(mg/L)	Hardness as CaCo3 (mg/L)	Total Dissolved Solid (mg/L)	Fecal Coliforms (MPN/100 ml)	Total Coliforms (MPN/100 ml)
Jan-19	8.15	26	80	18	2.8	240	25	164	126	290	328	8.15	>1600
Feb-19	7.85	28	110	18	3	280	27	200	140	340	390	7.85	>1600
Mar-19	7.82	30	136	20	2.8	290	30	240	120	360	386	7.82	>1600
Apr-19	7.84	28	112	19	3	260	24	196	124	320	372	7.84	>1600
May-19	7.79	30	120	20	2.6	278	25	200	148	348	410		>1600
Jun-19	7.84	26	126	20	2.8	290	30	230	128	358	430		>1600
Jul-19	7.86	25	118	19	3	270	22	220	100	320	390		>1600
Aug-19	6.89	27	120	20	2.6	274	26	222	102	324	392		>1600
Sep-19	6.94	26	120	22	2.8	260	25	220	80	300	400		>1600
Oct-19	8.05	28	124	20	2.8	280	28	234	78	312	415		>1600
Nov-19	8.1	26	116	20	3	284	33	236	74	310	344		>1600
Dec-19	8.23	28	124	18	2.2	268	30	230	56	286	328		>1600
Class C Surface Water Quality Criteria	**6 to 9**	**3 mg/L or less**			**4 mg/L or more**								**5000 or less**

Source: Uttarakhand Environmental Protection & Pollution Control Board (UEPPCB)

Table 17B: Water Quality of River Suswa at Mothrawala (Downstream of Mothrawala), Dehradun, Uttarakhand, 2020

Month	pH	BOD (mg/L)	COD (mg/L)	Temp (◦C)	DO (mg/L)	Alkalinity as CaCo3 (mg/L)	Chloride (mg/L)	Calcium as Ca(mg/L)	Magnesium as Mg(mg/L)	Hardness as CaCo3 (mg/L)	Total Dissolved Solid (mg/L)	Fecal Coliforms (MPN/100 ml)	Total Coliforms (MPN/100ml)
Jan-20	8.1	26	104	17	4.2	240	25	180	120	300	380		>1600
Feb-20	8.34	28	112	18	4	260	30	210	150	360	368		>1600
Mar-20	8.11	26	94	20	3.6	270	32	220	120	340	376	>1600	>1600
Apr-20	7.96	34	132	19	3	330	40	220	150	370	254	>1600	>1600
May-20	8.13	29	116	19	3.6	395	30	255	135	390	387	>1600	>1600
Jun-20	6.67	26	110	20	3.8	360	27.5	200	150	350	255	>1600	>1600
Jul-20	7.59	30	124	21	2.8	365	25	145	130	275	448	>1600	>1600
Aug-20	7.65	32	128	23	26	230	25	162	100	262	288	>1600	>1600
Sep-20	8.3	26	106	26	4	306	22	125	93	218	428	>1600	>1600
Oct-20	7.9	28	112	25	3	360	40	302	85	387	712	>1600	>1600
Nov-20	7.64	26	104	24	3.6	552	37	278	113	391	749	>1600	>1600
Dec-20	7	27	108	22	3	344	65	258	57	315	650	>1600	>1600
Class C Surface Water Quality Criteria	**6 to 9**	**3 mg/L or less**			**4 mg/L or more**								**5000 or less**

Source: Uttarakhand Environmental Protection & Pollution Control Board (UEPPCB)

Table 18A: River Ganga after confluence of River Song near Satyanarayan Temple D/S Raiwala, Dehradun, Uttarakhand 2019

Month	pH	BOD (mg/L)	COD (mg/L)	Temp (◦C)	DO (mg/L)	Alkalinity as CaCo3(mg/L)	Chloride(mg/L)	Calcium as Ca(mg/L)	Magnesium as Mg(mg/L)	Hardness as CaCo3 (mg/L)	Total Dissolved Solid (mg/L)	Fecal Caltform (MPN/100 mL)	Total Caltform (MPN/100 mL)
Jan-19	8.02	<1	4	17	10.4	64	5	38	32	70	114		40
Feb-19	7.42	<1	4	16	10	70	5	46	32	78	96	26	50
Mar-19	7.48	<1	4	19	9.8	62	4	42	30	72	86	17	40
Apr-19	7.62	<1	4	17	9.8	60	5	36	32	68	88	17	40
May-19	7.54	<1	4	18	10.2	68	5	38	34	72	80	14	50
Jun-19	7.62	<1	4	19	9.8	66	5	42	32	74	82	17	40
Jul-19	7.7	<1	4	18	10.2	62	4	44	26	70	78	26	50
Aug-19	7.48	<1	4	18	10.4	64	5	46	26	72	80	17	40
Sep-19	8.23	<1	4	20	9.8	58	7	40	28	68	73	30	50
Oct-19	8.12	<1	4	20	10	60	6	42	24	66	62	26	60
Nov-19	7.95	<1	4	19	11.8	58	5	40	20	60	69	17	50
Dec-19	7.94	<1	4	18	10.4	73	8	44	22	66	79	14	40
Class C Surface Water Quality Criteria	**6 to 9**	**3 mg/ or less**			**4 mg/L or more**								**5000 or less**

Source: Uttarakhand Environmental Protection & Pollution Control Board (UEPPCB)

Table 18B: River Ganga after confluence of River Song near Satyanarayan Temple D/S Raiwala, Dehradun, Uttarakhand 2020

Month	pH	BOD (mg/L)	COD (mg/L)	Temp (◦C)	DO (mg/L)	Alkalinity as CaCo3(mg/L)	Chloride(mg/L)	Calcium as Ca(mg/L)	Magnesium as Mg(mg/L)	Hardness as CaCo3 (mg/L)	Total Dissolved Solid (mg/L)	Fecal Caltform (MPN/100 mL)	Total Caltform (MPN/100 mL)
Jan-20	7.8	1	4	17	10.2	84	8	44	32	70	120	30	90
Feb-20	8.44	1	6	17	10	85	12	68	46	114	230	40	90
Mar-20	7.94	1.2	6	20	10.8	100	9	85	51	136	279	30	80
Apr-20	8.2	1.2	3	20	10.6	110	10	60	22	82	236	40	80
May-20	7.5	1	6	19	8.4	120	10	80	75	155	213	50	70
Jun-20	7.75	1.2	6	20	8.6	256	9.5	148	110	258	251	40	88
Jul-20	8	1.2	6	22	8.8	169	17	118	83	201	262	40	70
Aug-20	7.6	1.4	6	23	8.6	184	10	190	50	240	222	60	110
Sep-20	8.15	2	6	29	10.6	165	13	90	2	152	328	70	130
Oct-20	8.18	1.2	6	29	8.6	235	10	140	60	200	317	84	140
Nov-20	7.15	1	6	18	8.4	55	10	40	30	70	154	70	120
Dec-20	8	1.4	6	20	9.2	100	9	70	40	110	240	63	110
Class C Surface Water Quality Criteria	**6 to 9**	**3 mg/L or less**			**4 mg/L or more**								**5000 or less**

Source: Uttarakhand Environmental Protection & Pollution Control Board (UEPPCB)

4. Groundwater

116. The hydrogeology of the district is mainly controlled by the geology and geomorphology. A wide variation in the geology and land forms, in the area, gives rise to different hydrogeological conditions. Broadly Dehradun district is divided into three hydrogeological units, viz. (1) Himalayan Mountain Belt (2) Siwalik zone and (3) Doon Gravels

117. Groundwater is the main source of irrigation and is utilized through dug wells, and tube wells. The depth to water level varies widely depending upon topography, drainage, bedrock geology etc. in the district. As per Central Ground Water Board (CGWB) report on Dehradun District Groundwater Scenario, 2006, Depth to Water (DTW), in the southernmost part of the district, ranges between 5 and 10 m. The area close to the hills is represented by water table >15 m bgl. The intermediate part has DTW in the range between 10 and 15 mbgl. During the post monsoon period the 5-10 m and 10-15 m ranges of DTW increased and the >15 m group is reduced.

118. Analysis of CGWB's long term water level data of Pre-monsoon reveals that larger part of the Doon Valley shows a rise in water levels between 0 and 2 m. A small area in the south-east part of the valley close to the foot hills shows water level decline between 0 and 2 m. The decadal fluctuation shows that by and large the area has groundwater potential with low development of shallow aquifers

119. **Groundwater Utilization.** There are six developmental blocks in District Dehradun. Two blocks (Chakrata and Kalsi) fall in mountainous terrain where the slopes are high and water resources are not estimated for these blocks. Water Resources are estimated, using Groundwater Estimation Committee (GEC)1997 methodology, for Raipur, Doiwala, Sahaspur and Vikas Nagar blocks as the topography is by and large plain, in these blocks. The block areas are divided into command and non-command. Draft for all uses and recharge from all sources are calculated for command and non-command areas. The stage of groundwater development, for command area, ranges from 53.78 to 78.34% while it ranges from 19.23 to 51.23% for non-command areas. All the four blocks are categorized as Safe.

120. The proposed water supply subproject area Package 1 of Banjarawala in Dehradhun falls in the Raipur block. In Raipur Block the estimated Net Annual Groundwater Availability is 20.37 MCM for command area while for non-command area it is 255.86 MCM. The total utilization for all uses is estimated as 12.57 MCM with stage of development at 61.70% for command area and 78.82 MCM with stage of development at 30.80% for non-command area of Raipur block.

121. Raipur block is categorized as **SAFE** as per the categorization adopted by the CGWB. 'Safe' area in terms of categorisation leaving a large scope for further development of the resource for domestic, industrial, agricultural and other uses. However, this large scope may give rise to over exploitation of the resources, in case its development is not planned properly in a scientific way.

122. **Groundwater Quality.** As per CGWB report (2011), seventy four water samples were collected by CGWB from different groundwater structures located in District Dehradun, during Pre-monsoon, 2007. The samples were got analyzed for their electrical conductivity (EC), pH, calcium, magnesium, carbonate and bicarbonate. The groundwater is suitable for domestic and irrigation purposes, with respect to these parameters.

123. A report published in the Journal of Environmental & Analytical Toxicology in 2017 shows Hydro-chemical study of surface and ground water were performed by for determining its suitability for drinking, industrial and agricultural purposes. In this study, the evaluation of various physico-chemical parameters such as pH,EC, TDS, bicarbonate and alkali metals (Na, K, Ca and Mg) of the surface and ground water has been carried out in selected sites of Dehradun and results were compared with the standard limits as per WHO guidelines for drinking water and were accessed statistically (Table 19). The average values of all physiochemical and alkali metals were found within the permissible limits of the WHO guideline for drinking water and also within Indian standard limits but some sites of surface and ground water were found to have even higher as compared to standard (Appendix 2). The deterioration in the quality of the water could be accounted to rapid urbo-industralization activities, increase in population with change of life style, excess use of chemical fertilizers, pesticides in soil to meet the increasing demand in the market, or unplanned out flow of effluent destroyed the water quality of ecologically rich state of Uttarakhand, India. So, there is a need to establish sewage treatment plants in major human settlements so that untreated sewage couldn't contaminate the water bodies.

Table 19: Comparison of Surface and Ground Water Quality with Drinking Water Standards (WHO and Indian Standard)

S.No.	Parameter	WHO	Indian Standard	Surface Water				Ground Water			
				Site-I	Site-II	Site-III	Site-IV	Site-I	Site-II	Site-III	Site-IV
1	pH	-	6.5-8.5	7.24	7.43	7.35	7.21	7.24	7.25	7.19	7.15
2	EC (µ mho/cm)	300	-	389.67	502.96	405.45	362.05	359.23	346.26	356.19	347.75
3	TDS(mgl-1)	-	500	496.11	663.33	673.33	651.11	389.22	398.89	465.55	404.44
4	Total Alkalinity(mgl-1)	-	200	165	172.62	161.45	154.45	158.66	159.61	150.37	147.44
5	Sodium(mgl-1)	200	200	7.9	11	11	10.02	5.73	6.19	5.63	5.71
6	Potassium(mgl-1)	12	-	4.52	15.29	6.53	5.37	2.96	7.09	4.67	4.07
7	Calcium(mgl-1)	75	200	35.43	35.87	36.96	30.64	23.58	30.61	28.67	20.93
8	Magnisium(mgl-1)	50	-	22.09	24.42	26.87	18.16	18.97	21.18	18.6	17.25

Site-I : FRI campus	New forest estate lies north of Dehradun- Chakrata Road, about 6 Km from main Dehradun town surrounding Clock Tower. The area is situated between 30°20'05.4" N Latitude and 77°59'15.3" E longitude and 640.08 m.
Site-II : Clock tower	The clock tower is the heart of Dehradun city and encircled by the city's commercial centres like famous "Paltan bazar". The area is situated between latitude 30°19'32.4" N and longitude 78°02'34.4" E and is located at an elevation of 640 m.
Site-III: Selaqui industrial area	Selaqui is located towards west of the main township of Dehradun along the Chakrata road and it is about 19 km from the Clock tower. The area is situated between latitude 30°21'40"N and longitude 77°50'44.8"E at an altitude of 635 m.
Site-IV; Karwapani	There are a number of wetlands in the Doon valley, the most common are fresh water swamps include Doodpani, Golatappar, Gularghati, Laltappar, Manuswamp, Mothoranwala, Nakranda, Ramgrah and Karwapani. It lies in the latitude 30°2" to 30° 26" (N) and Longitude77°52" to 78°-19" (E)

Source: Kumar et al., J Environ Anal Toxicol 2017, 7:1

124. **Hydrogeology of the Project area.** The project are part of the Doon Valley being intermontane in nature receives heavy rainfall (2000 mm) during the monsoon. The area is characterized by high rate of infiltration because of being underlain by unconsolidated and unsorted material of Doon Gravels, having a high degree of porosity and permeability. Groundwater occurs under unconfined condition. Water levels are generally in the range of 25 to 30 m below ground level in the area. Groundwater development in and around the study area is moderately low. The aquifers are composed mainly of sand, gravel and boulder. The quality of ground water is reported to be fresh and potable. [13]

5. Air Quality

125. Under the National Ambient Air Quality Monitoring (NAAQM) Programme, Uttarakhand Environmental Protection and Pollution Control Board (UEPPCB) is regularly monitoring the ambient air quality at Clock Tower, Raipur Road and ISBT in Dehradun City. The status of month-wise ambient air quality of the city during the period of 2019 and 2020) are presented in Table 20A and Table 20B respectively. While chemical pollutants; sulphur dioxides (SO_2) and oxides of Nitrogen (NOx) are well within the limits of National Ambient Air Quality standards 2009 but the sulphur dioxides (SO_2) concentrations are above the limit of WHO standard. The Particulate Matters (PM_{10} and $PM_{2.5}$) is exceeding the limits of both National Ambient Air Quality standards 2009, and WHO in all samples.

126. Air quality monitoring shall be conducted in the pre-construction phase (SIP period) by the contractor and shall be updated in IEE.

[13] Report on the Feasibility for Constructing a tubewell at Mothronwala, Dehradun district, uttarakhand prepared for Uttarakhand Jal Sansthan, Dehradun ,2013

Table 20A: Ambient Air Quality Characteristics (Year 2020)

City	Dehradun											
Locations	Clock Tower				Raipur Road				Himalayan Drug, ISBT			
Zone	Commercial/Residencial				Commercial/Residential				Commercial/Industrial			
Month	P.M.10 (µg/m3)	P.M.2.5 (µg/m3)	SO2 (µg/m3)	NO2 (µg/m3)	P.M.10 (µg/m3)	P.M.2.5 (µg/m3)	SO2 (µg/m3)	NO2 (µg/m3)	P.M.10 (µg/m3)	P.M.2.5 (µg/m3)	SO2 (µg/m3)	NO2 (µg/m3)
Jan-20	171.33	92.27	24.49	28.43	128.66	71.68	23.78	27.77	183.42	103.14	25.1	29
Feb-20	191.1	91	25.12	29.28	130.23	71.75	24.54	28.19	214.13	101.15	25.69	29.45
Mar-20	175.77	-	24.94	28.61	118.62	68.18	24.06	26.71	200.59	94.39	25.97	29.2
Apr-20	73.51	47.62	7.42	8.93	76.58	37.1	6.73	7.87	79.34	41.48	9.16	11.63
May-20	123.76	IF	17.65	21.55	100.87	46.37	14.04	18.5	110.49	75.61	15.41	19.91
Jun-20	120	IF	21.01	25	97.53	64.54	17.34	22.3	112.56	75.5	19.85	23.94
Jul-20	81.36	IF	20.94	24.98	88.38	42.83	19.1	22.75	93.83	53.7	20.7	24.57
Aug-20	88.67	RF	22.16	26.81	80.31	RF	20.97	22.93	92.24	RF	22.11	26.18
Sep-20	99.24	IF	22.45	27.42	93.73	66.86	21.82	25.56	104.17	76.62	23.11	27.46
Oct-20	162.77	IF	24.37	28.08	155.18	101.17	22.27	26.83	170.18	104.82	25.31	28.41
Nov-20	182.48	84.49	23.42	27.97	159.28	88.17	23.03	27.03	191.99	99.51	24.14	28.61
Dec-20	172.91	103.19	24.14	28.28	157.98	88.33	23.35	27.89	173.25	101.09	24.09	28.48
Average	**136.91**	**83.71**	**21.51**	**25.45**	**115.61**	**67.91**	**20.09**	**23.69**	**143.85**	**84.27**	**21.72**	**25.57**
Standards: 24 hours												
WHO Air Quality Guidelines, 2005 (µg/m^3)	**50**	**25**	**20**	**-**	**50**	**25**	**20**	**-**	**50**	**25**	**20**	**-**
India Ambient Air Quality Standard (µg/m^3)	**100**	**60**	**80**	**80**	**100**	**60**	**80**	**80**	**100**	**60**	**80**	**80**

Source: UEPPCB

Table 20B: Ambient Air Quality Characteristics (Year 2019)

City	Dehradun											
Locations	**Clock Tower**				**Raipur Road**				**Himalayan Drug, ISBT**			
Zone	**Commercial**				**Commercial/ Residential**				**Commercial/Industrial**			
Month	**P.M.10 (µg/m3)**	**P.M. 2.5 (µg/m3)**	**SO2 (µg/m3)**	**NO2 (µg/m3)**	**P.M.10 (µg/m3)**	**P.M. 2.5 (µg/m3)**	**SO2 (µg/m3)**	**NO2 (µg/m3)**	**P.M.10 (µg/m3)**	**P.M. 2.5 (µg/m3)**	**SO2 (µg/m3)**	**NO2 (µg/m3)**
January	165.25	82.82	23.84	28.41	131.14	67	21.87	26.47	243.12	97.72	25.15	28.4
February	182.59	80.53	24.88	28.9	113.44	63.8	22.28	26.6	220.94	88.49	25.94	29.45
March	159.28	86.67	25.66	29.39	125.21	48.27	24.88	28.67	209.34	105.01	26.24	30.16
April	171.59	97.36	25.48	29.72	117.8	63.44	26.51	31.1	212.1	111.06	26.1	30.19
May	185.26	104.56	26.06	29.87	132.38	80.93	23.42	28.58	215.7	117.56	25.82	29.85
June	196.74	100.97	25.97	29.24	136.15	82.27	23.11	27.96	222.01	113.41	25.87	29.78
July	174.77	IF	25.73	28.66	122.33	IF	23.12	28.14	220.36	IF	26.16	29.09
August	167.28	RF	24.43	28.36	119.27	RF	22.06	26.61	189.92	RF	25.23	28.35
September	143.58	RF	24.05	27.66	116.11	RF	23.57	27.02	168.16	RF	26.84	28.56
October	174.01	94.01	24.43	28.65	113	80.13	22.28	26.48	170.75	105.68	25.23	28.86
November	168.04	104.85	24.81	28.78	128.66	92.58	22.89	27.27	200.42	112.86	25.71	29.07
December	167.04	93.64	23.47	28.14	128.47	74.4	21.99	27.17	189.23	108.61	24.32	28.94
Average	**171.29**	**93.83**	**24.90**	**28.82**	**123.66**	**72.54**	**23.17**	**27.67**	**205.17**	**106.71**	**25.72**	**29.23**
Standards:24 hrs												
WHO	**50**	**25**	**20**	**-**	**50**	**25**	**20**	**-**	**50**	**25**	**20**	**-**
NAAQS: 2009	**100**	**60**	**80**	**80**	**100**	**60**	**80**	**80**	**100**	**60**	**80**	**80**

Source: UEPPCB

6. Noise Level

127. UEPPCB carried out monthly noise level monitoring at various locations of Dehradun city. As presented in the Table 21A and Table 21B, the noise levels at all monitoring locations during 2019 and 2020 are exceeding the standards (Appendix 4). According to the National Noise Level Standards of India, noise level in intersections which fall under silent zone, residential areas and commercial areas should not cross 50 dB, 55 dB and 65 dB, respectively, during daytime (6 am to 10 pm) and 40 dB, 45 dB and 55 dB, respectively, at night (10 pm to 6 am). WHO Guidelines Value for Noise Levels for silent zone, residential and commercial areas respectively should not exceed 55 dB, 55 dB and 70 dB during daytime, and 45 dB, 45 dB and 70 dB during nighttime. Transportation and horn used in vehicles are the major source of noise pollution in Dehradun city. Most of the monitoring results are within the permissible limit. Baseline ambient noise quality monitoring of shall be done during the SIP period by contractor and shall be updated in IEE.

Table 21A: Status of Noise Level Data for the Year 2020

Monitoring Station	Zone	Noise Level											
		Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
Survey Chowk	Commercial	70.0	68	70	51	71	72	74	70	70	71	69	70
Doon Hospital	Silence	58.0	57	55	47	53	55	57	71	61	62	67	63
Clock Tower	Commercial	73.0	71	71	57	71	71	70	68	73	73	69	73
Gandhi Park	Silence	53.0	56	54	44	52	55	53	64	58	58	62	57
Race Course	Residential	54.0	50	52	41	54	52	50	47	50	57	56	52
CMI Hospital	Commercial	64.0	69	71	55	71	74	72	65	68	67	66	67
Nehru Colony	Residential	54.0	54	54	43	55	56	54	56	56	56	55	57

Source: UEPPCB

Receptor/ Source	India National Noise Level Standards (dBA)[a]		WHO Guidelines Value for Noise Levels Measured Out of Doors[b] (One Hour LA_q in dBA)	
	Day	Night	07:00 – 22:00	22:00 – 07:00
Industrial area	75	70	70	70
Commercial area	65	55	70	70
Residential Area	55	45	55	45
Silent Zone	50	40	55	45

[a] Noise Pollution (Regulation and Control) Rules, 2002 as amended up to 2010.
[b] Guidelines for Community Noise. WHO. 1999

Table 21B. Status of Noise Level Data for the Year 2019

Monitoring Station	Zone	Noise Level											
		Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
Race Course	Residential	53.0	55	56	57	58	59.0	58	56	55	53	54.0	53
Doan Hospital	Silence	49.2	50	51	53	56	57.0	58	54	56	53	59.0	57
Clock Tower	Commercial	73.0	72	73	72	71	70.0	71	70	75	76	69.0	72
Gandhi Park	Silence	53.0	54	55	56	58	59.0	60	61	62	60	53.0	54
Survey Chowk	Commercial	73.0	74	73	74	73	74.0	72	73	75	74	70.0	71
CMI Hospital Chowk	Commercial	71.0	72	73	74	75	74.0	75	73	74	75	60.0	62
Nehru Colony	Residential	52.0	53	54	55	56	57.0	56	54	55	56	54.0	55

Source: UEPPCB

Receptor/ Source	India National Noise Level Standards (dBA)[a]		WHO Guidelines Value for Noise Levels Measured Out of Doors[b] (One Hour LA_q in dBA)	
	Day	Night	07:00 – 22:00	22:00 – 07:00
Industrial area	75	70	70	70
Commercial area	65	55	70	70
Residential Area	55	45	55	45
Silent Zone	50	40	55	45

[a] Noise Pollution (Regulation and Control) Rules, 2002 as amended up to 2010.
[b] Guidelines for Community Noise. WHO. 1999

B. Ecological Resources

128. Uttarakhand is beautiful state set at the foothills of the snow-clad Himalayas with lush green vegetation. There is a diverse range of flora and fauna in Uttarakhand, India. The vegetation of the state majorly comprises alpine trees and tropical rainforests. Wildlife in Uttarakhand thrives in these dense forests. With the varied flora and fauna in Uttarakhand, a number of National Parks have been set up in different parts of the country, which not only serve as a natural habitat for Uttarakhand flora and fauna, but also as a huge source of information for tourists who visit these parks.

129. Uttarakhand comprises of 13 districts spreading over an area of 51,082 sq. km, floristically, it falls under the west Himalayan Biogeography zone and it is well-known for floral diversity similar to any other Himalayan region in the country with an estimated 4,000 species of flowering plants having great economic medicinal, aromatic and artistic value. The endemic plant wealth of Uttarakhand is worth mentioning as it ultimately forms part of the National heritage. Uttarakhand Himalayas have about 116 species as indigenous group. *Are naria ferruginea; Chimonobambusa jaunsarensis, Gentian tetrasepala, G. saginoides, Meeboldia solenoids, Microschoenus duthiei, Trachycarpus takil, Poa rhadina*, etc. are some such species.

130. The area under forest in Uttarakhand is 3.4 million hectares, which constitutes 61.45% of its total land available for utilization. By legal status, reserve forests constitute 71.08%, protected forests 28.51% and unclassified forests 0.41% of the total forest area. The major forest types occurring in the state are Tropical Moist Deciduous, Tropical Dry Deciduous, Sub-tropical Pine, Himalayan Moist Temperate, Sub-Alpine and Alpine Forests. Forests are largely distributed throughout the state, with conifers and Sal being the major forest formation.

131. **Ecology of Dehradun district** is distinguished from most other districts in the state by the existence of very large forests chiefly stocked with sal. Forest products play an important role in the economy of the district. Besides, supplying fuel, fodder, bamboos and medicinal herbs, they also yield a variety of products like honey, lac, gum, resin, catechu, wax, horns and hides. The forests account for 1477 sq.kms of area, giving a percentage of 43.70 of the total area of the district. Vegetation of district Dehradun can be broadly classified into two forms, viz., Tropical and Temperate. Faunal biodiversity of Dehradun includes key species like Asiatic elephant, Bengal Tiger, Dhole, Wild Buffalo etc.

132. **Dehradun City**, the district head quarter, is an urban area surrounded by hilly forested areas. There is no remaining natural habitat within the developed area of the city. Some forest areas (Raipur Reserve Forest, Bandal Reserve Forest) are situated outside the Municipal area towards north and north-east. Variety of species of shrubs, climbing plants and grasses are found in these forests. Sal and Chir are predominant in and around Dehradun. The closest protected area is Rajaji National Park situated 10 km west of the Dehradun City. Designated as National Park in 1964, it spreads over an area of 820 square kilometres (sq. km) and is endowed with pristine beauty and rich bio-diversity. This has over 23 species of mammals, including elephants and tigers, and 315 avifauna species. The other protected areas in the Dehradun district are: (i) Benog Wildlife Sanctuary near Mussooriee, north of Dehradun, and (ii) one Conserve Reserve (Asan reservoir & its environs), northwest of Dehradun.

133. None of the project components are falling within protected or forest areas and no wildlife has been reported within the proposed service area. There are no eco-sensitive or protected areas within proposed project activity areas of Package 2 comprising part of Municipal ward

numbers 83 and 85. The closest protected areas are Rajaji National Park situated within 5 km and New Forest Campus within 10 km radial distances from the proposed centrally located tube well and OHT location in Mothorowala. This is based on the screening conducted using the Integrated Biodiversity Assessment Tool (IBAT). Other key biodiversity areas, Asan Barrage, Binog Sanctuary- Bhadraj- Jharipani, Jhilmil Jheel Conservation Reserve, Kalesar Wildlife Sanctuary and Simbalbara National Park, are found within 50 km radial distance (Appendix 7). Therefore, the project will pose no risk or impact on biodiversity and natural resources. The subproject components also do not fall within the ambit of Doon Valley Notification.

C. Economic Development

1. Land use

134. **Land use.** The world has seen the development and growth of urban areas at a faster pace. The rapid urban growth and development have resulted in the increase in the share of India's urban population from 79 million in 1961 that was about 17.92 percent of India's total population to 388 million in 2011 that is 31.30 percent of India's total population. This fast rate of increase in urban population is mainly due to large scale migration of people from rural and smaller towns to bigger cities in search of better employment opportunities and better quality of life. Urban sprawl has resulted in loss of productive agricultural lands, open green spaces and loss of surface water bodies.

135. Landuse/Landcover (LUCC) is an important indicator in understanding the interactions between human activities and the environment. The rapid changes of land cover are often characterized by urban sprawl, farmland displacement and deforestation leading to the loss of arable land, habitat destruction, and the decline of the natural greenery areas. The loses have a substantial impact on urban environmental conditions such as biodiversity, climate change, and atmosphere particulate pollution at local and/or global scales

136. A study on Urban Sprawl and its impact on landuse/landcover dynamics of **Dehradun city**, India carried out by Bhat et.al (2017) using remote sensing and GIS techniques was published in the International Journal of Sustainable Built depicts that the current trend of urban growth has the most obvious environmental impacts on the surrounding ecosystems, land resources, structure and pattern of the urban area and hence quality of life. The study area is part of the Dehradun city and is located at 30°19' N latitude and 78°20' E longitude. The area is underwent large urban land use changes in the last few years. It was also found that some kind of urbanization is undergoing in the protected areas of the region. There are significant spatial and temporal changes in the pattern of land use/land cover in the city of Dehradun as shown in Table 22 A. The positive changes were observed in the Urban and built up, fallow and forest land classes. The negative changes were observed in forest, Agriculture, Mixed vegetation and River bed. The study shows that there is a remarkable urban sprawl in and around the city between 2004 and 2014 because 6.13 sq.km of agricultural land, fallow land and vacant land has been lost to built-up land during this period. Based on these findings, the study area has undergone considerable changes in the pattern and structure of urban features. The landscape analysis has also been supported by the urban sprawl measurement. The results of the sprawl measurement reveal that there has been high rate of sprawl and dispersed nature of urban development between 2004 and 2014.

137. There is a remarkable change in the agricultural land with a negative growth of 9.47 percent. It decreased about 39 percent from 25.45 sq.km to 17.65 sq.km between 2004 and 2014. Out of these eight classes, forests cover only 2.13 sq. km in 2014, while as it was about 2.54

sq.km in 2004, thus showing a negative growth of about 0.50 percent. This area may be termed as environmentally conserved. The river bed and restricted area has almost remained unchanged. Mixed vegetation in the form of plantation has decreased from 7.96 sq.km in 2004 to 4.85 sq.km in 2014, thus showing a negative trend of 3.76 percent.

Figure 22: Landuse/Landcover Map 2002

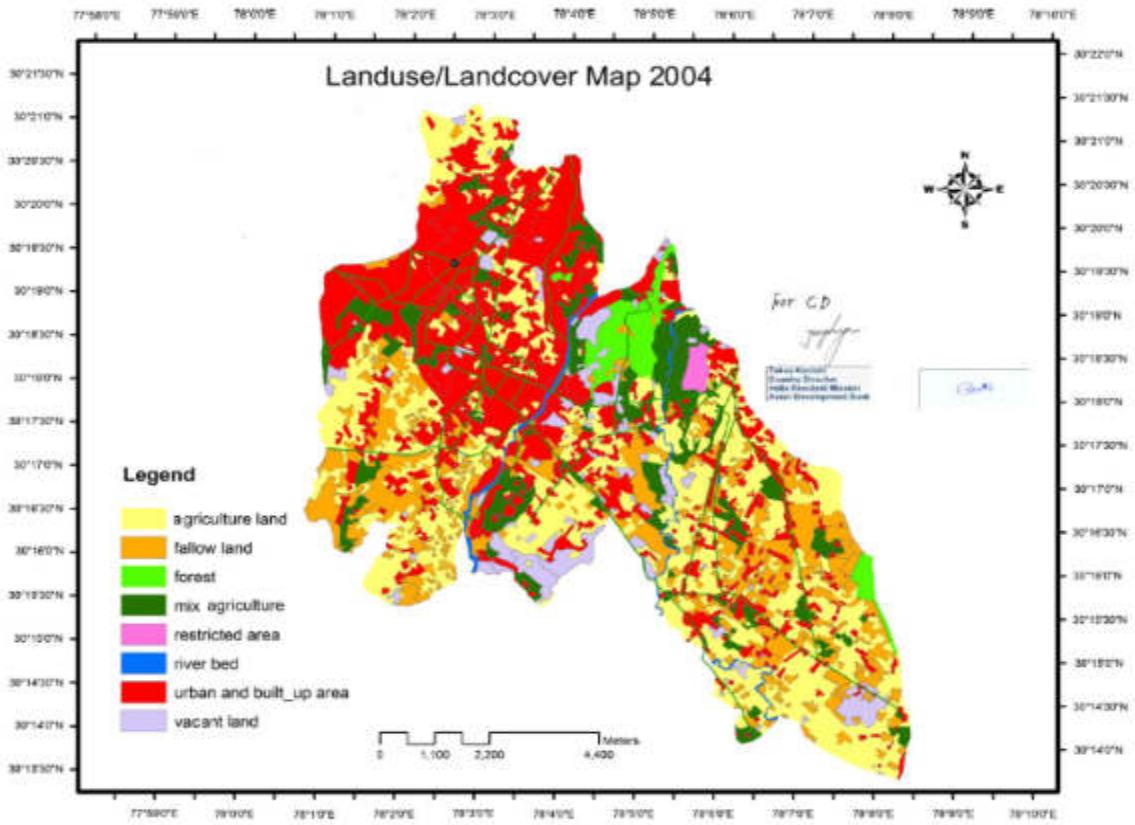


Figure 23: Landuse / Landcover Map 2014

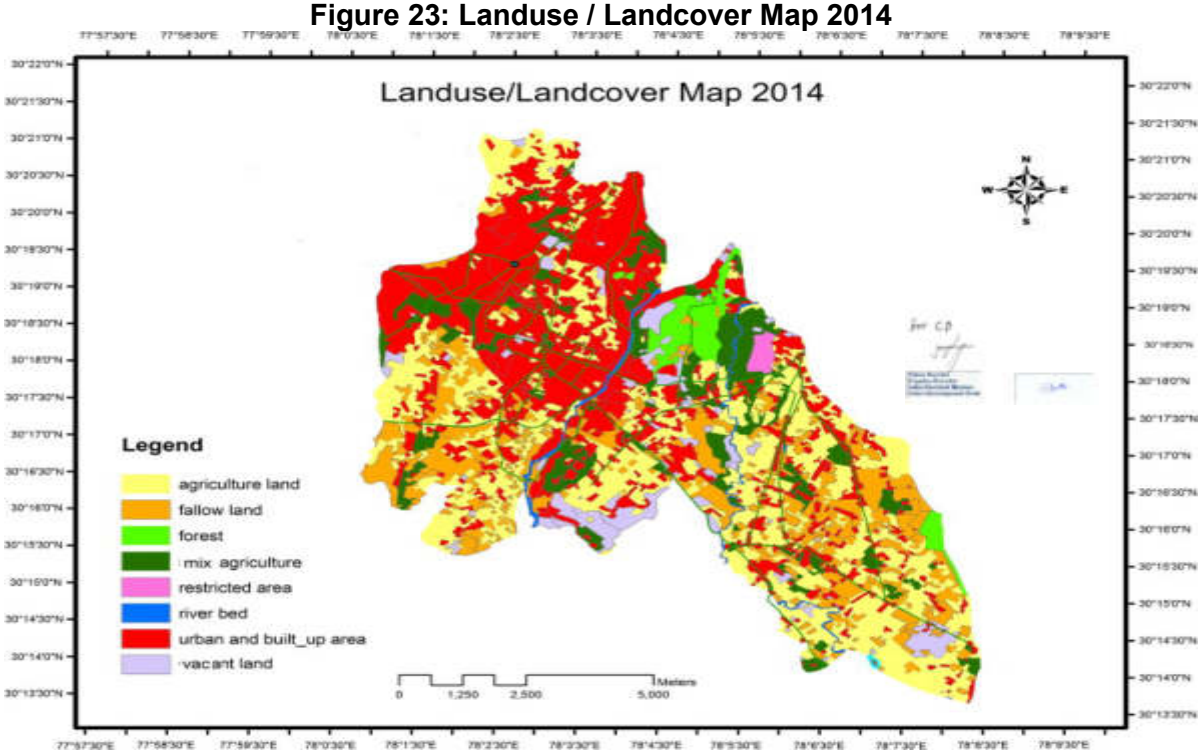


Figure 24: Landuse/Landcover Change Detection Map (2004 – 2014)

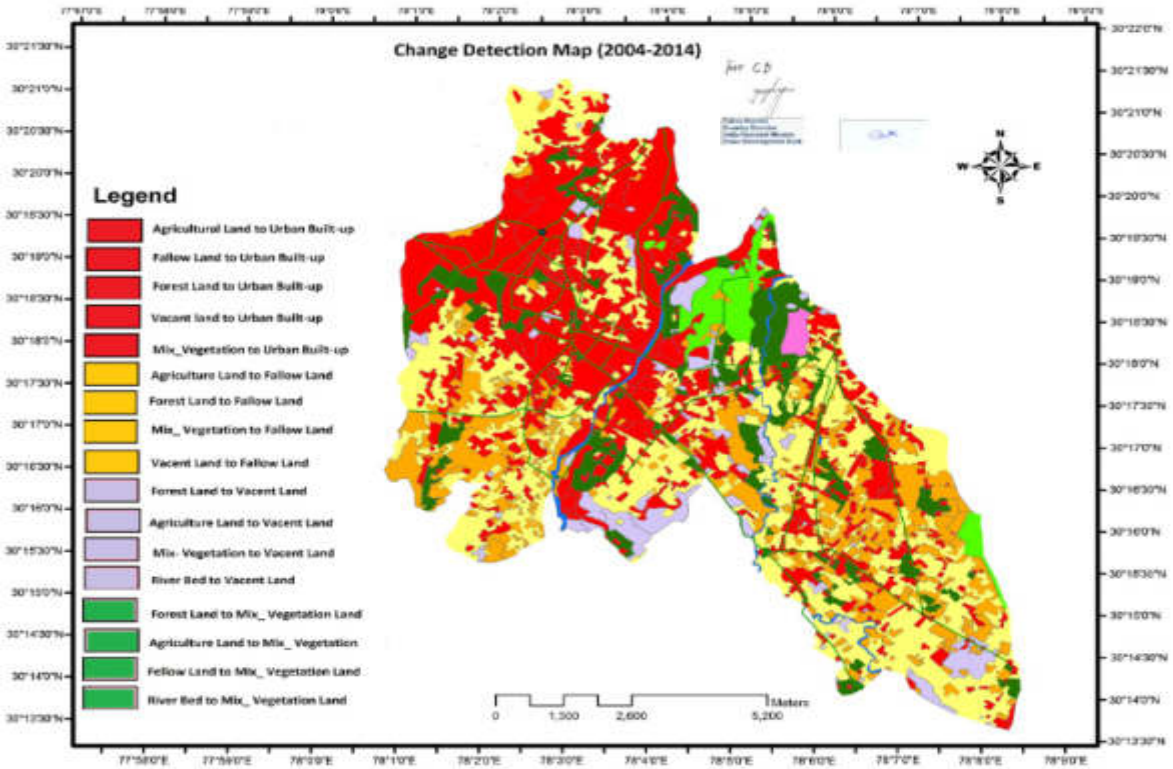


Table 22 A: Overall Percentage Change in Different Class

Land Use Type	Area 2004 (sq.km)	Area 2014 (sq.km)	Change in area (sq.km)	Percentage Change (%)
Urban and built up	27.16	34.08	6.92	8.4
Agriculture	25.45	17.65	-7.8	-9.47
Forest	2.54	2.13	-0.41	-0.5
Fallow	13.97	17.5	3.53	-4.21
Riverbed	0.89	1.54	0.65	0.79
Vacant Land	4.31	3.81	-0.5	-0.61
Restricted Area	0.41	0.41	0	0
Mixed Vegetation	7.96	4.85	-3.11	-3.76
	82.69	**81.97**		

138. **The service area proposed under Banjarawala Package 2** subproject is located in the southern part of newly expanded Dehradun city which consists parts of ward nos 83 (Kedarpur) and 85 (Mothrowala). Until 2017 these wards / areas were outside the limits of Dehradun Municipal Corporation (DMC). After the 2018 re-boundary mission of Dehradun city, these areas have now become part of the DMC and as such are now part of Dehradun city. These newly merged areas and its infrastructures are mainly designed for serving rural population. However, due to proximity of State highway and Dehradun urban areas, these areas have been drastically developed and now these have been part of Dehradun Nagar Nigam.

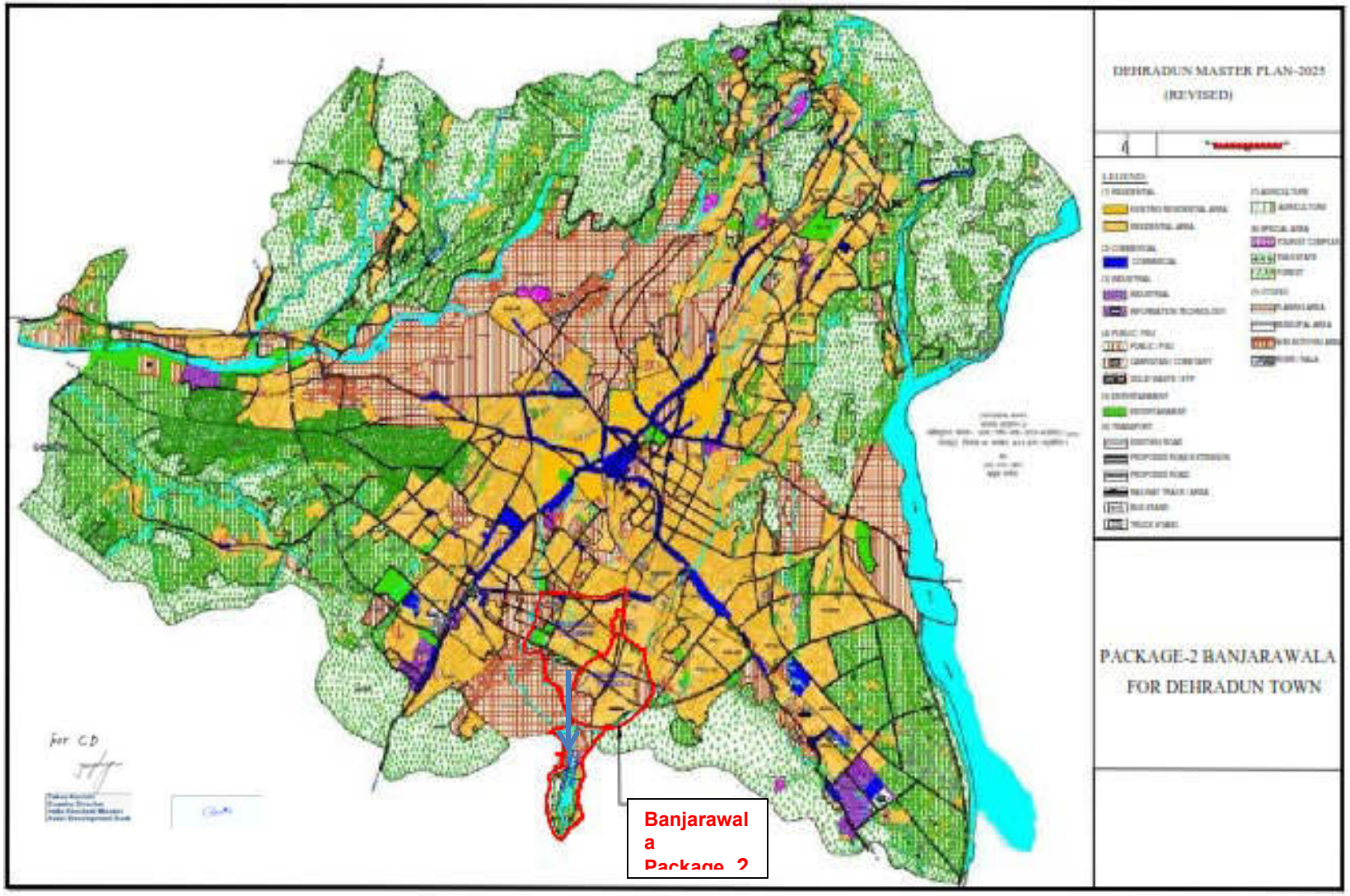
139. As per the Dehradun Master Plan - 2025 (revised)on Dehradun Nagar Nigam , the main land use classes along with areas of the Banjarawala Package 1, 2 and 3 comprising of ward nos 83 (Kedarpur), 84 (Banjarawala) and 85 (Mothrowala) are given below in Table 22 B and Figure 25. ResIdential land is the main land category comprising about 63% of the total area. Agricultural and Forest lands occupies about 11% and 2.5% of lands respectively.About 23% lands not Notified as per the Master plan (Table 22B)

Table 22B: Land use data as per Master plan -2025 of Dehradun Nagar Nigam

Land area Details of Banjarawala Dehradun (Package-1,2,3)		
Land	**AREA (sqm)**	**Area (%)**
Total Land Area	9815106.711	
Residence Land area	6209424.057	63.26
Non-Notified Area	2280439.246	23.23
Agriculture Land Area	1076926.853	10.97
Forest Land Area	248318.448	2.53
	Total Area	100

Source: Dehradun Nagar Nigam

Figure 25: Dehradun Master Plan -2025 Showing Banjarawala Package 2 Subproject Area



Source: Dehradun Nagar Nigam

2. Industry & Agriculture

Economy of Dehradun is mainly service sector based. Industrial development is very limited. After the formation as a separate state in 2000, the industrial development in Uttarakhand has been picked up. There are no major industries located in and around the Dehradun City. The Dehradun District houses 37 large and medium scale industrial units (which include 7 chemical/pharmaceutical units, 8 electrical and 4 food processing units) providing employment for about 8,278 persons.

140. The main source of economy in Dehradun is its tourist places. The city's economy is enhanced by the presence of nearby national parks, mountain peaks and historical sites. Dehradun has a per capita income close to $2400 (per 2012 figures: national average $800). It has enjoyed strong economic growth in the last 20 years. Dehradun has experienced a commercial and information technology upswing, amplified by the establishment of software technology parks of India (STPI) and SEZs (Special economic zones) throughout. Regional offices of Genpact, Spice Digital, Serco, Aptara and India MART are present in Dehradun. A number of manufacturing units are present in the Selaqui area.

141. Major defense production establishments include the Ordnance Factory Dehradun, the Opto Electronics Factory of the Ordnance Factories Board, Defense Electronics Application Laboratory and Instruments Research and Development Establishment of the Defense Research and Development Organization which manufactures products for the Indian Armed Forces. Many of these are located in the Raipur area. The Ordnance Factory estate is located in the middle of mountains. The state government has announced construction of a film city in Dehradun, The proposed Keadarpur, Mothrowala –Banjarawala areas have none of defense establishment.

142. Owing to its hilly topography, agricultural development in the state is also limited. Although limited, the State draws advantage from fertile lands availability of abundant water. Dehradun and surroundings were well known for production the famous “Basmati” rice crop. However, of late, the development pressure has conversed many of these agricultural lands. Also, nestled in a wide and thickly forested valley of the Sivalik ranges, Dehradun is also famous for its fruit orchards such as leechis and mangoes.

3. Existing Infrastructure

143. **Water Supply**. The water supply system was introduced in Dehradun in 1885. Pipelines were laid from a natural spring at Kolukhet situated 25 km from Dehradun. The water supply system was re-modeled and underwent major augmentation between 1936 and 1937. Source of water supply for the city is combination of surface and subsurface water. The existing water supply system in Dehradun city, which is more than 30 years old, consists of three sub systems viz. North zone, South zone and Pithuwala zone. The North zone is supplied mostly with surface water sources, and south and Pithuwala zones are supplied with ground water from tube wells located at various places in the city.

144. . At present, ground water is the main source, providing 76% of its total supply 102 MLD. Water supply system covers almost the entire City with a distribution network of 1964 km. Due to old system, water losses are high. Water is supplied four hours a day; but supply is not constant throughout the City owing to system defects. Water is currently supplied through mobile tankers in some areas. Average per capita supply is about 124 litres per day. Uttarakhand Peya Jal Nigam (UPJN) and Uttarakhand Jal Sansthan (UJS) have respectively involved in development and day-to-day operation of water supply system.

145. In some of the areas coming under the present sub-project, water supply scheme was executed/being executed by the UJS under various schemes. Information gathered from UJS related to existing water supply works are summarized below:

146. In Banjarawala, Mothrowala & Kedarpur areas water Supply distribution network in DMA-1 is done under the World Bank Project. five nos. of tube wells viz. 1) at Saket Farm near the Bindal River Bridge (Haridwar Road) 2) at Banjarawala Inter College 3) at Bangali Kothi 4) at PNB ATM and 5) at Motrowala exists in the project area. There are three existing overhead tanks in the sub-project area i.e. 250 KL near PNB ATM, 1000 KL at Mothrowala and 800 KL at Bangali Kothi. The distribution network in the sub-project area is laid over a period of time.

147. **Storm Water Drainage System.** Owing to high rainfall and the hilly topography, natural drainage is well developed in Dehradun. Roadside drains, connected to natural streams, are developed all over the City, except in newly added areas and few slums. However, the conditions of most of the drains need cleaning, re-modelling and repairs. Temporary flooding, mainly due to choking and encroachment of drains, is experienced in some low-lying areas during monsoon The Dehradun Nagar Nigam (DNN) develops and maintains the storm water drainage system in the City.

148. The sub-project area is newly incorporated/merged into Dehradun Municipal Corporation. Presently there is no proper storm water drainage system. To make matters worse, sewage from the septic tanks constructed as part of individual houses is flowing into these drains because there is no sewerage system. Some of the major nalas passing through this sub project area are in dilapidated condition and are choked by garbage and debris

149. Due to hilly terrain, Dehradun has a natural drainage pattern with sufficient gradients to drain off storm water easily into the two main natural drainage, streams i.e. rivers Bindal and Rispana. The slope of both the main rivers i.e. Rispana and Bindal is from North to South. Practically the whole town, wherever Roads or brick pavement exist have some or the other kind of side drains leading to storm water drains except in slums or some parts of peripherals areas which have recently been included in the limits of Nagar Nigam.

150. **Proposed service area** under the subproject is part of the Bindal River catchment, which drains out the water from Suswa and Song river into Ganga river. The discharge from stormwater drains of the project area is proposed at 18 outfall locations, for Banjarawala Package 2. The discharge will be done to following *nalas* and rivers: *nala* at Mothrowala area, **nala** at inter colony road, *nalas* near Mahalakshmipuram, Vishnupuram and to Ripsana and Bindal rivers**.** All these *nalas* or drains ultimately join Ripsana River which inturn joins River Ganga.

151. Practically the whole town, wherever Roads or brick pavement exist have some or the other kind of side drains leading to storm water drains except in slums or some parts of peripherals areas which have recently been included in the limits of Nagar Nigam. However, the conditions of most of the drains need cleaning re-modelling and repairs. There are 8 Nos. of drainage basin covering the town are: (i) Bindal Basin; (ii) Bindal Sub Basin No.1; (iii) Bindal Sub Basin No.2;(iv) Bindal Sub Basin No.3; (v) Rispana Basin; (vi) Asan River Basin; (vii) Dulhani River Basin; (viii) Tons River Basin and (ix) Song River Basin.

152. The Name of the main drains discharging their flow in to Rispana and Bindal rivers and the catchment areas draining to these are given below in Table 23 and 24.

Table 23: Major Drains Joinnig River Rispana

S.NO	Name of the Drains	Length (km)/Width (m)	Area connected with Drains
1	I.T. Park Drain	2.8 km Width 3 to 5 m	i. Dhoran Village ii. Shastara Dhara Road Rajeshwar Rao Nagar
2	Mayur Vihar Drain	5.4 km Width 3 to 5 m	i. Sondhowali ii. Chindowali iii. Mayur vihar iv. Keval vihar v. Suman Puri State Bank colony
3	Ambiwala Gurudwara Nala	6 km Width 3 to 4 m	i. Badrish colony ii. Jyoti Vihar iii. Dharampur Danda iv. Shastri Nagar v. Defence colony Inderpur
4	Nehru colony I block by pass	3.7 km Width 1.5 m	i. Nehru colony ii. Haridwar road iii. Pragati vihar iv. Saket colony v. Rispana puram Dharampur
5	Survey chowk upto Rajpur road Deal	3 km Width 1.2 m	i. Karanpur ii. Old Dalanwala iii. Vikas lane iv. Azaad colony v. Adarsh vihar Deal colony
6	Nala Panichowk	1 km Width 1.2 m	i. Vikas lane colony D-2.3,4 ii. Kewal vihar iii. Sumanpuri Nala Pani road

Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

Table 24: Major Drains joining River Bindal

Sl.No.	Name of Drains	Length/(km) width(m)	Connected areas
1	From Brijlok to New cant Road Nala	4.5 km width 6m	i. Salawala ii. Chandralok colony iii. Dilaram Bazaar iv. New cant. road v. Rajpur Road
2	Mannu Ganj Nala	4.8 km width 3m to 5 m	i. Ghantaghar to Moti Bazaar ii. Neshvilla road iii. Mannu Ganj iv. Moti Bazaar v. Anand Chowk vi. Dandipur vii. Khadri viii. Jilak Road
3	Govind Garh Nala	2.5 km width 2m to 4 m	i. Shanti vihar ii. Teachers colony

Sl.No.	Name of Drains	Length/(km) width(m)	Connected areas
			iii. Rajendra nagar iv. Saiyyed Mohalla v. Yamuna colony
4	Chorakhala Nala	1 km width 2m to width	i. Mitralok ii. Deeplok iii. Akashdeep iv. Rajender Bag b- block
5	Bhandari Bagh Nala	3.5 km width 4 to 6 m	i. Lakshmi bagh ii. Vishvakarma colony iii. Bhandari Bagh iv. Pathari Bagh v. THDC colony
6	Chandra Nagar to Race course drain	5.5 km width 2 to 5 m width	i. Haridwar road ii. Race course iii. Chander Nagar iv. Police line v. Race course A.B.C block vi. Saraswati Vihar
7	Subhash Road Police head office	4 km width 1.5 m	i. Subhash road ii. Cross road iii. New survey road iv. Kacchari road v. Chander Nagar
8	Asian school Nala	2.2 km width 3m	i. Ganga Vihar ii. Kalindi Enclave iii. Kanwali village iv. Engineer Enclave v. Om vihar vi. Shastri Nagar

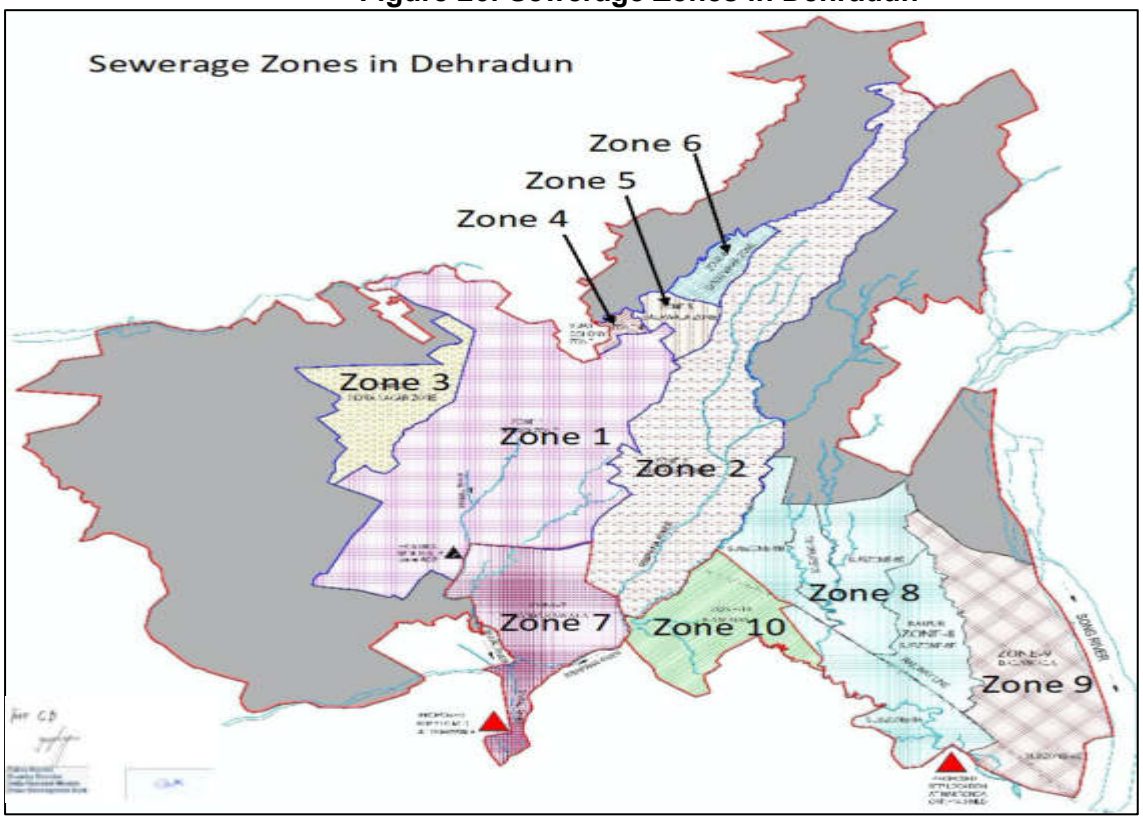
Source: Project Management Unit, UIRUDP and Design and Supervision Consultants

153. **Solid waste management:** According to the "Dehradun Nagar Nigam (DNN)" the city on an average, generates about 200 MT of MSW per day. The assessment is based on the assumption of per capita generation @ 0.4kg/capita/day. Besides domestic, other major sources of MSW generation of the city are shops and commercial establishments, hotels and restaurants and fruit and vegetable markets. The DDN is responsible for solid waste management including collection, transportation and safe disposal. Waste is collected through community bins, and the DDN also introduced door-to-door waste collection in part of the City. Street sweeping is carried out regularly. Collected waste is transported to the disposal site at Lakhani, 7 km northeast, where waste is disposed in trenches and covered with soil.

154. **Sewerage.** Since the re-boundary of Dehradun in 2018, Dehradun Municipal Corporation has extended its municipal boundary limit by merging nearby Urbanised areas. Thus, there are 100 number wards in the jurisdiction of Dehradun Nagar Nigam. Taking cognizance of the newly merged areas to the Dehradun Municipal Corporation, four additional zones namely Zones 7, 8, 9 and 10 have been made after giving due consideration to the topography within the new municipal boundaries. After addition of these four new zones, there will be total 10 zones in Dehradun (Figure 26). These four zones are located in the southern and south-eastern parts of Dehradun. There is no existing sewerage system in these newly added areas. In most of the areas, sewage from the individual septic tanks exit/seep/flow/overflow directly into the nearby storm water drains. In some of the areas located adjoining to the nala sewage directly discharges

into nala. (Refer photographs in Appendix 26). Open defecation is not uncommon. Most of the residential and commercial buildings and educational institutions have on-site septic tanks and soak pits. Though septic tank is an accepted onsite treatment, but as the septic tanks are not designed and maintained properly, the effluent does not confirm to the standards. The effluent from the septic tanks is directly let into the open drains. In the absence of a safe disposal system for sewage, the people are facing unhealthy and unhygienic environmental conditions.

Figure 26: Sewerage Zones in Dehradun



Source: Detailed Project Report

155. **Transportation:** Dehradun has a well-developed road network of 463 km, of which 363 km are maintained by DDN and the rest by Public Works Department (PWD). Arterial roads are wide and surfaced with bitumen, and the internal roads are mostly of cement concrete. Roads in the City centre are very narrow and congested with traffic and pedestrian, and in the out areas roads are comparatively wide and under-utilised. City public transportation system mainly comprises buses and three-wheeler auto-rickshaws. National highways (NH) 72 and 72A pass through the city and is well connected by road with New Delhi (255 km) and other cities Chandigarh (130 km); Haridwar (54 km); Agra (382 km); Shimla (221 km) and Nainital (297 km). The city is connected to other parts of the state through various radial roads. These roads are originating from the city core with Rajpur road, Haridwar road, Saharanpur Road and Chakrata Road and forming the major travel corridors. NH-72 passes through the city connecting Rishikesh and Haridwar in the east to Himachal Pradesh in the western side. NH-72A connects the city with Saharanpur in the S-W and Roorkee in the south. Other important roads in the city are Kaulagarh road, Raipur Road, Sahastradhara road, Kanwli Road, New Cantonment Road, Subhas Road and East Canal Road.

156. Dehradun is also well connected by railways with regular services to Delhi Calcutta, Mumbai, Varanasi and Lucknow.

157. Dehradun railway station is part of the Northern Railways (NR) zone, railway station was established in year 1899 by Britishers, it is the last station on the Northern railway line in the area. Dehradun is served by Dehradun Airport, also known as Jolly Grant Airport which began its commercial operations in on 30 March 2008. The airport is 27 kilometres (17 mi) from the city centre and lies in Doiwala. The nearest international airport is in New Delhi. There is also a helicopter service from Dehradun to Chinyalisour a town in Uttarkashi district and Gauchar.

158. **Power supply:** Hydro power is the main source of energy in Uttarakhand. Uttarakhand Jal Vidyut Nigam Limited (UJVNL) is responsible for power generation and Uttarakhand Power Corporation Limited (UPCL) is responsible for power transmission and distribution in the State. Power is supplied from the central grid by overhead cables carried on metal and concrete poles, mainly located in public areas alongside roads. The power supply is erratic and there are frequent outages in warmer months, and large fluctuations in voltage

159. **Irrigation practices.** Both surface and subsurface sources are being developed for irrigation purpose. The perennial rivers/ springs/ gadheras are being developed by constructing canals and guls. Canals in District Dehradun run for a length of 786 km. There are four main canal systems namely Bijapur, Rajpur, Kalanga and Jakhan. These canal systems were developed during the British period and now being maintained by the state irrigation department. The Rajpur canal system, Jakhan canal system, Kalanga canal system, and Bijapur canal system have 7,5,7 and 10 numbers of canals, respectively. Sub surface water is developed through tube wells. Most of these tube wells are located in the Intermontane Doon Valley tapping the Doon Gravels. Besides the canals and tube wells, there are other irrigation practices like pump sets, hydrum, hauz, tanks etc.

160. **Healthcare.** The healthcare facilities in Dehradun consist of private and public hospitals, formal and informal service providers as well as secondary and tertiary healthcare with single clinic doctors. In spite of having special status under the National Health Mission, the city is facing healthcare crisis due to shortage of medical manpower in the state and financial constraints. Hospitals and medical centres in the Dehradun are plagued by non-functioning equipment in the operating theatre and insufficient number of labour rooms. [1]Hospitals in the city include the Doon Hospital, Uttaranchal Ayurvedic Hospital, Combined Medical Institute (CMI) Hospital, Luthra Hospital, and Government Hospital Premnagar (managed by the state government).

D. Socio Cultural Resources

1. Demography

161. The Dehradun city is located in Uttarakhand state of India. Dehradun city is governed by Municipal Corporation which comes under Dehradun Metropolitan Region. As per provisional reports of Census India, population of Dehradun in 2011 is 569,578; of which male and female are 298,638 and 270,940 respectively. Although Dehradun city has population of 569,578; its urban / metropolitan population is 706,124 of which 372,362 are males and 333,762 are females. Total no. of Slums in Dehradun city & it's Outgrowth numbers 32,861 in which population of 158,542 resides. This is around 27.58% of total population of Dehradun city & its outgrowth which is 574,840. The sex ratio of the city is 907 per 1000 males. And child sex ratio of is 873 girls per 1000 boys, lower than the national average. There are 31,600 boys and 27,580 are girls. The

child forms 10.59% of total population of Dehradun City. The number of children of age under six in Dehradun city is 60,339 as per figure from Census India report on 2011.

162. Hindi, the official state language, is the primary language in Dehradun. English is also used, particularly by defence wing and the white-collar workforce. Other major regional languages are Garhwali, which is spoken by 23%, Kumaoni 20%, Jaunsari 1.3% and Nepali 1.1%.

163. Hinduism is majority religion in Dehradun city with 82.53 % followers. Islam is second most popular religion in city of Dehradun with approximately 11.75 % following it. In Dehradun city, Christianity is followed by 1.06 %, Jainism by 0.63 %, Sikhism by 3.50 % and Buddhism by 3.50 %. Around 0.01 % stated 'Other Religion'; approximately 0.24 % stated 'No Particular Religion'.

164. Literacy rate of Dehradun at 88.36 percent is the highest in the region. Male literacy is 91.76 percent and female literacy is 84.63 percent. Total 449,950 people are literate in Dehradun of which males and females are 244,462and 205,488 respectively.

165. The City has been growing steadily since 1971. The growth of the city has been phenomenal during 1991-2001 when there was an influx of population of immigrants to this town. However, thereafter also the growth was not stable. The average decadal increase is 36.5%. The last decadal (2001-2011) growth is only 27.14%. Details of decadal population growth rate of Dehradun city is shown in Table 25 and Demographic Statistics of Dehradun municipal areas as per Census 2011 has been shown in Table 26.

166. As per 2011 Census India, population of **Banjarawala Package 1, 2 and 3** comprising wards 83 (Kedrapur), 84 (Banjarawala) and 85 (Mothorowala) is 19575. Hinduism is majority religion in the project area. Apart from Hindi, Garhwali, Kumaoni and Nepali are the major languages spoken by the poject area people.

Table 25: Population and decadal growth rate of Dehradun Municipal Area

Sl. No.	Year	Population	Decadal Growth Rate
1	1971	166000	-
2	1981	211000	27.11%
3	1991	270000	27.96%
4	2001	448000	65.93%
5	2011	569578	27.14%

Source: Census of India & DPR.

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Table 26: Demographic Statistics of Dehradun Municipal Area

Population	Persons	Males	Females
Total	5,69,578	2,98,638	2,70,940
In the age group 0-6 years	60,339	32,220	28,119
Scheduled Castes (SC)	69,239	36,422	32,817
Scheduled Tribes (ST)	4,386	2,336	2,050
Literates	4,49,950	2,44,462	2,05,488

Population	Persons	Males	Females
Illiterate	1,19,628	54,176	65,452
Total Worker	1,92,518	1,55,110	37,408
Main Worker	1,71,719	1,41,629	30,090
Main Worker - Cultivator	798	642	156
Main Worker - Agricultural Laborers	1,911	1,590	321
Main Worker - Household Industries	7,442	6,046	1,396
Main Worker - Other	1,61,568	1,33,351	28,217
Marginal Worker	20,799	13,481	7,318
Marginal Worker - Cultivator	388	198	190
Marginal Worker - Agriculture Laborers	822	650	172
Marginal Worker - Household Industries	1,243	651	592
Marginal Workers - Other	18,346	11,982	6,364
Marginal Worker (3-6 Months)	18,182	11,624	6,558
Marginal Worker - Cultivator (3-6 Months)	374	189	185
Marginal Worker - Agriculture Laborers (3-6 Months)	587	441	146
Marginal Worker - Household Industries (3-6 Months)	1,020	535	485
Marginal Worker - Other (3-6 Months)	16,201	10,459	5,742
Marginal Worker (0-3 Months)	2,617	1,857	760
Marginal Worker - Cultivator (0-3 Months)	14	9	5
Marginal Worker - Agriculture Laborers (0-3 Months)	235	209	26
Marginal Worker - Household Industries (0-3 Months)	223	116	107
Marginal Worker - Other Workers (0-3 Months)	2,145	1,523	622
Non-Worker	3,77,060	1,43,528	2,33,532

Source: Census of India, 2011

2. History, Culture and Tourism

167. **History***:* The history of the city of Uttarakhand, Dehradun (nicknamed "Doon Valley") is linked to the story of Ramayana and Mahabharata. It is believed that after the battle between Ravana and Lord Rama, Lord Rama and his brother Lakshmana visited this site. Also, known as 'Dronanagari' on the name of Dronacharya, legendary Royal guru to the Kauravas and Pandavas in the epic Mahabharata is believed to have been born and resided in Dehradun. Evidences such as ancient temples and idols have been found in the areas surrounding Dehradun which have been linked to the mythology of Ramayana and Mahabharata. These relics and ruins are believed to be around 2000 years old. Furthermore, the location, the local traditions and the literature reflect this region's links with the events of Mahabharata and Ramayana. Even after the battle of Mahabharata, the Pandavas had influence on this region as the rulers of Hastinapura with the

descendants of Subahu ruled the region as subsidiaries. Likewise, Rishikesh is mentioned in the pages of history when Lord Vishnu answered the prayers of the saints, slaughtered the demons and handed the land to the saints. The adjoining place called Chakrata has its historical impression during the time of Mahabharata.

168. In the seventh century this area was known as Sudhanagara and was described by the Chinese traveller Huen Tsang. Sudhanagara later came to be recognized as Kalsi. Edicts of Ashoka have been found in the region along the banks of river Yamuna in Kalsi indicating the wealth and importance of the region in ancient India. In the neighboring region of Haripur, ruins were discovered from the time of King Rasala which also reflects the region's prosperity. Before the name of Dehradun was used, the place is shown on old maps as Gurudwara (a map by Webb, 1808) or Gooroodwara (a map by Gerard, 1818). Gerard's map names the place as "Dehra or Gooroodwara". Surrounding this original Sikh temple were many small villages that are now the names of parts of the modern city.

169. Dehradun itself derives its name from the historical fact that Ram Rai, the eldest son of the Seventh Sikh Guru Har Rai, set up his "Dera" (camp) in "dun" (valley) in 1676. This 'Dera Dun' later on became Dehradun.

170. The Mughal Emperor Aurangzeb was highly impressed by the miraculous powers of charismatic Ram Rai. He asked the contemporary Maharaja of Garhwal, Fateh Shah to extend all possible help to Ram Rai. Initially a Gurudwara (temple) was built in Dhamawala. The construction of the present building of Darbar Shri Guru Ram Rai Ji Maharaj was completed in 1707. There are portraits of gods, goddesses, saints, sages and religious stories on the walls. There are pictures of flowers and leaves, animals and birds, trees, similar faces with pointed noses and big eyes on the arches which are the symbol of the colour scheme of Kangra-Guler art and Mughal art. High minarets and round pinnacles are the models of the Muslim architecture. The huge pond in the front measuring 230 x 80 feet had dried up for want of water over the years. People had been dumping rubbish; it has been renovated and revived.

171. Dehradun was invaded by Mahmud of Ghazni during his campaigns into India followed by Timur in 1368, Rohilla chief Najib ad-Dawlah in 1757 and Ghulam Qadir in 1785. In 1806 Nepalese King Prithvi Narayan Shah united many of the Indian territories that now fell under places such as Almora, Pathankot, Kumaon, Garhwal, Sirmur, Shimla, Kangra and Dehradun.

172. On the western front Garhwal and parts of Himachal Pradesh up to Punjab and on the eastern front the state of Sikkim up to Darjeeling became parts of Nepal for a brief period until the British East India Company went on war from 1814 to 1816. The war ended with signing of the Treaty of Sugowli where almost a third was ceded to British East India Company. The British got Dehradun in 1816 and colonised Landour and Mussoorie in 1827–1828.

173. Post-independence Dehradun and other parts of Garhwal and Kumaon were merged with United Provinces which was later renamed the state of Uttar Pradesh. In 2000, Uttarakhand state (earlier called Uttaranchal) was created from the northwestern districts of Uttar Pradesh under the Uttar Pradesh Re-organization Act 2000. Dehradun was made its interim capital.

174. **Culture and Tourism.** After becoming the capital, there has been continuous growth in education, communication and transport. As the state capital, Dehradun is home to many governments institutions. Dehradun is one of the oldest cities in the country and therefore, it is highly rich in culture and heritage. Even amidst all the technology and modernization, the locals of Dehradun are loyal to their traditions, and at every occasion or festival, they proactively take

part in all the celebrations. Since Dehradun is a major part of the Garhwal Region, the city is greatly influenced by the Garhwali Culture.

175. Dehradun has been home to artists and writers including Stephen Alter, Nayantara Sahgal, Allan Sealy, Ruskin Bond and also to country singer Cash. Dehradun was home to freedom fighters whose names are engraved in gold on the Clock Tower. It was called "The Gray City" in the initial days because ex-Army officers and VIPs considered this place ideal for residence after retirement.

176. Woolen blankets are typical of this region and worn by people living at high altitude. The traditional dresses of Dehradun are colorful and vibrant. Women's' traditional costume usually includes Bandhani, Ghagra Choli, Lehengas, Sarongs, Burkhas, Sarees and Long Skirts along with angora jackets while men usually wear Dhoti, Lungi, Kurta Pajamas and Turbans. In villages and to a lesser extent in towns, men wear the traditional dhoti, angarakha and langoti. The way dhotis are worn represents backgrounds and castes: short dhotis represent low status whereas long dhotis represent high. It is more common in urban areas for men to wear shirts and trousers, jeans and kurta-pyjamas. Hemp is grown in great quantities in this region, so its yarn is frequently used as lining.

177. There are fairs (melas) throughout the year. Notable fairs include Magh Mela, held on 14 January and Jhanda Mela in March, a fair for the Hindu community, that attracts Hindus from all over India and abroad. Some of the famous fairs and festivals in Dehradun are Magh Mela, Jhanda Fair, Tapkeshwar Mela, Laxman Sidhha Fair, Bissu Fair, Mahasu Devta's Fair, Saheed Veer Kesri Chandra Fair, Hanol Mela and Shivratri Fair

178. Dehradun, the headquarters of the district is visited by a large number of tourist every year, many of them enroute to Mussoorie. There are a number of places worth-seeing in Dehradun and its surroundings in terms of their tourism attractions such as Gurudwara temple, Sahastradhara, Robbers Cave, Dakpatthar, Tapkeshwari Mahadeo temple, Malsi Deer Park, Raipur spring, etc. Kalsi is an archaeological site situated close to River Yamuna on the way from Dehradun to the hill station of Chakrata.

179. Rajaji National Park is situated at the edge of the sprawling Dehradun valley, was founded in 1966 and spreads over an area of about 820 sq. km. Nestled in a lush valley of the Sivalik Range, the park is an ideal holiday resort with its many picnic spots and excursion sites for the nature lover. Rajaji National Park is one of the most famous national parks of India.

E. Environmental Settings of Investment Program Component Sites

180. Subproject components are located in immediate surroundings of Dehradun town which were converted into urban/semi-urban use for many years ago, and there is no natural habitat left at the proposed sites. All the existing infrastructure facilities are located in Banjarawala and Mothorowala areas located in southern part of newly expanded Zone 7 of Dehradun which consists of Kedarpur, Banjarawala and Mothrowala wards. The proposed subproject area (part of ward number 85 of Mothorowala and ward no 83 of Kedarpur) is an urban area and there are no protected or sensitive environmental areas such as forests, wildlife sanctuaries, wetlands or archeologically protected areas.

181. The proposed project will optimally utilize the groundwater sources. Due to nature of components, the existing infrastructure components do not fall under the ambit of any

environmental related regulations, and therefore there is no requirement of environmental permissions or clearances. No. AC pipes are there in the existing facilities which may create hazardous conditions for the workers and surrounding community.

182. None of the project components are falling within protected or forest areas and no wildlife has been reported within the proposed service area. There are no eco-sensitive or protected areas within proposed project activity areas of Package 2 comprising part of Municipal ward numbers 83 and 85. The closest protected areas are Rajaji National Park situated within 5 km and New Forest Campus within 10 km radial distances from the proposed centrally located tube well and OHT in Mothorowala site (co-ordinates: 30°16'03.83"N; 78°02'02.21"E). This is based on the screening conducted using the Integrated Biodiversity Assessment Tool (IBAT). Other key biodiversity areas, Asan Barrage, Binog Sanctuary- Bhadraj- Jharipani, Jhilmil Jheel Conservation Reserve, Kalesar Wildlife Sanctuary and Simbalbara National Park, are found within 50 km radial distance (Appendix 7). Therefore, the project will pose no risk or impact on biodiversity and natural resources. The subproject components also do not fall within the ambit of Doon Valley Notification."

183. Site environmental features of all subproject sites and photographs are presented in the following Table 27.

Table 27: Site Environmental Features

Sr. No	Subproject component	Environmental Features of the Site	Photographs
Sewerage Works			
1	**Sewer Network**	Sewerage system under Package 2 will be provided in parts of ward number 83 and 85, that are newly added areas of Dehradun Nagar Nigam and cater to an estimated population of 29860 for the ultimate design year 2051 Sewage collected from service area of Package 2 will be carried to proposed sewerage treatment plant (STP) based on SBR technology in Indrapuri Farm, Daudwala of Mothrowala ward which is proposed to be constructed under Banjarawala Package 1. The wastewater collection system will mainly rely on gravity pipes and will discharge into the STP Laying of about 45 km sewer pipes, including 44.00 km of high-density polyethylene (HDPE) pipe with diameter ranging from 225 to 355 mm and around 1 km of DI-K7 pipe of diameter varying from 350 to 700 mm diameter are proposed within the boundaries (RoW) of government roads and are assessed to not have any involuntary land acquisition impact. The roads through which the trunk sewer pipelines will be laid are under the ownership of Public Works Department (PWD) and the sewer network under Dehradun Nagar Nigam (DNN). Sewer pipes will be laid at a depth of 1 to 6m respectively as per topography. In the areas of water body crossing, main road crossings or deep cuttings (above 6-7 m depth), the sewers (around 3.5km) will be laid by trenchless method. There are no environmentally, archeologically sensitive or protected areas along the proposed sewer network alignment as per the preliminary design. There are no	 **Mothrowala Road** **Link road to Neelkanth Colony**

Sr. No	Subproject component	Environmental Features of the Site	Photographs
		notable or significant archeological places or protected monuments or areas in and around project area. No tree cutting will be required as per preliminary design. During laying of pipeline, due to loss of access, temporary livelihood loss to roadside vendors, Kiosks, is envisaged. Transect walks conducted (for the preparation of resettlement plan) along the proposed alignment have confirmed that no commercial establishments, permanent shops along the route will be impacted.	 **Doon University Road** **Ramkrishna Colony**
Water supply			

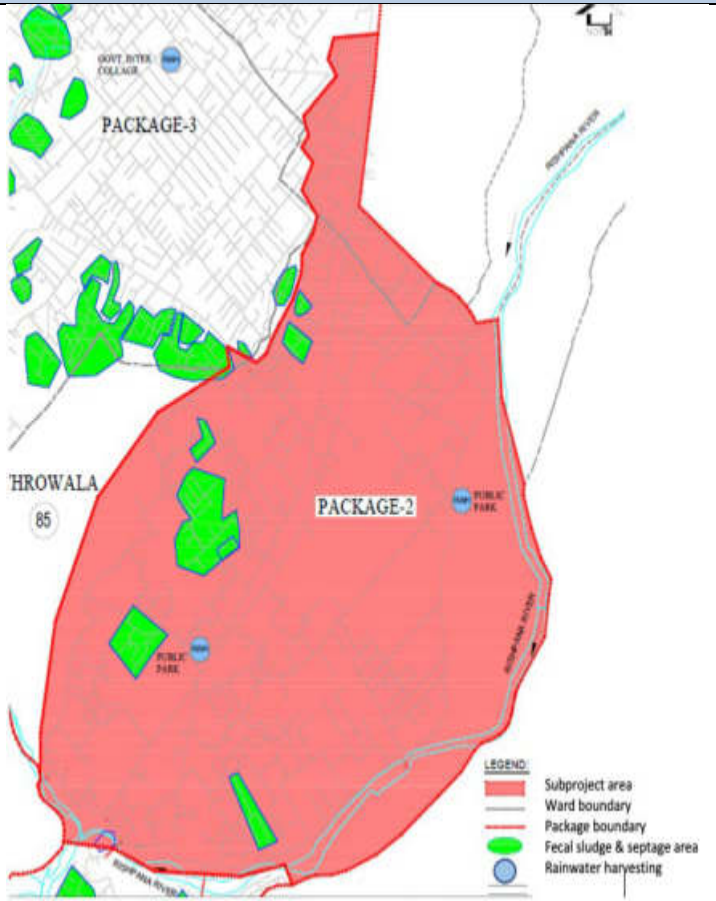
Sr. No	Subproject component	Environmental Features of the Site	Photographs
2	**Construction of Two Overhead Tanks (OHTs) and Three Deep Tube wells and Pumping stations**	Construction of 800 kilo liter (kl) OHT near Punjab National Bank (PNB) automated teller machine (ATM) at Mothrowala will be done at an existing OHT (of 250 kl capacity) location. The old OHT will be dismantled and the new 800 kl OHT will be constructed; no additional impact on structures is anticipated at the site. The land is under ownership of Uttarakhand Jal Sansthan (UJS). The other 650 kl OHT will be constructed at Geetanjali Enclave; the proposed land for the OHT is under the ownership of Dehradun Nagar Nigam (DNN). The land parcel identified for OHT at Geetanjali Enclave is vacant and free of encumbrances. Three deep tube wells with pumping arrangements will be installed as water source. The tube wells will be installed at same locations where the two new OHTs will be constructed (1500 lpm near PNB ATM at Mothorowala and 100 lpm at Geetanjali Enclave) and at the existing OHT location at Mothrowala near Nagar Nigam office. As mentioned, that land is under the ownership of UJS and DNN, no land will be acquired for the installation of tube wells at all three locations and no structures will be impacted at PNB ATM and Mothrowala location, The proposed water supply subproject area Package 2 of Banjarawala in Dehradhun falls in the Raipur block. Raipur block is categorized as **SAFE** as per the categorization adopted by the CGWB. 'Safe' area in terms of categorisation leaving a large scope for further development of the resource for domestic, industrial, agricultural and other uses. Due to past development of ground water extraction for water supply projects by Unit is estimated that the bore well depths should be considered in range of 180 to 200m to enhance quality of extracted ground water.	 **Near PNB ATM at Mothrowala** {Existing OHT to be demolished and new TW and OHT to be constructed} **Geetanjali Enclave** { New OHT and TW to be constructed}

Sr. No	Subproject component	Environmental Features of the Site	Photographs
		All the land parcels are flat and not under any productive use. No sensitive receptor or habitation exists closer/within the proposed site and no tree cutting will be required. No wild life has been reported in and around the site. Measures should be taken as per Construction and Demolition Management Rules, 2016 for safety during demolition works and safe disposal of demolished materials.	 **Mothrowala near Nagar Nigam office** {New TW to be constructed and existing OHT to be retained}
3	**Water supply Transmission and distribution network** .	New water supply pipelines of total length 60 km will be laid in the entire project area (59 km ductile iron pipe Class K7 (DI-K7) and 1 km DI-K9 pipes with diameter ranging from 100 mm to 450 mm) and new house connections will be provided from the transmission mains. The new service connections shall replace the old service connections at the entry point to the houses. Water supply pipes will be laid at a depth of 1m as per topography. Water supply pipelines will be laid within the RoW of Dehradun Nagar Nigam (DNN) and PWD roads Therefore, no impacts shall be envisaged on structures (temporary or permanent) and CPRs. No sensitive areas in or near the alignment in the stretches where Transmission main/feeder main and distribution network lines are proposed. Advance permissions from concerned authorities will be required for road cutting and traffic diversion. No environmentally sensitive areas in or near the	 **Tehri Nagar**

Sr. No	Subproject component	Environmental Features of the Site	Photographs
		alignment in the stretches where Rising main and distribution network lines are proposed. No tree cutting will be required as per preliminary design. No wild life has been reported within the proposed service area. There is no notable or significant archeological places or protected monuments or areas in and around project area In the entire project area, Most of the existing pipelines shall be left buried as it is. If the existing water pipes are in the same lining of new water supply pipes, the contractor through a detailed survey will establish the requirement of old pipes removal for giving way to new pipelines. Those pipes shall be removed and disposed in a controlled manner so as not to harm the environment. No. AC pipes are there in the existing facilities which may create hazardous conditions for the workers and surrounding community.	 **Dhaba Cant. road** **Shivam Vihar**

Sr. No	Subproject component	Environmental Features of the Site	Photographs
			Shakti Vihar
Storm water Drainage System			
4	**Storm water Drains and Outfalls**	Storm water drains will be constructed of total length 30 km on both sides of the existing roads. Drains will be constructed within RoW of public roads under the ownership of Nagar Nigam. Construction of drains is part of the road reconstruction work, making the sides of road in slope to accommodate rain flowing down to the existing drainage systems. This will prevent the erosion of top surface of road during monsoon. A total of 18 outfalls have been envisaged in the project area. Outfall structures shall be constructed at the end of storm water drains that discharge to nallah/river and major water body to reduce the velocity and prevent erosion. All these *nalas* or drains ultimately join Ripsana River which in turn joins River Ganga. It shall be ensured that outfall structure invert level shall be above HFL of the receiving water body. As the storm water drains will be constructed on the same roads, where sewer pipelines will be laid, it is envisaged that there will be no impact on existing environmental condition.	 **Nala in Mothrowala area** **Nala in Banjarawala -Mothrowala Area** **Discharge at Bindal River**

Sr. No	Subproject component	Environmental Features of the Site	Photographs
			Drainage Outfall Point at Bajarawala Area

Sr. No	Subproject component	Environmental Features of the Site	Photographs
5	**Groundwater Recharge pits and Rainwater Harvesting Structures**	Two rainwater harvesting structures have been proposed to be constructed at two public parks that are under the ownership of DNN and 10 sq.m area is required for each structure. 1. Near Veer Sahid Park, Mothrowala Road (N 15.958, E 1.945) 2. Public Park, Doon University Road (N 16.249, E 2.614) A total of 10 groundwater recharge pits along the primary and secondary existing natural drainage channels will be created and 05 sq.m area is required for each recharge pits. UUSDA will obtain NOCs from Nagar Nigam Dehradun for construction of groundwater recharge pits and rainwater harvesting structures. Rainwater harvesting is the technique of collection and storage of rainwater at surface or in sub-surface aquifers, before it is lost as surface run-off. The augmented resource can be harvested in the time of need. Artificial recharge is substantially beneficial, as this will help store the surplus rainwater in the form of ground water and in turn arrest the decline of water level and degradation of the quality. All the same it is ecofriendly.	 **Septage Management Area and Rainwater Harvesting Structures**
6	**Fecal Sludge and Septage Management (FSSM) System**	A FSSM system will be provided to collect fecal sludge and septage in low lying and/or low dense areas e.g. Dandi Village, Vishnupuram Colony, Shvkunj Colony and Mahalakshmi Pruam Colony that are not techno-	

Sr. No	Subproject component	Environmental Features of the Site	Photographs
		economically feasible to connect to sewerage system.. The collected Septage from Banjarawala (Package-1, 2 & 3) will be transported to 68 MLD Kargi STP which is equipped with septage co-treatment facility, At present, the Kargi STP is under utilized receiving only 12 to 15 MLD sewage against the 68 MLD design capacity and only 130 KLD of FSS is presently being disposed at Kargi STP for treatment (NIUA 2021). The location for proposed community-based septic tanks and soak pits will be decided during the detailed engineering design based on the results of topography surveys and consumer survey depending upon the households and population in the area during SIP by the contractor. Specific septic tank locations should be selected based on careful consideration on possible contamination of groundwater and surfacewater sources, odors, and other possible negative impacts on the environment and the relevant communities. Septage from the septic tanks will be regularly removed using trunks/sewer suction machines.	

VI. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Introduction

184. 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.

185. 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) **Pre-Construction Impacts** include impacts which are anticipated during construction works but planning are required for proposed mitigation measures before start of construction works i.e. during SIP period such as taking consents from various departments, planning for construction and workers camps, deployment of safety officer, arrangement of required barricades and caution boards etc.
(iv) **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.
(v) **Operation and maintenance (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.

186. 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).

187. 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.

188. The ADB Rapid Environmental Assessment Checklists for water supply, sewerage works and storm water drainage system have been used to screen the project for environmental impacts and to determine the scope of the IEE.

189. In the case of this project (i) most of the individual elements are relatively small and involve straightforward construction and operation, so impacts will be mainly localized and not greatly significant; (ii) negative impacts associated with sewage facilities such as odour treated wastewater discharge are already considered in design / siting of facilities, (iii) most of the predicted impacts are associated with the construction process, and are produced because that process is invasive, involving excavation and earth movements; and (iv) mostly being located in the built-up area of

Dehradun town/ 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. However, NOC is required for some identified locations from concerned authority. No works are proposed in the forest and designated protected areas.

B. Impacts – Design and Location

1. Location impact

190. **Location of Septic Tanks and Soak Pits**. **I**n areas which are not feasible to provide sewerage system due to techno-economic reasons, it is proposed to provide fecal sludge and septage management system, where in which sewage collected and partially treated on site in septic tanks, and the accumulated septage will be collected, and transported to STPs for further treatement and safe disposal. In the existing condition, septic tanks are not available for all the households, and therefore it is proposed to small construct septic tanks with soak pits in the areas to be served by FSSM. Septic tanks are proposed for individual households (one for 5 and 10 users), and at community-level (one for 20/50/100 households). At this preliminary design stage, the requirement in this subproject area is estimated as 9 (Base Year, 2021), 15 (Intermediate Year, 2036) and 23 (Ultimate year, 2051). The location for proposed septic tanks and soak pits will be decided as per topography and community survey depending upon the households and population in the area during detailed design by the contractor. Effluent from the septic tank will be discharged into a soak pit for further treatment and percolation into ground. The accumulated bottom solids (sludge/septage) will be collected and sent to STPs for further treatment and disposal.

191. Septic systems if not located, designed, constructed and operate properly may lead to pollution of ground and surface waters, soil, may generate odours, create nuisance and unhealthy conditions. Septic tanks produce gases such as methane, hydrogen sulphide, carbon dioxide, sulphur dioxide, ammonia, nitrogen etc., some of which produce bad odours, and may cause serious illness, and in some situations, can be explosive. Following location and design related measures are suggested:

(i) Avoid locating septic tanks very close to the houses (maintain at least 3 m in case of individual tanks, and 10 m in case of community septic tanks)
(ii) Ensure that tank is located in such a way that it is connected to house outlet via a straight sewer (i.e. avoid bends)
(iii) Locate septic tank in such a way that it is accessible and near to access road for empying, puming and cleaning purposes
(iv) Ensure adequate space for soak pit;
(v) locate soak pit (i) in the downstream of septic tank, (ii) at least 15 m away from water source (wells, hand pumps, water bodies, etc.,); additional distance may be required if the ground is rocky and fissures could take the outflow further (iii) at least 5 m from the nearest building, (iv) avoid areas where rainwater would stand or flow over the tank or vehicles could drive over it, and (v) groundwater is not shallow below the ground (not less than 5 m)

192. Specific septic tank and soak pit locations and technical specifications will be identified and confirmed during the detailed engineering design with careful consideration on possible contamination of groundwater and surface water sources, odors, and other possible negative impacts on the environment and the relevant communities.

193. **Location of Tube wells and OHTs:** Tube wells and OHTs are proposed in the existing Tube well /OHT locations of UJN under the ownership of Nagar Nigam Dehradun. They are away from houses, shops or any other premises used by people, thus establishing a buffer to reduce the effects of noise, dust and the visual appearance of the site. Only shrubs and bushes are present at sites and therefore no tree cutting will be required during construction of tube wells/OHTs as per preliminary design. No wildlife is reported at from the sites.

194. **Social and Cultural Resources.** There are no notable or significant archeological places or protected monuments or areas in and around project area. Therefore, no impacts envisaged but risk of uncovering archeological remains, given the long history of town, during the excavations cannot be ruled out completely. Construction contractors therefore should follow the below measures in conducting any excavation work:

(i) Create awareness among the workers, supervisors and engineers about the chance finds during excavation work;
(ii) Stop work immediately to allow further investigation if any finds are suspected;
(iii) Inform local Archeological Department / Museum office if a find is suspected and take any action, they require to ensure its removal or protection in situ
(iv) Prepare a chance find protocol (sample is provided in Appendix 10).

195. **Tree cutting at project sites**. In the proposed Tube well & OHT sites no notable tree cover or vegetation is present, hence no trees cuttings are required for construction as per the preliminary design. Water supply /Sewer pipelines and storm water drains will be laid in the vacant spaces adjacent to the roads within road right of way. In narrow roads, where there is no vacant RoW, the sewer pipeline will be buried at the middle of the road. There are no notable trees in the alignment; therefore, no tree cutting is envisaged in the preliminary design phase. Following measures need to be implemented to minimize and/or compensate for the loss of tree cover:

(i) Minimize removal of trees by adopting to site condition and with appropriate layout design
(ii) Obtain prior permission for tree cutting at sites that may require tree cutting finalized during detailed design
(iii) Plant and maintain 3 trees for each tree that is felled. as per UUSDA policy

196. A CRVA study is being done for the project and its recommendations shall be included in the updated IEE.

2. Design impacts

197. **Design of the proposed components.** The Central Public Health and Environmental Engineering Organization (CPHEEO) manual suggests a design period of 15/30 years in general while designing the systems for sewerage components. It is proposed to consider 2051 as the design year for all the components in order to maintain unanimity in the design period and design population. Accordingly, 2021 shall be the base year and 2036 the intermediate year to cross check the designs pertaining to intermediate demand. The rate of water supply has been taken as 135 lpcd for 100% population. Sewage generation is 82% of water supply (including 2% to account for infiltration). Technical design of all the elements of water supply tube wells, OHTs, pumping, transmission and distribution system etc.), and sewerage (sewer mains and network including manholes and house connections, etc., follows the relevant national planning and design guidelines.

198. Following environmental considerations has been included in the project to avoid and/or minimize adverse impacts and enhance positive benefits:

(i) Locating components and facilities appropriately by avoiding sensitive locations like forests and protected areas (environmentally, socially, and archeologically).
(ii) Recovering wash water from treatment process to optimise the water use
(iii) Treatment and reuse of sludge from treatment process; providing a covered shed of adequate space to air dry the processed sludge for at least 15 days at STPs
(iv) Designing the entire system to maintain optimal flow and terminal pressure, and optimising the overall energy usage
(v) Avoiding usage of asbestos containing materials
(vi) Reducing the incidence of water borne diseases by providing 100% population including urban poor with improved sanitation facility
(vii) Reuse of treated wastewater from STP for non-potable uses thereby reducing the load in freshwater resources
(viii) Adopting a combined approach of sewerage system and fecal sludge and septage management to cover 100% population of the project area with safe collection, conveyance and treatment of sewage generated in the town
(ix) Provision of appropriate personal protection equipment to the workers and staff

199. **Water Source Sustainability.** Based on proposed water supply rate of 135 lpcd for service area of Banjarawala Package 2, the total raw water demand is estimated as 1.45 MLD (base year 2021), 2.66 MLD (intermediate year 2031) and 3.87 MLD (ultimate design year 2051). Installation of three deep tube wells with 1000 liters per minute (lpm), 1500 lpm and 1500 lpm capacity are considered as source of water supply.

200. **Abstraction and Sustainability**. The water supply service area under this package is part of ward number 85 (Mothorwala ward). Currently, there is existing water supply in the area but its pipeline network (CI, GI and PVC) is more than 25 years old with the average supply level of around 110 lpcd for 4 to 6 hours per day, not meeting the performance standard. The source of existing water supply system is ground water. Ground water is being extracted through three tube wells. There are three associated pump houses and three existing overhead tanks having 250 kl, 900 kl and 1000 kl capacity.

201. There are six developmental blocks in District Dehradun. Two blocks (Chakrata and Kalsi) fall in mountainous terrain where the slopes are high and water resources are not estimated for these blocks. Water Resources are estimated, using Groundwater Estimation Committee (GEC)1997 methodology, for Raipur, Doiwala, Sahaspur and Vikas Nagar blocks as the topography is by and large plain, in these blocks. The block areas are divided into command and non-command. Draft for all uses and recharge from all sources are calculated for command and non-command areas. The stage of groundwater development, for command area, ranges from 53.78 to 78.34% while it ranges from 19.23 to 51.23% for non-command areas. All the four blocks are categorized as Safe.

202. The proposed water supply service area Package 2 of Dehradhun falls in the Raipur block. In Raipur Block the estimated Net Annual Groundwater Availability is 20.37 MCM for command area while for non-command area it is 255.86 MCM. The total utilization for all uses is estimated as 12.57 MCM with stage of development at 61.70% for command area and 78.82 MCM with stage of development at 30.80% for non-command area of Raipur block.

203. Raipur block is categorized as **SAFE** as per the categorization adopted by the CGWB. 'Safe' area in terms of categorisation leaving a large scope for further development of the resource for domestic, industrial, agricultural and other uses. However, this large scope may give rise to over exploitation of the resources, in case its development is not planned properly in a scientific way.

204. According to CGWB, Groundwater is developed mainly through tube wells and India mark-II hand pumps. Jal Sansthan, Jal Nigam and Irrigation departments have constructed a number of tube wells in Dehradhun district to meet the domestic and irrigational requirements. In hilly areas, springs and gadheras form the main sources of drinking water. The depth of the tube wells, constructed in Doon Valley, range in depth from 50 to 150 m bgl whereas the discharge ranges from 500 to 1500 lpm. Urban water supply is mainly through tube well whereas the rural domestic water supply is through India Mark-II hand pumps, guls, springs and tube wells.

205. **The Uttarakhand Pey Jal Nigam** is responsible for construction of tube wells in the state to cater to the needs of drinking water in urban and rural areas. The subsurface strata charts of the tube wells indicate that the horizons comprising of gravel, boulder, clays, sand and pebbles were formed either individually or in different combinations.

206. The subsurface strata charts obtained from **Uttarakhand Pey Jal Nigam** also indicate that the horizons comprising of boulders and gravels set in coarse sandy matrix are the main aquifer zones. These horizons are found more than once as one goes into the depth. The water bearing horizons are separated by the clay horizons having few small pebbles and gravels which mostly act as aquicludes. The aquifers occur at about 20 m below the ground level to as deep as more than 100 m as there are evidences of encountering multiple aquifer zones.

207. The perusal, of strata charts, also indicates that there are about 9 to 18 horizons at each location. There are instances about repetitions of horizons at different depths. The yields of the wells mostly depend on the thickness of the aquifer zones. Although the aquifers are encountered at shallow depths, the tube wells constructed for drinking and irrigation purposes have gone as deeper as more than 100 m to tap the multiple aquifer zones to obtain better yields.

208. Holistically, it is observed that the depth of tube wells is ranging from 70 m to 180 m deep. Though aquifer zones are encountered at shallow depth (40m), in 90% of cases, deeper wells are being drilled to tap as many water bearing zones as possible to enjoy sustaining yields and long pumping hours @20 hours per day. The average diameter of tube wells constructed by Jal Nigam is 8 – 10". Most of the wells have very high yields ranging from 400 LPM to 3000 LPM.

209. **A case study from project area.** The existing water supply system in Dehradun city, which is more than 30 years old, consists of three sub systems viz. North zone, South zone and Pithuwala zone. The North zone is supplied mostly with surface water sources, and south (where subproject is located) and Pithuwala zones are supplied with ground water from tube wells located at various places in the city. All water supply scheme of the city is implemented by Uttarakhand Pey Jal Nigam (UPJN) and maintained by Uttarakhand Jal Sansthan (UJS). During enquiry from various organizations including UPJN/UJS, it was informed that the ground water table at Dehradun is good and depletion is not a cause of concern as the annual recharging is adequate.

210. There are about 140 tube wells in the urban area of Dehradun city and these tube wells are being used for the drinking water supply to the residents of Dehradun. During the interaction with officials at Jal Sansthan, it was understood that the average depth of these wells ranges between

70 and 120 m and the average yield is about 1500 litres per minute (LPM). The average diameter of tube wells constructed by Jal Sansthan is 8 – 10 inches. As per the available information, the cumulative discharge of the above tube wells is 185 million liters per day (MLD).

211. **A hydrogeological investigation** was carried out for constructing a tube well at Mothronwala, Dehradun district, for Uttarakhand Jal Sansthan (UJS) which is about 2.5 km from the proposed Tube well site near Nagar Nigam office at Mothorowala. (Ward 85) shows that Groundwater occurs under unconfined condition and water levels are generally in the range of 25 to 30 m below ground level in the area. Groundwater development in and around the study area is moderately low. The aquifers are composed mainly of sand, gravel and boulder.

212. A tube well was drilled down to a depth of 130 m and saturated water bearing horizons from 57-60, 75-87 91-96 and 119-123 were tapped for the construction of a production well. The Static Water Level of this tube well was measured to be 28.5 m and the discharge of the ground water abstraction structure is measured to be 2000 lpm for a moderate drawdown. It can be concluded that tube well constructed to the recommended depth of 130m will give a sustainable discharge of 1500 to 1800 iters per minutes (lpm) to enjoy sustaining yields and long pumping hours @20 hours per day. The average diameter of tube wells constructed by Jal Nigam is 8 – 10". Ground water quality in the area is reported chemically suitable for drinking purposes.

213. During the detailed design, the contractor will conduct confirmatory site-specific groundwater studies/surveys and confirm the sustainability of proposed tube well sources. No objection certificate (NOC) from CGWB for groundwater withdrawal shall be obtained by the UUSDA before award of contract/before start of construction. Recommendations, if any, of CGWB shall be included in the EMP and will be implemented.

214. Given the climate change effects, the rainfall is becoming more erratic and unpredictable, combined with increasing frequency of extreme weather events. The project should therefore account for these. To ensure groundwater sustainability, the following measures should therefore be implemented during the implementation:

(i) Prepare a groundwater harvesting and artificial recharge plan;
(ii) Creation of artificial recharge pits in public places / public buildings. Local body can issue a notification to this effect.
(iii) Household level artificial recharge (like roof top rainwater harvesting) should be encouraged.
(iv) Groundwater regulation – options to close / discontinue all the tube wells in houses used for domestic purposes in service area in a phased manner once the project is implemented.

215. **Groundwater Quality**. As per CGWB report (2011), seventy four water samples were collected by CGWB from different groundwater structures located in District Dehradun. The samples were got analyzed for their electrical conductivity (EC), pH, calcium, magnesium, carbonate and bicarbonate. The groundwater is suitable for domestic and irrigation purposes, in respect of these parameters.

216. In any case, the DBO contractor must ensure that supplied water to the household meets the drinking water standards, and if any additional / specific treatment (such as defluorination or softening) required, it must be included in the treatment process. As there is no sewerage system at present, groundwater is at risk of contamination due to discharge of untreated wastewater. Open defecation is not uncommon, and indiscriminate solid waste disposal is prevalent. The sewerage

system being developed under the project will prevent the untreated sewage flow in open drains. A source protection plan shall be prepared to avoid source contamination at tube wells.

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  (i) Prepare a source protection plan for tube wells
  (ii) Prevent flow of untreated wastewater in the drains
  (iii) Ensure proper construction of tube wells including casing pipes to prevent water contamination from well spaces, and due to flooding
  (iv) Measures should be taken to control the open defecation, and to close all unsafe latrines (for example pit latrines).
  (v) A cement seal between ground level and 5 m below land surface may be provided to avoid surface contamination to the ground water.
  (vi) The tube well should be developed with air compressor followed by pump till the water becomes sand / silt free.
  (vii) Awareness programs shall be conducted regarding the sanitation practices and its effect on groundwater quality

217. **Use of Hazardous/Harmful substances in Water Treatment.** Water treatment may involve application hazardous/harmful chemicals such as in chlorination, disinfection etc. Measures are required to reduce the usage as well the handle if any hazardous substances safely following prevailing rules and regulations. For disinfection, the bid specifies, however, the use of Chlorine as disinfectant. Groundwater from the tube well will be directly pumped to OHTs and water will be chlorinated prior to distribution. There is invariably a safety risk when chlorine is handled. Safety precautions are necessary to ensure the safety of workers and citizens. Following measures are suggested:

(i) Reduce the use of chemicals in the treatment process to the extent possible provide non-chemical alternatives or easily recoverable and/or reusable chemicals or biocompatible alternatives
(ii) Establish proper handling / storage / application system according to the relevant standards, safety precautions and prevent accidental release / spill
(iii) Provide leak/spill detection, collection / capture and safe disposal facilities such as chlorine absorption and neutralization facility
(iv) Provide ventilation, lighting, entry and exit facilities; visible and audible alarm facilities to alert chemical/chlorine leak
(v) Facility for isolation in the event of major leakages
(vi) Eye wash and shower facility
(vii) Personal protection and safety equipment for the operators (masks, oxygen cylinders, gloves, etc.,)
(viii) Provide training to the staff in safe handling and application of chemicals, material safety, and standard operating procedures and emergency responses
(ix) Develop emergency response procedures

218. **Mixing of industrial effluent in wastewater.** One of the critical aspects in sewerage system operation is, change in raw sewage characteristics at inlet of sewage treatment plant may affect the process and output quality. STP is designed for municipal wastewater, which does not include industrial effluent. Characteristics of industrial effluent widely vary depending on the type of industry, and therefore disposal of effluent into sewers may greatly vary the inlet quality at STP and will upset process and affect the efficiency. Mixing of industrial effluent will severely deteriorate the quality of treated wastewater, and therefore the proposed reuse plan. Reuse of such water may

have significant impact on public health, and on land and water. Following measures should be incorporated to safeguard the sewerage system and the intended reuse:

(i) No industrial wastewater shall be allowed to dispose into municipal sewers
(ii) As there is a risk of potential mixing of industrial waste, no domestic wastewater from industrial units shall be allowed into municipal sewers
(iii) Ensure that there is no illegal discharge through manholes or inspection chambers
(iv) Conduct public awareness programs in coordination with UEPPCB and Dehradun Nagar Nigam
(v) Conduct regular wastewater quality monitoring (at inlet and at outlet of STP) to ensure that the treated wastewater quality complies with the effluent standards

219. **Sewer system – collection and conveyance.** The sewerage system is designed as a separate system of sewage collection (i.e., caters only to domestic wastewater). The underground gravity sewers will carry sewage from households to trunk sewers and further to the sewerage treatment plant (STP) in Indrapuri Farm, Daudwala of Mothrowala ward which is proposed to be constructed under Package 1.To maximize the benefits as intended, Dehradun Municipality should ensure that all existing septic tanks in service area of Package 2 that are being provided by sewers are phased out by bypassing the inlet and connecting the toilet discharge from each house directly to sewerage system. Accumulation of silt in sewers in areas of low over time, overflows, blockages, power outages, harmful working conditions for the workers cleaning sewers etc. are some of the issues that needs to be critically looked into during the sewer system design. A properly designed system is a must for system sustainability. Measures such as the following shall be included in sewer system design to ensure that the system provides the benefits as intended:

(i) Limit the sewer depth where possible
(ii) Sewers shall be laid away from water supply lines and drains (at least 1 m, wherever possible);
(iii) In all cases, the sewer line should be laid deeper than the water pipeline (the difference between top of the sewer and bottom of water pipeline should be at least 300 mm)
(iv) In unavoidable, where sewers are to be laid close to storm water drains, appropriate pipe material shall be selected (stoneware pipes shall be avoided)
(v) For shallower sewers and especially in narrow roads, use small inspection chambers in lieu of manholes;
(vi) Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replaced if broken to minimize silt/garbage entry
(vii) Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope and gas vents in gravity mains to prevent buildup of solids and hydrogen sulfide generation
(viii) Take necessary precautionary measures to protect sewer network, and to avoid disposal of solid wastes, debris, wastewater into newly laid sewers from the time it is constructed to the start of operation phase

220. **Design of the Storm Water Drainage System.** The design of the storm water drainage system will ensure that only storm water or rainwater will be flowing to the drainage canals once they become operational. The final detailed design will ensure that the following:

(i) Inlets to the drainage system be positioned away from outlets of septic tanks and grey water lines of households or commercial establishments. This will avoid the situation where the drainage system will be used as discharge point of septic and household wastes that could pollute the receiving bodies of water; and

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(ii) Silt traps are integrated in the design to avoid heavy siltation in the drainage system during monsoon season that could eventually affect the receiving bodies of water at the outfalls of the drainage system.

221. The design of the storm water outfalls will ensure the following:

(i) Siltation or sedimentation chambers (or similar structures) be constructed at the outfalls with sizes depending on the peak volume flow. This will avoid heavy siltation and pollution of the receiving body of water;
(ii) Position the outfalls at locations enough to provide space for the construction of siltation or sedimentation chambers (or similar structures);
(iii) Position the outfalls and siltation or sedimentation chambers (or similar structures) at locations that will be accessible for maintenance and cleaning during the operation phase.

222. **Environmental Audit of Existing Water Supply Infrastructure.** It is proposed to utilize existing water supply infrastructure like tube wells (TW), overhead tanks (OHTs), pump houses etc. with necessary improvements. As per the ADB SPS 2009, these are associated facilities and therefore the component operation shall comply with the ADB and applicable environmental laws of India. Besides, ADB SPS lays emphasis on impacts and risks on biodiversity and natural resources, pollution prevention abatement including hazardous waste, occupational health and safety, community health and safety, and physical cultural resources. A random environmental audit is conducted to (i) assess the compliance of the existing infrastructure with environmental legislations and (ii) improve environmental performance to minimize future potential liabilities. The preliminary audit note is given in Appendix 12. A more detailed environmental audit and risk assessment shall be carried out during detailed design stage and incorporated into the final IEE.

223. The proposed water supply subproject area (part of ward number 85 of Mothorowala) is an urban area and there are no protected or sensitive environmental areas such as forests, wildlife sanctuaries or archeologically protected areas. Therefore, there are no risks or impacts on biodiversity and natural resources. The proposed project will optimally utilize the groundwater sources. Due to nature of components, the existing infrastructure components do not fall under the ambit of any environmental related regulations, and therefore there is no requirement of permissions or clearances. No. AC pipes are there in the existing facilities which may create hazardous conditions for the workers and surrounding community. Besides, the generation and disposal of debris and discarded materials, and construction phase health and safety need to be considered and mitigated to comply with the SPS provisions. Following table 28 provides component wise compliances and concerns. Corrective actions for the identified environmental concerns are discussed in the following section.

Table 28: Environmental Audit of Existing Facilities

Infrastructure	Details	Proposed Rehabilitation	Compliance with environmental regulatory framework	Environmental Concerns
Tube wells	**Locations:** 1.TW near PNB ATM [Co-ordinates:	Replacement of pipes, submersible pumps, cables, panels, valves, flow meters and civil structures.	No requirements under existing laws.	Occupational health and safety, public safety during the construction

Infrastructure	Details	Proposed Rehabilitation	Compliance with environmental regulatory framework	Environmental Concerns
	30°16'58.17"N, 78°1'56.87"E (rehabilitation of existing TW of 500 lpm capacity based on requirement) 2.TW near Nagar Nigam office, Mothrowala [Co-ordinates: 30°16'3.83"N, 78°2'2.21"E (rehabilitation of existing TW of 700 lpm capacity based on requirement)	Depth of the tube wells will not be increased. As discussed with Jal Sansthan, the yield from the tube wells at Mothrowala and Banjarawala (Near PNB ATM) was very less, as such; the existing tube wells shall be replaced by new one with increased static head and higher efficiency. Both the existing tube wells will be retained to supply water in the current service areas during construction period. After installation and functioning of new water supply sources (3 nos new tube wells), UJN will take decision about discarding them.		works Disposal of discarded material, debris There are no asbestos containing material/AC pipes noticed
Overhead tanks (OHTs)	The following two existing structures are to be repaired / rehabilitated: 1.Existing overheat tank of 25 KLl near PNB ATM will be dismantled to construct new 800 KL capacity OHT. 2. Overhead tank (1000 kl) near Nagar Nigam office, Mothorwala to be retained and used after refurbishment	▪ Demolition ▪ Civil repairs , rehabilitation, and construction of replacement of pipes, connections, electrical and mechanicals parts as required ▪ Cleaning of OHT	No requirements under existing laws	There are no asbestos containing pipes in existing connections Occupational health and safety, public safety during the construction works Disposal of discarded material, debris

Infrastructure	Details	Proposed Rehabilitation	Compliance with environmental regulatory framework	Environmental Concerns
Pump house	2 pumping stations (near PNB ATM and near Nagar Nigam office, Mothorwala)	Replacement of pumps, motors Civil repairs and rehabilitation, Replacement of pipes, connections, electrical and mechanicals parts as required	No requirements under existing laws	Spillage of oils, lubricants etc., Occupational health and safety, public safety during the construction works Disposal of discarded material, waste oils, mechanical and electrical parts, debris
Transmission and distribution	Currently, there is about 117 km existing water supply in the area but its pipeline network (CI, GI and PVC) is more than 25 years old	In the entire project area, 60 km new water pipelines will be laid and new house service connections will be provided from the newly laid main. Most of the existing pipelines shall be left buried as it is. If the existing water pipes are in the same lining of new water supply pipes, the contractor through a detailed survey will establish the requirement of old pipes removal for giving way to new pipelines. Those pipes shall be removed and disposed in a controlled manner so as not to harm the environment.	No requirements under existing laws	There is no underground AC pipes in distribution lines Accidental disturbance / need to remove in narrow roads Occupational health and safety, public safety during trenching Disposal of old pipes / debris

224. **Corrective Measures.** As presented in the above table, there are no regulatory non-compliance issues in the existing infrastructure. The environmental concerns are mainly related to occupational health and safety, public safety; disposal of debris, discarded materials etc., A work

specific environmental management plan needs to be prepared for these aspects. The exact nature of rehabilitation and repair works will be known only during the detailed design phase as the detailed technical audit will be conducted by the DBO contractor and the required rehabilitation and repair measures will be proposed accordingly.

225. **Fecal Sludge and Septage Management (FSSM).** Septage is the settled solid matter in semi-solid condition usually a mixture of solids and water settled at the bottom of septic tank. It has an offensive odour, appearance and is high in organics and pathogenic microorganisms. A FSSM system will be provided to collect fecal sludge and septage in low lying and/or low dense areas of Package 2, e.g. Dandi Village, Vishnupuram Colony, Shvkunj Colony and Mahalakshmi Pruam Colony that are not techno-economically feasible to connect to sewerage system. This facility is expected to cover a population of 1350 in the base year 2021 and 4450 at the ultimate design year 2051 under Septage management for Banjarawala Package 2. The collected Septage from Banjarawala (Package-1, 2 & 3) will be transported to 68 MLD Kargi STP which is equipped with septage co-treatment facility. At present, the Kargi STP is under utilized receiving only 12 to 15 MLD sewage against the 68 MLD design capacity. Based on the projection of population increase, it has been estimated that the contributing areas of all three Packages (part of wards 83,84 and 85) will generate septage of 1.77 kilo liters per day (KLD), 3.13 KLD & 4.75 KLD during the base (2021), intermediate (2036) & ultimate (2051) years respectively. Contributing area of Package 2 (part of ward nos. 83 and 85) will have 0.44 KLD, 0.82 KLD & 1.46 KLD of septage during the base, Intermediate & ultimate years respectively.

226. Collection of sewage and sullage from individual households will be by 110 mm dia uPVC pipes and conveyance will be through sewers laid on road to community septic tank (150 mm dia UPVC pipe). The location and number of proposed septic tanks and soak pits will be decided during the detailed engineering design based on the results of topography surveys and consumer survey depending upon the households and population in the area during SIP by the contractor. Specific septic tank locations should be selected based on careful consideration on possible contamination of groundwater and surfacewater sources, odors, and other possible negative impacts on the environment and the relevant communities. Septage from the septic tanks will be regularly removed using trunks/sewer suction machines.

227. During the detailed design phase, number of mobile tankers required to collect and transport the septage to 68 MLD Karzi STP, frequency of collection depending on the size of septic tanks etc., will be worked out accordingly. IEE needs to be updated during the detailed design phase to reflect the final project design. Although handling, transportation and disposal into STP is completely mechanized, the system will however be operated by the workers, therefore proper precautions as workers will be dealing with highly harmful septage. Accessibility of septic tanks to mobile suction tankers to collect septage is critical for success of the septage management system. At STP, the septage will be mixed with the sewage and will be co-treated in the STP. Septage will be in concentrated and partially degraded form, and disposal of the same into STP inlet stream may upset the sewage treatment process, may generate bad odours, and may ultimately affect the quality of treated wastewater. Treatment process needs to be properly designed. Following measures are suggested for implementation:

(i) Conduct detailed survey of the households to be covered with FSSM to design the system to suit the local conditions, such as type of septic tanks and their location in the houses
(ii) Create awareness program on the FSSM from collection to treatment system that will be adopted. FSSM-related behavior campaigns will also be implemented as part of

behavior change programs. This will also make the households aware of materials/substances that may kill septic tank bacteria if discharged into drains or flushed down the toilets (refer for guidance - https://www.csrd.bc.ca/sites/default/files/liquid-waste-management/Septic-Smart/Docs/dos-and-donts.pdf)

(iii) Design the sewage treatment process duly considering mixing of septage
(iv) Ensure that the FSSM system is completely mechanized no human touch, even accidentally, from collection at household to discharge into STP, and in periodic cleaning of tankers
(v) Demarcate a proper area for cleaning of mobile tankers in STP premises, and ensure that the wastewater shall be discharged into STP
(vi) Provide proper training to the workers, and staff in safe handling of FSSM tasks, provide all necessary personal protection equipment
(vii) Ensure proper facilities for workers including showers, wash areas, toilets, drinking water, eating and resting places
(viii) Conduct regular health checks
(ix) Prepare Health and Safety Plan for FSSM

228. **Design of Septic tank and Soak Pit. .** The design of Septic tank system must ensure careful consideration on possible contamination of groundwater and surface water sources, odors, and other possible negative impacts on the environment and the relevant communities. The final detailed design will ensure the following:

(i) Ensure septic tank is constructed on a level surface
(ii) Design septic tanks as watertight / water sealed structures with appropriate materials such as reinforced cement concrete
(iii) Ensure adequate room for above the liquid level for scum accumulation, and adequate free board
(iv) Design proper, safe and secured access to septic tank for inspection and cleaning; ensure appropriate size and sealing cover with locking arrnagement, and ensure that it is watertight to account for flooding and/or high-water table conditions
(v) Ensure that septic tank inlet sewers and outlet sewers are watertight
(vi) Design proper gas ventilation systems such as vent pipes appropriately to collect and disperses gases to avoid accumulation and bad odours
(vii) Ensure appropriate design and materials for soak pits to ensure that effluent is adequately treated, absorbed into the soil without contaminating groundwater; ensure that top of the soak is pit is covered properly

229. **Environmental Audit of Existing Sewerage Infrastructure at 68 MLD Kargi STP.** A FSSM system will be provided to collect fecal sludge and septage in low lying and/or low dense areas of Package 2, e.g. Dandi Village, Vishnupuram Colony, Shvkunj Colony and Mahalakshmi Pruam Colony that are not techno-economically feasible to connect to sewerage system. The collected Septage from Banjarawala (Package-1, 2 & 3) will be collected & transported to the 68 MLD Kargi STP equipped with septage co-treatment facility.

230. As per the ADB SPS 2009, this is an associated facility and therefore, the operation shall comply with the ADB and applicable environmental laws of India. Preliminary environmental audit is conducted and attached in Appendix 28 and a summary is provided below:

(i) The existing 68 MLD capacity Kargi STP equipped with septage co-treatment facility was commissioned in October 2015 as a part of ADB loan project [14] under the Uttarakhand Urban Sector Development Investment Program (UUSDIP). Urban Development Department, GoU is the owner of this STP, and Operation and Maintenance (O&M) is done by M/s Gharpure Engineering & Construction (P) Ltd. The Urban Development Department is also the executing agency for this current Banjarawala subproject and UUSDA is the implementing agency.

(ii) At present, the Kargi STP is receiving only 12 to 15 MLD sewage against the 68 MLD design capacity and 130 KLD of FSS which is presently being disposed at Kargi STP for treatment (NIUA, 2021).

(iii) Based on the projection of population increase it has been estimated that the contributing area of Banjarawala Package 1, 2 and 3 (part of wards 83,84 and 85) will generate septage of 1.77 kilo liters per day (KLD), 3.13 KLD & 4.75 KLD during the base (2021), Intermediate (2036) & ultimate (2051) years respectively. Contributing area of Package 2 (part of ward nos. 83 and 85) will have 0.44 KLD, 0.82 KLD & 1.46 KLD of septage during the base, Intermediate & ultimate years respectively. Therefore, the 68 MLD capacity Kargi STP can accommodate the estimated amount septage generated from. of Banjarawala Package 1, 2 and 3 project areas up to design period 2051.

(iv) Due to implementation of proposed septage management programme, utilization of existing STP capacity will be improved. The existing treatment technology, SBR, being an aerobic process and conducted in a compact and a closed system with automated operation, as a result odour nuisance will be very minimal and negligible.

(v) A study conducted by the National Institute of Urban Affairs (NIUA)[15] indicates that the design load capacity of Kargi STP for COD, BOD, and TSS based on a composite sample tested in June 2019 is exceeded during the day (8 am-4 pm), hence co-treatment of septage can be done between 4 pm- 8 am (Appendix 28), after providing a storage facility. Meanwhile, based on 2019-2020 data, only TSS exceeds the design load capacity at the inlet which is 400 mg/L.

(vi) Consent to Establish (CTE) from Uttarakhand Environmental Protection & Pollution Control Board (UEPPCB) has been obtained and renewal of Consent to Operate (CTO) was done in 2019 and is valid up to 31 March 2022 (Ref. Enclosure 1 & 2 of Appendix 28).

(vii) Month-wise treated effluent quality analysis results of Kargi STP (Enclosure 4 of Appendix 28), for the year 2019 and 2020 (upto October) reveal that all outlet water quality parameters, i.e., BOD, pH and TSS are well within the standards prescribed by the UEPPCB per approved CTO. BOD values range from 8.08 to 9.56 mg/L and are below the 30 mg/L standard. Meanwhile, pH values range from 7.54 to 8.23 and also comply with the standard range which is 6.5-9.0. Lastly, TSS, with values from 9.30 to 13.78 mg/L, are well within the 100mg/L standard.

(viii) The outlet water quality results for pH, BOD and TSS are also well within the Effluent Discharge Standards for STP as per National Green Tribunal (NGT) order dated 30.04.2019 (Appendix 4), except for COD values which are almost at the standard level. Outlet water quality values are presented in Appendix 28, in comparison with the UEPPCB and NGT standards.

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[14] ADB. Uttarakhand Urban Sector Development Investment Program-Project 1; and ADB. Uttarakhand Urban Sector Development Investment Program-Tranche 2.

[15] A report on "Co-Treatment of Septage at STPs of Ganga Towns in Uttarakhand" by the National Institute of Urban Affairs (NIUA), 2019

(ix) The treated effluent is being utilized for gardening/green area development within the STP premises, Balance is being discharged into the adjoining Bindal river through a covered drain of about 250 m length as approved under the CTO of UEPPCB (Enclosure 2 of Appendix 28).
(x) The dewatered sludge from centrifuge is currently disposed off to a suitable location within the STP premises for further drying and use as manure. The surplus/excess sludge (if any) is disposing off to Government owned landfill site with a solid waste management plant at Shisambara[16] at about 25 km away.

231. In summary, the existing Kargi STP has sufficient capacity to accept fecal sludge and septage (FSS) from Packages 1, 2 and 3 service areas, and is currently accepting FSS from other areas also. It has all regulatory approvals from UEPPCB, with a CTO valid until 31 March 2022. There are no other legal requirements, and it is compliant with all regulatory requirements. The Kargi STP is functioning, and effluent quality is well within the prescribed CTO standards based on available information. Information on fecal coliform analysis is not available, hence, it is recommended to monitor the said parameter and compare against the prescribed CTO standard. It is also noted that the effluent quality meets the stringent NGT standards. There are no environment related issues/complaints from the community regarding the existing 68 MLD Kargi STP. During the detailed design stage, a detailed assessment will be conducted, and any further improvement required in the treatment or in the facility will be implemented as part of the project.

C. Pre-construction Impacts

232. **Utilities**. Telephone lines, electric poles and wires, water lines within the proposed project locations may require to be shifted in few cases. To mitigate the adverse impacts due to relocation of the utilities, the contractor, in collaboration with Nagar Nigam will:

(i) identify the locations and operators of these utilities to prevent unnecessary disruption of services during construction phase; and
(ii) instruct construction contractors to prepare a contingency plan to include actions to be done in case of unintentional interruption of services
(iii) informing the local community in advance if utilities will be disrupted during construction); and
(iv) Require contractors to prepare spoils management plan and traffic management plan.

233. **Site selection of construction work camps, stockpile areas, storage areas, and disposal areas.** Priority is to locate these near the project location. However, if it is deemed necessary to locate elsewhere, sites to be considered will not promote instability and result in destruction of property, vegetation, irrigation, and drinking water supply systems. Residential areas will not be considered for setting up construction 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 forest areas, water bodies, swamps or in areas which will inconvenience the community.

[16] The Shishambara waste management plant was inaugurated in January 2018 under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) scheme of the central government with an aim to achieve scientific collection, disposal and processing of around 350 metric ton of waste produced in the city every day. Shishambara solid waste management plant on 8.3 hectares in the city and is being implemented on the public private partnership (PPP) mode. The operations at the plant include composting, recycling, Refuse Derived Fuel (RDF) as well as sanitary land fill (SLF). The biggest advantage of the plant is that it is completely covered so there is no chance of any stench going outside.

Construction sites will be selected by DBO contractor in compliance with these conditions and the same will be reflected in Site Environmental Management Plan (SEMP) which is to be prepared by DBO contractor prior to start of construction and approved by PIU. Material stockpiles will be protected by bunds during the monsoon season to prevent silt runoff into drains. The subproject is likely to generate soil from excavations, which needs to be disposed of safely. The following measures should be considered for disposal of surplus and/or waste soil:

(i) The excavated soil should be removed from construction area at the earliest for beneficial reuse such as land raising / filling of excavated areas.
(ii) Soil should be covered with tarpaulin sheets during the transportation.
(iii) Soil transportation should not be done during the peak hours and should avoid narrow and heavy traffic routes and important religious or tourist sites

234. **Site selection of 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. To mitigate the potential environmental impacts, locations of quarry site/s and borrow pit/s (for loose material other than stones) would be assessed by PIU. Priority would be sites already permitted by Mines and Geology Department. If new sites are necessary, these would be located away from population centers, drinking water intakes and streams, cultivable lands, and natural drainage systems; and in structurally stable areas. 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 and Geology and local revenue administration. If additional quarries will be required after construction is started, then the construction contractor shall use the mentioned criteria to select new quarry sites, with written approval of PIU.

D. Construction Impacts

235. The civil works for the subproject include excavation for water supply and sewerage pipelines, construction of Tube wells, OHTs, rainwater harvesting pits & tanks and storm water drains. This work will be confined to sites, and construction will include general activities like site clearance, excavation for foundations, and creation of concrete structures will be one of the major construction activities for this project. Most such structures will be constructed from reinforced concrete (RC), where steel reinforcing rods and bars are placed and attached by hand to create an interior skeleton for the foundations, walls, columns, plinths, etc., and heavy-duty metal and timber/plywood formwork is bolted around the outside to build a mould into which pre-mixed concrete is poured. Once the concrete has set, the formwork is removed, and the concrete surface is finished by masons by hand if necessary. Some buildings, such as the pump station, facilities, etc., may be constructed from brick work, in which case this work will be done using standard house-building techniques. Some components of TSPS and STP may comprise a variety of prefabricated elements which will be are installed on site as ready-made individual units. These will be directly brought from the manufacturers place to the sites lifted into position by crane, affixed to plinths or other installation points, and connected up to pipe work and the electricity supply. Since these works are confined to the boundary of identified sites, there is no direct or significant interference of construction work with the surrounding land use. However, construction dust, noise, use of local roads for transportation of construction material, waste, labour camps etc., will have a negative impact, which needs to be avoided or mitigated properly.

236. Tube wells will be constructed in an enclosed area and drilling will be carried out by deploying a Direct Rotary/Percussion/Dual Rotary Rig, down to a recommended depth below ground level and the borehole may be converted into a production well by tapping all the saturated

granular zone. Once this is created, the rest of the construction will follow the general construction procedures and once the work is over and site is cleared,

237. Subproject also include linear works and will install a total of around 45 km sewer pipes [including 44 km of high-density polyethylene (HDPE) pipe of diameter 225 mm to 355 mm and around 1 km of DI-K7 pipe of 350 mm to 700 mm diameter)] and 60 km new water pipelines [59 km ductile iron pipe Class K7 (DI-K7) and 1 km DI-K9 pipes with diameter ranging from 100 mm to 450 mm)] will be laid and new house service connections will be provided from the newly laid main.

238. Laying of water supply pipelines and trunk/collection sewer mains pipeline are proposed within the boundaries of RoW of government roads. No impact (either temporary or permanent) on structures and common property resources (CPRs) is envisaged. However, during laying of pipeline, due to loss of access, temporary livelihood loss to roadside vendors, kiosks, is envisaged. The diameter of proposed sewer pumping main is between 225 mm to 700 mm and the road width on such locations where pipe laying is proposed ranges from 4 to 15 meter. . While water pipes are/will be located on one or either side of the roads, the sewers will be laid in the middle of the road to avoid any disturbing the water pipes. In narrow roads, where there is no vacant RoW, the pipeline will be buried within the roadway and there could be some temporary impacts in narrow roads.

239. Sewers will be mostly laid by open cut method. In the areas of water body crossing, main road crossings or deep cuttings (above 6-7 m depth), the sewers (around 5 km) will be laid by trenchless method. Water pipes will be laid in the ground without a maximum cover of 1 m, so that depth of excavation will be up to 1.5-1.8 m. A total of 1,950 manholes, including 1,150 brick masonry circular manholes; 620 in-situ RCC circular manholes; and around 180 precast RCC manholes based on the assessment of subsoil condition and traffic loads, will be installed along the sewer network

240. The storm water collection network has been planned to collect the storm runoff from the contributing catchments and will be finally discharged to nearby water bodies which ultimately discharged to River Ripsana. In the project area mainly in Mothrowala ward, there are existing drains which are generally open and are heavily silted and chocked. In view of above, new drains are proposed along the existing natural nala/drain considering the topography of the area and storm water drains with precast RCC cover will be constructed on side of existing government roads therefore no land acquisition issue observed.

241. 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 deeper than 1.5 m will be protected by shoring/bracings to avoid collapse of trenches, and also to avoid any risk to surrounding buildings. 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. Extraneous soil after backfilling of trenches shall be used for filling low lying area or stored/ dumped in approved debris disposal sites.

242. 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 of the town where there are a variety of human activities, will result in impacts to the environment and sensitive receptors such as schools, religious places, hospitals and the community in general. Although these anticipated impacts are temporary and for short duration, require proper mitigation measures

to limit the impacts to acceptable levels. Physical impacts will be reduced by the method of working and scheduling of work. Likely impacts of construction phase, and appropriate mitigation measures are discussed below:

243. **Sources of Materials.** Significant amount of gravel, sand, coarse aggregate, and cement will be required for this project. The construction contractor will be required to:

(i) Use material sources permitted by government only;
(ii) Verify suitability of all material sources and obtain approval of PIU; and
(iii) Submit to PIU on a monthly basis documentation of sources of materials. If contractor is purchasing ready mix concrete, asphalt/macadam and aggregates from third party, contractor will assure that all the parties/ suppliers are having CTE/CTO from UEPPCB and will collect the copy of these certificates and submit to PIU/ DSC consultants.

244. **Air Quality.** During drilling of wells apart from dust air pollution can result from the emission of non-condensable gases, and exhaust gas from generators, compressors and vehicles. As the drilling is a temporary activity, no significant long-term impacts on air quality are expected,

245. 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. These however will be temporary limiting to construction activities only. To mitigate the impacts, construction contractors will be required to:

(i) Plan the work sites properly, and demarcate the sites for stockpiling of, soils, gravel, and other construction materials away from the traffic, vehicle, general worker movement to avoid disturbance of loose materials;
(ii) Damp down exposed soil and any stockpiled material on site by water sprinkling;
(iii) Use tarpaulins to cover sand and other loose material when transported by trucks;
(iv) Clean wheels and undercarriage of haul trucks prior to leaving construction site;
(v) Don't allow access in the work area except workers to limit soil disturbance and prevent access by barricading and security personnel
(vi) Fit all heavy equipment and machinery with air pollution control devices which are operating correctly and limit idling time of construction vehicles to 3 to 5 minutes to minimize local air pollution. VContractor's vehicles and equipment should compulsorily have PUC and submit PUC to PIU before deployment at site
(vii) Obtain, CTE and CTO for batching plant, hot mix plant, crushers etc. if specifically established for this project.
(viii) If contractor is purchasing ready mix concrete, asphalt/macadam and aggregates from third party, contractor will assure that all the partier/ suppliers are having CTE/CTO from UEPPCB and will collect the copy of these certificates and submit to PIU/consultants; PIU will approve the source only after all the certificates are submitted
(ix) Conduct ambient air quality monitoring periodically as per Environmental Management Plan (EMP)

246. **Surface Water Quality.** Water is required as a drilling fluid in well drilling. Drilling fluid/mud including cuttings shall be contained and properly disposed by the drilling contractor, to avoid affecting the quality of the nearby surface and groundwater sources.

247. Works during rains. Run-off from stockpiled materials and chemical contamination from fuels and lubricants during construction works can contaminate downstream surface water quality of the streams. These potential impacts are temporary and short-term duration only. However, to ensure that these are mitigated, construction contractor will be required to:

(i) Prepare and implement a spoils management plan (Appendix 12);
(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, consult with PIU on designated disposal areas;
(iv) Inspect all the drainage at construction site/construction camp/labor camp etc. and clear all the drainage lines so that no water stagnation/flooding may occur during heavy rainfall
(v) As for a possible avoid trench works and excavation works (pipe laying) during monsoon season to avoid any water logging and accident due to it
(vi) If open trenches are not avoidable during monsoon, keep ready all the mitigations measures to avoid water logging such as dewatering pumps and sufficient pipes, traffic assistance, barricades etc.
(vii) Inspect and verify all the emergency measures and emergency control system before start of monsoon, keep the emergency response committee on high alert during monsoon/heavy rain fall
(viii) Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies;
(ix) Place storage areas for fuels and lubricants away from any drainage leading to water bodies;
(x) Dispose any wastes generated by construction activities in designated sites; and
(xi) Conduct surface quality inspection according to the Environmental Management Plan (EMP).

248. **Noise and Vibration Levels.** Noise is one of the most ubiquitous disturbances to the environment particularly during the construction and operation phases. Noise will generate during drilling, well testing, tripping and cementing but are temporary and will decline when all the wells have been drilled and tested.

249. Construction works will be conducted along the roads in urban/semi urban area, where there are houses, schools and hospitals, religious places and small-scale businesses. Increase in noise level may be caused by excavation, particularly breaking of cement concrete or bitumen roads, operation of construction equipment like concrete mixers, and the transportation of equipment, materials, and people. Vibration generated from construction activity, for instance from the use of pneumatic drills, will have impact on nearly buildings. 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) Horns should not be used unless it is necessary to warn other road users or animals of the vehicle's approach;
(iii) As far as possible use new construction machineries and keep all the old machineries in good and maintained state.
(iv) 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 receptor;
(v) Maximum sound levels should not exceed the WHO guideline values for noise levels.

(vi) Identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity;
(vii) Consult the custodians of important buildings, cultural and tourism authorities and local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals.
(viii) Conduct Noise monitoring according to the Environmental Management Plan (EMP).

250. **Landscape and Aesthetics.** Some trees may be required to cut due to which landscape and aesthetics of those sites will be reduced. The construction works will produce 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. Haphazard disposal of these will have negative impacts on landscape and overall aesthetics. These impacts are negative but are of short-term and reversible by mitigation measures. The construction contractor will be required to:

(i) Take all the efforts to reduce numbers of tree cutting by amending design;
(ii) Compensatory plantation in the ratio of 1:3 is required to increase landscape and aesthetics of the sites where tree cutting has been done
(iii) Prepare and implement spoils management plan;
(iv) Avoid stockpiling of excess excavated soils;
(v) Coordinate with ULB for beneficial uses of excess excavated soils or immediately dispose to designated areas;
(vi) Recover used oil and lubricants and reuse or remove from the sites;
(vii) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas;
(viii) Remove all wreckage, rubbish, or temporary structures which are no longer required; and
(ix) Request PIU to report in writing that the necessary environmental restoration work has been adequately performed before acceptance of work.

251. **Groundwater Quality.** Increased demand for groundwater is anticipated during the construction phase for construction activities and personal consumption by workers. Even a small project can require 100 m^3/day of water. Uncontrolled extraction of water may affect availability of water to locals. It is expected that most fill material will generally be compacted dry. The pressure testing of pipelines will be carried out with compressed air. The testing of water retaining structures such as pumping stations, water will be used but limited to a single filling of the structure.

252. The project area is in Raipur block of Dehradhun district which is categorized as “SAFE” as per the categorization adopted by the CGWB. According to CGWB, in the project area depth to water level ranges between 10 and 15 m below ground level in pre monsoon of 2006 while post monsoon varied from 5 m to 15 m below ground level.

253. In addition, construction waste, if left unattended, may result in percolation of leachate through the soil strata reaching the groundwater table contaminating. These potential impacts are temporary and short-term duration only. It is necessary that arrangement for safe drinking water is made prior to start of work. Water will be supplied for consumption only after adequate analysis and requisite treatment. The workers may also be trained on the need for judicious use of freshwater resources. The contractors will use water in consideration to its value as a resource. Mitigation measures will include:

(i) Prevent pollutants from contaminating the soil and the groundwater;

(ii) All tube wells, test holes, monitoring wells that are no longer in use or needed shall be properly decommissioned;
(iii) Storage of lubricants and fuel at least 50 m from water bodies;
(iv) Storage of fuel and lubricants in double hulled tanks. Fuel and other petroleum products stored at storage areas away from water drainage and protected by impermeable lining and bunded 110%;
(v) Daily control of machinery and vehicles for leakages;
(vi) Collection of waste during construction activities;
(vii) Provide uncontaminated water for dust suppression;
(viii) Enclose the construction area to prevent unauthorized access

254. Another physical impact that is often associated with excavation is the effect on drainage and the local water table if groundwater collects in the voids. Here groundwater occurs in shallow depths, and rains are high during monsoon season. 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. These potential impacts are temporary and short-term duration only. However, to ensure that these are mitigated, construction contractor will be required to:

(i) Prepare and implement a spoils management plan (Appendix 13);
(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, consult with PIU on designated disposal areas;
(iv) Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies;
(v) Place storage areas for fuels and lubricants away from any drainage leading to water bodies;
(vi) Dispose any wastes generated by construction activities in designated sites; and
(vii) Conduct surface quality inspection according to the Environmental Management Plan (EMP).

255. **Accessibility.** Excavation along the roads, hauling of construction materials and operation of equipment on-site can cause traffic problems. Potential impact is negative but short term and reversible by mitigation measures. The construction contractor will be required to:

(i) Prepare and implement a Traffic Management Plan (Appendix 14)
(ii) Plan transportation routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites;
(iii) Schedule transport and hauling activities during non-peak hours;
(iv) Locate entry and exit points in areas where there is low potential for traffic congestion;
(v) Keep the site free from all unnecessary obstructions;
(vi) Drive vehicles in a considerate manner;
(vii) Coordinate with Traffic Police for temporary road diversions and for provision of traffic aids if transportation activities cannot be avoided during peak hours; and
(viii) Notify affected sensitive receptors by providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints.

256. Wherever road width is very narrow, there will be temporary loss of access to pedestrians and vehicular traffic (including 2-wheelers) during the laying of pipes. Under those circumstances, contractor shall adopt following measures:

(i) Inform the affected local population 1-week in advance about the work schedule
(ii) Plan and execute the work in such a way that the period of disturbance/ loss of access are minimum.
(iii) Provide pedestrian access in all the locations until normalcy is restored. Provide wooden/metal planks over the open trenches at each house to maintain the access.

257. **Trenchless Pipe Installation**. Trenchless pipe laying involves the use of horizontal direction drilling (HDD) which involves a hydraulic machinery to drill a horizontal tunnel for a new pipe, so no trenches are dug, and excavation is limited to the entry and exit points. Noise generated due to HDD may affect the neighboring communities and other sensitive receptors (such as students at schools and other educational institutes, patients at hospitals etc.).

258. During drilling bentonite slurry may be used to cooling the drill bit, lubricating the drill bit and drill rods, increasing the stability of the borehole, etc. A part of the original bentonite slurry may be recycled and reused, while the remaining slurry may spill out to the watercourses. If the bentonite slurry is not properly collected and treated, it will contaminate the adjacent watercourse. The contractors' mitigation measures will include but not necessarily be limited to the following measures:

(i) Pipes shall be installed by the horizontal directional drilling (HDD) methods where required. If the method is not feasible for any road, the contractor shall inform the Project Manager and gain prior approval for an alternative method or for open trench method.
(ii) Excavation material shall be removed from the conduit as the work progresses. No accumulation of excavated material within the conduit will be permitted.
(iii) The contractor shall provide sediment and erosion control measures in accordance with local environmental legislation.
(iv) The contractor shall supply portable mud tanks or construct temporary mud pits to contain excess drill fluids during construction. Spent drilling fluids and cuttings shall be confined to the entrance and exit pits.
(v) The contractor shall take all necessary precautions to minimize the damage to the adjacent properties. Drilling fluid/ bentonite slurry that enters the pipe shall be removed by flushing or other suitable methods. Sediment tanks of sufficient capacity constructed from pre-formed individual cells of approximately 6-8m3 capacities shall be used for settling wastewaters prior to disposal.
(vi) The contractor shall be responsible for cleanup and restoration of the site.
(vii) Pits excavated to permit connection of bored pipe shall be backfilled, and disturbed areas shall be restored to their original state or better. Sections of sidewalks, curbs, and gutters or other permanent improvements damaged during HDD operations shall be repaired or replaced at the contractor's expense.

259. **Traffic diversion and/or road closure**. Laying of sewer lines and construction of drains simultaneously may significantly impact the traffic movement. This should be avoided as far as possible by proper planning of construction works. If traffic diversion and/or road closure is required for the proposed works, prior consent from traffic department will be required and prior information to affected areas and public should be disseminated through consultations by DSC. Proper road signage and traffic aids should be provided at site. Excavation along the roads, hauling of construction materials and operation of equipment on-site can cause traffic problems. As the trenchless method adopted for sewers of more than 6-7 m deep avoiding open cut excavation, this

will avoid large scale disturbances in the busy roads. Potential impact is negative but short term and reversible by mitigation measures. The construction contractor will be required to:

(i) Plan sewer line works to minimize traffic disturbance / blockades; as the both water and sewer lines are to be laid in all the roads and streets in the town, work planning is crucial to minimize the inconvenience to public due to repeated excavations
(ii) Prepare and implement a Traffic Management Plan (Appendix 14)
(iii) Duly consider and select sections for trenchless method of pipe laying based on traffic conditions
(iv) Locate entry and exit points in areas where there is low potential for traffic congestion;
(v) Keep the site free from all unnecessary obstructions;
(vi) Coordinate with Traffic Police for temporary road diversions and for provision of traffic aids if transportation activities cannot be avoided during peak hours;
(vii) Notify affected sensitive receptors by providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints.
(viii) Maintain sufficient access to houses and shopkeepers (commercial establishments) during pipe/sewer laying work through metal sheets and temporary bridges

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260. **Socio-Economic – Income.** The project components will be located in government land and there is no requirement for land acquisition or any resettlement. Construction works will impede the access of residents to specific site in limited cases. The potential impacts are negative and moderate but short-term and temporary. The construction contractor will be required to:

(i) Prepare and implement spoils management plan (Appendix 13);
(ii) Leave spaces for access between mounds of soil;
(iii) Provide walkways and metal sheets where required to maintain access across for people and vehicles;
(iv) Increase workforce in the areas with predominantly institutions, place of worship, business establishment, hospitals, and schools;
(v) Consult businesses and institutions regarding operating hours and factoring this in work schedules; and
(vi) Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.

261. **Socio-Economic – Employment**. Manpower will be required during the 36-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 employ local labour force, to the maximum extent, possible.

262. **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 labor laws (Appendix 6);
(ii) Following best practice health and safety guidelines: IFC's General EHS Guidelines[17], WHO Interim Guidance (and its updates) on Water, Sanitation, Hygiene and Waste

[17]https://www.ifc.org/wps/wcm/connect/554e8d80488658e4b76af76a6515bb18/Final%2B%2BGeneral%2BEHS%2BGuidelines.pdf?MOD=AJPERES

management for the COVID19 virus (Appendix 15), and Sector Specific (Water and Sanitation) Guidelines[18];

(iii) ADB's Interim Advisory Note on Protecting the Safety and Well-Being of Workers and Communities from COVID-19 (2020) (Appendix 27)

(iv) Develop and implement site-specific occupational health and safety (OHS) Plan which will include measures such as: (a) excluding public from the site; (b) ensuring all workers are provided with and use personal protective equipment; (c) OHS Training[19]for all site personnel; (d) documented procedures to be followed for all site activities; and (e) documentation of work-related accidents;

(v) Conduct work in confine spaces, trenches, and at height with suitable precautions and using standards and safe construction methods; do not adopt adhoc methods; all trenches deeper than 1.5 m shall be provided with safety shoring/braces; and avoid open cutting method for trenches deeper than 6-7 m by adopting trenchless technology

(vi) Ensure that qualified first aid is provided at all times. Equipped first-aid stations shall be easily accessible throughout the site;

(vii) Provide medical insurance coverage for workers;

(viii) Secure all installations from unauthorized intrusion and accident risks;

(ix) The project area experiences extreme temperature during summer months of April and May, which may affect the health of workers engaged in construction work. Contractor should take necessary measures during summers including the following:

- Work schedule should be adjusted to avoid peak temperature hours (12 – 3 PM)
- Provide appropriate shade near the workplace; allow periodic resting and provide adequate water
- Provide necessary medicine and facilities to take care of dehydration related health issues

(i) Provide supplies of potable drinking water;

(ii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances;

(iii) 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;

(iv) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted;

(v) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas;

(vi) Ensure moving equipment is outfitted with audible back-up alarms;

(vii) 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

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[18] https://www.ifc.org/wps/wcm/connect/e22c050048855ae0875cd76a6515bb18/Final%2B%2BWater%2Band%2BSanitation.pdf?MOD=AJPERES

[19] **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.**

(viii) 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.

(ix) Conduct regular health check-ups for workers

- Provide periodical awareness camps and special trainings for workers for health issues and risks in construction sites

263. **Occupational Health and Safety Plan due to COVID 19 Pandemic.** PMU, PIUs, Consultants and contractors to ensure that: (i) package wise details and evidences such as photographs/display board for grievance redress mechanism (GRM)/health and safety (H&S) measures taken at work sites due to COVID 19 pandemic are included in monthly monitoring report; and (ii) ensure that efficient implementation of the H&S Plan developed by the project in response to COVID-19 pandemic. Important protocols or measures in the H&S Plan are to ensure that the following are complied with at the offices and worksites of the project: (i) screening of employees and workers; (ii) record keeping of screening results; (iii) availability and use of appropriate PPEs; (iv) social distancing; (v) proper office set up reconfiguration to ensure social distancing; (vi) new office and work site meeting arrangements; (vii) regular disinfection of work areas, vehicles and equipment; and (viii) provision of adequate ventilation in indoor spaces or wearing masks, among others. PIU safeguards officer with the assistance of the safeguards experts of DSCs and Contractors EHS officers to take precautions, provide continuous induction and continue conducting regular safeguards implementation trainings including implementation monitoring of regular usage of PPEs and COVID-19 related safety measures. Key reminders for the PMU, PIUs, contractors, and workers to comply with the following occupational health and safety measures as stated in the agreed OHS Plan:

(i) Ensure project staff, consultants, contractors, and workers have in their mobile devices the Aarogya Setu App, which is a mobile application developed and recommended by the government to proactively reach out to and inform the users of the app regarding risks, best practices and relevant advisories pertaining to the containment of COVID-19;

(ii) Mandatory isolation of the personnel or workers, either asymptomatic or showing symptoms, who have had direct contact with anyone tested positive for COVID-19. Follow the isolation procedures issued by the government;

(iii) Proper disposal of used PPE following guidelines and procedures issued by the government;

(iv) Conduct daily briefing on the developments of COVID-19 in the state or country, either through emails, meetings or daily toolbox talks;

(v) When possible, allow work from home arrangement based on the nature of jobs;

(vi) If necessary, pick up and drop off facility be extended to staff (based on the distance of the staff residence from office and on availability of safe mode of transport);

(vii) Avoid face to face meetings – critical situations requiring in-person discussion must follow social distancing. Do not convene in-person meetings of more than 10 people;

(viii) If possible, conduct all meetings via conference calls. Recommend use of cell phones, texting, web meeting sites and conference calls for project discussions;

(ix) Contractor to help its workers arrange a systematic procurement of all daily needs and groceries at worksites. This will avoid each and every worker going to shops for these daily needs;

(x) Contractor to arrange for contactless payment of wages to workers, where possible;

(xi) Allow distributed break times for workers to maintain social distancing and reduce contact;

(xii) Remind employees and workers to maintain good health by getting adequate sleep; eating a balanced and healthy diet, avoiding alcohol/smoking; and consuming plenty of fluids; and

(xiii) Remind employees and workers to extend their adherence to the H&S protocols at their respective homes. Infection may happen beyond the borders of offices and work sites.

264. **Asbestos Containing Materials.** No Asbestos containing material (ACM) is proposed to be used in the subproject construction. There are least possibilities of presence of ACM in the existing water supply/sewerage infrastructures. Given the dangerous nature of this material for both workers and citizens, additional measure should be taken to protect the health of all parties in the event (however unlikely) that AC pipes are encountered. It is suggested not to remove the AC pipes and lay new pipes parallel to it and left AC pipes in-situ. This will remove risks of handling and disposal of AC pipes. Further, prior to start of construction works, PIU will develop a protocol to be applied in any instance that AC pipes are encountered, to ensure that appropriate action is taken. This should be based on the approach recommended by the United States Environmental Protection Agency (USEPA),[20]and amongst other things, should involve:

(i) Training of all personnel (including manual laborers) to enable them to understand the dangers of AC pipes and to be able to recognize them in situ;
(ii) Reporting procedures to inform PIU immediately if AC pipes are encountered;
(iii) Development and application of a detailed H&S procedure to protect both workers and citizens. This should comply with national and international standards for dealing with asbestos and should include: (a) removal of all persons to a safe distance; (b) usage of appropriate breathing apparatus and protective equipment by persons delegated to deal with the AC material; and (c) Procedures for the safe removal and long-term disposal of all asbestos- containing material encountered.

265. **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. The construction contractor will be required to:

(i) Plan routes to avoid times of peak-pedestrian activities.
(ii) Liaise with PIU in identifying risk areas on route cards/maps.
(iii) Maintain regularly the vehicles and use of manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.
(iv) Provide road signs and flag persons to warn of on-going trenching activities.

266. Some parts of the project areas are characterized by narrow roads. Particularly, the areas located on slopes have very narrow roads with sharp turns and are accessible only to pedestrians. Besides impeding the access, the trench excavation and pipe laying will pose safety risks to pedestrians and the people living in these areas. The construction contractor will be required to:

(i) Trench excavation and pipeline works shall be conducted in a safe manner; if the allowing public movement along the work sites (pedestrians or vehicles as the case may be) is likely to cause safety risks, movement should be blocked temporarily and work shall be conducted; in such areas, conducting night work or working in small stretches to avoid blockage of traffic/movement no more than few hours in due consultation with the local community and ULB shall be planned

[20] In the USA, standards and approaches for handling asbestos are prescribed by the Occupational Health and Safety Administration (OHSA) and the Environmental Protection Agency (EPA) and can be found at http://www.osha.gov/SLTC/asbestos

(ii) All trenches deeper than 1.5 m shall be provided with safety shoring/braces; and avoid open cutting method for trenches deeper than 6-7 m by adopting trenchless technology
(iii) Survey the surrounding vulnerable buildings for likely issues in structural stability / differential settlement during the excavation works
(iv) Provide prior information to the local people about the nature and duration of work
(v) Conduct awareness program on safety during the construction work
(vi) Undertake the construction work stretch-wise; excavation, pipe laying and trench refilling should be completed on the same day
(vii) Provide hard 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

267. **Establishment and Operation of Construction Camps and Workers Facilities**. It is likely that the contract may employ workers from outside project area, and therefore may provide temporary workers accommodation during the construction phase. Proper provision and maintenance of facilities is necessary for proper living conditions and avoid health, environment and safety issues. Workers camps may also adverse impacts on surrounding communities. Operation of construction camps can cause temporary air and noise pollution from machine operation, water pollution from storage and use of fuels, oils, solvents, and lubricants. Potential impacts are negative but short-term and reversible by mitigation measures. The construction contractor will be required to:

(i) Consult PIU before locating project offices, sheds, and construction plants;
(ii) Minimize removal of vegetation and disallow cutting of trees;
(iii) Provide drinking water, water for other uses, and sanitation facilities for employees;
(iv) Provided temporary rest and eating area at all work sites
(v) Ensure conditions of livability at work camps are maintained at the highest standards possible at all times; living quarters and construction camps shall be provided with standard materials (as far as possible to use portable ready to fit-in reusable cabins with proper ventilation); thatched huts, and facilities constructed with materials like GI sheets, tarpaulins, etc., shall not be used as accommodation for workers; accommodation shall meet the IFC standards for workers accommodation[21] which include: provision of safe housing, availability of electricity, plumbing, water and sanitation, adequate fire protection and dormitory/room facilities; accommodation shall be in the range from 10 to 12.5 cubic meters (volume) or 4 to 5.5 square meters (surface) per worker, a minimum ceiling height of 2.10 meters; a reasonable number of workers are allowed to share the same room – (standards range from 2 to 8 workers); workers with accompanying families shall be provided with a proper and safe accommodation (IFC benchmark standards for workers accommodation is provided in Appendix 16) Prohibit employees from poaching wildlife and cutting of trees for firewood;
(vi) Train employees in the storage and handling of materials which can potentially cause soil contamination;
(vii) Recover used oil and lubricants and reuse or remove from the site;
(viii) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas;
(ix) Remove all wreckage, rubbish, or temporary structures which are no longer required; and
(x) Report in writing that the camp has been vacated and restored to pre-project conditions before acceptance of work.

[21] https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_gpn_workersaccommodation

268. **Social and Cultural Resources.** For this project, excavation will occur at locations known not to have archaeological values, so it could be that there is a low risk of such impacts. Nevertheless, the construction contractor will be required to:

(i) Follow the protocol for chance finds in any excavation work;
(ii) Create awareness among the workers, supervisors and engineers about the chance finds during excavation work;
(iii) Stop work immediately to allow further investigation if any finds are suspected;
(iv) Inform local Archaeological Department / Museum office if a find is suspected; take any action they require ensuring its removal or protection in situ.

269. **Debris disposal.** Prior to the commencement of works, contractor shall identify a debris disposal site in consultation with the PIU and DSC consultants. Contractor will follow all the prescribed rules during construction and adhering to following criteria:(including but not limited to)

(i) The site shall be selected preferably from barren, infertile lands. In case agricultural land needs to be selected, top-soil stripping, stacking and preservation should be undertaken prior to initiation of any activities.
(ii) Debris disposal site shall be at least 200 m away from surface water bodies.
(iii) No residential areas shall be located within 100 m downwind side of the site.
(iv) The site is minimum 250 m. away from sensitive locations like hospitals, religious places, ponds/lakes or other water bodies.
(v) The local governing body and community shall be consulted while selecting the site.

270. **Night works.** Most of the construction works shall be undertaken only during day hours. Night works are required only in the extreme conditions such as road having heavy traffic in daytime and/or no alternate access can be provided for the road users, extreme climatic conditions (extreme hot during summers), religious fairs/celebrations in daytime etc. Contractors are required to take prior approval from PIU/consultants and concerned town authorities for night works. Contractors are required to adhere following conditions for night works including those prescribed by concerned authorities:

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(i) Prepare a night work protocol and obtain prior approval from PIU, and strictly implement and report on implementation of protocol during the workers
(ii) Contractors should have handheld noise level meter for measurement of noise during night hours
(iii) Contractors should have handheld lux meter for the measurement of illumination during night hours
(iv) Preferably electrical connections are available for running equipment otherwise soundproof/super silent Diesel Generator set should be available
(v) Sound level should not increase as prescribe by CPCB
(vi) Illumination should be as follows-

Table 29: Illumination Standards for Night Working

Minimum illumination (lx)	Areas to be illuminated	Type of work activity
54	Illumination throughout the work area	General work area lighting, and performance of visual tasks of large size, or medium contrast, or low require accuracy

Minimum illumination (lx)	Areas to be illuminated	Type of work activity
108	Illumination of work area and areas adjacent to equipment	Performance of visual tasks of medium size, or low to medium contrast, or medium required accuracy
216	Illumination of task	Performance of visual tasks of small size, or low contrast or high required accuracy or fine finish

(i) As far as possible ready-mix concrete from batching plant to be used, otherwise the concrete should be prepared away from residential areas and brought to the site
(ii) All the noisy activities like hammering, cutting, crushing, running of heavy equipment should be done in daytime and avoided in nighttime
(iii) Workers engaged in night works should have adequate rest/sleep in daytime before start of night works
(iv) Worker engaged for night works should have previous experience of night works and should be physically fit for such works including clear vision in night
(v) All the necessary provisions of traffic aids such as traffic signals, road signage, barricades, cautions boards, traffic diversion boards etc. should be available with fluorescent/retro-reflective arrangements
(vi) Workers should be trained before start of night works about risks and hazards of night works and their mitigation measures and should be provided all the protective aids (PPEs) including fluorescent/retro-reflective vests
(vii) Horns should not be permitted by equipment and vehicles
(viii) Workers should not shout and create noise
(ix) First aid and emergency vehicles should be available at site
(x) Emergency preparedness plan should be operative during night works
(xi) Old persons and pregnant women and women having small kids should not work in nighttime
(xii) All the vehicles and equipment being used at night works should have adequate type of silencers/enclosures/mufflers to reduce noise
(xiii) All the vehicles should be checked for working head lamps, tail lamps, inner lights etc. before start of night works
(xiv) PIU/DSC site engineers and contractor's safety personnel should closely monitor the safety of works continuously and noise and illumination levels on hourly basis and maintain photographic and video graphic records as well as register the observations.
(xv) Night works should be stopped early in the morning at least one hour before start of pedestrian/traffic movement
(xvi) After completion of night works all the site should be cleaned and maintained obstruction free for daytime movement of vehicles and pedestrians
(xvii) Drivers and workers should be alert and responsive during night works
(xviii) All the wages to workers working in night hours should be as per the applicable labour acts
(xix) Avoid any nuisance which may create problems to nearby habitants and work peacefully during night hours
(xx) Night works should not be conducted near hospitals and during peak seasons such as peak tourist season, students' exam times etc.

271. **Reinstatement of Working Areas on Completion**. The contractor will reinstate all working areas and access routes as work proceeds during construction. All plant, equipment, materials, temporary infrastructure and vehicles will be removed at the earliest opportunity and the surface of the ground restored as near as practicable to its original condition.

E. Operation and Maintenance Impacts

272. In the operational phase, all facilities and infrastructure will operate with routine maintenance, which should not affect the environment. Facilities will need to be repaired from time to time, but environmental impacts will be much less than those of the construction period as the work will be infrequent, affecting small areas only.

273. **Water Supply System**. Operation and Maintenance of the water supply system will be carried out by DBO contractor for 5 years and then Dehradun Nagar Nigam directly or through an external operator. The water supply system is intended to deliver potable water meeting drinking water standards (Appendix 2) to the consumers at their homes. This must be ensured.

274. The system has a design life of 30 years, during which 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.

275. Recurrence of pipe bursting and leakage problems in water supply system will be managed by the leak detection and water auditing surveys. The operating agency will be required to ensure that the leak detection and rectification time is minimized. The main O&M activities of the refurbished infrastructure will be detection and repair of leaks and, pipe bursts. These are however likely to be minimal as proper design selection and good quality pipe material should mean that leaks are minimal. The bulk meters that are provided as part of this sub-project will be of great use in detecting leaks in network. Leak repair work will be similar to the pipe laying work. Trenches will be dug to reveal the leaking area and the faulty connection will be re-fitted, or the pipe will be removed and replaced if necessary.

276. It is proposed to use chlorine for disinfection of water, therefore there is a safety risk due to handling of large quantities of chlorine at the tube well. Likely impacts will be negligible if the various measures are suggested safety features and equipment to meet with any accidental eventuality are included in the design and development of the facility. During the operation phase, it is necessary that the facility is operated by trained staff as per the standard operating procedures.

(i) Chlorinator facility is operated only by trained staff and as per the standard operating procedures
(ii) In case of any accident and/or maintenance activity, the staff should follow documented procedures only
(iii) It is suggested to develop an Emergency Response System (ERS) for the chlorine leakage

277. **Operation and Maintenance of the sewerage systems** will be carried out by DBO contractor for 5 years and then by Dehradun Nagar Nigam directly or through an external operator. The sewerage system is intended to collect and convey and dispose entire sewage coming from package 2 subproject areas to the proposed STP under Package 1 at Indrapuri Farm, Daudwala along with all sewage of Package 1 and Package 3 for treatment. Operation will involve collection and conveyance of wastewater from houses to STP for treatment. It has to be ensured that the contractor obtains the relevant consents from UEPPCB for operation of STP and also ensure compliances to all the conditions as mentioned in the CTO.

278. **Leakage and Overflows.** There are also certain environmental risks from the operation of the sewer system, most notably from leaking sewer pipes as untreated fecal material can damage human health and contaminate both soil and groundwater. It will be imperative therefore that the operating agency establishes a procedure to routinely check the operation and integrity of the sewers, and to implement rapid and effective repairs where necessary. There is an occupation health risk to workers engaged in sewer maintenance activities. Following measures should inter alia be followed:

(i) As far as possible, use CCTV mechanism to detect the problems in pipelines and do not engage persons for this purpose (
(ii) As far as possible use mechanized cleaning of manholes and pipelines by using modern techniques and machines and do not engage persons for this purpose and engage persons only if mechanized cleaning is not possible in any way
(iii) Ensure that employees and line management understand the risks through proper instruction, training and supervision.
(iv) Use gas detector before entering any person inside manhole to detect any hazardous or inflammable gas present inside the manhole.
(v) Provide suitable personal protective equipment that may include waterproof / abrasion-resistant gloves, footwear, eye and respiratory protection. Face visors are particularly effective against splashes. Equipment selection and a proper system for inspection and maintenance are important.
(vi) (Provide adequate welfare facilities, including clean water, soap, nail brushes, disposable paper towels, and where heavy contamination is foreseeable, showers.
(vii) For remote locations portable welfare facilities should be provided.
(viii) Areas for storage of clean and contaminated equipment should be segregated and separate from eating facilities.
(ix) Provide adequate first-aid equipment, including clean water or sterile wipes for cleansing wounds, and a supply of sterile, waterproof, adhesive dressings.
(x) Make effective arrangements for monitoring the health of staff.
(xi) Keep emergency preparedness plan ready before start of the work on sewage system cleaning

279. **Occupational Health and Safety**. There will be risk of health of workers during operation and maintenance if repair and maintenance crews do not abide by the proper health and safety procedures and therefore, they may suffer infectious diseases. The following measures will be implemented:

(i) Ensure routine vaccinations for workers for influenza, tetanus, and Hepatitis “B” (in consultation with appropriate physicians);
(ii) Install railing around all process tanks and pits. Require use of a life line and personal flotation device (PFD) when workers are inside the railing, and ensure rescue buoys and throw bags are readily available;
(iii) Use PFDs when working near waterways;
(iv) Implement a confined spaces entry program that is consistent with applicable national requirements and internationally accepted standards. Valves to process tanks should be locked to prevent accidental flooding during maintenance;
(v) Use fall protection equipment when working at heights;
(vi) Maintain work areas to minimize slipping and tripping;
(vii) Implement fire and explosion prevention measures in accordance with internationally accepted standards;

(viii) Workers must be trained to recognize potential hazards, use proper work practices and procedures, recognize adverse health effects, understand the physical signs and reactions related to exposures, and are familiar with appropriate emergency evacuation procedures. They must also be trained to select and use the appropriate PPE;
(ix) Provide all the personal protective equipment like gum boots, nose mask, gloves etc. for the protection of workers;
(x) The workplace will be equipped with fire detectors, alarm systems and fire-fighting equipment. The equipment will be periodically inspected and maintained in good working condition;
(xi) Providing adequate personnel facilities, including washing areas and areas to change clothes before and after work;
(xii) Medical check-up will be conducted on regular basis and the health conditions will be monitored;
(xiii) First aid facilities required to attend immediately for meeting emergency situations will be made available at the facility;
(xiv) Maintain good housekeeping in waste processing and storage areas;
(xv) Conduct detailed identification and marking of all electrical connections prior to any maintenance work;
(xvi) Use specially trained personnel to demount electrical parts; (xvii) Provide safe means of access and egress from confined places, such as stairs and ladders, and safety ropes;
(xvii) Avoid operating combustion equipment for prolonged periods unless the area is actively ventilated; and
(xviii) Avoid exposure to excessive noise levels beyond permissible limits set out by local and international regulations.

280. When installing or repairing mains adjacent to roadways, implement procedures and traffic controls, such as:

(i) Establishment of work zones so as to separate workers from traffic and from equipment as much as possible;
(ii) Reduction of allowed vehicle speeds in work zones;
(iii) Use of high-visibility safety apparel or reflectorized vests for workers in the vicinity of traffic;
(iv) For night work, provision of proper illumination for the work space, while controlling glare so as not to blind workers and passing motorists; and
(v) Locate all underground utilities before digging.

281. **Community Health and Safety**. Neighboring community is likely to be temporarily disrupted due to mismanagement of overflows, hazardous waste and materials and odor and noise nuisance. However, public safety in respect of operational impacts is best secured through the prevention of unauthorized access. Operational staff will be trained in and comply with all the provisions of the UUSDA Health and Safety requirements, delineated by the contractor before handing over the plant.

(i) Develop and implement appropriate protocols to reduce risks to safety, public health, and environment that include well-written instructions;
(ii) Response to overflows by preventing, containing, minimizing, the overflow where it is feasible and safe to do so;
(iii) Develop a contingency plan (site-specific);

(iv) Protect components of sewage pumping stations from flood damage where it is feasible to do so (for instance, protecting components from rising flood water to enable reinstating more rapidly);
(v) Train operators on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training;
(vi) Implement inspection programs to maintain the mechanical integrity and operability of pressure vessels, tanks, piping systems, relief and vent valve systems, containment infrastructure, emergency shutdown systems, controls and pumps, and associated process equipment;
(vii) Prepare written Standard Operating Procedures (SOPs) for filling containers or equipment as well as for transfer operations by personnel trained in the safe transfer and filling of the hazardous material, and in spill prevention and response;
(viii) Transport and dispose waste residues from screens in legal and approved disposal sites;
(ix) Make available spill response equipment sufficient to handle at least initial stages of a spill;
(x) Train and educate operational personnel on response activities in the event of spill, release, or chemical emergency; and
(xi) Provide quality monitoring tests for groundwater and surface water resources adjacent to project locations.

282. **Pathogens and Vectors**. Workers and staff at wastewater and septage facilities and fields where treated wastewater is applied, as well as operators of septage collection vehicles, can be exposed to the many pathogens contained in sewage. Processing of sewage can generate bio aerosols which are suspensions of particles in the air consisting partially or wholly of microorganisms, such as bacteria, viruses, molds, and fungi. These microorganisms can remain suspended in the air for long periods of time, retaining viability or infectivity. Workers may also be exposed to endotoxins, which are produced within a microorganism and released upon destruction of the cell, and which can be carried by airborne dust particles. Vectors for sewage pathogens include insects (e.g., flies), rodents (e.g. rats) and birds (e.g. gulls). Mitigation. Recommended measures to prevent, minimize, and control exposure to pathogens and vectors include wastewater and sludge treatment, and land application. Specific mitigation measures that will be employed include

(i) Safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors;
(ii) Use of vacuum trucks or tugs for removal of fecal sludge instead of manual methods;
(iii) Provide and require use of suitable personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves, aprons, boots, etc.). Provide prompt medical attention and cover any skin trauma such as cuts and abrasions to prevent infection and use protective clothing and goggles to prevent contact with spray and splashes;
(iv) Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. This practice also helps minimize chemical and radionuclide exposure;
(v) Encourage workers at wastewater facilities to wash hands frequently;
(vi) Provide worker immunization (e.g. for Hepatitis B and tetanus) and health monitoring, including regular physical examinations;

(vii) Reduce aerosol formation and distribution, for example by planting trees around the aeration basin to shield the area from wind and to capture the droplets and particles
(viii) Reducing aeration rate, if possible, but not to the detriment of wastewater treatment efficiency;
(ix) Avoid handling screenings by hand to prevent needle stick injuries;
(x) Maintain good housekeeping in sewage processing and storage areas; and
(xi) Advise individuals with asthma, diabetes, or suppressed immune systems not to work at wastewater treatment facilities, because of their greater risk of infection.

283. **Operation of FSSM**. A FSSM system will be provided to collect fecal sludge and septage in low lying and/or low dense areas that are not techno-economically feasible to connect to sewerage system. The collected Septage from Banjarawala (Package-1, 2 & 3) will be transported to 68 MLD Kargi STP which is equipped with septage co-treatment facility, At present, the Kargi STP is under utilized receiving only 12 to 15 MLD sewage against the 68 MLD design capacity.

284. Under septage management, septic tanks and soak pits are proposed (individual and community based) and pipe inside the properties for connection-to-connection chamber and property connection chamber outside property. This also includes the pipeline on road and connection up to community septic tanks and finally to STP for co-treatment. Although system will be completely mechanized, given the very harmful nature of septage, following precautionary measures shall be implemented:

(i) Create awareness program on the FSSM in general public; FSSM-related behavior campaigns will also be implemented as part of behavior change programs;
(ii) Implement Health and Safety Plan for FSSM;
(iii) Provide proper training to the workers, and staff in safe handling of FSSM tasks, provide all necessary personal protection equipment and ensure their usage;
(iv) Ensure that the system is operated completely mechanically, with least involvement of workers; there shall be no direct contact of septage to any worker or staff
(v) Ensure proper facilities for workers including showers, wash areas, toilets, drinking water, eating and resting places
(vi) Conduct regular health checks
(vii) Ensure that tankers cleaning is done mechanically, and in the demarcate area at STP, and the wastewater generated in the process shall be discharged into STP.
(viii) Standard Operating Procedure (SOP) for cleaning of sewers and septic tanks by CPHEEO shoud be followed. [22]

285. **Closure Plan of Septic tanks**. A number of households would be connected to the sewerage network under the Project. However, the existing septic tank system that is being used by the residents should be closed appropriately. This is to prevent the contamination of groundwater or surface water or land resulting from improperly closed septic tank system or septic tank failure. Effective and proper closure of septic tanks can be achieved when the sullage present in the system is emptied into a larger mobile tank which is later sent to the treatment plant for effective treatment. Later, the walls of the septic walls should be removed and disposed as construction debris appropriately. Subsequently, the empty septic tank pit should be filled with stone, coarse and fine sand material to complete the septic tank closure. Towards this, the Nagar Nigam should establish a mechanism by which the household owners can hire recognized service

[22] http://cpheeo.gov.in/upload/5c0a062b23e94SOPforcleaningofSewersSepticTanks.pdf

providers to perform effective septic tank closures and the Nagar Nigam can issue a closure permit after inspection.

286. **Storm Water Drainage Systems.** Storm water drainage system ensure that surface runoff generated during rainy season is properly collected, transported and discharged to the nearest water body without causing any health or environmental problems. The catchment outside the project boundary and contributing runoff in the area shall also be considered while designing storm water drainage system.

287. The drainage system is in its best when it is maintained as properly as designed. For this purpose, it is necessary that the drains keep their shape and slope in the designed manner during their lifetime. It is also necessary to ensure that the drains retain their full cross section, particularly for the monsoon. The extent of these repairs depends upon location of the drain, nature of nearby habitation and cross drainage structures. Garbage, solid waste and road cleanings enter the drain resulting in silting and solid crustation of extraneous material making the maintenance difficult. Regular maintenance and monitoring of the drains so as to ensure that the drains remain functional, and their discharge capacity does not reduce.

288. The DBO contractor will operate and maintain the system for a period of 5 years after completion of construction and commissioning the new system. Thereafter, the Nagar Nigam, Dehradun will maintain the storm water drainage system on a regular basis. The system of maintenance can be classified into following three categories:

(i) Continuous regular maintenance
(ii) Periodical maintenance
(iii) Special maintenance/Repairs for improvement.

289. Periodical inspection and maintenance of drains is very necessary as failure of drains may occur more due to deficiency in maintenance rather than defect in design. The principal activities may be:

(i) De-silting
(ii) Cleaning of obstruction, debris and blockage
(iii) Repairing of lining immediately at the commencement of damage or deterioration

290. During the rain also, a watch should be kept at the exit and entry point for water for the presence of undesirable collection of rubbish, polythene/paper bags blocking the passage of water and in every way ensuring free unobstructed flow of rainwater. The condition of road camber also needs to be watched. During rains, especially after heavy showers, all cross-drainage structure should be inspected to observe any blockage due to debris, log of wood and other such materials. A watch on the deficiencies in the drainage system should be kept and problem locations identified, and a record kept. Necessary corrective measures should be adopted immediately after rains. A watch on missing manhole covers and broken covers is also required to be kept and replacement/repairs carried out on priority to avoid accidents.

291. **Pollution of receiving bodies of water and nuisance due to siltation and accumulation of wastes in the drains**. Discharge of wastewater and solid waste from households and roadsides may clog the drains in the medium or longer term. This may result to accumulation of putrescible organic materials causing odor nuisance to the community and pollution to the receiving bodies of water in the area. This may also attract vectors of communicable diseases such as pests and

rodents in the drainage system that could affect public health. Following precautionary measures shall be implemented by the O&M contractor during 5 years of O&M period and then by the Dehradun Nagar Nigam afterwards :

(i) strict instruction or directive to households and commercial establishments not to discharge septic wastes and grey water into the drainage system;
(ii) strict promotion and enforcement of good waste management practices at household level; and
(iii) regular monitoring and cleaning of the silt traps, drains, and siltation or sedimentation chambers (or similar structures) at the outfalls, to prevent entry or accumulation of silt and solid wastes inside these drains and siltation chambers.

292. **Community hazards due to destroyed or removed drainage cover**. The design of the drainage system suggests that no drainage will be constructed without cover. Once constructed, there is a possibility that the covers may be damaged or removed in the medium or long term. The situation exposes the drainage as hazard to people, animals and vehicles in the area, especially at night. Dehradun Nagar Nigam to conduct regular inspection of the drainage alignments and ensure that all drainage covers are intact. In case of damage or loss of drainage cover, the Nagar Nigam shall provide replacement of this cover to avoid occurrence of accidents

293. **Biological hazards** are among the environmental risks that may adversely impact the health and wellness of the workers and the community. Breakouts of diseases such as diarrhea, flu or pandemics such as the COVID19 shall be avoided. Designs and implementation of treatment systems shall ensure that disease-causing pathogens or viruses are disinfected and will not cause any health issues. The World Health Organization has released an interim guidance on Water, Sanitation, Hygiene and Waste Management for the COVID19 virus (Appendix 15). Measures on managing wastewater and fecal waste and keeping water supplies safe are critical to avoid the start or spread of any disease.

294. **COVID-19 transmission through fecal matter and workplace safety measures for waste water works during operation phase.** Coronavirus infections are a serious threat to health systems globally. The U.S. Center for Disease Control (CDC) says: “The virus has been detected in the feces of some patients diagnosed with COVID-19. At this time, the risk of transmission of the virus that causes COVID-19 through sewerage systems is thought to be low. Although transmission of COVID-19 through sewage may be possible, there is no evidence to date that this has occurred. Water supply and wastewater management are essential services and need to be geared up in order to prevent any interruptions due to any pandemic events like COVID-19. The detailed measures required to be adopted to ensure seamless operations during such events are given in Appendix 24.

F. Cumulative Impacts

295. Cumulative impacts are those that result from the successive, incremental, and/or combined effects of a project or activity when added to other existing, planned, and/or reasonably anticipated future ones. The subproject aims to improve sewerage systems in Package 2 area of Banjarawala of Dehradun by creating required new infrastructures.

296. The water supply service area under this package is part of ward 85 (Mothorowala) and there is existing water supply in the area which is fully groundwater (tube well) based. The pipeline network is more than 25 years old, of material CI, GI and PVC. The present average supply level

is around 110 lpcd for 4 to 6 hours per day. The improved water supply system is also proposed to utilize groundwater source.

297. Raipur block of Dehradhun district falls under the “SAFE Category” as per the categorization adopted by the Central Groundwater Board (CGWB). ‘Safe’ area in terms of categorisation leaving a large scope for further development of the resource for domestic, industrial, agricultural and other uses. However, this large scope may give rise to over exploitation of the resources, in case its development is not planned properly in a scientific way. Strict monitoring of groundwater abstraction and various measures already suggested to enhance groundwater recharge, will minimize any cumulative impacts.

298. Both water supply and sewerage works including pipe laying works are proposed to be taken up simultaneously in the service area of Package 2 of Banjarawala area which is a small developing area/town congested with people, traffic and activities. There are sensitive places like hospitals, schools, and religious places. Works will be spread over entire project area, covering all the roads and streets. Although no other notable public works are anticipated during the project implementation on public roads, there will be usual construction activities, such as building constructions as Zone 7 in Southern part of newly expanded Dehradun city is a rapidly developing area. Given dry and windy weather conditions, dust generation from cumulative construction activities may be significant, and this may increase the particulate matter concentration in ambient air. Dust control measures suggested in the EMP aim to minimize the dust generation from the subproject construction activities. Suggested trenchless method, by avoiding excavation, will also help in reducing the overall dust generation from the subproject activities. If there are any road improvement works proposed to be implemented in project area, scheduling of works needs to be coordinated with the respective road agency (Nagar Nigam or Public Works Department) so that improved roads are not subjected for excavation. There is also a need to streamline sewer line works to avoid repeated excavations in the same road/street. The increase in road traffic, disturbance to traffic, public safety and workers safety issues, damage to existing utilities, influx of outstation workers, etc., due to various simultaneous construction works will be notable. However, the measures suggested in the EMP will minimize these impacts greatly, and therefore effective implementation of EMP must be ensured. Thus, the net impacts are unlikely to be significant.

299. There are no large scale ongoing or proposed developments in the project area, except for the proposed works under UUSDA, which includes the water supply, drainage and sewerage works. Hence, cumulative impacts will arise mainly from the construction of this proposed sewerage subproject and other minor works (if any) under UUDSA. The daily activities of construction workers residing temporarily at the subproject area may also contribute to the cumulative impacts.

300. It may be noted that sewer pipelines will be laid on the same roads along which water supply pipelines will be laid. The sewer pipelines will be laid along the center of the road and water pipelines along any one side of the road. Civil works for laying of both the water supply and sewer pipelines will be done simultaneously to reduce the impact duration;

301. However, such cumulative impacts will be “moderate” in magnitude during the peak of construction phase. Gradually as the construction approaches completion, the magnitude of cumulative impacts will lessen to “low” magnitude. The sensitivity of the resources, natural and artificial, within the main areas of influence has been taken into account, together with the types of works involved and their intensities.

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

303. . Noise levels near the construction sites will increase but the duration will be short. Ground vibrations due to concrete mixers, rollers, and excavators may be annoying, and damages may occur especially to older buildings. But mitigation measures, if implemented as proposed in this IEE report, will minimize these problems.

304. Traffic management during construction will be very important. A traffic management plan will be developed in consultation with relevant local traffic management agencies to ensure that the plan will be effective. After the project construction phase is over, the traffic condition will return to normal, and the operation of the project itself will have a long-term cumulative benefit to the people.

305. Although there will be temporary increase in the noise levels, fugitive dust, and common air emissions near the construction areas, no adverse residual effects to human health will occur because the impacts are short-term, localized, and will not be significant with the implementation of mitigation measures discussed in this IEE report.

VII. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Overview

306. The active participation of stakeholders including local community, NGOs/CBOs, and the media in all stages of project preparation and implementations essential for successful implementation as well as operation 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 are a must as per the ADB SPS 2009.

307. 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 network improvements will be provided, and government and utility agencies responsible for provision of services, Dehradun Nagar Nigam, Public Health Engineering Department, and Uttarakhand Pollution Control Board. Secondary stakeholder are NGOs and CBOs working in the area, community representatives, beneficiary community in general, government agencies, the executing and implementing agencies (UDD and UUSDA), Government of India and the ADB.

B. Public Consultation

308. The meaningful consultations[23] and disclosure program are a continuous process throughout the project implementation, including project planning, design and construction. During IEE preparation stage, public consultations were conducted near proposed Tube well and OHT locations and other locations of proposed water supply and sewerage networks to access the awareness of general public, present sanitation situations, environmental and health conditions in town, their opinion about the proposed project and suggestions. Local residents, businesspersons (vendors, hawkers, shopkeepers etc.), Government officials, women and residents were consulted during public consultations (February 2019). The proposed water supply, sewerage and storm water drainage facilities proposed under subproject Package 2 will cover parts of ward numbers 83 (Kedarpur) and 85 (Mothrowala) located in the southern periphery of newly expanded Dehradun, Zone 7. Key stakeholders were local residents and NGO's from sub project areas of Dehradun and are direct beneficiaries. Details of public consultations are given in Appendix 18.

1. Consultation during Project Preparation

309. Focus-group discussions with affected persons and other stakeholders were conducted to learn their views and concerns. Consultations were held at Doon University Road to Mothrowala, New Canal Road, Neelkanth Colony, Shriram Vihar, Geetanjali Enclave, Ramkrishna Colony, Swarn Ganga Enclave and at the office of Nagar Nigam, urban local body (ULB) and along the

[23] ADB SPS requires meaningful consultation to be a process that (i) begins early in the project preparation stageand iscarriedoutonas anongoingprocess throughout theprojectcycle;(ii)providestimelydisclosureofrelevantandadequate informationthatisunderstandableandreadilyaccessibletoaffectedpeople;(iii)isundertakeninanatmospherefree of any socio-economic and cultural etc. pressure ; (iv) is gender inclusive and responsive, and is responsive to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and otherstakeholdersinto decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues

pipeline stretch by the DPR consultants. The details such as salient features of technical provisions in projects, proposed project implementation schedule, benefits as well as possible inconveniences and envisaged adverse impacts; environmental and social, gender inclusion, community awareness and participation, have been shared. The viewpoints of the stakeholders have been incorporated into the draft IEE report for the project.

Table 30: List of Public Consultations Held in Package 2 Subproject Area

Sl. No.	Date	Location	Total participants	Female participants	Type of stakeholder
1	26.02.2019	Nagar Nigam Office, Dehradhun	19	1	Nagar Nigam Officials
2	06.01.2021	Doon University Road Mothrowala	19	07	Nearby residents, general public
3	07. 01.2021	New Canal Road Mothrowala	16	09	Nearby residents, general public
4	08. 01.2021	Neelkanth Colony, Shriram Vihar and Geetanjali Enclave	18	04	Nearby residents, general public
5	08. 01.2021	Ram Krishna Colony, Swarn Ganga Enclave, Triharinagar	15	06	Nearby residents, general public
	Total		**87**	**27**	

310. Public consultation had been conducted to assess the impact of proposed civil work on the livelihood of the people, local environmental set up and also to prepare Initial Environmental Examination (IEE). The site verification reveals that, all the components of the subprojects are either located on vacant government land or along the existing right-of-way (RoW) of the city. The subproject details have been explained in detail to the people who are involved in public consultation and also asked their suggestions and willingness to complete the proposed civil work. It is observed that people shown their willingness in favour of this proposed water supply and sewerage project. They are agreed to take up house service connections. Details of public consultations are attached in Appendix 18. Points / issues raises / feedback received are listed below:

(i) Awareness and extent of the project and development components
(ii) Benefits of Project for the economic and social upliftment of Community
(iii) Labour availability in the Project area or requirement of outside labour involvement
(iv) Local disturbances due to Project Construction Work
(v) Necessity of tree felling etc. at project sites
(vi) Water logging and drainage problem if any
(vii) Climatic Conditions
(viii) Drinking water problem
(ix) Sewerage system
(x) Forest and sensitive area nearby the project site
(xi) Movement of wild animal etc.
(xii) Pollution level during construction period specially dust and noise pollution
(xiii) Health and Hygiene
(xiv) Safety of residents during construction phase
(xv) Solid waste disposal system
(xvi) Reuse of treated effluent

(xvii) Disposal of treated effluent in natural water body
(xviii) Requirement of enhancement of other facilities.

311. The feedback received from the local people during discussions on above topics are summarised below:

(i) People were aware of the proposed Project of water supply and sewerage in the town.
(ii) They were concerned about the poor sewerage and irregular water supply conditions.
(iii) There is not any forest, wildlife or any sensitive /unique environmental, component nearby the project area...
(iv) There are no historical/cultural and religious sites in nearby the subproject area.
(v) Solid waste collection facility is poor in this area.
(vi) It was demanded that contractor should use modern machinery and water sprinkler to control dust and noise during construction phase. All the pollution control measures will be adopted at site to control the fugitive emission in the area and for control of noise.
(vii) Local people demanded that the contractor should take care of the safety arrangement during construction phase and should provide traffic diversion routes to avoid the vehicle congestion.
(viii) Treated water and sludge to be provided to locals for reuse in agricultural activities free of cost

312. It was also observed that people are willing to extend their cooperation as the proposed activities are proposed to enhance the infrastructure service levels and the living standard of the public. The public expressed their concern regarding the nuisance and disturbance (dust, road closure and traffic management activities) during the construction stage which can have impact on their day-to-day activities. Public demanded for advance notice before construction and proper warning signs along the construction area to avoid accidents and inconvenience. Public opined that an appropriate operation and maintenance system should be in place, especially for sewerage system, for its best functioning and to have the maximum health and aesthetic benefits.

2. Consultation during construction

313. Prior to start of construction, Nagar Nigam Dehradun and PIU with the assistance of DSC will conduct information dissemination sessions at major intersections and solicit the help of the local community leaders/prominent citizens to encourage the participation of the people to discuss various environmental issues. 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, and provide a mechanism through which stakeholders can participate in project monitoring and evaluation.

314. A constant communication will be established with the affected communities to redress the environmental issues likely to surface during construction and operational phases and also regarding the grievance redress mechanism. Nagar Nigam Dehradun and PIU with the help of consultants will organize public meetings and will appraise the communities about the progress on the implementation of EMP. Meetings will also be organized at the potential hotspots/sensitive locations before and during the construction. Continuous public consultation will be carried out by the PMU, PIU officials, consultants and contractors throughout the project lifecycle.

C. Information Disclosure

315. Executive summary of the IEE will be translated in the local language and made available at the offices of UUSDA-UDD, Nagar Nigam, PMU and PIU. Copies of summary will be provided to participants of city level workshop to be organized in Dehradun city. Hard copies of the IEE will be accessible to citizens as a means to disclose the document and at the same time creating wider public awareness. Electronic version of the IEE in English and executive summary in Hindi will be placed in the official website of the ULB/UUDP/UUDSP/PMU after approval of the IEE by Government and ADB. Stakeholders will also be made aware of grievance register and redress mechanism.

316. Public information campaigns via newspaper/radio/TV, 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.

317. 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.

318. Project related information shall be disclosed through public consultation and making relevant documents available in public locations. PMU and PIUs shall provide relevant safeguards information in a timely manner, in an accessible place and in a form and languages understandable to affected person and other stakeholders. For illiterate people, other suitable communication methods will be used.

319. The following documents shall be made available at the offices of project agencies - PMU, PIU and Block level offices for public reference, and shall also be uploaded on respective websites.

(i) Summary of project and draft IEE (in Hindi and English)
(ii) Draft IEE Report (in English)
(iii) Final IEE Report (in English)
(iv) Updated/amended IEE (in English)
(v) Corrective action plan prepared during project implementation (English)
(vi) Semi-annual Environmental Monitoring Reports (English)

320. A concise summary of project and draft IEE report (in Hindi), providing all necessary details of proposals, implementation arrangements, subproject locations, likely issues and mitigation and monitoring measures and grievance redress mechanism, shall be made available to the stakeholders at consultation meetings. This should also provide contact information of project agency. This summary shall also be displayed at the notice boards of PMU, PIU and other public places. During project implementation, relevant information about any major changes to project scope will be shared with beneficiaries, affected persons, vulnerable groups, and other stakeholders. The above documents should be submitted to ADB for disclosure on ADB website.

VIII. GRIEVANCE REDRESS MECHANISM

A. Project Specific Grievance Redress Mechanism

321. A project-specific grievance redress mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of Affected Persons (AP's) concerns, complaints and grievances about the social and environmental performance at the level of the project. The GRM will aim to provide a time-bound and transparent mechanism to record and resolve social and environmental concerns linked to the project.

322. A project-specific, four-tier grievance redress mechanism (GRM) covers both social and environment issues. The GRM will be established to register, evaluate, and facilitate the resolution of affected persons' concerns, complaints, and grievances about the performance of social and environmental issues in the project Implementation. It will aim to provide a time-bound and transparent mechanism to voice and resolve social and environmental concerns. Assessment of the GRM designed and implemented for Uttarakhand Urban Sector Development Investment Program (UUSDIP)[24] shows that the system was effective in timely resolution of grievances in a transparent manner.[25] The multichannel, project-specific, three-tier GRM is functional at UUSDIP, hence the design of GRM for UUSDIP[2] takes into account the proposed institutional structure for UUDP[26] and the positive features and learning's from the previous GRM.

323. **Common GRM**. A common GRM will be in place for social, environmental, or any other grievances related to the project. The GRM will provide an accessible and trusted platform for receiving and facilitating resolution of affected persons grievances related to the project.

324. The grievance redress mechanism will provide an accessible, inclusive, gender-sensitive and culturally appropriate platform for receiving and facilitating resolution of affected persons' grievances related to the project. The construction works under the contract package will be carried-out along inhabited areas, therefore, it is anticipated that it may lead to some disturbance and inconvenience to local people. In order to provide a direct channel to the affected persons and stakeholders for approaching project authorities and have their grievance registered and redressed in an appropriate time frame, PMU will establish a Grievance Redress Mechanism, which will be functional throughout the project period.

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[24]The procedures followed for grievance redresss during implementation of UUSDIP Loan 1 & 2 included the project level GRM, including providing toll free number for grievance registering, Samadhan (www.samadhan.uk.gov.in), portal of Government of Uttarakhand and the Chief Minister's helpline. Complaints received through various channels were mostly minor and pertained to damage to existing water supply pipelines and disruption of water supply during construction, delays in road restoration, pending new connections and increase in Noise and dust levels Complaints related to damage to private property (compound walls/steps, etc.) were less in number. The grievances were resolved in coordination with the contractors. Complaints received were immediately referred by the CAPA/DSC supervision staff to the IPIU Nodal officer (safeguards) and concerned engineer at PIU, who advised them on further action. Follow up with the contractor on complaint resolution was undertaken by PIU Nodal officer CAPA; and DSC and final feedback sought from complainant upon resolution. Complaints requiring inter-departmental coordination were referred to the IPMU for resolution, and feedback provided to complainant. ThePMU kept regular track of grievances through WhatsApp and email also, ensuring registration and follow-up till its successful resolution.

[6]Town-level grievance registration data at PIU level indicates that a large number of grievances were registered, pointing to the effectiveness of the multi-channel GRM. No major grievance was received for both the phases of UUSDIP . The GRM helped smoothen the process of project implementation, hence the proposed architecture for the UUDP GRM remains similar, with some refinement, taking into account the changes in institutional setup proposed for project implementation.

[26]Logistics support at field level will be key to successful management of grievance redress under UUDP. The target date for establishment of the first level (PIU level) and second level (Zonal level) of GRM is before loan negotiation.

325. A Complaint receiving system will be put in place at each site with the help of Community Awareness & Public Participation Agency (CAPPA). A Complaint Register and Complaint Forms will be made available at the site office of each contractor, with a display board indicating availability of such facility.

326. Public awareness campaigns within entire ULB/Municipal area will ensure that awareness on grievance redress procedures is generated. The nodal officer- social/environment at field level through Community Awareness & Public Participation Agency (CAPPA) will conduct ULB/Municipal area-based awareness campaigns to ensure that poor and vulnerable households are made aware of grievance redress procedures and entitlements. Contractors will provide pamphlets to communities prior to start of works and billboards during construction. The pamphlets and billboards will include relevant environmental and social safeguards, GRM information, and contact details of key personnel from PIU and contractors.

327. Affected persons will have the flexibility of conveying grievances/suggestions by dropping grievance redress/suggestion forms in complaint/suggestion boxes that will be installed by project PIUs or by e-mail, by post, or by writing in complaints register in ULB offices/complaints register at contractor's work site. Appendix 19 has the sample grievance registration form. 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 and feedback provided to the complainant on action/decision taken. The Safeguard and Safety Officer of town/city level PIU will have the overall responsibility for timely grievance redressal on environmental and social safeguards issues and for registration of grievances, related disclosure, with the assistance of project consultants. In case of grievances that are immediate and urgent in the perception of the complainant, the contractor, and officials of PIU with assistance from Community Awareness and Public Participation Agency (CAPpA) on-site will provide the most easily accessible or first level of contact for quick resolution of grievances. Contact numbers and names of the concerned PIU safeguard and safety officer, contractors, CAPpA and PIU personal will be posted at all construction sites at visible locations.

B. Grievance Redress Process

328. Grievances of affected persons will first be brought to the attention of the Community Awareness and Public Participation Agency (CAPPA), and PIU. Grievances not redressed will be brought to the Town Level Committees (TLC) set up to monitor project implementation in each town. The TLC, acting as a grievance redress committee (GRC) is chaired by the Mayors or Chairpersons with representatives of ward members, the District Magistrate, Commissioner, Uttarakhand Peya Jal Nigam (UPJN), Uttarakhand Jal Sansthan (UJS), Public Works Department (PWD), business, and civil society. As a GRC, the TLC will meet every month (if grievances are brought to the Committee), determine the merit of each grievance, and resolve grievances within a month of receiving the complaint. This will accept complaints regarding the social safeguard issues in implementation of the project. The grievances received and actions taken will be included into the environmental monitoring reports submitted to ADB. The following 4-stage process will be followed in grievance redress. GRM structure for UIRUDP is presented in the Figure 34 below.

(i) **1st level grievance**: Complaints received (written or oral communication) will be registered in Complaint Register assigning complaint number with date of receipt The PMDSC/PIU will review the complaint and direct the Contractor for necessary action; depending on the type/nature of complaint the Contractor will be given reasonable

time for corrective action; the CAPPA will inform the complainant, within 24 hours, the time frame in which the corrective action will be taken by e-mail or telephonically; if the grievance referred will not fall under the purview of the project/program, the same will be intimated to the complainant; Contractor will take corrective action or as directed by PMDSC; the CAPPA in coordination with PMDSC will conduct the site visit to check the action taken and its appropriateness. The action taken will be documented in the Complaint Register, and the complaint will be closed if it is satisfactorily addressed (within 7 days of receipt of compliance/grievance) and the complainant will be informed through e-mail/telephonically.

(ii) **2nd level grievance:** In case of no satisfactory action in Level-1, the complainant can approach PMU/PMDSC for necessary action; CAPPA will assist the complainant in doing so. PMU with the assistance of PMDSC will initiate action and take the corrective measures as required, and CAPPA will intimate the complainant about the action taken; and Upon satisfaction of complainant, the case will be closed and marked as resolved within 15 days of receipt of compliance/grievance

(iii) **3rd level grievance:** if complainant would be non-satisfied with the action made or due to noncompliance of grievance at Level 2, the complainant can approach the Grievance Redress Committee (maximum 7 days)

329. **Grievance Redress Committee**. The Town Level Committee (TLC) will act as a grievance redress committee (GRC)[27] for both social safeguard & environment issues. The TLC would be chaired by Mayor of Dehradun Municipal Corporation and will have the member from civil society, elected representatives and government officials. Grievances related to Social and environmental safeguards will be handling by TLC[28] in its regular meetings. The PMU Social Development and Gender Officer (SCGO) and Environment Specialist and CAPPA will assist the TLC in facilitating in smooth functioning of GRM.

330. The PMU will submit RP/EMP/SEMP implementation report to ADB's review, and will ensure that affected persons will receive compensation and other assistances as per EM prior to commencement of civil works. The issues relating to environment will be redressed as per the guidance provided in EMP/SEMP.

331. The project GRM notwithstanding, an aggrieved person shall have access to the country's legal system at any stage and accessing the country's legal system can run parallel to accessing the GRM and is not dependent on the negative outcome of the GRM. In case of grievance related to land acquisition, resettlement and rehabilitation, the affected persons will have to approach a legal body/court specially proposed under the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (RFCTLARRA[29]), 2013.

332. **ADB's Accountability Mechanism.** The People who may /are in future being, adversely affected by the project may submit complaints to ADB's Accountability Mechanism. The Accountability Mechanism provides an independent forum and process whereby people adversely affected by ADB-assisted projects can voice, and seek a resolution of their problems, as well as

[27]It is suggested for each PIU to have a dedicated WhatsApp group for registration of grievances and receipt of quick feedback, to be followed by more formal communication. And Project contractors in all project towns will have a toll-free number with specific working hours for registration of grievances related to UUDP.

[28]The TLC has been formed at each of the targeted town/city level for planning and monitoring of work, resolve issues related to departmental coordination etc. It is headed by Commissioner /Executive Officer ULB(Chairman) and Executive Engineer of UJS/UJN, public works department (PWD) and head of PIU acting as Member Secretary.

[29]Ministry of Law and Justice. The Act has received the assent of the President on the 26 September 2013.

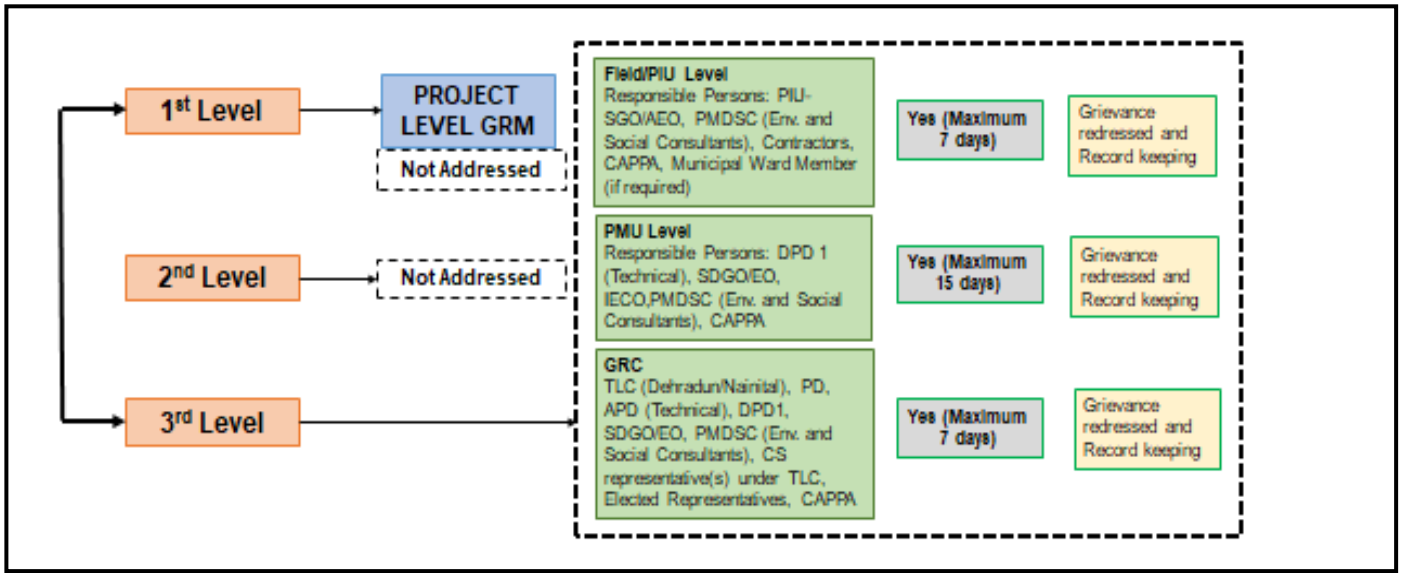
report alleged violations of ADB's operational policies and procedures. Before submitting a complaint to the Accountability Mechanism, affected people should make an effort in good faith to solve their problems by working with the concerned ADB operations department. Only after doing that, and if they are still dissatisfied, should they approach ADB accountability mechanism[30].

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

334. **Periodic review and documentation of lessons learned**. The PMU project officers (Social and community development officer and Environmental Specialist will periodically review the GRM functioning at PIU/PMDSC/Construction Contractor level and record information on the effectiveness of the mechanism, especially on the project's ability to transparently prevent and address the reported grievances.

335. **Costs.** As part of the EMP cost the construction contractors will be allocating budget for pamphlets and billboards as per requirement. All costs involved in resolving the complaints (meetings, consultations, communication and reporting/information dissemination) will be borne by the concerned PIU at town level while costs related to escalated grievances will be met by the PMU. Cost estimates for grievance redress are included in resettlement cost estimates.

Figure 27: Grievance Redress Process for UUDP



AEO = Assistant Environmental Officer; APD = Additional Program Director; CAPPA = Community Awareness and Public Participation Agency; CS = Civil Society DBO = Design Build and Operate Contractor; DPD = Deputy Program Director; EO = Environmental Officer; IECO = Information Education and Communication Officer; PD = Program Director; PIU = Project Implementation Unit; PMDSC = Project Management, Design & Construction Supervision Consultant; PMU = Project Management Unit; SDGO = Social Development and Gender Officer, SGO = Social and Gender Officer; TLC = Town Level Committee

[30]Accountability Mechanism. http://www.adb.org/Accountability-Mechanism/default.asp.

IX. ENVIRONMENTAL MANAGEMENT PLAN

A. Environmental Management Plan

336. An Environmental Management Plan (EMP) has been developed to provide mitigation measures to reduce all negative impacts to acceptable level and monitoring the same. This is presented in the following tables (Tables 32 to 37), which shows the potential environmental impacts, proposed mitigation measures and responsible agencies for implementation and monitoring.

337. The purpose of the environmental management plan (EMP) is to ensure that the activities are undertaken in a responsible, non-detrimental manner with the objectives of: (i) providing a proactive, feasible, and practical working tool to enable the measurement and monitoring of environmental performance on-site; (ii) guiding and controlling the implementation of findings and recommendations of the environmental assessment conducted for the project; (iii) detailing specific actions deemed necessary to assist in mitigating the environmental impact of the project; and (iv) ensuring that safety recommendations are complied with.

338. A copy of the EMP must be kept at work sites at all times. This EMP will be included in the bid documents and will be further reviewed and updated during implementation. The EMP will 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 constitutes a failure in compliance.

339. For civil works, the contractor will be required to (i) establish an operational system for managing environmental impacts (ii) carry out all of the monitoring and mitigation measures set forth in the EMP; and (iii) 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 EMP. The contractor shall allocate budget for compliance with these EMP measures, requirements and actions.

340. The contractor will be required to submit to PIU, for review and approval, a site-specific environmental management plan (SEMP) 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 SEMP; and (iv) budget for SEMP implementation. No works can commence prior to approval of SEMP.

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

Table 31: Design Stage Environmental Management Plan

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation/ Monitoring	Cost and Source of Funds
Location impacts of proposed components	Nearby community may be affected due to increased pollution during construction and operation	Sites should be selected so that nearby community may have no or minimum impact due to proposed works	DBO Contractor / PIU	Project cost
All work sites	Tree cutting	(i) Minimize removal of trees by adopting to site condition and with appropriate layout design of STP or any other site with trees (ii) Obtain prior permission for tree cutting at STP site or at any other site that may require tree cutting finalized during detailed design (iii) Plant and maintain 3 trees for each tree that is removed	DBO Contractor / PIU	Project cost
Site preparation	Removal of solid waste and other nuisance materials	(i) Ensure that the project sites are cleared of solid waste or other nuisance materials (ii) Dispose solid waste from existing sites and materials into designated locations (dumping in vacant lot is not allowed). Appendix 13 provides the documentation for the Materials Recovery Facility and the Checklist for Solid Waste Management Transport	PIU	
Design water supply and sewerage works	Non-compliance or non-adherence with the environmental considerations proposed in preliminary designs during detailed design:	Ensure compliance with the following during the detailed design: (i) Locating components and facilities appropriately by avoiding sensitive locations like forests and protected areas (environmentally, socially, and archeologically). (ii) Avoiding usage of asbestos containing materials (iii) Reducing the incidence of water borne diseases by providing 100% population including urban poor with potable water supplies (iv) Reuse of treated wastewater from STP for non-potable uses thereby reducing the load in freshwater resources (v) Adopting a combined approach of sewerage system and faecal sludge and septage management to cover 100%	DBO Contractor / PMU	Project cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation/ Monitoring	Cost and Source of Funds
		population of the project area with safe collection, conveyance and treatment of sewage generated in the town (vi) Provision of appropriate personal protection equipment to the workers and staff		
Design of sewerage system	Potential risks from natural hazards including severe climate change impacts such as flooding	ADB's Guidelines for Climate Proofing Investment in the Water Sector: Water Supply and Sanitation[31] will be followed	DBO Contractor/PMU	Project cost
Seismic sensitivity	Damage to infrastructure and potential risks: project area in Severe earthquake risk zone (Zone V)	(i) Designs of project component structures shall comply with relevant codes of design such as Bureau of Indian Standard (BIS) specifications for earthquake resistant design (IS: 1893: Criteria for earthquake resistant design of structures).	DBO Contractor/PIU	Project cost
Groundwater source	Groundwater contamination	(i) Prepare a source protection plan for tube wells and open wells (ii) Prevent flow of untreated wastewater in the drains (iii) Ensure proper construction of tube wells including casing pipes to prevent water contamination from well spaces, and due to flooding (iv) Measures should be taken to control the open defecation, and to close all unsafe latrines (for example pit latrines). (v) Awareness programs shall be conducted regarding the sanitation practices and its effect on groundwater quality	DBO Contractor and ULB/PIU	Project costs and ULB cost
Change in raw sewage quality	Mixing of industrial effluent with sewage	(i) No industrial wastewater shall be allowed to dispose into municipal sewers (ii) As there is a risk of potential mixing of industrial waste, no domestic wastewater from industrial units shall be allowed into municipal sewers (iii) Ensure that there is no illegal discharge through manholes or inspection chambers (iv) Conduct public awareness programs; in coordination with UEPPCB and CLC.	DBO Contractor and PIU / PMU	Project Cost

[31] Guidelines for Climate Proofing Investment in the Water Sector: Water Supply and Sanitation (adb.org)

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation/ Monitoring	Cost and Source of Funds
		(v) Conduct regular wastewater quality monitoring (at inlet and at outlet of STP) to ensure that the treated wastewater quality complies with the effluent standards		
Sewer network – collection and conveyance	Poor design leading to overflows, blockages, and creating nuisance, pollution	(i) Limit the sewer depth where possible (ii) Sewers shall be laid away from water supply lines and drains (at least 1 m, wherever possible); (iii) In all cases, the sewer line should be laid deeper than the water pipeline (the difference between top of the sewer and bottom of water pipeline should be at least 300 mm) (iv) In unavoidable, where sewers are to be laid close to storm water drains, appropriate pipe material shall be selected (stoneware pipes shall be avoided) (v) For shallower sewers and especially in narrow roads, use small inspection chambers in lieu of manholes; (vi) Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replaced if broken to minimize silt/garbage entry (vii) Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope and gas vents in gravity mains to prevent buildup of solids and hydrogen sulfide generation (viii) Take necessary precautionary measures to protect sewer network, and to avoid disposal of solid wastes, debris, wastewater into newly laid sewers from the time it is constructed to the start of operation phase	DBO Contractor/PIU	Project cost
FSSM	Occupational health and safety issues, and impact on STP process	(i) Conduct detailed survey of the households to be covered with FSSM to design the system to suit the local conditions, such as type of septic tanks and their location in the houses (ii) Create awareness program on the FSSM from collection to treatment system that will be adopted. FSSM-related behavior campaigns will also be implemented as part of behavior change programs. This will also make the households aware of materials/substances that may kill septic tank bacteria if discharged into drains or flushed down the	DBO Contractor/PIU	Project cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation/ Monitoring	Cost and Source of Funds
		toilets (refer for guidance - https://www.csrd.bc.ca/sites/default/files/liquid-waste-management/Septic-Smart/Docs/dos-and-donts.pdf) (iii) Design the sewage treatment process duly considering mixing of septage (iv) Ensure that the FSSM system is completely mechanized no human touch, even accidentally, from collection at household to discharge into STP, and in periodic cleaning of tankers (v) Demarcate a proper area for cleaning of mobile tankers in STP premises, and ensure that the wastewater shall be discharged into STP (vi) Provide proper training to the workers, and staff in safe handling of FSSM tasks, provide all necessary personal protection equipment (vii) Ensure proper facilities for workers including showers, wash areas, toilets, drinking water, eating and resting places (viii) Conduct regular health checks (ix) Prepare Health and Safety Plan for FSSM Following measures are also suggested during design phase of septic tanks • (i) Ensure septic tank is constructed on a level surface (ii) Design septic tanks as watertight / water sealed structures with appropriate materials such as reinforced cement concrete (iii) Ensure adequate room for above the liquid level for scum accumulation, and adequate free board (iv) Design proper, safe and secured access to septic tank for inspection and cleaning; ensure appropriate size and		

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation/ Monitoring	Cost and Source of Funds
		sealing cover with locking arrnagement, and ensure that it is watertight to account for flooding and/or high-water table conditions (v) Ensure that septic tank inlet sewers and outlet sewers are watertight (vi) Design proper gas ventilation systems such as vent pipes appropriately to collect and disperses gases to avoid accumulation and bad odours (vii) Ensure appropriate design and materials for soak pits to ensure that effluent is adequately treated, absorbed into the soil without contaminating groundwater; ensure that top of the soak is pit is covered properly		
Storm Runoff	Beside storm water, silts and wastewater from other sources may enter the proposed storm drain and may pollute the drain and the receiving bodies of water. Chances of disposal of solid waste by the locals into the drains resulting clogging of drains and polluting the receiving bodies of water	The design to consider the following: - Provision of cover slab in the design to avoid the illegal entry of waste water and solid waste disposal. - The inlet design to ensure that only storm or rainwater flows into the drainage system. - Prevent households from connecting outlets of septic tanks and grey water to the drainage lines. - Provide siltation or sedimentation chambers (or similar structures) at the outfalls of the drainage system to prevent solid wastes or silts from flowing directly to the receiving body of water.	Storm Runoff	Beside storm water, silts and wastewater from other sources may enter the proposed storm drain and may pollute the drain and the receiving bodies of water. Chances of disposal of solid waste by the locals into the drains resulting clogging of drains and polluting the

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation/ Monitoring	Cost and Source of Funds
		- Position the outfall enough to have space for the provision of siltation or sedimentation ponds (or similar structures), including accessibility during maintenance phase		receiving bodies of water
Preparation of plans and protocols	Various impacts	(i) Preparation of Asbestos Cement Management (ACM) Management Plan (ii) Prepare traffic management plan (iii) Prepare occupational health and safety plan (iv) Prepare spoils management plan	DBO Contractor and DSC (for ACM plan)	Approval of plans by PIU

Table 32: Environmental Management Plan of Anticipated Impacts during Pre-Construction

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
Environmental monitoring of baseline conditions of air, noise, water and soil	To establish base line environmental conditions	Environmental monitoring through NABL accredited laboratory	Construction contractor	Consultants/PIU	Contractor
Utilities	Telephone lines, electric poles and wires, water lines within proposed project area	(i) Identify and include locations and operators of these utilities in the detailed design documents to prevent unnecessary disruption of services during construction phase; and (ii) Require construction contractors to prepare a contingency plan to include actions to be taken in case of unintentional interruption of services	DBO Contractor in collaboration with PIU and with approval of PMU	(i) List of affected utilities and operators; (ii) Bid document to include requirement for a contingency plan for service interruptions (example provision of water if disruption is more than 24 hours), spoil management plan (Appendix 13), and traffic management	Project Cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
		(iii) inform the local community in advance if utilities will be disrupted during construction). (iv) Require contractors to prepare spoils management plan (Appendix 13) and traffic management plan (Appendix 14)		plan (Appendix 14)	
Social and Cultural Resources	Ground disturbance can uncover and damage archaeological and historical remains	Develop a protocol for use by the construction contractors in conducting any excavation work, to ensure that any chance finds are recognized, and measures are taken to ensure they are protected and conserved.	DBO Contractor and PIU	Chance Finds Protocol	No cost required. Mitigation measures are part of TOR of PIU and Consultant
Construction work camps, hot mix plants, stockpile areas, storage areas, and disposal areas.	Disruption to traffic flow and sensitive receptors	(i) Prioritize areas within or nearest possible vacant space in the project location; (ii) If it is deemed necessary to locate elsewhere, consider sites that will not promote instability and result in destruction of property, vegetation, irrigation, and drinking water supply systems; (iii) Do not consider residential areas; (iv) Take extreme care in selecting sites to avoid	Contractor to finalize locations in consultation and approval of PIU	(i) List of selected sites for construction work camps, hot mix plants, stockpile areas, storage areas, and disposal areas. (ii) Written consent of landowner/s (not lessee/s) for reuse of excess spoils to agricultural land	No cost required. Mitigation measures are part of TOR of PIU and Consultant and also part of contractual terms

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
		direct disposal to water body which will inconvenience the community. (v) For excess spoil disposal, ensure (a) site shall be selected preferably from barren, infertile lands. In case agricultural land needs to be selected, written consent from landowners (not lessees) will be obtained; (b) debris disposal site shall be at least 200 m away from surface water bodies; (c) no residential areas shall be located within 100 m downwind side of the site; and (d) site is minimum 250 m away from sensitive locations like settlements, ponds/lakes or other water bodies.			
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) Prioritize sites already permitted by the Department of Mines and Geology (ii) If other sites are necessary, inform construction contractor that it is their responsibility to verify the suitability of all material sources and to obtain the approval of PMU and	DBO Contractor to prepare list of approved quarry sites and sources of materials with the approval of PIU	(i) List of approved quarry sites and sources of materials; (ii) Bid document to include requirement for verification of suitability of sources and permit for additional quarry sites if necessary.	No cost required. Mitigation measures are part of TOR of PIU and Consultant and also part of contractual terms

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
		(iii) If additional quarries will be required after construction is started, inform construction contractor to obtain a written approval from PIU.			
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 (including CTE for STP from UEPPCB), permits, clearance, NOCs, etc. prior to award of civil works. Following consents are required- Tree cutting- local authority Storage, handling and transport of hazardous materials- UEPPCB Sand mining, quarries, borrow areas- Department of mines and Geology Traffic diversion/road cutting- local authority, traffic police (ii) Ensure that all necessary approvals for construction to be obtained by contractor are in place before start of construction (iii) Acknowledge in writing and provide report on compliance all obtained consents, permits, clearance, NOCs, etc. (iv) Include in detailed	DBO Contractor and PIU and Consultant	Incorporated in final design and communicated to contractors.	No cost required. Cost of obtaining all consents, permits, clearance, NOCs, etc. prior to start of civil works responsibility of PIU. Mitigation measures are part of TOR of PIU and Consultant

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
		design drawings and documents all conditions and provisions if necessary			
Storm Runoff	Beside storm water, silts and wastewater from other sources may enter the proposed storm drain and may pollute the drain and the receiving bodies of water. Chances of disposal of solid waste by the locals into the drains resulting clogging of drains and polluting the receiving bodies of water	The design to consider the following: - Provision of cover slab in the design to avoid the illegal entry of waste water and solid waste disposal. - The inlet design to ensure that only storm or rainwater flows into the drainage system. - Prevent households from connecting outlets of septic tanks and grey water to the drainage lines. - Provide siltation or sedimentation chambers (or similar structures) at the outfalls of the drainage system to prevent solid wastes or silts from flowing directly to the receiving body of water. - Position the outfall enough to have space for the provision of siltation or sedimentation ponds (or	DBO Contractor and PIU and Consultant	Incorporated in final design and communicated to contractors, prior to award of contract	No cost required. Mitigation measures are part of TOR of PIU and Consultant and also part of contractual terms

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
		similar structures), including accessibility during maintenance phase			
Storm water Drainage operations .	Impact to the environment, workers, and community due to accidents or accidental discharge of domestic wastewater into the drainage system	Development of O&M manual that is comprehensive and includes measures to prevent discharge of domestic wastewater to the storm water drainage system and accidents due to the drainage canals	DBO Contractor and PIU and Consultant	Availability of final version of O&M manual	No cost required. Mitigation measures are part of TOR of PIU and Consultant and also part of contractual terms
Updating of IEE and SEMP	Expecting minor impacts, during construction period only and mitigation measures are addressed.	(i) Update IEE based on detailed designs, and submits to ADB for review, approval, and disclosure prior to commencement of work. (ii) Formulate SEMP during implementation and get approval from the PD. (iii) Relevant information shall be disclosed.	PIU and Consultant	PMU	No costs required
EMP Implementation Training	Irreversible impact to the environment, workers, and community.	Project manager and all key workers of contractors will be required to undergo EMP implementation training including spoils management, Standard operating procedures (SOP) for construction works; health and safety (H&S), core labor laws, applicable environmental laws etc.	Contractor, DSC	PIU/PMU	Cost of EMP Implementation Orientation Training to contractor is responsibility of PMU.

Table 33: Environmental Management Plan of Anticipated Impacts during Construction

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
EMP Implementation	Irreversible impact to the environment, workers, and community	(i) Contractor is required to depute a qualified and experienced EHS officer/supervisor for monitoring of EMP implementation measures (ii) Project manager and all key workers will be required to undergo training on EMP implementation including spoils management, Standard operating procedures (SOP) for construction works; occupational health and safety (OH&S), core labor laws, applicable environmental laws, etc.	Construction Contractor	(i) Certificate of Completion (Safeguards Compliance Orientation) (ii) Posting of Certification of Completion at worksites (iii) Posting of EMP at worksites	Contractor, Project cost
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) Plan the work sites properly, and demarcate the sites for stockpiling of, soils, gravel, and other construction materials away from the traffic, vehicle, general worker movement to avoid disturbance of loose materials (ii) Damp down exposed soil and any stockpiled material on site by water sprinkling; (iii) Use tarpaulins to cover sand and other loose material when transported by trucks; (iv) Clean wheels and undercarriage of haul trucks prior to leaving construction site (v) Don't allow access in the work area except workers to limit soil disturbance and prevent access by barricading and security personnel (vi) Fit all heavy equipment and machinery with air pollution control devices which are operating correctly, and limit idling time of construction vehicles to 3 to 5 minutes to minimize local air pollution. Contractor's vehicles and equipment should compulsorily have PUC and submit to PIU before deployment at site (vii) Obtain, CTE and CTO for batching plant, hot mix plant, crushers etc. if specifically established for this project.	Construction Contractor	(i) Location of stockpiles; (ii) Complaints from sensitive receptors; (iii) Heavy equipment and machinery with air pollution control devices; (iv) Certification that vehicles are compliant with Air Act (v) Reports of air quality monitoring	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		(viii) If contractor procures any material (such as ready mix concrete, asphalt/macadam, aggregates etc.,) from third party agencies, contractor shall ensure that such agencies have all necessary clearances / permissions as required under the law; these include CTE/CTO from UEPPCB, environmental clearance, etc., contractor shall collect the copy of these certificates and submit to PIU; PIU will approve the source only after all the certificates are submitted (ix) Conduct air quality monitoring according to the Environmental Management Plan (EMP).			
Surface water quality	Works in rains/ Mobilization of settled silt materials, and chemical contamination from fuels and lubricants during installation of pipelines, and discharge of drilling fluid/mud during water well drilling can contaminate nearby surface water quality.	(i) Prepare and implement a spoils management plan (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, consult with PIU on designated disposal areas; (iv) Inspect all the drainage at construction site/construction camp/labor camp etc. and clear all the drainage lines so that no water stagnation/flooding may occur during heavy rainfall (v) As for a possible avoid trench works and excavation works (pipe laying) during monsoon season to avoid any water logging and accident due to it (vi) If open trenches are not avoidable during monsoon, keep ready all the mitigations measures to avoid water logging such as dewatering pumps and sufficient pipes, traffic assistance, barricades etc. (vii) Inspect and verify all the emergency measures and emergency control system before	Construction Contractor	(i) Areas for stockpiles, storage of fuels and lubricants and waste materials; (ii) Number of silt traps installed along trenches leading to water bodies; (iii) Records of surface water quality inspection; (iv)Effectiveness of water management measures; (v) No visible degradation to nearby drainages, nalahs or water bodies due to civil works	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		start of monsoon, keep the emergency response committee on high alert during monsoon/heavy rain fall (ix) Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies; (x) Place storage areas for fuels and lubricants away from any drainage leading to water bodies; (xi) Dispose any wastes generated by construction activities in designated sites; and (xii) Conduct surface quality inspection according to the Environmental Management Plan (EMP). (xiii) Drilling fluid/mud including cuttings from well drilling shall be contained and properly disposed by the drilling contractor, to avoid affecting the quality of nearby surface water.			
Ground Water Quality	Contamination of ground water quality due to spillage of oil and lubricants	• Prepare and implement a spills management plan; • Provide impermeable liner on the ground and place layer of mortar or concrete over it in the oil and lubricants storage areas, provide spillage trap in oil and lubricant store, use dip tray and pump to pour oil from oil and lubricant drums; • Dispose any oil contaminated wastes generated by construction activities in scientific manner; and • Conduct ground water quality monitoring according to the Environmental Management Plan (EMP).	Contractor	(i) Areas for storage of fuels and lubricants and waste materials; (ii) Number of oil traps installed in oil and lubricant storage areas; (iii) Records of ground water quality monitoring;	Cost for implementation of mitigation measures responsibility of contractor.
Noise and Vibration Levels	Increase in noise and vibration levels due to earth-moving and excavation	(i) Plan activities in consultation with PIU/Consultant so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance; (ii) Horns should not be used unless it is necessary	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Use of silencers in noise-producing	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
	equipment, and the transportation of equipment, materials, and people	to warn other road users or animals of the vehicle's approach; (iii) Minimize noise from construction equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and portable street barriers the sound impact to surrounding sensitive receptor; (iv) Identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity (v) Consult local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals. (vi) Maximum sound levels should not exceed the WHO guideline for noise levels. (vii) Periodical monitoring of noise quality as per EMP		equipment and sound barriers; (iii) Equivalent day and nighttime noise levels (see Appendix 4 of this IEE)	
Landscape and aesthetics	Impacts due to excess excavated earth, excess construction materials, and solid waste such as removed concrete, wood, packaging materials, empty containers, spoils, oils,	(i) Prepare and implement spoils management plan (Appendix 13); (ii) Avoid stockpiling of excess excavated soils; (iii) Coordinate with ULB/PIU for beneficial uses of excess excavated soils or immediately dispose to designated areas; (iv) Recover used oil and lubricants and reuse or remove from the sites; (v) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; (vi) Remove all wreckage, rubbish, or temporary structures which are no longer required; and (vii) Request PIU to report in writing that the necessary environmental restoration work has been adequately performed before acceptance of	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Worksite clear of hazardous wastes such as oil/fuel (iii) Worksite clear of any excess excavated earth, excess construction materials, and solid waste such as removed concrete, wood,	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
	lubricants, and other similar items.	work.		packaging materials, empty containers	
Existing Infrastructure and Facilities	Disruption of service and damage to existing infrastructure at specified project location	(i) Obtain from PIU the list of affected utilities and operators if any; (ii) Prepare a contingency plan to include actions to be done in case of unintentional interruption of service (iii) Inform the local community in advance if utilities will be disrupted during construction	Construction Contractor	Existing Utilities Contingency Plan	Cost for implementation of mitigation measures responsibility of contractor.
Ecological Resources – Terrestrial	Loss of vegetation and tree cover	(i) Minimize removal of vegetation and disallow cutting of trees; (ii) If tree-removal will be required, obtain tree-cutting permit from the concerned department; and (iii) Plant three native trees for every one that is removed.	Construction Contractor	PIU to report in writing the no of trees cut and planted.	Cost for implementation of mitigation measures responsibility of contractor.
Ecological Resources – Faunal	Hunting, fishing or harm to animals within construction zone	• Prohibit workers from poaching and fishing in river and make awareness among workers If any animal or fish is entrapped during construction works, provide safe passage for them and do not harm them	Construction Contractor	PIU/Consultants to monitor such activities which can harm to animals and fishes	Cost for implementation of mitigation measures responsibility of contractor.
Land use	Environmental Issues due to land use change	The impact due to change in land use will be negligible due to this project.	Not applicable	Not applicable	Not applicable
Accessibility	Traffic problems and conflicts near project locations and haul road	i) Plan sewer line works to minimize traffic disturbance / blockades; as the sewer lines are to be laid in all the roads and streets in the town, work planning is crucial to minimize the inconvenience to public. (ii) Prepare and implement a Traffic Management Plan (Appendix 14) (ii) Duly consider and select sections for trenchless method of pipe laying based on traffic conditions (iii) Plan transportation routes so that heavy vehicles do not use narrow local roads, except in	Construction Contractor	(i) Traffic route during construction works including number of permanent signage, barricades and flagmen on worksite; (ii) Complaints	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		the immediate vicinity of delivery sites; (iv) Schedule transport and hauling activities during non-peak hours; (v) Locate entry and exit points in areas where there is low potential for traffic congestion; (vi) Keep the site free from all unnecessary obstructions; (vii) Drive vehicles in a considerate manner; (viii) Coordinate with Traffic Police for temporary road diversions and with for provision of traffic aids if transportation activities cannot be avoided during peak hours; (ix) Notify affected sensitive receptors 1-week in advance by providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints. (x) Plan and execute the work in such a way that the period of disturbance/ loss of access are minimum. (xi) Provide pedestrian access in all the locations until normalcy is restored. Provide wooden/metal planks over the open trenches at each house to maintain the access.		from sensitive receptors; (iii) Number of signage placed at project location.	
Socio-Economic – Income.	Impede the access of residents and customers to nearby shops	(i) Prepare and implement spoils management plan (Appendix 13). Contractor to Implement RP and to follow mitigation measures prescribed (ii) Leave spaces for access between mounds of soil; (ii) Provide walkways and metal sheets where required for people; (iii) Increase workforce in front of critical areas such as institutions, place of worship, business establishment, hospitals, and schools; (iv) Consult businesses and institutions regarding operating hours and factoring this in work schedules; and (v) Provide sign boards for pedestrians to inform	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Spoils management plan (iii) Number of walkways, signage, and metal sheets placed at project location.	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		nature and duration of construction works and contact numbers for concerns/complaints.			
Socio-Economic - Employment	Generation of temporary employment and increase in local revenue	(i) Employ local labour force, or to the maximum extent possible (i. (iii) Comply with labor laws	Construction Contractor	(i) Employment records; (ii) Records of sources of materials (iii) Compliance to labor laws (see Appendix 6 of this IEE)	Cost for implementation of mitigation measures responsibility of contractor.
Occupational Health and Safety	Occupational hazards which can arise during work	(i) Comply with all national, state and local core labor laws (see Appendix 6 of this IEE); Following best practice health and safety guidelines: IFC's General EHS Guidelines[32] and Sector Specific (Sanitation) Guidelines[33] (ii) Develop and implement site-specific occupational health and safety (OH and S) Plan which will include measures such as: (a) excluding public from the site; (b) ensuring all workers are provided with and use personal protective equipment like helmet, gumboot, safety belt, gloves, nose musk and ear plugs; (c) OH and S Training for all site personnel; (d) documented procedures to be followed for all site activities; and (e) documentation of work-related accidents; (iii) Conduct work in confine spaces, trenches, and at height with suitable precautions and using standards and safe construction methods; do not adopt adhoc methods; all trenches deeper than 1.5 m shall be provided with safety shoring/braces; and avoid open cutting method for trenches deeper than 6-7 m by adopting trenchless technology	Construction Contractor	(i) Site-specific OH and S Plan; (ii) Equipped first-aid stations; (iii) Medical insurance coverage for workers; (iv) Number of accidents; (v) Supplies of potable drinking water; (vi) Clean eating areas where workers are not exposed to hazardous or noxious substances; (vii) record of H and S orientation	Cost for implementation of mitigation measures responsibility of contractor.

[32]https://www.ifc.org/wps/wcm/connect/554e8d80488658e4b76af76a6515bb18/Final%2B-%2BGeneral%2BEHS%2BGuidelines.pdf?MOD=AJPERES
[33]https://www.ifc.org/wps/wcm/connect/e22c050048855ae0875cd76a6515bb18/Final%2B-%2BWater%2Band%2BSanitation.pdf?MOD=AJPERES

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		(iv) Ensure that qualified first-aid can be provided at all times. Equipped first-aid stations shall be easily accessible throughout the site; (v) Provide medical insurance coverage for workers; (vi) Secure all installations from unauthorized intrusion and accident risks; (vii) The project area experiences extreme temperature during summer months of April and May, which may affect the health of workers engaged in construction work. Contractor should take necessary measures during summers including the following: (a) work schedule should be adjusted to avoid peak temperature hours (12 – 3 PM); (b) provide appropriate shade near the workplace; allow periodic resting and provide adequate water, and (c) provide necessary medicine and facilities to take care of dehydration related health issues (viii) Provide supplies of potable drinking water; (vi) Provide clean eating areas where workers are not exposed to hazardous or noxious substances; (ix) Provide H andS 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; (x) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted; (xi) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas; (xii) Ensure moving equipment is outfitted with audible back-up alarms;		trainings (viii) personal protective equipment; (ix) % of moving equipment outfitted with audible back-up alarms; (xi) permanent sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. (xii) Compliance to core labor laws (see Appendix 6 of this IEE)	

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		(xiii) 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; (xiv) Disallow worker exposure to noise level greater than 85 dBA for a duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively. (xv) Conduct regular health check-ups for workers (xvi) Provide periodical awareness camps and special trainings for workers for health issues and risks in construction sites (xviii) Provide proper solid and liquid waste management system in workers' campsite, separate from spoils and debris disposal, as their presence can add to existing waste volume at the project sites.			
	Health risk of construction workers due to COVID-19. • Prepare the health and safety guidance for COVID-19 at work sites and get approval of PMU;	Prepare the health and safety guidance for COVID-19 at work sites and get approval of PMU ; • Strictly follow and implement the H&S guidance for COVID-19 at worksite; • Everyone entering the worksite must wear a mask. • At the entrance of the worksite/camp site every personnel must wash their hands for 20 second with maintaining a distance of at least 1m (3 ft) from each other; • A designated EHS/Medical person should stay all time during work and ensure physical distances (minimum 1m) among workers, disinfecting surfaces that are commonly used and investigate worker/site personnel health and safety. • Discourage site personnel to gather and gossip at any time, rather encourage physical distance	Construction Contractor	PIU / DSC with the assistance of DBO contractor	Cost for implementation of mitigation measures responsibility of contractor

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		while chatting/discussing. • Ensure sufficient stock of soap, sanitizer, washing facility and safe water at the workers' dwelling (both camp site and home). • Encourage frequent hand washing and social distancing at campsite. • Ensure personal distance at least 1 meter (3 feet), preferably 2m (6ft) during lunch, dinner and prayer. • Train workers on how to properly put on, use/wear, and take off protective clothing and equipment. Make these trainings mandatory at worksites and provide 10-15 minutes of a workday for such 'training and encouragement' activities.			
Community Health and Safety.	Traffic accidents and vehicle collision with pedestrians during material and waste transportation	(i)Trench excavation and pipeline works shall be conducted in a safe manner; if the allowing public movement along the work sites (pedestrians or vehicles as the case may be) is likely to cause safety risks, movement should be blocked temporarily and work shall be conducted; in such areas, conducting night work or working in small stretches to avoid blockage of traffic/movement no more than few hours in due consultation with the local community and ULB shall be planned (ii) All trenches deeper than 1.5 m shall be provided with safety shoring/braces; and avoid open cutting method for trenches deeper than 6-7 m by adopting trenchless technology (iii) Survey the surrounding vulnerable buildings for likely issues in structural stability / differential settlement during the excavation works (iv) Provide prior information to the local people about the (v) Plan routes to avoid times of peak-pedestrian activities. (vi) Liaise with PIU/ULB in identifying high-risk	Construction Contractor	(i) Traffic Management Plan; (ii) Complaints from sensitive receptors	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		areas on route cards/maps. (vii) Maintain regularly the vehicles and use of manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure. (viii) Provide road signs and flag persons to warn of on-going trenching activities.			
Safety of sensitive groups (children, elders etc.) and other pedestrians in narrow streets	Trench excavation 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 on safety during the construction work (iii) Undertake the construction work stretch-wise; excavation, pipe laying and trench refilling should be completed on the same day (iv) Provide 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	Complaints from neighborhood and monitoring of accidents	Cost for implementation of mitigation measures responsibility of contractor.
Night Works	Public inconvenience due to traffic diversion, disturbance due to excessive noise and access loss, occupational health and safety issues etc.	Prepare a night work protocol and obtain prior approval from PIU, and strictly implement and report on implementation of protocol during the workers; Contractors should have handheld noise level meter for measurement of noise during night hours Contractors should have handheld lux meter for the measurement of illumination during night hours Preferably electrical connection is available for running equipment otherwise soundproof/super silent Diesel Generator set should be available Sound level should not increase as prescribe by CPCB Illumination should be as prescribed in protocol As far as possible ready-mix concrete from batching plant to be used, otherwise the concrete should be prepared away from residential areas and brought to the site All the noisy activities like hammering, cutting,	Contractor	Night work plan / protocol submitted by contractor and approved by PIU/Consultant	Contractor

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		crushing, running of heavy equipment should be done in daytime and avoided in nighttime Workers engaged in night works should have adequate rest/sleep in daytime before start of night works Worker engaged for night works should have previous experience of night works and should be physically fit for such works including clear vision in night All the necessary provisions of traffic aids such as traffic signals, road signage, barricades, cautions boards, traffic diversion boards etc. should be available with fluorescent/retro-reflective arrangements Workers should be trained before start of night works about risks and hazards of night works and their mitigation measures and should be provided all the protective aids (PPEs) including fluorescent/retro-reflective vests Horns should not be permitted by equipment and vehicles Workers should not shout and create noise First aid and emergency vehicles should be available at site Emergency preparedness plan should be operative during night works Old persons and pregnant women and women having small kids should not work in night-time All the vehicles and equipment being used at night works should have adequate type of silencers/enclosures/mufflers to reduce noise All the vehicles should be checked for working head lamps, tail lamps, inner lights etc. before start of night works PIU/DSC site engineers and contractor's safety personnel should closely monitor the safety of works continuously and noise and illumination			

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		levels on hourly basis and maintain photographic and video graphic records as well as register the observations. Night works should be stopped early in the morning at least one hour before start of pedestrian/traffic movement After completion of night works all the site should be cleaned and maintained obstruction free for daytime movement of vehicles and pedestrians Drivers and workers should be alert and responsive during night works All the wages to workers working in night hours should be as per the applicable labour acts Avoid any nuisance which may create problems to nearby habitants and work peacefully during night hours Night works should not be conducted near hospitals and during peak seasons such as peak tourist season, students' exam times etc.			
Work in narrow streets	will pose high risk to children and elders in the locality	(i) Conduct awareness program on safety during the construction work (ii) Undertake the construction work stretch-wise; excavation, pipe laying and trench refilling should be completed on the same day (iii) Provide 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 (iv) Trench excavation and pipeline works shall be conducted in a safe manner; if the allowing public movement along the work sites (pedestrians or vehicles as the case may be) is likely to cause safety risks, movement should be blocked temporarily and work shall be conducted; in such areas, conducting night work or working in small stretches to avoid blockage of traffic/movement no more than few hours in due consultation with the			Responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		local community and ULB shall be planned			
Trenchless Pipe Installation	Noise generated due to HDD may affect the neighboring communities and other sensitive receptors (such as students at schools and other educational institutes, patients at hospitals etc.). Bentonite slurry spilled out to the watercourses may contaminate the adjacent surface water. •	Pipes shall be installed by the horizontal directional drilling (HDD) methods where required. If the method is not feasible for any road, the contractor shall inform the Project Manager and gain prior approval for an alternative method or for open trench method. Provide outdoor sound blanket or noise curtain wall to help alleviate the noise impact due to HDD. Monitor the noise level to ensure the maximum levels are not exceeded. Excavation material shall be removed from the conduit as the work progresses. No accumulation of excavated material within the conduit will be permitted. • The contractor shall provide sediment and erosion control measures in accordance with local environmental legislation. • The contractor shall supply portable mud tanks or construct temporary mud pits to contain excess drill fluids during construction. Spent drilling fluids and cuttings shall be confined to the entrance and exit pits. • The contractor shall take all necessary precautions to minimize the damage to the adjacent properties. The contractor shall take all necessary precautions to minimize the damage to the adjacent properties.	Contractor	Trenchless work plan / protocol submitted by contractor and approved by PIU/ DSC Consultant	Contractor

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		• Drilling fluid/ bentonite slurry that enters the pipe shall be removed by flushing or other suitable methods. Sediment tanks of sufficient capacity, constructed from pre-formed individual cells of approximately 6-8m^3 capacities shall be used for settling waste-waters prior to disposal. • The contractor shall be responsible for cleanup and restoration of the site. • Pits excavated to permit connection of bored pipe shall be backfilled, and disturbed areas shall be restored to their original state or better. Sections of sidewalks, curbs, and gutters or other permanent improvements damaged during HDD operations shall be repaired or replaced at the contractor's expense.			
Construction camps and worker facilities	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) Consult with PIU before locating project offices, sheds, and construction plants; (ii) Minimize removal of vegetation and disallow cutting of trees; (iii) Provide drinking water, water for other uses, and sanitation facilities for employees; (iv) Provided temporary rest and eating area at all work sites (v) Ensure conditions of livability at work camps are always maintained at the highest standards possible; living quarters and construction camps shall be provided with standard materials (as far as possible to use portable ready to fit-in reusable cabins with proper ventilation); thatched huts, and facilities constructed with materials like GI sheets, tarpaulins, etc., shall not be used as accommodation for workers; accommodation shall meet the IFC standards for workers accommodation which include: provision of safe	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Drinking water and sanitation facilities for employees	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		housing, availability of electricity, plumbing, water and sanitation, adequate fire protection and dormitory/room facilities; accommodation shall be in the range from 10 to 12.5 cubic meters (volume) or 4 to 5.5 square meters (surface) per worker, a minimum ceiling height of 2.10 meters; a reasonable number of workers are allowed to share the same room – (standards range from 2 to 8 workers); workers with accompanying families shall be provided with a proper and safe accommodation (IFC benchmark standards for workers accommodation is provided in Appendix 16) (vi) Train employees in the storage and handling of materials which can potentially cause soil contamination; (vii) Recover used oil and lubricants and reuse or remove from the site; (viii) Manage solid waste according to the preference hierarchy: reuse, recycling and disposal to designated areas; (ix) Ensure unauthorized persons specially children are not allowed in any worksite at any given time.			
Groundwater exploitation	Uncontrolled extraction of water may affect availability of water to locals. Contamination of groundwater from construction related sources such a fuel and liquid wastes.	To avoid over exploitation of groundwater resources, judicious use and proper scientific planning is required for further developments by the Government. Prevent pollutants from contaminating the soil and the ground water. • All tube wells, test holes, monitoring wells that are no longer in use or needed shall be properly decommissioned; • Storage of lubricants and fuel at least 50 m from water bodies • Storage of fuel and lubricants in double hulled tanks. Fuel and other petroleum products stored at storage areas away from water drainage and protected by impermeable lining and bunded 110%. • Daily control of machinery and vehicles for leakages Collection of waste during construction activities •	Construction Contractor	Contractor through a NABL accredited laboratory and approved by PIU/ DSC Consultant	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		Provide uncontaminated water for dust suppression • Monitor groundwater quality according to the environmental monitoring plan.			
Social and Cultural Resources	Risk of archaeological chance finds	(i) Strictly follow the protocol for chance finds in any excavation work; (ii) Create awareness among the workers, supervisors and engineers about the chance finds during excavation work (iii) Stop work immediately to allow further investigation if any finds are suspected; (iv) Inform local Archeological Department / Museum office if a find is suspected and take any action, they require to ensure its removal or protection in situ	Construction Contractor	Records of chance finds	Cost for implementation of mitigation measures responsibility of contractor.
Monsoon preparedness	Disruption of utilities and water logging in trenches	(i) As for a possible avoid trench works and excavation works (pipe laying) during monsoon season to avoid any water logging and accident due to it (ii) if open trenches are not avoidable during monsoon, keep ready all the mitigations measures to avoid water logging such as dewatering pumps and sufficient pipes, traffic assistance, barricades etc. (iii) keep emergency response system ready before monsoon/heavy rain fall	Construction Contractor	Monsoon preparedness plan	Cost for implementation of mitigation measures responsibility of contractor.
Submission of EMP implementation report	Unsatisfactory compliance to EMP	(i) Appointment of supervisor to ensure EMP implementation (ii) Timely submission of monitoring reports including pictures	Construction contractor	Availability and competency of appointed supervisor Monthly report	Cost for implementation of mitigation measures responsibility of contractor.
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; and (ii) All excavated roads shall be reinstated to original condition.	Construction Contractor	PIU/Consultant report in writing that (i) worksite is restored to original	Cost for implementation of mitigation measures responsibility of

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		(iii) All disrupted utilities restored (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 re-grassed using the guidelines set out in the re-vegetation specification that forms part of this document. (vii) The contractor must arrange the cancellation of all temporary services. (viii) Request PIU to report in writing that worksites and camps have been vacated and restored to pre-project conditions before acceptance of work.		conditions; (ii) camp has been vacated and restored to pre-project conditions; (iii) all construction related structures not relevant to O and M are removed; and (iv) worksite clean-up is satisfactory.	contractor.

Table 34: Environmental Management Plan of Anticipated Impacts during Operation Stage

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
Water supply system operation	Supply of water not meeting drinking water standards, health and environment issues	(i) Ensure that water supplied to the consumers at all times meet the drinking water standards; carry out regular sampling and testing, and disseminative information; (ii) Undertake regular monitoring and maintenance of water supply infrastructure. Ensure zero wastewater discharge from the water treatment process via collection and recirculation of process wastewater / backwash water; (i) Ensure that all conditions/standards prescribed by	O and M contractor for 5 years and then Nagar Nigam	Nagar Nigam , Dehradun	O and M cost of contractor

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		UEPCB are compiled duly (ii) Ensure that chlorinator facility is operated only by trained staff and as per the standard operating procedures; in case of any accident and/or maintenance activity, ensure that the staff follows documented procedures only Implement Emergency Response System (ERS) for the chlorine leakage; (vii) Guidelines and Emergency plan for handling and storing chlorine is attached as Appendix 17.			
Check for blockage and leakage problems reducing the water losses	It may affect the water supply system	Effectiveness of leak detection and water auditing to reduce the water losses Implementation of regular O&M schedules	O&M contractor for 5 years and then Nagar Nigam Dehradun	Nagar Nigam Dehradun	O & M cost of contractor
Routine maintenance of OHTs and other facilities to ensure delivery of safe drinking water	Health impact due to supply of unsafe drinking water in the system	Ensure periodical maintenance of pumps and cleaning of OHRs, to ensure delivery of safe drinking water Periodical testing of treated water to ensure treated water quality meets the required standards	O and M contractor for 5 years and then Nagar Nigam Dehradun	Nagar Nigam , Dehradun	O and M cost of contractor
Sewerage system operation: collection and conveyance	Environmental and health issues due to operation of sewer network	(i) Establish regular maintenance program, including: • Regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups. Cleaning should be conducted more frequently for problem areas. • Inspection of the condition of sanitary sewer structures and identifying areas that need repair or maintenance. Items to note may include cracked/deteriorating pipes; leaking joints or seals at manhole; frequent line blockages; lines that generally flow at or near capacity; and suspected infiltration or	O and M contractor(DBO) for 5 years and then Nagar Nigam	Nagar Nigam , Dehradun	O and M cost of contractor

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		exfiltration; and • Monitoring of sewer flow to identify potential inflows and outflows • Conduct repairs on priority based on the nature and severity of the problem. Immediate clearing of blockage or repair is warranted where an overflow is currently occurring or for urgent problems that may cause an imminent overflow (e.g. pump station failures, sewer line ruptures, or sewer line blockages); (ii) Review previous sewer maintenance records to help identify "hot spots" or areas with frequent maintenance problems and locations of potential system failure, and conduct preventative maintenance, rehabilitation, or replacement of lines as needed; (iii) When a spill, leak, and/or overflow occurs, keep sewage from entering the storm drain system by covering or blocking storm drain inlets or by containing and diverting the sewage away from open channels and other storm drain facilities (using sandbags, inflatable dams, etc.). Remove the sewage using vacuum equipment or use other measures to divert it back to the sanitary sewer system. (iv) Prohibit/prevent disposal of wastewater/effluent from industrial units in the sewers; ensure regular checking to ensure no illegal entry of industrial wastewater into sewers (v) Develop an Emergency Response System for the sewerage system leaks, burst and overflows, etc. (vi) Provide necessary health and			

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		safety training to the staff (vii) Provide all necessary personnel protection equipment (viii) During cleaning/clearing of manholes and sewer lines great precautions should be taken for the safety of workers conducting such works. As far as possible use remote / CCTV mechanism to identify/detect the problems in sewers and do not engage persons for this purpose As far as possible use mechanized cleaning of manholes and sewers by using modern techniques and machines and do not engage persons for this purpose Ensure that maintenance staff and supervisors understand the risks; provide proper instructions, training and supervision. Use gas detector to detect any hazardous or inflammable gas in confined areas like sewers /manholes prior to maintenance process Provide suitable personal protective equipment that may include waterproof / abrasion-resistant gloves, footwear, eye and respiratory protection. Face visors are particularly effective against splashes. Equipment selection and a proper system for inspection and maintenance are important. Provide adequate welfare facilities, including clean water, soap, nail brushes, disposable paper towels, and where heavy contamination is foreseeable, showers. For remote locations portable welfare facilities should be provided.			

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		Areas for storage of clean and contaminated equipment should be segregated and separate from eating facilities. Provide adequate first-aid equipment, including clean water or sterile wipes for cleansing wounds, and a supply of sterile, waterproof, adhesive dressings. Make effective arrangements for monitoring the health of staff. Keep emergency preparedness plan ready before starting the work of sewage system cleaning Standard Operating Procedure (SOP) for Cleaning of Sewers and Septic Tanks by CPHEEO shoud be followed (http://cpheeo.gov.in/upload/5c0a062b23e94SOPforcleaningofSewersSepticTanks.pdf			
Occupational Health and Safety	Health risk of workers due to COVID-19.	• Prepare and implement a health and safety plan that is based on the developments about COVID-19 at the local and global fronts. All protocols contained in the health and safety plan should comply with all national health and safety regulations related to COVID-19 and with internationally recognized guidelines for dealing with COVID-19, such as the WHO guidelines.	O and M contractor for 5 years and then Nagar Nigam Dehradun	Nagar Nigam , Dehradun	O and M cost of contractor
Pathogens and Vectors	Workers may expose to the endotoxins, which are produced within a microorganism and released upon destruction of the cell and which can be	Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors; • Use vacuum trucks or tugs for removal of fecal sludge instead of manual methods; • Provide and require use of suitable	O and M contractor for 5 years and then Nagar Nigam Dehradun	Nagar Nigam , Dehradun	O and M cost of contractor

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
	carried by airborne dust particles. Vectors for sewage pathogens include insects (e.g. flies), rodents (e.g. rats) and birds (e.g. gulls).	personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves, aprons, boots, etc.). Especially provide prompt medical attention and cover any skin trauma such as cuts and abrasions to prevent infection and use protective clothing and goggles to prevent contact with spray and splashes; • Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. This practice also helps to minimize chemical and radionuclide exposure; • Encourage workers at wastewater facilities to wash hands frequently; • Provide worker immunization (e.g. for Hepatitis B and tetanus) and health monitoring, including regular physical examinations; • Reduce aerosol formation and distribution, for example by planting trees around the aeration basin to shield the area from wind and to capture the droplets and particles • Reducing aeration rate, if possible • Avoid handling screenings by hand to prevent needle stick injuries; • Maintain good housekeeping in sewage processing and storage areas; • Advise individuals with asthma, diabetes, or suppressed immune systems not to work at wastewater treatment facilities, especially composting facilities, facility because of their greater risk of infection			
Repair and	All work sites	Implementation of dust control, noise	O and M	Nagar Nigam ,	O and M

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
maintenance activities of Water Supply and sewerage Construction disturbances, nuisances, public and worker safety,		control, traffic management, and safety measures. Site inspection checklist to review implementation is appended at Appendix 20.	contractor for 5 years and then Nagar Nigam Dehradun	Dehradun	cost of contractor
Leakage and Overflows	It may affect the water supply and sewer systems, contaminate land, water and create public health issues	Effective operation to avoid and/or immediate clearance of such leaks, blockages; • Implementation of regular O&M schedules.	O and M contractor for 5 years and then Nagar Nigam Dehradun	Nagar Nigam , Dehradun	O and M cost of contractor
Asset management	Reduction in NRW Increased efficiency of the system	Preparation and implementation of O and M Manual	O and M contractor for 5 years and then Nagar **Nigam** Dehradun	Nagar Nigam , Dehradun	O and M cost of DBO contractor
Storm water Drainage operations .	Impact to the environment, workers, and community due to accidents or accidental discharge of domestic wastewater into the drainage system	Development of O&M manual that is comprehensive and includes measures to prevent discharge of domestic wastewater to the storm water drainage system and accidents due to the drainage canals. Refer Appendix 22 for guidelines for safety during Monsoon Months	DBO Contractor and PIU and Consultant	Availability of final version of O&M manual	No cost required. Mitigation measures are part of TOR of PIU and Consultant and also part of contractual terms
Storm Water Runoff	- Illegal entry of waste water from buildings or households; -Solid Waste disposal to the drains resulting to	-The design includes cover slab for the proposed drain hence, it should be ensured that each drain is provided with cover slab -Prepare and implement maintenance plan.	O and M contractor for 5 years and then Nagar Nigam Dehradun	Nagar Nigam , Dehradun	O and M cost of contractor

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
	water pollution and clogging	- Provision of regular monitoring.			

Table 35: Environmental Monitoring Plan for Construction Stage

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
Construction disturbances, nuisances, public and worker safety,	All work sites	Implementation of dust control, noise control, traffic management, chance finds protocol, asbestos pipes management and safety measures. Site inspection checklist to review implementation is appended at Appendix 20.	Weekly during construction	Supervising staff and safeguards specialist	No costs required
Tree cutting and plantation	Tube well /OHT, and water / sewer pipe laying sites	Obtain permission from concerned authority for any tree cutting and plant trees in the ratio of 1:3.	Weekly during construction	Supervising staff and safeguards specialist	Contractors cost
Ambient air quality	4 locations (TW / OHT sites pipe laying locations , construction camps and workers camp locations)	PM10, PM2.5, NO2, SO2, CO	Once before start of construction and once in each season (yearly 3 times, except monsoon) during construction	DBO Contractor	Cost for implementation of monitoring measures responsibility of contractor
Ambient noise	4 locations (TW / OHT sites , pipe laying locations , construction camps and workers camp locations)	Day time and nighttime noise levels	Once before start of construction and at the start of noisiest construction activities (use of pneumatic drills, breaking of cement or bitumen roads, operation of concrete mixers,	DBO Contractor	Cost for implementation of monitoring measures responsibility of contractor

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
			trenchless pipe installation)		
Soil quality	4 locations (TW / OHT sites , pipe laying locations , construction camps and workers camp locations)	pH, Elect. Conductivity (at 25^0C), Moisture (at 105^0C), Texture (silt, clay, sand), Calcium (as CaO), Magnesium (as Mg), Permeability, Nitrogen (as N), Sodium (as Na), Phosphate (as PO4), Potassium (as K), Organic Matter, oil and grease	Once before start of construction and once in each season (yearly 3 times, except monsoon) during construction	DBO Contractor	Cost for implementation of monitoring measures responsibility of contractor
Ground Water quality	4 locations (TW / OHT sites , pipe laying locations , construction camps and workers camp locations)	pH, TDS, Total Hardness, Zn, Chloride, Iron, Copper, DO, Manganese, Sulphate, Nitrate, Fluoride, Hg, Cadmium, Cr+6, Arsenic, Lead, Total Alkalinity, Phosphate, Phenolic compound	Once before start of construction and once in each season (yearly 3 times, except monsoon) during construction	DBO Contractor	Cost for implementation of monitoring measures responsibility of contractor
Surface water quality	4 locations (Locations shall be selected based on the location of surface water bodies closer to the construction zones)	pH, Turbidity, Total Hardness, DO, BOD, COD, Chloride, Hg, Iron, TDS, TSS, Calcium, Zn, Cr+6, Magnesium, Copper, Manganese, Sulphate, Cyanide, Nitrate, Sodium, Potassium, Fluoride, Cadmium, Arsenic, Lead, Boron, Selenium, Aluminium, Total residual Chlorine	Once before start of construction and once in each season (yearly 3 times, except monsoon) during construction	DBO Contractor	Cost for implementation of monitoring measures responsibility of contractor

Table 36: Environmental Monitoring Plan for Operations Stage

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
Monitoring of plantations	Plantations locations	Number. of tree survived	Monthly	O and M contractor (DBO Contractor) for 5 years and then Nagar Nigam	Contract O and M cost / Nagar Nigam, Dehradun
Periodic maintenance of the drainage system	Drainage system	Number of inspection and maintenance (desilting, repairs, removal debris and blockages) works	as per O&M plan	O and M contractor(DBO	Contract O and M cost /

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
		conducted		Contractor) for 5 years and then Nagar Nigam	Nagar Nigam, Dehradun
Sewer network to sustain operational efficiency and avoid clogging and early occurrence of leakages	Sewer network	to be included in the O&M plan prepared under the project	as per O&M plan	O and M contractor(DBO Contractor) for 5 years and then Nagar Nigam	Contract O and M cost / Nagar Nigam, Dehradun
Achieving Septic Tank Closure	Town	Numbers of septic tanks closed;	Yearly/ bi-Yearly	Nagar Nigam, Dehradun	Nagar Nigam, Dehradun
Monitoring of Raw water quality of Tube wells	Tube wells	Parameters as per drinking water standards (IS 10,500-2012)	Monthly once	O and M contractor (DBO-Hybrid Contractor) for 5 years and then Nagar Nigam	Contract O and M cost / Nagar Nigam, Dehradun
Monitoring of quality of water supplied to consumers	Consumer end- random sampling in all wards	Parameters as per drinking water standards (IS 10,500-2012)	Bi-weekly	O and M contractor (DBO-Hybrid Contractor) for 5 years and then Nagar Nigam	Contract O and M cost / Nagar Nigam, Dehradun
Water supply system operation	Supply of water not meeting drinking water standards, health and environment issues	(i) Ensure that water supplied to the consumers at all times meet the drinking water standards; carry out regular sampling and testing, and disseminative information; (ii) Undertake regular monitoring and maintenance of water supply infrastructure. Ensure zero wastewater discharge from the water treatment process via collection and recirculation of process wastewater / backwash water; (iii) Ensure that all conditions/standards prescribed by UEPCB are complied duly (iv) Ensure that chlorinator facility is operated only by trained staff and as per the standard	O and M contractor for 5 years and then Nagar Nigam	Nagar Nigam , Dehradun	O and M cost of contractor

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
		operating procedures; in case of any accident and/or maintenance activity, ensure that the staff follows documented procedures only Implement Emergency Response System (ERS) for the chlorine leakage; (vii) Guidelines and Emergency plan for handling and storing chlorine is attached as Appendix 17.			

B. Institutional Requirements

342. The Department of Urban Development (UDD), Government of Uttarakhand is the Executing Agency and Uttarakhand Urban Sector Development Agency (UUSDA) is the Implementing Agency for the Uttarakhand Inclusive Urban Development Project (UIRUDP). UUSDA under UDD is responsible for management, coordination and execution of all activities funded under this project. A Project Management Unit (PMU), established within the UUSDA, will implement the project.

343. **Project Management Unit (PMU).** The PMU will be headed by a Program Director (PD), a senior IAS Officer, of Additional Secretary rank; the Program Director will be supported by Additional Program Director (APD), Technical (an officer of Chief Engineer rank), Additional Program Director (APD), Administration (a State Cadre level Administrative Officer or a junior IAS Officer) and a Finance Controller (a State Cadre level Officer from finance discipline). APD Technical will be supported by Deputy Program Directors of Superintendent Engineer rank; DPD 1 will be responsible for Project Implementation and DPD 2 responsible for Procurement Planning and Contracts. DPD 1 is the focal person for coordinating with the PIUs, safeguards and GESI implementation. The Deputy Program Directors will be assisted by Project Managers of Executive Engineer rank and Deputy Project Managers (DPMs) of Assistant Engineer rank. PMU will have a position of Social Development and Gender Officer (SDGO) and Environmental Officer (EO) responsible for safeguards implementation to assist the PMU, DPD 1. The Environmental Officer will assist DPD 1 of PMU for implementation of environmental management plan (EMP) provisions and other environmental issues as per IEE/ EMP in compliance with ADB's SPS 2009 and GoI rules. There will also be an Information, Education and Communication (IEC) Officer. The PMU will support two PIUs, one at Dehradun and the other at Nainital; the PIUs will be responsible for planning, implementation, monitoring and supervision, and coordination of all activities under the UIRUDP. Each PIU will be headed by a Project Manager of Executive Engineer (EE) rank, reporting to the DPD 1.

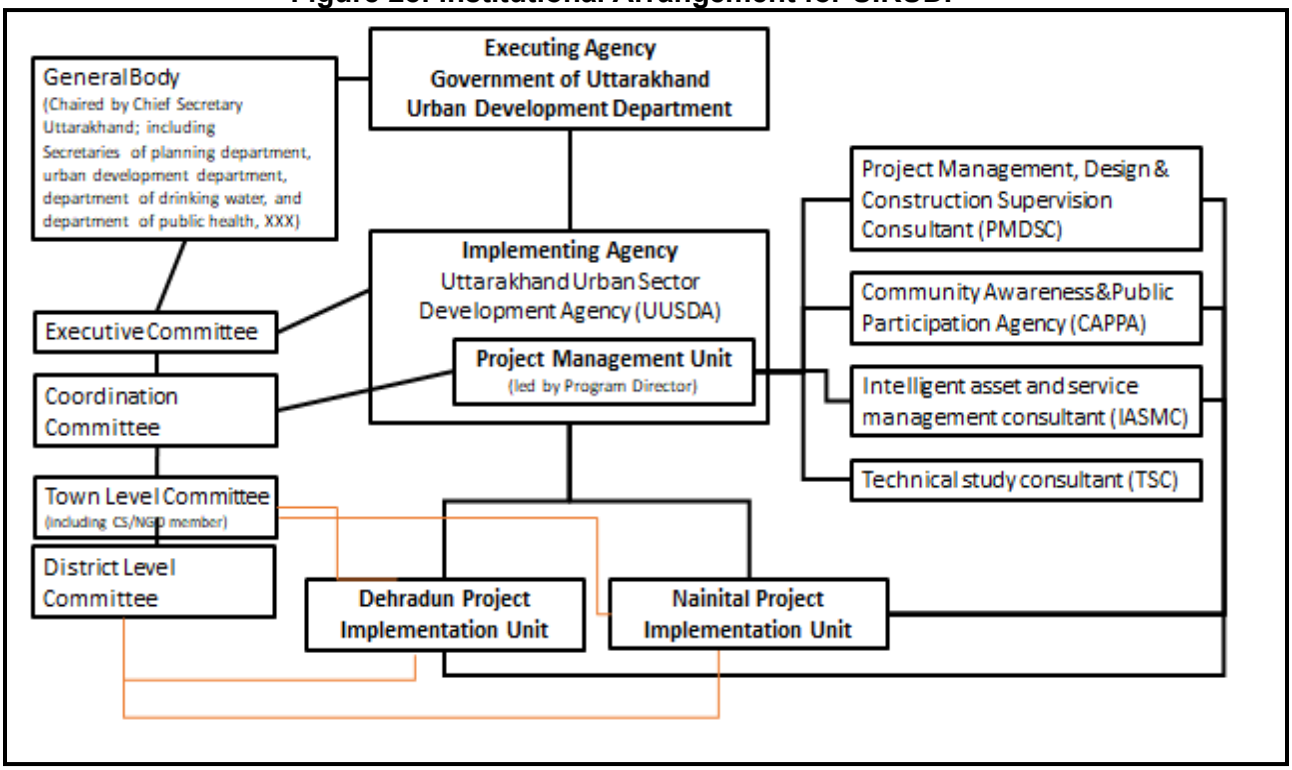
344. **Project Implementation Units (Town/City Level).** Each PIU (established one each in Dehradun and Nainital) will be headed by a Project Manager of Executive Engineer rank. Project Manager will be supported by three Deputy Project Managers of Assistant Engineer (Civil) and Assistant Engineer (electrical and mechanical) rank. Further, Junior Engineers will assist the Deputy Project Managers in project implementation. One of the Junior Engineer will be designated as social focal point (Assistant Social Development Officer) and the other as environmental focal point (Assistant Environmental Officer).

345. **Project Management and Design Supervision Consultant.** PMU will be supported by a Project Management and Design Supervision Consultant (PMDSC) to supervise, monitor and oversee project implementation, support on policy reform related issues and compliance of all the reporting requirements of GoU, other statutory regulatory bodies and Asian Development Bank in line with SPS 2009. PIU will also be supported by the PMDSC on supervision monitoring and to oversee the implementation of projects, including compliance of ADB's SPS 2009 and other environmental and social issues as per relevant State and GoI rules. There will be two Environmental Experts (EE) and two Social, Gender and Resettlement Expert (SGRE) at the PMDSC.

346. **Safeguards Compliance Responsibilities.** DPD 1 will be the focal point for both social and environmental safeguard implementation and compliance. Environmental and Social Development Officers will have the overall responsibility of ensuring compliance with ADB SPS 2009 and will support DPD 1. The PMU will have overall responsibility for implementation of the

IEEs, RPs, EMPs, SEMP, GESI action plan, and appropriate monitoring and reporting responsibilities. The Environmental Officer (EO) will be primarily facilitating implementation of EMPs, SEMP and other environmental related compliances with support of Environmental Experts of the PMDSC. The environment experts (EE) of PMDSC will conduct environmental assessments including the finalization of IEEs and prepare semi-annual environmental monitoring reports (SEMR). The PMDSC is also responsible to organize training and capacity development programs. The Social Development and Gender Officer (SDGO) will facilitate implementation, monitoring and reporting of resettlement plans and other related compliances, while IECO will oversee the community awareness, public outreach, training, capacity building preparation of IEC materials, and enhance information, education and communication among the local public, regarding gender, social, environmental related issues of UIRUDP. An independent agency titled, "Community Action and Public Participation Agency, (CAPPA) will assist the PMU and PIUs in implementation of resettlement plans and function as a community outreach agency for construction facilitation, public disclosure and other communication and capacity building awareness and documentation and reporting as per requirements. Contractor will appoint an Environment, Health and Safety (EHS) supervisor to implement EMP.

Figure 28: Institutional Arrangement for UIRUDP



347. Environmental Safeguards roles and responsibilities are summarised below:

348. **Tasks of Environmental Officer at PMU Level**. The following are the key environmental safeguard tasks and responsibilities of the Environmental Officer at the PMU level:

(i) review and approve the updated/final IEEs;
(ii) ensure that the updated/final IEEs/EMPs reflect latest/final project designs from the DBO contractor;

(iii) ensure that EMPs including Health and Safety COVID-19 Plans and associated costs are included in bidding documents and civil works contracts;
(iv) With the help of the PMDSC EE, review and approve the SEMPs from the Contractor;
(v) provide oversight on environmental management aspects of the project, and ensure SEMPs and EMPs are implemented by contractors;
(vi) establish a system to monitor environmental safeguards of the project including monitoring the indicators set out in the monitoring plan of the EMP;
(vii) facilitate and confirm overall compliance with all government rules and regulations regarding site and environmental clearances as well as any other environmental requirements, as relevant;
(viii) with the help of the PMDSC EE, review, monitor and evaluate effectiveness with which the SEMPs, EMPs, and Health and Safety Plans are implemented, and recommend necessary corrective actions to be taken;
(ix) with the help of the PMDSC EE, prepare and submit semi-annual monitoring reports (SEMR) to ADB;
(x) ensure timely disclosure of final IEEs/EMPs and SEMRs, including corrective action plan ensure timely disclosure of final IEEs/EMPs and SEMRs, including corrective action plans, if any, in project website and in a form accessible to the public;
(xi) address any grievances brought about through the grievance redress mechanism (GRM) described in this EARF in a timely manner;
(xii) undertake regular review of safeguards related loan covenants, and the compliance in program implementation; and
(xiii) organize periodic capacity building and training programs for UIRUDP stakeholders, PMU, and PIU staff on safeguards.

349. **Project Implementation Units (Town/City Level).** The PIUs will be responsible for the day-to-day activities of project implementation in the field and will have direct supervision to all contractors at subproject sites. Each PIU will have a Junior Engineer, designated as the Assistant Environmental Officer (AEO) who will perform the following specific tasks, with support from PMDSC, Environmental Expert:

(i) Ensure compliance with government and ADB requirements on environmental safeguards;
(ii) Oversee day-to-day implementation of SEMPs by contractors, including compliance with all government rules and regulations, and conduct regular site visits/inspections;
(iii) Liaise with local offices of regulatory agencies in obtaining clearances /approvals; assist PMU for clearances obtained at town/city level;
(iv) Take necessary action for obtaining rights of way;
(v) Review and approve contractor SEMPs;
(vi) Review the contractors' monthly reports on SEMP implementation;
(vii) Prepare quarterly monitoring reports and submit to PMU;
(viii) Inform PMU of unanticipated impacts and formulate corrective action plan;
(ix) Recommend issuance of work construction work completion certification to the contractor upon verification of satisfactory post-construction clean-up.
(x) Ensure continuous public consultation and awareness;

(xi) Coordinate grievance redress process and ensure timely actions by all parties; and
(xii) Support all other environmental safeguards-related activities and tasks of the PMU as may be needed.

350. **Project Management and Design Supervision Consultants**. The PMU and PIU Environmental Officer and Assistant Environmental Officers will be supported by the EE of the PMDSC. Following are the key tasks of Environmental Expert of PMDSC:

(i) Work closely with PMU, PIU and Contractor design teams to include environmental considerations in project location, design and technical specifications;
(ii) Identify statutory clearance / permissions / approvals required and assist the PMU and PIU in obtaining them;
(iii) Assist in including standards/conditions of regulatory clearances and consents, if any, in the project design;
(iv) Assist the PMU and PIU in the review of Contractor' SEMPs;
(v) Prepare updated/final IEEs and EMPs based on the DBO contractor's detailed design, SEMPs, and in accordance with country's environmental legal frameworks and ADB SPS 2009;
(vi) Ensure the quality and format of IEE reports, and other environmental safeguard documents following ADB Handbook of Styles and Usage;
(vii) Lead / assist PIU in public consultations and include inputs from the public consultation in the project design and EMP, and proper documentation in the IEEs;
(viii) Advise / assist PIU in disclosing relevant information on safeguards to affected people and relevant stakeholders;
(ix) Assist the PIU in monitoring the implementation of EMPs/SEMPs and ensure compliance by the Contractors including subcontractors;
(x) Carry out site verification of EMP/SEMP implementation on a regular basis;
(xi) Provide guidance on resolving issues pertaining to effective and efficient implementation of proposed environmental mitigation measures per EMPs/SEMPs during construction phase. Identify, non-compliance or unanticipated impacts, if any, and initiate corrective actions and report to PMU;
(xii) Assist the PIU in the review and approval of monthly monitoring reports submitted by Contractor;
(xiii) Assist the PIU in consolidating and preparing quarterly Environmental Monitoring Reports (EMR) and submit to PMU;
(xiv) Assist the PMU in preparing semi-annual environmental monitoring report per the requirement of ADB;
(xv) Assist the PMU/PIU with any capacity building activities for stakeholders;
(xvi) Assist PIU in establishing GRM for the Project;
(xvii) Assist PIU in grievance redress, advise the contractor on appropriate actions on grievances, ensure timely resolution and proper documentation;
(xviii) Support all other environmental safeguards-related activities and tasks of the PMU and PIUs as may be needed.

351. **Design, Build and Operate (DBO) contractor.** The EMP provisions as per the approved IEEs are to be included in bidding and contract documents and verified by the PIUs and PMU.

The implementation of EMP will be made binding i.e., mandatory on contractor as part of the employer's requirement in the bid and contract documents. The contractor will be required to appoint an Environment, Health and Safety (EHS) supervisor to implement the EMP, and prepare and submit to PMU and PIU, for review and approval, Site-specific EMP (SEMP) which includes (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 per EMP; and (iv) budget for SEMP and EMP implementation. No works can commence until SEMP is approved by PMU/PIU. Contractors will carry out all environmental mitigation and monitoring measures outlined in EMP, approved SEMP and their contracts.

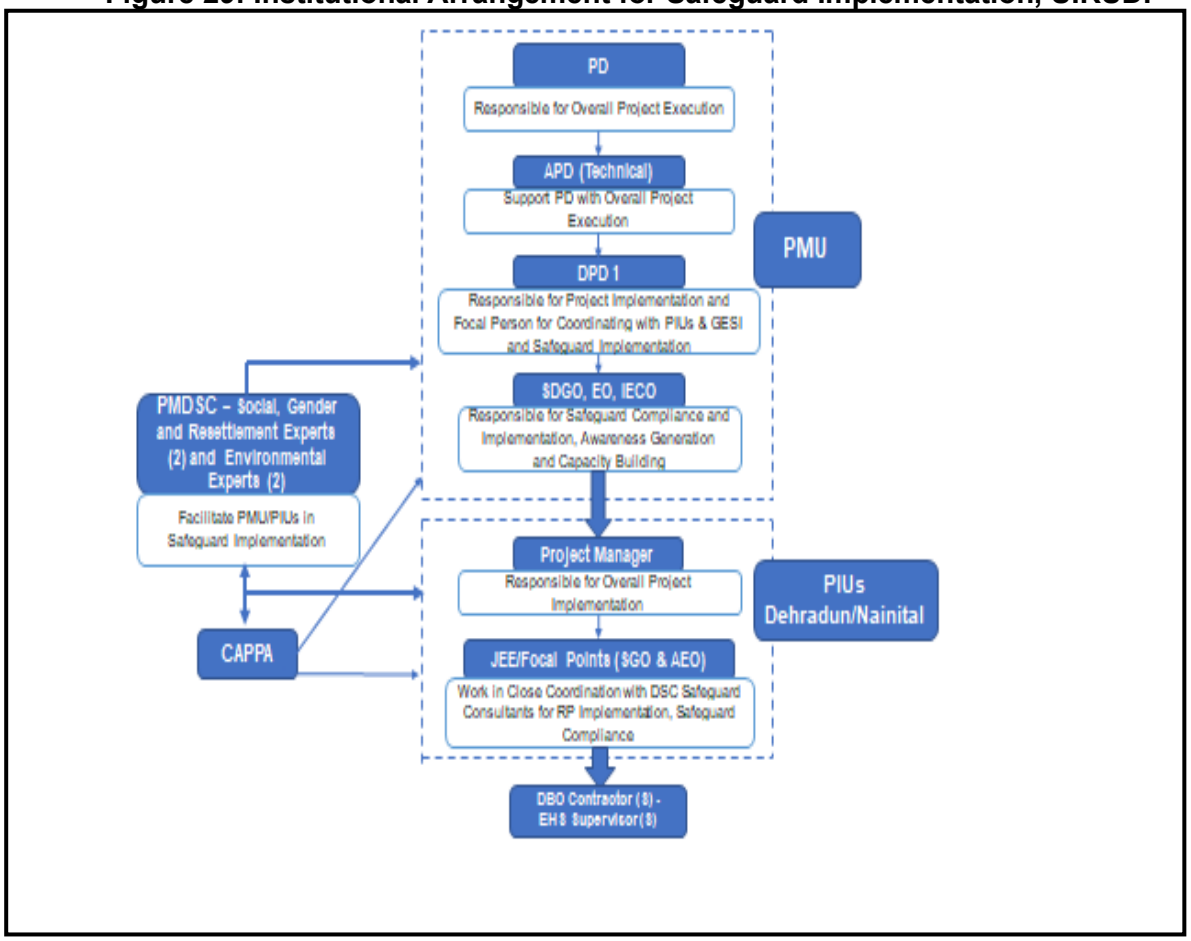
352. A copy of the EMP/approved SEMP will be always kept on-site during the construction period. Non-compliance with, or any deviation from, the conditions set out in the EMP/SEMP constitutes a failure in compliance and will require corrective actions.

353. The PMU and PIUs will ensure that bidding and contract documents include specific provisions requiring contractors to comply with: (i) all applicable labor laws and core labor standards on (a) prohibition of child labor as defined in national legislation, international treaties for construction and maintenance activities;(b) equal pay for equal work of equal value regardless of gender, ethnicity, or caste; and (c) elimination of forced labor; and with (ii) the requirement to disseminate information on sexually transmitted diseases, including HIV/AIDS, to employees and local communities surrounding the project sites. Key responsibilities of the EHS supervisor are:

(i) Prepare SEMP and submit to PMU/PIU for approval prior to start of construction;
(ii) Ensure implementation of SEMP and report to PIU/PMDSC on any new or unanticipated impacts; seek guidance from the PMU/PIU/PMDSC to address the new or unanticipated impact in accordance with ADB SPS 2009;
(iii) Ensure that necessary pre-construction and construction permits are obtained;
(iv) Conduct orientation and daily briefing sessions to workers on environment, health and safety;
(v) Ensure that appropriate worker facilities are provided at the workplace and labor camps as per the contractual provisions;
(vi) Carry out site inspections on a regular basis and prepare site-inspection checklists/reports;
(vii) Record EHS incidents and undertake remedial actions;
(viii) Conduct environmental monitoring (air, noise, etc.,) as per the monitoring plan
(ix) Prepare monthly EMP monitoring reports and submit to PIU;
(x) Work closely with PIU AEO and PMDSC EE to ensure communities are aware of project-related impacts, mitigation measures, and GRM; and
(xi) Coordinate with the PIU and PMDSC on any grievances received and ensure that these are addressed in an effective and timely manner.

354. The following Figure 29 shows the institutional responsibility of safeguard implementation at all stages of the UIRUDP project:

Figure 29: Institutional Arrangement for Safeguard Implementation, UIRUDP



AEO = Assistant Environmental Officer; APD = Additional Program Director; CAPPA = Community Awareness and Public Participation Agency; DBO = Design Build and Operate Contractor; DPD = Deputy Program Director; EO = Environmental Officer; IECO = Information Education and Communication Officer; PD = Program Director; PIU = Project Implementation Unit; PMDSC = Project Management, Design & Construction Supervision Consultant; PMU = Project Management Unit; SDGO = Social Development and Gender Officer, SGO = Social and Gender Officer

C. Institutional Capacity and Development

355. The Implementing Agency, UUSDA, has experienced project staffs, which have knowledge and primary experience of ADB supported project implementation from earlier loans. It is hence understood that they have required familiarity with ADB environmental safeguard policies and its implementation. PMU SPM and PIU SOs will be trained by PMDSC safeguards experts and CAPPA team on safeguards issues related to the project, GESI action plan and GRM. The IEE,EMP and RP and GESI action plan provided indicative capacity building program which included modules on: (i) introduction and sensitization to ADB SPS 2009, on environmental, involuntary resettlement and indigenous people policies and requirements; (ii) project related requirements as provided in the IEE, RP, EMP and GESI action plan, (iii) review, updating and preparation of the IEEs, SEMPs, RPs, DDRs and IPPs (if required) upon the completion of project detailed design; (iii) improved coordination within nodal departments; (iv) monitoring and reporting system; and (v) project GRM. Briefings on safeguards principles, GRM and GESI action plan will also be conducted to the contractors upon their mobilization by PIU SOs supported by PMDSC and CAPPA.

356. The following Table 37 presents the outline of capacity building program to ensure EMP implementation. The estimated cost is Rs.200,000 (excluding trainings of contractors which will be part of EMP implementation cost during construction) to be covered by the project's capacity building program. 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 ES of DSC. The capacity building program will consider participatory learning methods to the extent possible, including learning by doing, role playing, group exercises, on-the-job training, etc. to ensure effectiveness. A post-training assessment that can be compared to the pre-training assessment may be administered to measure the effectiveness of the program.

Table 37: Outline Capacity Building Program on EMP Implementation

Description	Target Participants and Venue	Estimate (INR)	Cost and Source of Funds
1. Introduction and Sensitization to Environmental Issues (1 day) - ADB Safeguards Policy Statement - Government of India and Uttarakhand applicable safeguard laws, regulations and policies including but not limited to core labor standards, OH and S, etc. - Incorporation of EMP into the project design and contracts - Monitoring, reporting and corrective action planning	All staff and consultants involved in the project At PMU (combined program for all subprojects)	INR 50,000 (Lump sum)	Included in the overall program cost
2. EMP implementation (1/2 day) - EMP mitigation & monitoring measures -Roles and responsibilities - Public relations, - Consultations - Grievance redress - Monitoring and corrective action planning - Reporting and disclosure - Construction site standard operating procedures (SOP) -- Chance find (archeological) protocol - AC pipe protocol - Traffic management plan - Waste management plan - Site clean-up & restoration	All PIU staff, contractor staff and consultants involved in the subproject At PIU	Rs.100,000 (Lump sum)	Included in subproject cost estimates
3. Contractors Orientation to Workers (1/2 day) - Environment, health and safety in project construction (O H and S, core labor laws, spoils management, etc.)	Once before start of work, and thereafter regular briefing every month once. Daily briefing on safety prior to start of work All workers (including unskilled laborers)	Rs. 50,000	DBO Contractors cost

Summary of Capacity Building cost for EMP Implementation

- Contractor Cost - INR 50,000
- PMU Cost - INR 150,000
- **Total - INR 200,000**

D. Monitoring and Reporting

357. Immediately after mobilization and 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 staff for EMP implementation (EHS supervisor) is mobilized. PIU will review and approve the report and allow commencement of works.

358. During construction, results from internal monitoring by the contractor will be reflected in their monthly EMP implementation reports to the PIU. DSC will review and advise contractors for corrective actions if necessary.

359. Quarterly report shall be prepared PMDSC and PIU and submitted to PMU for review and further actions.

360. Based on monthly & quarterly reports and measurements, PMU (assisted by PMDSC) will submit Semi-Annual Environmental Monitoring Report (Appendix 21). Once concurrence from the ADB is received the report will be disclosed on UUSDA/PMU websites.

361. ADB will review project performance against the project 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

E. EMP Implementation Cost

362. 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. There are some of the provisions in bid documents like compliance of the requirements of health and safety during construction works as per applicable labor laws, labor insurance, equipment fitness, provision of labor welfare facilities, healthcare facilities etc. which are unanimously bound to contractor bidding for the project therefore it is understood that costs for such requirements are bound to contractor and no need to consider as cost of EMP implementation. Regardless of this, any costs of mitigation by the construction contractors or consultants are included in the budgets for the civil works and do not need to be estimated separately here. Mitigation that is the responsibility of PIU/ULB will be provided as part of their management of the project, so this also does not need to be duplicated here. Cost for the capacity building program is included as part of the project. A CRVA study is being done for the project and its recommendations shall be included in the updated IEE. Cost of environmental management is given in Table 38.

Table 38: Cost Estimates to Implement the EMP

Sr. No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost (INR)	Costs Covered By
A.	**Mitigation Measures**						

Sr. No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost (INR)	Costs Covered By
1	Compensatory plantation measures	Construction	lump sum	-		1,000,000	Civil works contract
2	Arrangement of resources for prevention of health risk from COVID 19 pandemic	Construction	lump sum	-		1,500,000	Civil works contract
	Subtotal (B)					**25,00,000**	
B.	**Monitoring Measures#**						
1	Air quality monitoring:	Pre-construction and construction	per sample	50	14500	725,000	Civil works contract
2	Noise levels monitoring	Pre-Construction and construction	Per sample	50	4500	225,000	Civil works contract
3	Ground Water Quality	Pre-Construction and construction	Per sample	50	10500	525,000	Civil works contract
4	Surface Water Quality	Pre-Construction and construction	Per sample	50	10000	5,00,000	Civil works contract
5	Soil Quality	Pre-construction and construction	Per sample	50	10000	5,00,000	Civil works contract
	Subtotal (C)					**2,475,000**	
C.	**Capacity Building**						
1	Introduction and sensitization to environment issues	Pre-construction	lump sum			50,000	PMU
2..	EMP implementation	Construction	lump sum			100000	PMU
3	Contractors Orientation to Workers on EMP implementation	Prior to dispatch to worksite	lump sum			50,000	Civil works contract
	Subtotal (D)					**200,000**	
D	**Civil Works$**						
1	Water Sprinkling for dust suppression	Construction	Days	2160	1600	3,456,000	Civil works contract
2	Rainwater Harvesting for water conservation	Construction	Nos.	Per requirement	Lump Sum	1,000,000	Civil works contract
4	Provision for PPEs for labors and supervisory staff	Construction	lump sum			500,000	Civil works contract

Sr. No	Particulars	Stages	Unit	Total Number	Rate (INR)	Cost (INR)	Costs Covered By
	Subtotal (D)					**4,956,000**	
E	**Statutory Fees**						
	Statutory Fees		lump sum		**50,000**	**50,000**	Project Cost
	Subtotal (E)					**50,000**	
F	**Grievance Redressal and public disclosure Mechanism**						
	Grievance Redressal Mechanism Resolutions	Construction			Lump Sum	500,000	Civil works contract
	Public consultations on Environmental aspects	Construction	Month	84	5000	420,000	Civil works contract
	Sub Total (G)					**920,000**	
	Grand Total (A+B+C+D+E+F)				**INR**	**11,101,000**	
					USD	**152,068**	

Computation of total number of samples for environmental monitoring as per Appendix 23
$ Excluding, Barricading, road restoration, Traffic Management, these are taken as part of the civil work cost

X. CONCLUSION AND RECOMMENDATION

363. The process described in this document has assessed the environmental impacts of all elements of development of water supply, sanitation and drainage systems in newly-added wards since the 2018 re-boundary located in the southern periphery of Dehradun town. The subproject is located in Zone 7, which is divided into three work packages based on topography and hydrology. The service area under Banjarawala Package 2, comprising part of ward number 83 (Kedarpur) and 85 (Mothrowala) are proposed for implementation under the design-build-operate (DBO) modality.

364. Since the water supply system is in deteriorating condition, new water source and pipeline network have been included in the scope of this project with consumer connections it is also designed to develop a comprehensive sewerage system to collect, treat, and dispose/reuse the domestic wastewater safely. This is being provided in a combination of underground sewerage system and Fecal Sludge and Septage Management (FSSM) system .. Construction of storm water drainage system has been proposed as currently there is no planned storm water drainage (SWD) system and most of the existing drains are engrossed and choked with garbage, debris and silt.

365. 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. During the construction phase, impacts mainly arise from the construction dust and noise, the need to dispose of large quantities of waste soil and import a similar amount of sand to support the sewer in the trenches; and from the disturbance of residents, businesses, traffic and important buildings by the construction work. The social impacts (access disruptions) due to construction activities are unavoidable, as the residential and commercial establishments exist along the roads where sewers will be laid. A resettlement plan has also been developed in accordance with ADB SPS 2009 and Government of India laws and regulations.

366. The subproject area is an urban area and there are no protected or sensitive environmental areas such as forests, wildlife sanctuaries or archeologically protected areas. Therefore, there are no risks or impacts on biodiversity and natural resources. The proposed project will optimally utilize the groundwater sources. Due to nature of components, the existing infrastructure components do not fall under the ambit of any environmental related regulations, and therefore there is no requirement of permissions or clearances. No. AC pipes are there in the existing facilities which may create hazardous conditions for the workers and surrounding community.

367. None of the project components are falling within protected or forest areas and no wildlife has been reported within the proposed service area. There are no eco-sensitive or protected areas within proposed project activity areas of Package 2 comprising part of Municipal ward numbers 83 and 85. The closest protected areas are Rajaji National Park situated within 5 km and New Forest Campus within 10 km radial distances from the proposed centrally located tube well and OHT in Mothorowala site (co-ordinates: 30°16’03.83”N; 78°02’02.21”E).. This is based on the screening conducted using the Integrated Biodiversity Assessment Tool (IBAT). Other key biodiversity areas, Asan Barrage, Binog Sanctuary- Bhadraj- Jharipani, Jhilmil Jheel Conservation Reserve, Kalesar Wildlife Sanctuary and Simbalbara National Park, are found within 50 km radial distance. Therefore, the project will pose no risk or impact on biodiversity and

natural resources. The subproject components also do not fall within the ambit of Doon Valley Notification.

368. Currently, there is no sewerage system provided in the subproject area, which is around 359 Hectare (Ha) comprising of part of municipal ward numbers 83 (Kedarpur) and 85 (Mothrowala). The waste water from kitchens & bathrooms is discharged into storm water drains culminating finally to the drain/river or on ground, which pollutes the environment and contaminates the ground/surface water. Open defecation is not uncommon. Most of the residential and commercial buildings and educational institutions have on-site septic tanks and soak pits. Though septic tanks is an accepted onsite treatment, as the septic tanks are not designed and maintained properly, the effluent does not confirm to the standards. The effluent from the septic tanks is directly let into the open drains.

369. The water supply service area considered under this Package 2 is part of ward number 85 (Mothrowala). Currently, there is existing water supply in the area but its pipeline network (CI, GI and PVC) is more than 25 years old with the average supply level of around 110 lpcd for 4 to 6 hours per day, not meeting the performance standard. The source of existing water supply system is ground water. The source of existing water supply system is ground water. Ground water is being extracted through three tube wells. There are three associated pump houses and three existing overhead tanks having 250 kl, 900 kl and 1000 kl capacity.

370. The storm water collection network has been planned to collect the storm runoff from the contributing catchments and will be finally discharged into River Bindal and nearby water bodies. New drains are proposed along the existing natural nala/drain considering the topography of the area and storm water drains to be constructed on side of existing government roads therefore no land acquisition issue observed.

371. In the absence of adequate supply of potable water and safe disposal system of sewage as mentioned above, the people of sub project areas of Dehradun are facing unhealthy and unhygienic environment therefore, public representatives are also demanding facilities of safe and improved water and sewerage system along with drainage system on priority basis.

372. One STP of capacity 11 MLD based on sequential batch reactor (SBR) process. will be constructed at Indrapuri Farm, Daudwala of Mothrowala ward under Banjarawala Package 1. The sewage from all three packages (Package 1, 2 & 3) comprising part of ward numbers 83, 84 and 85, will be carried to this STP for treatment. The STP location is chosen taking into consideration of the travel time of sewage to trunk mains, maximum sewerage area, and land availability and reasonable distance to water bodies for ease of disposal of treated effluent. Based on the projection of population increase, it has been estimated that the contributing area of all three packages will have 4.42 million liters per day (MLD), 7.61 MLD & 10.80 MLD of wastewater during the base (2021), Intermediate (2036) & ultimate (2051) years respectively. It has been also estimated that the contributing area of Package 2 (part of ward nos 83 and 85) will have 1.23 million liters per day (MLD), 2.21 MLD & 3.19 MLD capacity of treating wastewater during the base, Intermediate & ultimate years respectively.

373. A FSSM system will be provided to collect fecal sludge and septage in low lying and/or low dense areas of Package 2, e.g. Dandi Village, Vishnupuram Colony, Shvkunj Colony and Mahalakshmi Pruam Colony that are not techno-economically feasible to connect to sewerage system. This facility is expected to cover a population of 1350 in the base year 2021 and 4450 at the ultimate design year 2051 under Septage management for Banjarawala Package 2. The collected Septage from Banjarawala (Package-1, 2 & 3) will be transported to 68 MLD

Kargi STP which is equipped with septage co-treatment facility. At present, the Kargi STP is under utilized receiving only 12 to 15 MLD sewage against the 68 MLD design capacity and only 130 KLD of FSS is presently being disposed at Kargi STP for treatment (NIUA 2021). Based on the projection of population increase, it has been estimated that the contributing areas of all three Banjarawala packages (part of wards 83,84 and 85) will generate septage of 1.77 kilo liters per day (KLD), 3.13 KLD & 4.75 KLD during the base (2021), intermediate (2036) & ultimate (2051) years respectively.

374. It is proposed to continue the groundwater as source of water supply and the service area is part of ward number 85 (Mothrowala). Installation of three deep tube wells with 1000 liters per minute (lpm), 1500 lpm and 1500 lpm capacity and construction of two over-head tanks with 650 kilo liter (kl) and 800 kl capacity are proposed to accommodate growing population demand in the area. Per capita water supply rate of 135 liters per day (LPD) is considered as per the CPHEEO norms. Based on the projection of population increase the water demand of the area is estimated as 1.45 MLD (base year 2021), 2.66 MLD (intermediate year 2036) and 3.87 MLD (ultimate design year 2051). The present service area i.e., Banjarawala Package 2 in Dehradhun falls in Raipur block which is categorized as **SAFE** as per the categorization adopted by the CGWB and leaving a large scope for further development of the resource for domestic, industrial, agricultural and other uses. During interaction with various organizations including UPJN/UJS, it was informed that the ground water table at Dehradun is good and depletion is not a cause of concern as the annual recharging is adequate. There are about 140 tube wells in the urban area of Dehradun city and these tube wells are being used for the drinking water supply to the residents of Dehradun.There are about 140 tube wells in the urban area of Dehradun city and these tube wells are being used for the drinking water supply to the residents of Dehradun. The average depth of these wells ranges between 70 and 120 m and the average yield is about 1500 litres per minute (LPM). Groundwater quality is fit for drinking as per Indian Standards for Drinking Water (IS:10500, 2012) therefore, only disinfection treatment in form of chlorination is proposed prior to supply. Tube wells and OHTs are proposed in the existing campus of UJN under the ownership of Nagar Nigam Dehradun. They are away from houses, shops or any other premises used by people, thus establishing a buffer to reduce the effects of noise, dust and the visual appearance of the site. Only shrubs and bushes are present at sites and therefore no tree cutting will be required during construction of tube wells/OHTs as per preliminary design. No wildlife is reported at from the sites.

375. In the entire project area, 60 km new water pipelines (59 km ductile iron pipe Class K7 (DI-K7) and 1 km DI-K9 pipes with diameter ranging from 100 mm to 450 mm) will be laid at a depth of 1m depending on topography and 9650 numbers new house service connections will be provided from the newly laid mains. If the existing water pipes are in the same lining of new water supply pipes, a contractor through a detailed survey will establish the requirement of old pipes removal for giving way to new pipelines. Those pipes shall be removed and disposed in a controlled manner so as not to harm the environment.

376. The subproject will also install a total of around 45 km sewer pipes (at a depth of 1 to 6m as per topography), including 44 km of high-density polyethylene (HDPE) pipe of diameter 225 mm to 355 mm and around 1 km of DI-K7 pipe of 350 mm to 700 mm diameter. The wastewater collection system will mainly rely on gravity pipes and will discharge into the STP. The subproject proposes to construct 1950 manholes, based on the assessment of subsoil condition and traffic loads. The manholes will be constructed at an interval of 25 m distance well within the ROW of government roads along the sewer network. Sewer house service connection up to property chambers are proposed for 1650 (during operation and maintenance period) houses in the

targeted zone that will be connected to the sewer system in the new added wards under Dehradhun Nagar Nigam.

377. A total of 30 km storm water drains with precast RCC cover will be constructed alongside the roads to facilitate smooth draining of storm water coming on the roads. These drains will be on both sides of the roads within RoW of public roads under the ownership of Nagar Nigam Dehradun. In order to reduce velocity and prevent erosion, drain outfall structures will be constructed at the end of storm water drains that discharge to major drains and river (Bindal and Ripsana). A total of 18 outfalls structures have been envisaged in the project area. It shall be ensured that outfall structure invert level shall be above high flood level of the receiving water body. All these drains ultimately join Ripsana River which in turn joins River Ganga.

378. As a part of climate adaptation measures groundwater recharge pits and rainwater harvesting structures will be developed and installed in the Banjarawala Package 2 project area. A total of 10 groundwater recharge pits along the primary and secondary existing natural drainage channels will be created. Two Rainwater harvesting structures will be constructed in Public Parks. Artificial recharge is substantially beneficial, as this will help store the surplus rainwater in the form of ground water and in turn arrest the decline of water level and degradation of the quality. All the same it is ecofriendly.

379. Except water lines and sewer works, all other construction activities will be confined to the selected sites, and the interference with the general public and community around is minimal. There will be temporary negative impacts, arising mainly from construction dust and noise, hauling of construction material, waste and equipment on local roads (traffic, dust, safety etc.), mining of construction material, occupation health and safety aspects. The sewer system will be designed as a separate sewer system that carries only the domestic/municipal wastewater and will not mix with storm water drainage systems. No industrial wastewater will be allowed into the sewers.

380. Sewer pipelines will be laid on the same roads along which water supply pipelines will be laid. Sewers will be laid underground in the roads and streets. While water pipes are/will be located on one or either side of the roads, the sewers will be laid in the middle of the road to avoid any disturbing the water pipes. Civil works for laying of both the water supply and sewer pipelines will be done simultaneously to reduce the impact duration. . In the areas of water body crossing, main road crossings or deep cuttings (above 6-7 m depth), the sewers (around 3.5 km) will be laid by trenchless method.

381. During pipe laying works tree cutting is not envisaged as per design, however If any tree is required to be cut, compensatory tree plantation will be carried out in 1:3 ratio. No tree cuttings will be required as per preliminary design for sewer and storm water drainage works. There are no environmentally, archeologically sensitive or protected areas in the town. There are no structures (either temporary or permanent) or common property resources (CPRs) on the proposed pipe/drain right of way. During preparation of the resettlement plan transect walks conducted along the proposed alignment have confirmed that no commercial establishments, permanent shops along the route will be impacted. It will impact mobile vendors, roadside temporary shops which are anticipated to face temporary income loss during the construction period at Doon University Road and Mothrowala Bridge.

382. Water pipes and sewer line works covering almost entire sub-project area will be constructed along public roads in the semi-urban areas congested with people, activities and traffic and subproject is likely to have significant impacts during construction. Impacts mainly arise from the construction dust and noise; from the disturbance of residents, businesses, traffic by the

construction work, safety risk to workers, public and nearby buildings due to deep trench excavations, especially in narrow roads, dust, access impediment to houses and business, disposal of large quantities of construction waste, etc. These are all general impacts of construction in urban areas, and there are well developed methods of mitigation that are suggested in the EMP

383. Anticipated impacts of sewerage system during operation and maintenance will be related to repair of blocks, overflows and leakages in sewers. Sewers are not 100% watertight and leaks can occur at joints. Faulty section will be exposed and repaired following the same basic procedure as when the sewer was built. Also, sewer pipes require regular maintenance as silt inevitably collects in areas of low flow over time. Necessary equipment for cleaning and removal of blockages in the sewers are included in the project.

384. Discharge of wastewater and solid waste from households and roadsides may clog the drains in the medium or longer term. This may result to accumulation of putrescible organic materials causing odor nuisance to the community and pollution to the receiving bodies of water in the area. This may also attract vectors of communicable diseases such as pests and rodents in the drainage system that could affect public health. Mitigation measures includes : (i) strict instruction or directive to households and commercial establishments not to discharge septic wastes and grey water into the drainage system; (ii) strict promotion and enforcement of good waste management practices at household level; and (iii) regular monitoring and cleaning of the silt traps, drains, and siltation or sedimentation chambers (or similar structures) at the outfalls, to prevent entry or accumulation of silt and solid wastes inside these drains and siltation chambers

385. Mitigation will be assured by a program of environmental monitoring conducted during construction and operation to ensure that all measures are implemented, and to determine whether the environment is protected as intended. This will include observations on-site and off-site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported to the PMU. Mitigation and monitoring measures, along with the project agency responsible for such actions, form part of the Environmental Management Plan.

386. During the design and construction period of 42 months, the contractor will have the responsibility of maintaining the existing water supply levels and provide good quality water to consumers at least for the duration and adequate pressure being maintained presently. Operation and Maintenance of the all project facilities will be carried out by DBO contractor for 5 years and then Dehradun Nagar Nigam directly or through an external operator. In the operational phase, all facilities and infrastructure will operate with routine maintenance, which should not affect the environment. Facilities will need to be repaired from time to time, but environmental impacts will be much less than those of the construction period as the work will be infrequent, affecting small areas only. Improved system operation will comply with the operation and maintenance manual and standard operating procedures to be developed for all the activities.

387. UUSDA needs to (i) implement regular monitoring of the drainage system in order to ensure that it is functioning well, ensure that all drainage covers are intact and only storm water will be flowing to the drainage channels (ii) undertake regular maintenance activities such as drainage cleaning to ensure that no clogging occurs.

388. In the project, in a large portion of the project town areas, the septic tank system in individual households is replaced with direct connections to the new sewerage network. The non-use of the existing septic tanks may result in its failure thereby contaminating the surface and groundwater in the region. Hence, an action plan comprising of pumping the sullage, treating it

at the STP and closing the septic tank pit with stones, coarse and fine aggregates shall be developed and implemented during the operation Phase.

389. Stakeholders were involved in developing the IEE through face-to-face discussions, on site meetings, and a city level consultation workshop, which was conducted for larger public participation in the project. Views expressed by the stakeholders were incorporated into the IEE and 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 PMU and ADB websites. The consultation process will be continued during project implementation to ensure that stakeholders are engaged in the project and have the opportunity to participate in its development and implementation. The project's grievance redress mechanism will provide the citizens with a platform for redress their grievances, and describes the informal and formal channels, time frame, and mechanisms for resolving complaints about environmental performance.

390. The Environmental Management Plan (EMP) proposed in the project includes mitigation measures for identified impacts, training and capacity building activities, a monitoring plan to ensure that the environmental standards are maintained throughout the project construction period and a reporting plan to ensure that the project is implemented as per environmentally sound engineering and construction practices. The total estimated cost for implementing the EMP is approximately **11,101,000**/= (eleven million one hundred one thousand only). A CRVA study is being done for the project and its recommendations shall be included in the updated IEE.

391. The draft IEE and EMP will be included in the bid and contract documents to ensure compliance with the conditions set out in this document. The contractor will be required to submit to PIU, for review and approval, an updated EMP / site environmental management plan (SEMP) 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; and (iii) monitoring program as per EMP.

392. The EMP will assist the PMU, PIU, consultants and contractors in mitigating the environmental impacts, and guide them in the environmentally sound execution of the proposed project. The EMP will also ensure efficient lines of communication between PIU/ULB, PMU, consultants and contractor. 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. No works are allowed to commence prior to approval of SEMP. A copy of the EMP/approved SEMP will be kept on site during the construction period at all times

393. The subproject will benefit the general public by contributing to the long-term improvement of water supply, sewerage and storm water drainage systems and community livability in the service area comprising part of wards 83 (Kedarpur) and 85 (Mothrowala) of Dehradhun city. The benefits arising from this subproject include: (i) better public health particularly reduction in waterborne and infectious diseases; (iv) reduced risk of groundwater contamination; (v) reduced risk of contamination of treated water supplies; and (vi) improvement in quality of water quality due to avoidance of disposal of untreated effluent. Improved sewerage and drainage systems will also significantly reduce the incidence of waste water accumulation in the subproject area and hence reduce health risks to the citizens and improve the visual quality and landscape character of the area. The successful implementation of the water supply project will result in better control over the NRW management, improved monitoring system and overall demand management along with energy reduction.

394. The potential adverse environmental impacts are mainly related to the construction period, which can be minimized by the mitigation measures and environmentally sound engineering and construction practices. Therefore, as per ADB SPS, the project is classified as environmental Category B and does not require further environmental impact assessment. However, to conform with government guidelines all necessary permissions and NOCs are to be obtained from the concerned departments prior to start of construction.

395. This IEE shall be updated by PMU during the detailed design phase to reflect any changes, amendments and will be reviewed and approved by ADB.

396. **Recommendations.** The following are recommendations applicable to the subproject to ensure no significant impacts:

(i) Works can not start until (i) IEE is updated and approved by ADB during detailed design, (ii) SEMP is prepared by contractor and approved by PIU/PMU, (iii) COVID-19 health and safety plan as part of overall H&S plan is prepared by contractor and approved by PMU, (iv) GRM is established and operataionalized
(ii) During the detailed design, the contractor will conduct confirmatory site-specific groundwater studies/surveys and confirm the sustainability of proposed tube well sources.
(iii) No objection certificate (NOC) from CGWB for groundwater withdrawal shall be obtained by the UUSDA before award of contract/before start of construction. Recommendations, if any, of CGWB shall be included in the EMP and will be implemented.
(iv) Obtain all required statutory clearances at the earliest time possible and include in the IEE report before award of contract/ before start of construction and ensure that all conditions/provisions are incorporated in the detailed design;
(v) Include this IEE in bid and contract documents;
(vi) Ensure that the project sites are cleared of solid waste and other nuisance materials disposed in designated disposal sites per Solid Waste Management Rules 2000 and its amendment;
(vii) Ensure that sludge management protocols are compliant with environmental regulations (Solid Waste Management Rules 2016) and solid waste disposal should have a designated site (dumping on vacant lot is not allowed);
(viii) Update/revise this IEE based on detailed design and/or if there are unanticipated impacts, change in scope, alignment, or location;
(ix) Conduct safeguards induction to the contractor upon award of contract;
(x) Strictly supervise EMP implementation;
(xi) Ensure contractor appointed qualified EHS officers prior to start of works
(xii) Documentation and reporting on a regular basis as indicated in the IEE;
(xiii) Continuous consultations with stakeholders;
(xiv) Timely disclosure of information and establishment of grievance redressal mechanism (GRM);
(xv) Involvement of contractors, including subcontractors, in first-level GRM;
(xvi) The contractor should comply with relevant government regulations and guidelines on COVID-19 prevention and control, and/or with international good practice guidelines such as WHO's Interim Guidance regarding Considerations for Implementing and Adjusting Public Health and Social Measures in the Context of COVID-19 (2020) and

on Water, Sanitation, Hygiene and Waste Management for the COVID19 virus (Appendix 15), and the ADB's Interim Advisory Note on Protecting the Safety and Well-Being of Workers and Communities from COVID-19 (2020) (Appendix 27) and other relevant guidelines/references in its Annex.

(xvii) Commitment from PMU, PIUs, project consultants, and contractors to protect the environment and the people from any impact during project implementation.

397. Key reminders for the PMU, PIUs, contractors, and workers to comply with the following occupational health and safety measures for COVID-19 OHS Plan:

(i) Ensure project staff, consultants, contractors, and workers have in their mobile devices the Aarogya Setu App, which is a mobile application developed and recommended by the government to proactively reach out to and inform the users of the app regarding risks, best practices and relevant advisories pertaining to the containment of COVID-19;

(ii) Mandatory isolation of the personnel or workers, either asymptomatic or showing symptoms, who have had direct contact with anyone tested positive for COVID-19. Follow the isolation procedures issued by the government;

(iii) Proper disposal of used PPE following guidelines and procedures issued by the government;

(iv) Conduct daily briefing on the developments of COVID-19 in the state or country, either through emails, meetings or daily toolbox talks;

(v) When possible, allow work from home arrangement based on the nature of jobs;

(vi) If necessary, pick up and drop off facility be extended to staff (based on the distance of the staff residence from office and on availability of safe mode of transport);

(vii) Avoid face to face meetings – critical situations requiring in-person discussion must follow social distancing. Do not convene in-person meetings of more than 10 people;

(viii) If possible, conduct all meetings via conference calls. Recommend use of cell phones, texting, web meeting sites and conference calls for project discussions;

(ix) Contractor to help its workers arrange a systematic procurement of all daily needs and groceries at worksites. This will avoid each and every worker going to shops for these daily needs;

(x) Contractor to arrange for contactless payment of wages to workers, where possible;

(xi) Allow distributed break times for workers to maintain social distancing and reduce contact;

(xii) Remind employees and workers to maintain good health by getting adequate sleep; eating a balanced and healthy diet, avoiding alcohol/smoking; and consuming plenty of fluids; and

(xiii) Remind employees and workers to extend their adherence to the H&S protocols at their respective homes. Infection may happen beyond the borders of offices and work sites.

Appendix 1A: Rapid Environmental Assessment (REA) Checklist

Sewerage Treatment

Instructions:
The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (RSES) for endorsement by the Director, RSES and for approval by the Chief Compliance Officer.
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: India/Uttarakhand Integrated and Resilient Urban Development Project: Water supply Subproject at Banjarawala-Package-2, Dehradun, Uttarakhand

Sector Division: Urban Development

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting **Is the project area**			
Densely populated?	√		The proposed Package 2 subproject area (part of ward number 85 of Mothorowala and 83 of Kedarpur) is an urban area. Subproject activities extend to the entire town including the densely populated areas. No major negative impacts envisaged, because Sewer pipelines are proposed within the boundaries (RoW) of government roads and will be constructed without causing disturbance to house, and commercial establishment.
Heavy with development activities?	√		Targeted service area consisting part of ward nos 83 (Kederpur) and 85 (Mothrowala) located in the southern part of Dehradun city, Zone 7. These are newly added municipal areas where urban expansion is considerable
Adjacent to or within any environmentally sensitive areas?		√	There are no any environmentally sensitive areas within or near to any proposed site The subproject corridor is not within or adjacent to any environmentally sensitive area. There are no protected or sensitive environmental areas such as forests, wildlife sanctuaries or archeologically protected areas. Therefore, there are no risks or impacts on biodiversity and natural resources. The nearest environmentally sensitive area is Rajaji National Park.
Cultural heritage site		√	
Protected Area		√	
Wetland		√	
Mangrove		√	

SCREENING QUESTIONS	Yes	No	REMARKS
Estuarine		√	
Buffer zone of protected area		√	
Special area for protecting biodiversity		√	
Bay		√	
B. Potential Environmental Impacts Will the Project Cause…			
Impairment of historical/ cultural monuments/areas and loss/damage to these sites?		√	Not applicable.
Interference with other utilities and blocking of access to buildings; nuisance to neighboring areas due to noise, smell, and influx of insects, rodents, etc.?	√		**Anticipated during construction and operations but can be avoided and mitigated**. No sewerage treatment plant (STP) is proposed under Package 2. It has been proposed that sewage collected from Package 2 will be carried to proposed STP at Indrapuri Farm, Daudwala of Mothrowala ward to be constructed under Banjarawala Package 1. During construction, sewers will be laid underground and may interfere temporarily with access and other utilities. Coordination with the concerned agencies will be conducted in finalizing alignment and shifting of utilities, if necessary
dislocation or involuntary resettlement of people		√	**Not anticipated** Project does not involve any land acquisition. A Resettlement plan will be prepared if there are any involuntary resettlement. During the sewer construction, particularly in narrow streets and streets with on street commercial activities, there may be temporary disruption or relocation of hawkers and vendors.
disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups		√	**Not anticipated.** Contractors shall prioritize hiring local labor force. Some of the skilled workers may be brought from outside but numbers should not be so large to have impacts on social services
Impairment of downstream water quality due to inadequate sewage treatment or release of untreated sewage?		√	**Not anticipated.** No sewerage treatment plant (STP) is proposed in Package 2. It is proposed to reuse treated effluent generated from the proposed STP under Banjarawala Package 1 in gardening, agriculture, manhole flushing and other non-potable uses. The excess / surplus treated effluent from STP that is not reused will be discharged into the adjoining Bindal river. The river remains mostly dry except during rains, and there are no water intake points in the immediate downstream. River carries the untreated wastewater and solid wastes from the town. Hence No impacts envisaged

SCREENING QUESTIONS	Yes	No	REMARKS
Overflows and flooding of neighbouring properties with raw sewage?		√	**Not anticipated.** Risks, climate change factors and forecasted demands are considered in the design and capacity of the sewerage systems.
Environmental pollution due to inadequate sludge disposal or industrial waste discharges illegally disposed in sewers?		√	**Not anticipated.** STP design includes sludge collection, handling, treatment and disposal. Standards are provided for the use of sludge as manure. Sewerage system design ensure no industrial effluent will be allowed into the network.
Noise and vibration due to blasting and other civil works?	√		**Anticipated but temporary**, **site-specific and can be mitigated**. Blasting for underground works is prohibited in UUSDA works. Nuisance or disturbance due to noise may be experienced but minimized with mitigation measures specified in the EMPs. Scheduling of works and prior information with the affected people will be conducted.
Risks and vulnerabilities related to occupational health and safety due to physical, chemical, and biological hazards during project construction and operation?	√		**Anticipated but temporary, site-specific and can be mitigated**. EMPs and contract provisions include requirements for an Occupational Health and Safety (OHS) plan. The contractor's OHS plan shall be reviewed and cleared by the PIU prior to commencement of works
Discharge of hazardous materials into sewers, resulting in damage to sewer system and danger to workers?		√	**Not anticipated.** This sewerage system will cater only to municipal wastewater, no Industrial wastewater discharge is allowed into the sewerage system.
Inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances, and protect facilities?		√	**Not anticipated.** No sewerage treatment plant (STP) and SPS are proposed under this Package 2.
Road blocking and temporary flooding due to land excavation during the rainy season?	√		**Anticipated but temporary, site-specific and can be mitigated** Road blocking for pipe laying works may be required and mitigation measures are required as per IEE/EMP. Underground construction works (sewer laying, foundations) should be carried out in non-monsoon period to avoid Flooding.

SCREENING QUESTIONS	Yes	No	REMARKS
Noise and dust from construction activities?	√		**Anticipated during construction but temporary, site-specific and can be mitigated**. No major noise-generating activities like rock blasting is anticipated. As the sewers will be laid on the road surface, cutting open of road surface using pneumatic drills will produce noise and dust. Temporary nuisance/disturbance due to noise and dust may be experienced by sensitive receptors. These impacts will be minimized with mitigation measures specified in the EMPs. Scheduling of works appropriately and prior information to the affected people will minimize the impact. Dust generation will be controlled through water sprinkling, immediate transportation of excess soil, covered transport system etc.
Traffic disturbances due to construction material transport and wastes?	√		**Anticipated during construction but temporary, site-specific and can be mitigated.** Linear activities like sewer laying along the roads is likely to disrupt traffic. Vehicle movement for construction purpose will increase the traffic. Identification of alternate routes, allowing limited - at least one-way traffic, prior information about the works and alternative arrangements, providing information/sign boards etc. will reduce the impact.
Temporary silt runoff due to construction?	√		**Anticipated** during construction but temporary, site-specific and can be mitigated. EMPs and contract provisions include requirement for contractors to provide silt control measures
Hazards to public health due to overflow flooding, and groundwater pollution due to failure of sewerage system?		√	**Not anticipated.** Sewerage system will be designed with applicable standards. Adequately trained staff and necessary equipment will be in place for regular operation and maintenance of the system. Proposed treatment system will be efficient and appropriate repair and maintenance procedure will be developed. Sufficient funds for operation will be ensured. Backup power supply system is part of project.

SCREENING QUESTIONS	Yes	No	REMARKS
Deterioration of water quality due to inadequate sludge disposal or direct discharge of untreated sewage water?		√	**Not anticipated.** STP design includes sludge handling and treatment facilities to as per statutory standards. Inadequate sludge disposal or direct discharge of untreated sewage water may have impact on environment therefore adequate measure of sludge disposal and prohibit discharge of untreated sewage should be taken
Contamination of surface and ground waters due to sludge disposal on land?		√	**Not anticipated.** STP design includes sludge handling and treatment facilities to as per statutory standards. O&M manual includes testing procedures and acceptable parameters for disposal in river
Health and safety hazards to workers from toxic gases and hazardous materials which may be contained in sewage flow and exposure to pathogens in untreated sewage and unstabilized sludge?	√		**Anticipated during construction but temporary, site-specific and can be mitigated**. Workers may be exposed during cleaning of blockages in sewerage network. However, O&M Manuals will include standard operating procedures. All necessary health and safety training and personal protection equipment will be given to workers and staff during operation of sewerage system. Implementation of contractors' H&S will be strictly enforced by the PIUs.
Large population increase during project construction and operation that causes increased burden on social infrastructure (such as sanitation system)?		✓	**Not anticipated**. Most of the unskilled workers will be hired from local labor force. Some skilled workers may be brought from outside, but numbers will not be so large to have impacts on social infrastructure
Social conflicts between construction workers from other areas and community workers?		✓	**Not anticipated.** Most of the unskilled workers will be hired from local labor force. Some skilled workers may be brought from outside, but numbers will not be so large to have impacts on social infrastructure. No conflicts envisaged.
Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?	✓		**Anticipated but temporary, site-specific and can be mitigated.** Construction will not involve use of explosives and chemicals. During operations, chemicals such as pH adjusters, flocculants, or coagulants may be used. The complete list of chemicals, quantities, and requirements for safe use and storage will be included in the final IEE The EMPs in the current IEEs already include measures and monitoring requirements conforming to IFC EHS Guidelines. O&M Manuals will include health and safety requirements for managing chemicals

SCREENING QUESTIONS	Yes	No	REMARKS
Community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?	✓		**Anticipated but temporary, site-specific and can be mitigated**. Work area will be clearly demarcated with security access for the workers and project-concerned members only. Community health and safety risks are present during construction such as risks from excavations for pipe laying, equipment and vehicle operations which should be identified and implemented in the site-specific EMPs

Checklist for Preliminary Climate Risk Screening

Country/Project Title: India/Uttarakhand Integrated and Resilient Urban Development Project: Water supply Subproject at Banjarawala-Package-2, Dehradun, Uttarakhand

Sector: Urban Development
Subsector: Waste Water
Division/Department: SARD/SAUW

Item	Screening Questions	Score	Remarks[1]
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	1	The subproject components are located in the southern periphery of Dehradun city, comprising part of ward numbers 83 (Kedarpur) and 85 (Mothrowala). Dehradun is most vulnerable to climate mediated risks. Mountainous regions are vulnerable to climate change and have shown "above average warming" in the 20th century. Impacts are expected to range from reduced genetic diversity of species to erratic rainfall leading to flash floods to glacial melt in the Himalayas leading to increased flooding that will affect water resources within the next few decades. The area is earthquake prone and falls in a region of high to very high seismic hazard. Adequate measures will be included in the designs to Safeguard facilities from extreme events. The detailed engineering aspects will be undertaken by contractor with the competent authority's approval. No such issue may affect the Project

[1] If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc.)?	0	No such issue may affect the project
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of Project outputs (e.g., construction material)?	0	No such issues may affect the project
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (Scheduling and cost) of project output(s)?	0	No such issue may affect the project
Performance of project outputs	Would weather/climate conditions and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	0	Weather conditions may disrupt regular operations of sewage treatment plants. Moreover, components require continuous power to operate that may be affected by low Precipitation conditions. Back-up powers (such as solar panels) may be provided in cases of such extreme event. No problem will be envisaged in future which likely affect the performance of project output

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response will be categorized as high risk project.

Result of Initial Screening (Low, Medium, High): **Medium Risk Category**

Other Comments: The proposed subproject activity does not involve any construction STP and SPS. Only sewer networks are proposed and the anticipated environmental impacts are very marginal and the construction activity does not impose any threat to the existing climatic condition

Appendix 1B: Rapid Environmental Assessment (REA) Checklist

WATER SUPPLY

Instructions:
This checklist is to be prepared to support the environmental classification of a project. It is to be attached to the environmental categorization form that is to be prepared and submitted to the Chief Compliance Officer of the Regional and Sustainable Development Department.
This checklist is to be completed with the assistance of an Environment Specialist in a Regional Department.
This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB checklists and handbooks on (i) involuntary resettlement, (ii) indigenous peoples planning, (iii) poverty reduction, (iv) participation, and (v) gender and development.
Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts.
Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project Title: India/Uttarakhand Integrated and Resilient Urban Development Project: Water supply Sub-project at Banjarawala-Package-2, Dehradun,

Sector Division: Urban Development

SCREENING QUESTIONS	Yes	No	Remarks
Water Supply			
A. Project Siting Is the project area			
Densely populated?	√		The water supply service area under this package is part of ward number 85 (Mothrowala) located in the Zone 7 of southern periphery of Dehradun, including the densely populated areas. There are no major negative impacts envisaged, because Tube wells /OHTs will be constructed in the same vicinity of Government land. The water pipeline will be located within the ROW of existing roads and will be constructed without causing disturbance to houses, and commercial establishments.
Heavy with development activities?		√	Targeted service area consisting part of ward nos 85 (Mothrowala) located in the southern part of Dehradun city. These are newly added municipal areas where urban expansion is considerable. Banjarawala area of Dehradun city is fast developing area; urban expansion is considerable

SCREENING QUESTIONS	Yes	No	Remarks
Adjacent to or within, any environmentally sensitive areas?		√	There are no any environmentally sensitive areas within or near to any proposed site The subproject corridor is not within or adjacent to any environmentally sensitive area. There are no protected or sensitive environmental areas such as forests, wildlife sanctuaries or archeologically protected areas. Therefore, there are no risks or impacts on biodiversity and natural resources. The proposed project will optimally utilize the groundwater sources. The nearest environmentally sensitive area is Rajaji National Park.
Cultural heritage site		√	
Protected Area		√	
Wetland		√	
Mangrove		√	
Estuarine		√	
Buffer zone of protected area		√	
Special area for protecting biodiversity		√	
Bay		√	
B. Potential Environmental Impacts Will the Project cause…			
Pollution of raw water supply from upstream wastewater discharge from communities, industries, agriculture, and soil erosion runoff?		√	**Not anticipated** There is no pollution risk for existing resources as underground water shall be utilized for water supply
Impairment of historical/cultural monuments/areas and loss/damage to these sites?		√	**Not anticipated** There are no such notified sites within project area
Hazard of land subsidence caused by excessive ground water pumping?		√	**Not anticipated** The entire Dehradhun district including Raipur block in which Tube wells are proposed falls under “Safe category” by CGWB. For groundwater development
Social conflicts arising from displacement of communities?		√	**Not anticipated** Project does not involve any land acquisition. A Resettlement plan will be prepared if there are any involuntary resettlement. During water supply pipe laying, particularly in narrow streets and streets with busy commercial activities, there may be temporary disruption or relocation of hawkers and vendors. and these will be addressed through specific measures in the EMP.

SCREENING QUESTIONS	Yes	No	Remarks
Conflicts in abstraction of raw water for water supply with other beneficial water uses for surface and ground waters?		√	**Not Anticipated.** Surface water will not be used. Only ground water source will be used. Existing tube wells will be utilized as water source along with new ones for the proposed water supply project, therefore no conflicts may arise for ground water. The demand supply gap is to be met through reduction of losses in distribution system by introducing SCADA system. The proposed project will optimally utilize the groundwater sources
Unsatisfactory raw water supply (e.g. excessive pathogens or mineral constituents)?	√		Ground water shall be used as water source and mineral constituents are required to be checked before supplying to consumers. Raw water will be disinfected with chlorine prior to distribution. Water quality will be required to meet the Indian Standards for Drinking Water/IFC EHS Guideline (most stringent)
Delivery of unsafe water to distribution system?	√		Raw water will be treated prior to distribution. Unsafe water may be delivered if efficient maintenance of water supply distribution system is not done during operation phase
Inadequate protection of intake works or wells, leading to pollution of water supply?		√	No intake works are proposed.
Over pumping of ground water, leading to salinization and ground subsidence?		√	**Not Anticipated.** Only required and sanctioned water will be extracted from tube wells. Groundwater extraction shall be limited to the sustainable levels as indicated in the permits provided by the CGWB and whole district falls in “safe” category.
Excessive algal growth in storage reservoir?	√		Excessive algal growth may occur if storage reservoirs are not maintained regularly. Treated and disinfected water will be stored in the OHTs which are covered, so the problem will be minimal. Regular cleaning during operation will mitigate the problem.
Increase in production of sewage beyond capabilities of community facilities?		√	**Not Anticipated** Sewerage system has already been improved and augmented to adequate capacity including treatment under the UUSDIP
Inadequate disposal of sludge from water treatment plants?		√	Subproject does not include Water Treatment Plants
Inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities?		√	**Not Anticipated** The pumps will be installed within a building so chances of noise level spreading to outside premises are not anticipated. Low noise pumps and machineries are proposed in pumping stations. Adequate buffer and protection will also be ensured. No WTP is proposed
Impairments associated with transmission lines and access roads?	√		Temporary impairments may be anticipated along the new transmission line routes and access roads during construction stage but it will be mitigated by taking proper precaution measures

SCREENING QUESTIONS	Yes	No	Remarks
Health hazards arising from inadequate design of facilities for receiving, storing, and handling of chlorine and other hazardous chemicals.	√		Liquid chlorine has been proposed to be used for disinfection of water. Proper facility for storing and handling of chlorine shall be maintained all around to avoid such hazards and all safety precautions will be provided. Contractor has to take precautions in handling and usage of chlorine to avoid any health hazard, no other hazardous chemicals are expected to be used during construction works
health and safety hazards to workers from handling and management of chlorine used for disinfection, other contaminants, and biological and physical hazards during project construction and operation?	√		Contractor has to take precautions in handling and usage of chlorine to avoid any health hazard. Only Trained operator will operate the chlorination system. Proper precautionary measures will be taken during handling of chlorine
Dislocation or involuntary resettlement of people		√	**Not Anticipated** Subproject does not involve land acquisition or displacement. All works are proposed in Govt. lands therefore dislocation or involuntary resettlement of people are not anticipated. However, there may be temporary disturbance to business and squatters/vendors during construction. Appropriate measures will be suggested to mitigate the impact.
disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		√	No such impact is envisaged
Noise and dust from construction activities?	√		Noise and dust risk will be envisaged during construction works. All the construction machineries employed will comply with noise emission standards of Central Pollution Control Board. Dust suppression measures such as water sprinkling will be employed
Increased road traffic due to interference of construction activities?	√		Excavation and laying pipelines along public roads will interfere with the traffic. Construction material transport will increase traffic within city. Proper traffic management and construction planning will be ensured to minimize the interference
Continuing soil erosion/silt runoff from construction operations?	√		Work will mostly be conducted in dry season mostly; Construction work during monsoon shall be carried out with due care so that silt run off due to construction operation is prevented. No construction will be allowed during rains however, adequate mitigation measures will be included in SEMP.

SCREENING QUESTIONS	Yes	No	Remarks
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?	√		WTP is not proposed in the project, only ground water shall be used after adequate chlorination. Trained and skilled staff will be deployed during O&M period. Water sample testing and timely monitoring are proposed to ensure the quality of treated water prior delivery to the consumers. The drinking water quality parameters and acceptable levels are included in the contract.
Delivery of water to distribution system, which is corrosive due to inadequate attention to feeding of corrective chemicals?		√	**Not envisaged**. Non corrosive materials pipe will be used for distribution networks. DI pipes will be used for distribution system and are non-corrosive in nature. Also, Treated water will be tested prior distribution.
Accidental leakage of chlorine gas?	√		Accidental leakage of chlorine gas may take place during chlorination. Utmost care should be taken
Excessive abstraction of water affecting downstream water users?		√	**Not Anticipated** .Water for the project is proposed only ground water as source
Competing uses of water?		√	Not applicable. only ground water shall be used for water supply services
Increased sewage flow due to increased water supply	√		Development of sewerage system is also proposed under the same package keeping in mind 135 lpcd water demand for whole town.
large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	**Not Anticipated** Most of the unskilled workers will be hired locally, some of skilled workers will be brought from outside but numbers will not so large to have impacts on social infrastructure and services
Social conflicts if workers from other regions or countries are hired?		√	Outside workers will remain in labour camps and no social conflicts will envisaged.
risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during operation and construction?		√	**Not Anticipated** No explosives shall be used in project. Fuel and other chemicals will be used in very less quantities which will not have significant impact on community health and safety. Safe handling of fuels and chemicals will be ensured by contractor.
community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?	√		**Not Anticipated** Anticipated but temporary, site-specific and can be mitigated. Only worker and project concerned members will be allowed to visit the operational sites. Community health and safety risks are present during construction such as risks from excavations for pipe laying, equipment and vehicle operations which should be identified and mitigation measures to be adopted by the contractor to incorporate in the site-specific EMPs.

A Checklist for Preliminary Climate Risk Screening

Country/Project Title: India/Uttarakhand Integrated and Resilient Urban Development Project: Water supply Subproject at Banjarawala-Package-2, Dehradun, Uttarakhand
Sector: Urban Development
Subsector: Water Supply
Division/Department: SARD/SAUW

Screening Questions		**Score**	**Remarks**[34]
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	1	The water supply subproject components are located in the southern periphery of Dehradun city, comprising part of ward number 85 (Mothrowala). Dehradun is most vulnerable to climate mediated risks. Mountainous regions are vulnerable to climate change and have shown "above average warming" in the 20th century. Impacts are expected to range from reduced genetic diversity of species to erratic rainfall leading to flash floods to glacial melt in the Himalayas leading to increased flooding that will affect water resources within the next few decades. The area is earthquake prone and falls in a region of high to very high seismic hazard. Adequate measures will be included in the designs to Safeguard facilities from extreme events. The detailed engineering aspects will be undertaken by

[34] If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

			contractor with the competent authority's approval. No such issue may affect the Project
	Would the project design (e.g., the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc.)?	0	No such issue may affect the project
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g., prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g., construction material)?	0	No such issues may affect the project
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s) ?	0	No such issues may affect the project
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g., annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	0	Weather conditions may disrupt regular operation of sewage treatment plants. Moreover, components require continuous power to operate that may be affected by low Precipitation conditions. Back-up powers (such as solar panels) may be provided in cases of such extreme event. No problem will be envisaged in future which likely affect the performance of project output

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include

providing a score of 1 in all responses) or a 2 in any single response will be categorized as high-risk project.

Result of Initial Screening (Low, Medium, High): Medium risk

Other Comments: The proposed subproject activity involves construction of three new Tube wells and 2 new OHTs.The proposed project will optimally utilize the groundwater sources and the anticipated environmental impacts are very marginal and the construction activity does not impose any threat to the existing climatic condition

Appendix 1C: Rapid Environmental Assessment (REA) Checklist

Storm Water Drainage

Instructions:
The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (RSES) for endorsement by the Director, RSES and for approval by the Chief Compliance Officer.
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: India / Uttarakhand Urban Sector Development Agency (UUSDA)
Storm Water Drainage System Subproject at Banjarawala-Package-2, Dehradun City

Sector Division: Urban Development

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting **Is the project area**			
Densely populated?	√		Subproject activities includes the densely populated areas. There are no major negative impacts envisaged, because storm water drains will be constructed alongside the existing government roads, along the existing natural nala/drain considering the topography of the area and can be constructed without causing disturbance to houses, and commercial establishments.
Heavy with development activities?	√		Targeted service area consisting of part of ward nos 83 (Kederpur) and 85 (Mothrowala) located in the southern part of Dehradun city. These are newly added municipal areas where urban expansion is considerable
Adjacent to or within any environmentally sensitive areas?		√	There are no any environmentally sensitive areas within or near to any proposed site There are no protected or sensitive environmental areas such as forests, wildlife sanctuaries or archeologically protected areas. Therefore, there are no risks or impacts on biodiversity and natural resources. The nearest environmentally sensitive area is Rajaji National Park.

SCREENING QUESTIONS	Yes	No	REMARKS
Cultural heritage site		√	
Protected Area		√	None of the subproject component sites are adjacent to or within any protected area
Wetland		√	
Mangrove		√	
Estuarine		√	
Buffer zone of protected area		√	
Special area for protecting biodiversity		√	
Bay		√	
B. Potential Environmental Impacts Will the Project Cause…			
Impairment of historical/ cultural monuments/areas and loss/damage to these sites?		√	Not applicable.
interference with other utilities and blocking of access to buildings; nuisance to neighbouring areas due to noise, smell, and influx of insects, rodents, etc.?	√		**Anticipated during construction and operations but can be avoided and mitigated**.. During construction, it may interfere temporarily with access and other utilities. Coordination with the concerned agencies will be conducted in finalizing alignment and shifting of utilities, if necessary. The works will be mainly restricted within the existing storm water drains.
dislocation or involuntary resettlement of people		√	**Not anticipated** Project does not involve any land acquisition. A Resettlement Plan will be prepared if there are any involuntary resettlement.
disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups		√	**Not anticipated.** Contractors shall prioritize hiring local labour force. Some of the skilled workers may be brought from outside but numbers should not be so large to have impacts on social services
Impairment of downstream water quality due to inadequate sewage treatment or release of untreated sewage?		√	**Not applicable** as sub project pertains to construction of storm water drains
Overflows and flooding of neighbouring properties with raw sewage?		√	**Not anticipated.** Risks, climate change factors and forecasted demands are considered in the design. The proposed subproject will reduce the water logging and flooding in the drainage zones Flooding and overflowing will be avoided through regular operation and maintenance. .

Environmental pollution due to inadequate sludge disposal or industrial waste discharges illegally disposed in sewers?		√	**Not applicable**
Noise and vibration due to blasting and other civil works?	√		**Anticipated but temporary**, **site-specific and can be mitigated**. Blasting for underground works is prohibited in UUSDA works. Nuisance or disturbance due to noise may be experienced but minimized with mitigation measures specified in the EMPs. Scheduling of works and prior information with the affected people will be conducted.
risks and vulnerabilities related to occupational health and safety due to physical, chemical, and biological hazards during project construction and operation?	√		**Anticipated but temporary, site-specific and can be mitigated**. EMPs and contract provisions include requirements for an Occupational Health and Safety (OHS) plan. The contractor's OHS plan shall be reviewed and cleared by the PIUs prior to commencement of works. During execution stage the workers may face occupational health and safety related issues if personal protection measures are not used properly. No such impact is anticipated in operation stag
Discharge of hazardous materials into sewers, resulting in damage to sewer system and danger to workers?		√	**Not applicable**
Inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances, and protect facilities?		√	**Not applicable**
Road blocking and temporary flooding due to land excavation during the rainy season?	√		**Anticipated but temporary, site-specific and can be mitigated.** Temporary **r**oad blocking for construction of culverts/drains shall be there for which proper traffic management and diversion arrangements may be required and mitigation measures are required as per IEE/EMP. Due care shall be taken to carry out the works during dry periods to avoid any incidence of temporary flooding in the areas.

Noise and dust from construction activities?	√		**Anticipated during construction but temporary, site-specific and can be mitigated**. No major noise-generating activities like rock blasting is anticipated. As the drains will constructed alongside the road surface, cutting of road surface using pneumatic drills will produce noise and dust. Temporary nuisance/disturbance due to noise and dust may be experienced by sensitive receptors. These impacts will be minimized with mitigation measures specified in the EMPs. During operations, there will be no such impacts. Scheduling of works appropriately and prior information to the affected people will minimize the impact. Dust generation will be controlled through water sprinkling, immediate transportation of excess soil, covered transport system etc.
traffic disturbances due to construction material transport and wastes?	√		**Anticipated during construction but temporary, site-specific and can be mitigated.** Linear activities along the road is likely to disrupt traffic. Vehicle movement for construction purpose will increase the traffic. Identification of alternate routes, allowing limited - at least one-way traffic, prior information about the works and alternative arrangements, providing information/sign boards etc. will reduce the impact.
temporary silt runoff due to construction?	√		**Anticipated during construction but temporary, site-specific and can be mitigated**. EMPs and contract provisions include requirement for contractors to provide silt control measures. Temporary silt run off may be there during rainy season. Majority of the works shall be carried out during dry periods to avoid such impacts. To avoid silt flow in drains, during construction, silt fencing arrangements will be provided at the banks of drains.
hazards to public health due to overflow flooding, and groundwater pollution due to failure of sewerage system?		√	**Not anticipated**
deterioration of water quality due to inadequate sludge disposal or direct discharge of untreated sewage water?		√	**Not anticipated**
contamination of surface and ground waters due to sludge disposal on land?		√	**No such impact is anticipated**

Health and safety hazards to workers from toxic gases and hazardous materials which may be contained in sewage flow and exposure to pathogens in untreated sewage and unstabilized sludge?	√		**Anticipated during construction but temporary, site-specific and can be mitigated**. Workers may be exposed during cleaning of blockages in drainage networks. However, O&M Manuals will include standard operating procedures. All necessary health and safety training and personal protection equipment will be given to workers and staffs during operation of drainage system. Implementation of contractors' H&S will be strictly enforced by the PIUs.
Large population increase during project construction and operation that causes increased burden on social infrastructure (such as sanitation system)?		✓	**Not anticipated**. Most of the unskilled workers will be hired from local labour force. Some skilled workers may be brought from outside, but numbers will not be so large to have impacts on social infrastructure
Social conflicts between construction workers from other areas and community workers?		✓	**Not anticipated.** Most of the unskilled workers will be hired from local labour force. Some skilled workers may be brought from outside, but numbers will not be so large to have impacts on social infrastructure. No conflicts envisaged.
Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		✓	**Not anticipated..** Construction will not involve use of explosives and chemicals. The EMPs in the current IEEs already include measures and monitoring requirements conforming with IFC EHS Guidelines. O&M Manuals will include health and safety requirements for managing chemicals
Community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?	✓		**Anticipated but temporary, site-specific and can be mitigated**. Work area will be clearly demarcated with security access for the workers and project-concerned members only. Community health and safety risks are present during construction such as risks from excavations for drains, equipment and vehicle operations which should be identified and implemented in the site-specific EMPs

Checklist for Preliminary Climate Risk Screening

Country/Project Title: India / Uttarakhand Urban Sector Development Agency (UUSDA) Storm Water Drainage System Subproject at Banjarawala-Package-2, Dehradun, Dehradun

Sector: Urban Development

Division/Department: SARD/SAUW

Screening Questions		Score	Remarks[35]
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	1	The water supply subproject components are located in the southern periphery of Dehradun city , comprising part of ward number 85 (Mothrowala). Dehradun is most vulnerable to climate mediated risks. Mountainous regions are vulnerable to climate change and have shown "above average warming" in the 20th century. Impacts are expected to range from reduced genetic diversity of species to erratic rainfall leading to flash floods to glacial melt in the Himalayas leading to increased flooding that will affect water resources within the next few decades. The area is earthquake prone and falls in a region of high to very high seismic hazard. Adequate measures will be included in the designs to Safeguard facilities from extreme events. The detailed engineering aspects will be undertaken by contractor with the competent authority's approval. No such issue may affect the Project
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-	0	No such issue may affect the project

[35] If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

Screening Questions		Score	Remarks[35]
	meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc.)?		
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	0	No such issues may affect the project
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s) ?	0	No such issues may affect the project
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	0	Weather conditions may disrupt regular operation of sewage treatment plants. Moreover, components require continuous power to operate that may be affected by low Precipitation conditions. Back-up powers (such as solar panels) may be provided in cases of such extreme event. No problem will be envisaged in future which likely affect the performance of project output

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1 - 4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response will be categorized as high risk project.

Result of Initial Screening (Low, Medium, High)**: Medium risk**

Other Comments: The proposed subproject activity involves construction of 30 Km storm water drain and 18 Outfall structures shall be constructed at the end of storm water drains that discharge to stream/river to reduce the velocity and prevent erosion. Construction of drains are part of the road reconstruction work, making the sides of road in slope to accommodate rain flowing down to the existing drainage systems The anticipated environmental impacts are very marginal and the construction activities does not impose any threat to the existing climatic conditions.

Appendix 2: Drinking Water Standards, Surface Water Quality Classification Ambient Air Quality, Vehicle, Diesel Generator Emissions Standards

Table 1: Applicable Drinking Water Quality Standards for ADB funded projects in India

Group	National Standards for Drinking Water[a]			WHO Guidelines for Drinking-Water Quality, 4th Edition, 2011[b]	Applicable Per ADB SPS [c, d]
	Parameter	Unit	Max. Concentration Limits[d]		
Physical	Turbidity	NTU	1 (5)	-	1 (5)
	pH		6.5 – 8.5	none	6.5 – 8.5
	Color	Hazen units	5 (15)	none	5 (15)
	Taste and Odor		Agreeable	-	Agreeable
	TDS	mg/l	500 (2,000)	-	500 (2,000)
	Iron	mg/l	0.3	-	0.3
	Manganese	mg/l	0.1 (0.3)	-	0.1 (0.3)
	Arsenic	mg/l	0.01 (0.05)	0.01	0.01
	Cadmium	mg/l	0.003	0.003	0.003
	Chromium	mg/l	0.05	0.05	0.05
	Cyanide	mg/l	0.05	none	0.05
	Fluoride	mg/l	1 (1.5)	1.5	1 (1.5)
	Lead	mg/l	0.01	0.01	0.01
	Ammonia	mg/l	0.5	none established	0.5
Chemical	Chloride	mg/l	250 (1,000)	none established	250 (1,000)
	Sulphate	mg/l	200 (400)	none	200 (400)
	Nitrate	mg/l	45	50	45
	Copper	mg/l	0.05 (1.5)	2	0.05 (1.5)
	Total Hardness	mg/l	200 (600)	-	200 (600)
	Calcium	mg/l	75 (200)	-	75 (200)
	Zinc	mg/l	5 (15)	none established	5 (15)
	Mercury	mg/l	0.001	0.006	0.001
	Aluminum	mg/l	0.1 (0.3)	none established	0.1 (0.3)
	Residual Chlorine	mg/l	0.2	5	0.2
Micro Germs	E-coli	MPN/100ml	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample
	Total Coliform	MPN/100ml			

[a] Bureau of India Standard 10200: 2012.
[b] Health-based guideline values.
[c] Per ADB SPS, the government shall achieve whichever of the ambient air quality standards is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the executing agency of the government will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS.
[d] Figures in parenthesis are maximum limits allowed in the absence of alternate source.

Table 2: Surface Water Quality Classification Criteria

Designated-Best-Use	Class of Water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100 ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6 mg/L or more Biochemical Oxygen Demand 5 days 20°C 2mg/L or les
Outdoor bathing (Organized)	B	Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/L or more Biochemical Oxygen Demand 5 days 20°C 3mg/L or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4 mg/L or more Biochemical Oxygen Demand 5 days 20°C 3 mg/L or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5 Dissolved Oxygen 4 mg/L or more Free Ammonia (as N) 1.2 mg/L or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH between 6.0 to 8.5 Electrical Conductivity at 25°C micro mhos/cm Max. 2250 Sodium absorption Ratio Max. 26 Boron Max. 2 mg/L

Source: Central Pollution Control Board
mg/L = milligram per liter, ml = milliliter, MPN = Most Probable Number

Table 3: Ambient Air Quality Standards

Parameter	Location [a]	India Ambient Air Quality Standard ($\mu g/m^3$)[b]	WHO Air Quality Guidelines ($\mu g/m^3$)		Applicable Per ADB SPS[e] ($\mu g/m^3$)
			Global Update [c] 2005	Second Edition 2000	
PM_{10}	Industrial Residential, Rural and Other Areas	60 (Annual) 100 (24-hr)	20 (Annual) 50 (24-hr)	-	20 (Annual) 50 (24-hr)
	Sensitive Area	60 (Annual) 100 (24-hr)	20 (Annual) 50 (24-hr)	-	20 (Annual) 50 (24-hr)

Parameter	Location [a]	India Ambient Air Quality	WHO Air Quality Guidelines (μg/m³)		Applicable Per ADB SPS[e]
PM_{25}	Industrial Residential, Rural and Other Areas	40 (Annual) 60 (24-hr)	10 (Annual) 25 (24-hr)	-	10 (Annual) 25 (24-hr)
	Sensitive Area	40 (Annual) 60 (24-hr)	10 (Annual) 25 (24-hr)		10 (Annual) 25 (24-hr)
SO_2	Industrial Residential, Rural and Other Areas	50 (Annual) 80 (24-hr)	20 (24-hr) 500 (10-min)	-	50 (Annual) 20 (24-hr) 500 (10-min)
	Sensitive Area	20 (Annual) 80 (24-hr)	20 (24-hr) 500 (10-min)	-	20 (Annual) 20 (24-hr) 500 (10-min)
NO_2	Industrial Residential, Rural and Other Areas	40 (Annual) 80 (24-hr)	40 (Annual) 200 (1-hr)	-	40 (Annual) 80 (24-hr) 200 (1-hr)
	Sensitive Area	30 (Annual) 80 (24-hr)	40 (Annual) 200 (1-hr)	-	30 (Annual) 80 (24-hr) 200 (1-hr)
CO	Industrial Residential, Rural and Other Areas	2,000 (8-hr) 4,000 (1-hr)	-	10,000 (8-hr) 100,000 (15-min)	2,000 (8-hr) 4,000 (1-hr) 100,000 (15-min)
	Sensitive Area	2,000 (8-hr) 4,000 (1-hr)	-	10,000 (8-hr) 100,000 (15-min)	2,000 (8-hr) 4,000 (1-hr) 100,000 (15-min)
Ozone (O_3)	Industrial Residential, Rural and Other Areas	100 (8-hr) 180 (1-hr)	100 (8-hr)		100 (8-hr) 180 (1-hr)
	Sensitive Area	100 (8-hr) 180 (1-hr)	100 (8-hr)		100 (8-hr) 180 (1-hr)
Lead (Pb)	Industrial, Residential, Rural and Other Areas	0.5 (Annual) 1.0 (24-hr)		0.5 (Annual)	0.5 (Annual) 1.0 (24-hr)
	Sensitive Area	0.5 (Annual) 1.0 (24-hr)		0.5 (Annual)	0.5 (Annual) 1.0 (24-hr)
Ammonia (NH_3)	Industrial Residential, Rural and Other Areas	100 (Annual) 400 (24-hr)			100 (Annual) 400 (24-hr)
	Sensitive Area	100 (Annual) 400 (24-hr)			100 (Annual) 400 (24-hr)

Parameter	Location [a]	India Ambient Air Quality	WHO Air Quality Guidelines (µg/m³)		Applicable Per ADB SPS[e]
Benzene (C_6H_6)	Industrial Residential, Rural and Other Areas	5 (Annual)			5 (Annual)
	Sensitive Area	5 (Annual)			5 (Annual)
Benzo(o)pyrene (BaP) particulate phase only	Industrial Residential, Rural and Other Areas	0.001 (Annual)			0.001 (Annual)
	Sensitive Area	0.001 (Annual)			0.001 (Annual)
Arsenic (As)	Industrial Residential, Rural and Other Areas	0.006 (Annual)			0.006 (Annual)
	Sensitive Area	0.006 (Annual)			0.006 (Annual)
Nickel (Ni)	Industrial Residential, Rural and Other Areas	0.02 (Annual)			0.02 (Annual)
	Sensitive Area	0.02 (Annual)			0.02 (Annual)

[a] Sensitive area refers to such areas notified by the India Central Government.

[b] Notification by Ministry of Environment and Forests, Government of India Environment (Protection) Seventh Amendment Rules, 2009

[c] WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide. *Global update 2005*. WHO. 2006

[d] Air Quality Guidelines for Europe Second Edition. WHO 2000.

[e] Per ADB SPS, the government shall achieve whichever of the ambient air quality standards is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the executing agency of the government will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS

Table 4: 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

Table 5: Emission limits for New DG sets up to 800 KW
(As per Environment (Protection) (Third Amendment) Rules, 2013)

TABLE

Power Category	Emission Limits (g/kW-hr)			Smoke Limit (light absorption coefficient, m^{-1})
	NOx +HC	CO	PM	
Upto 19 KW	≤ 7.5	≤ 3.5	≤ 0.3	≤ 0.7
More than 19 KW upto 75 KW	≤ 4.7	≤ 3.5	≤ 0.3	≤ 0.7
More than 75 KW upto 800 KW	≤ 4.0	≤ 3.5	≤ 0.2	≤ 0.7

Note:

1. The abbreviations used in the Table shall mean as under: NO_x – Oxides of Nitrogen; HC – Hydrocarbon; CO – Carbon Monoxide; and PM – Particulate Matter.
2. Smoke shall not exceed above value throughout the operating load points of the test cycle.
3. The testing shall be done as per D2 – 5 mode cycle of ISO: 8178- Part 4.
4. The above mentioned emission limits shall be applicable for Type Approval and Conformity of Production (COP) carried out by authorised agencies.
5. Every manufacturer, importer or, assembler (hereinafter referred to as manufacturer) of the diesel engine (hereinafter referred to as 'engine') for genset application manufactured or imported into India or, diesel genset (hereinafter referred to as 'product'), assembled or imported into India shall obtain Type Approval and comply with COP of their product(s) for the emission limits which shall be valid for the next COP year or, the date of implementation of the revised norms specified above, whichever earlier.

   Explanation.- The term 'COP year' means the period from 1st April to 31st March.
6. Stack height (in metres), for genset shall be governed as per Central Pollution Control Board (CPCB) guidelines.

DIESEL GENERATOR SETS : STACK HEIGHT

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

H = h+0.2x ÖKVA
H = Total height of stack in metre
h = Height of the building in metres where the generator set is installed
KVA = Total generator capacity of the set in KVA
Based on the above formula the minimum stack height to be provided with different range of generator sets may be categorised as follows:

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

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

Source : Evolved By CPCB
[Emission Regulations Part IV:COINDS/26/1986-87]

Appendix 3: Effluent Discharge Standards for STPs as per National Green Tribunal (NGT) order dated 30.04.2019

Sl. No.	Parameters	Parameters Limit
1	pH	5.5-9.0
2	BOD (mg/l)	Not more than 10 mg/l
3	COD (mg/l)	Not more than 50 mg/l
4	TSS (mg/l)	Not more than 20 mg/l
5	P-Total (mg/l)- for discharge into ponds/lakes	Not more than 1.0 mg/l
6	N-Total (mg/l)	Not more than 10 mg/l
7	Fecal Coliform (MPN/100ml)	Desirable- Less than 100 MPN/100ml Permissible- 230 MPN/100ml

Note: The standards recommended are applicable to entire country irrespective of Mega and Metropolitan Cities The standards will apply not only for new STPs but also for existing/under construction STPs without any delay

Appendix 4: Ambient Noise Level Standards

Receptor/ Source	India National Noise Level Standards[a] (dBA)		WHO Guidelines Value For Noise Levels Measured Out of Doors[b] (One Hour LA_q in dBA)		Applicable Per ADB SPS[c] (dBA)	
	Day	**Night**	**07:00 – 22:00**	**22:00 – 07:00**	Day time	Night time
Industrial area	75	70	70	70	70	70
Commercial area	65	55	70	70	65	55
Residential Area	55	45	55	45	55	45
Silent Zone	50	40	55	45	50	40

[a] Noise Pollution (Regulation and Control) Rules, 2002 as amended up to 2010.
[b] Guidelines for Community Noise. WHO. 1999
[c] Per ADB SPS, the government shall achieve whichever of the ambient air quality standards is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the executing agency of the government will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS.

Noise Limits for Diesel Generator Sets

Environment (Protection) Second Amendment Rules vide GSR 371(E), dated 17th May 2002 at serial no.94 and its amendments vide GSR No 520(E) dated 1st July 2003; GSR 448(E), dated 12th July 2004; GSR 315(E) dated 16th May 2005; GSR 464(E) dated 7th August 2006; GSR 566(E) dated 29th August 2007 and GSR 752(E) dated 24th October 2008; G.S.R. 215 (E), dated 15th March, 2011 under the Environment (Protection) Act, 1986)

Noise Limit for Generator Sets run with Diesel

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

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

The diesel generator sets should be provided with integral acoustic enclosure at the manufacturing stage itself.

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

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

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

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

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

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

2.4 These limits shall be regulated by the State Pollution Control Boards and the State Pollution Control Committees.

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

01. The manufacturer shall offer to the user a standard acoustic enclosure of 25 dB (A) insertion loss and also a suitable exhaust muffler with insertion loss of 25 dB(A).
02. The user shall make efforts to bring down the noise levels due to the DG set, outside his premises, within the ambient noise requirements by proper citing and control measures.
03. Installation of DG set must be strictly in compliance with the recommendations of the DG set manufacturer.
04. A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacturer which would help prevent noise levels of the DG set from deteriorating with use.

3.0 Limits of Noise for DG Sets (upto 1000 KVA) Manufactured on or after the 1st January, 2005

3.1 Applicability

01. These rules apply to DG sets upto 1000 KVA rated output, manufactured or imported in India, on or after 1st January, 2005.

02. These rules shall not apply to –

a) DG sets manufactured or imported for the purpose of exports outside India; and

b) DG sets intended for the purpose of sample and not for sale in India.

3.2 Requirement of Certification

Every manufacturer or assembler or importer (hereinafter referred to as the "manufacturer") of DG set (hereinafter referred to as "product") to which these regulations apply must have valid certificates of Type Approval and also valid certificates of Conformity of Production for each year, for all the product models being manufactured or assembled or imported from 1st January, 2005 with the noise limit specified in paragraph 1.

3.3 Sale, import or use of DG sets not complying with the rules prohibited

No person shall sell, import or use of a product model, which is not having a valid Type Approval Certificate and Conformity of Production certificate.

Appendix 5: Extract from Construction and 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), dateithe 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 Laws Applicable to Establishments Engaged in Construction of Civil Works

(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 Labor (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 and 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.3500/- per month or less. The bonus to be paid to employees getting Rs.2500/- per month or above up to Rs.3500/- per month shall be worked out by taking wages as Rs.2500/- 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) Construction and Demolition Waste Management Rules 2016- This Rule stipulate that-

- Every waste generator shall segregate construction and demolition waste and deposit at collection centre or handover it to the authorized processing facilities
- Shall ensure that there is no littering or deposition so as to prevent obstruction to the traffic or the public or drains.
- Large generators (who generate more than 20 tons or more in one day or 300 tons per project in a month) shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition or remodeling work,
- Large generators shall have environment management plan to address the likely environmental issues from construction, demolition, storage, transportation process and disposal / reuse of C & D Waste.
- Large generators shall segregate the waste into four streams such as concrete, soil, steel, wood and plastics, bricks and mortar,
- Large generators shall pay relevant charges for collection, transportation, processing and disposal as notified by the concerned authorities;

(xvi) Solid Waste Management Rules 2016- As per this Rule responsibility of Solid Waste Generator is as below.

- segregate and store the waste generated in three separate streams namely bio- degradable, non-biodegradable and domestic hazardous wastes in suitable bins and handover segregated wastes to authorized waste pickers or waste collectors as per the direction or notification by the local authorities

from time to time;

- store separately construction and demolition waste, as and when generated, in his own premises and shall dispose off as per the Construction and Demolition Waste Management Rules, 2016; and
- No waste generator shall throw, burn or burry the solid waste generated by him, on streets, open public spaces outside his premises or in the drain or water bodies.

(xvii) 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. Salient features of this Act are given below.

Employer shall-

- Provide and maintain, at suitable point, sufficient quantity of wholesome drinking water, such point shall be at least 6 meters away from any washing areas, urinals or toilets
- Provide sufficient urinals and latrines at convenient place, easily accessible by workers
- Provide free of charge, temporary living accommodations near to work sites with separate cooking place, bathing and lavatory facilities and restore the site as pre conditions after completing the construction works
- Provide crèche with proper accommodation, ventilation, lighting, cleanliness and sanitation if more than fifty female workers are engaged
- Provide first aid facilities in all construction sites

For safety of workers employer shall provide-

- Safe access to site and work place
- Safety in demolition works
- Safety in use of explosives
- Safety in operation of transporting equipment and appoint competent person to drive or operate such vehicles and equipment
- Safety in lifting appliance, hoist and lifting gears
- Adequate and suitable lighting to every work place and approach
- Prevention of inhalation of dust, smoke, fumes, gases during construction works and provide adequate ventilation in work place and confined space
- Safety in material handling and stacking/un stacking
- Safeguarding the machinery with fly-wheel of moving parts
- Safe handling and use of plants operated by compressed air
- Fire safety
- Limit of weight to be lifted by workers individually

- Safety in electric wires, apparatus, tools and equipment
- Provide safety net, safety sheet, safety belts while working at height (more than1.6 mtrs as per OSHA)
- Providing scaffolding, ladders and stairs, lifting appliances, chains and accessories where required
- Safety in pile works, concrete works, hot asphalt, tar, insulation, demolition works, excavation, underground construction and handling materials
- Provide and maintain medical facilities for workers
- Any other matters for the safety and health of workers

Appendix 7: IBAT screening report of Banjarawala Package 2

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Integrated Biodiversity Assessment Tool

PROXIMITY REPORT
BANJARAWALA PACKAGE 2

Country: India

Location: [30.3, 78]

Date of analysis: 24 May 2021 (GMT)

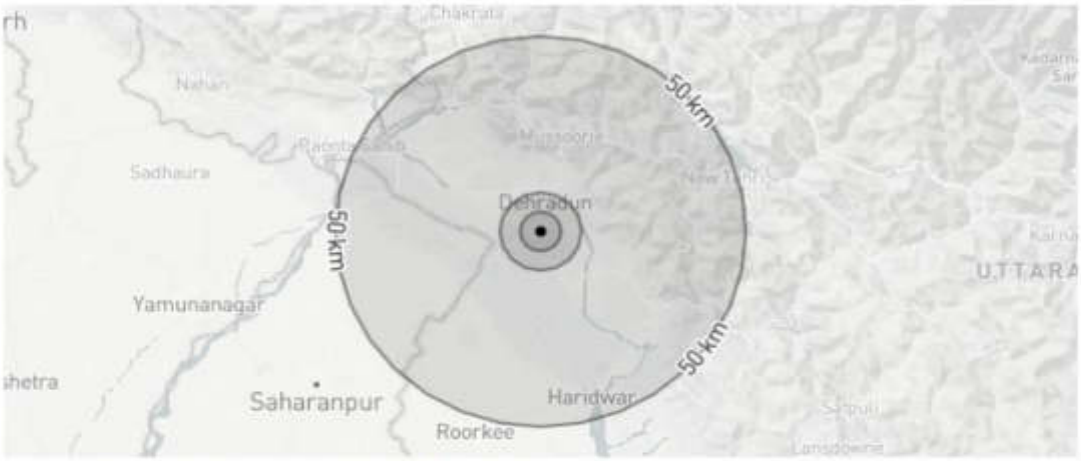
Buffers applied: 5 km | 10 km | 50 km

Generated by: Noime Walican

Organisation: ADB

Overlaps with:

Protected Areas	0
Key Biodiversity Areas	7
IUCN Red List	66



Displaying project location and buffers: 5 km, 10 km, 50 km

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About this report

This report presents the results of [6274-16621] proximity analysis to identify the biodiversity features and species which are located within the following buffers: 5 km, 10 km, 50 km.

This report is one part of a package generated by IBAT on 24 May 2021 (GMT) that includes full list of all species, protected areas, Key Biodiversity Areas in CSV format, maps showing the area of interest in relation to these features, and a 'How to read IBAT reports' document.

WARNING: IBAT aims to provide the most up-to-date and accurate information available at the time of analysis. There is however a possibility of incomplete, incorrect or out-of-date information. All findings in this report must be supported by further desktop review, consultation with experts and/or on-the-ground field assessment. Please consult IBAT for any additional disclaimers or recommendations applicable to the information used to generate this report.

Please note, sensitive species data are currently not included in IBAT reports in line with the Sensitive Data Access Restrictions Policy for the IUCN Red List. This relates to sensitive Threatened species and KBAs triggered by sensitive species.

Data used to generate this report

- UNEP-WCMC and IUCN, 2021. Protected Planet: The World Database on Protected Areas (WDPA)[On-line], Cambridge, UK: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net - May 2021.
- BirdLife International (on behalf of the KBA Partnership), 2021. Key Biodiversity Areas - April 2021.
- IUCN, 2021. IUCN Red List of Threatened Species - April 2021.

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Protected Areas

The following protected areas are found within 5 km, 10 km, 50 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

No protected areas within buffer distance

Key Biodiversity Areas

The following key biodiversity areas are found within 5 km, 10 km, 50 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

Area name	Distance
Rajaji National Park	5 km
New Forest Campus	10 km
Asan Barrage	50 km
Binog Sanctuary - Bhadraj - Jharipani	50 km
Jhilmil Jheel Conservation Reserve	50 km
Kalesar Wildlife Sanctuary	50 km
Simbalbara National Park	50 km

IUCN Red List of Threatened Species

The following threatened species are potentially found within 50km of the area of interest.

For the full IUCN Red List please refer to the associated csv in the report folder.

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Indotestudo elongata	Elongated Tortoise	REPTILIA	CR	Decreasing	Terrestrial

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Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Batagur dhongoka	Three-striped Roofed Turtle	REPTILIA	CR	Decreasing	Terrestrial, Freshwater
Ophrysia superciliosa	Himalayan Quail	AVES	CR	Unknown	Terrestrial
Ardeotis nigriceps	Great Indian Bustard	AVES	CR	Decreasing	Terrestrial
Vanellus gregarius	Sociable Lapwing	AVES	CR	Decreasing	Terrestrial
Gyps bengalensis	White-rumped Vulture	AVES	CR	Decreasing	Terrestrial
Sarcogyps calvus	Red-headed Vulture	AVES	CR	Decreasing	Terrestrial
Emberiza aureola	Yellow-breasted Bunting	AVES	CR	Decreasing	Terrestrial, Freshwater
Gyps tenuirostris	Slender-billed Vulture	AVES	CR	Decreasing	Terrestrial
Cuon alpinus	Dhole	MAMMALIA	EN	Decreasing	Terrestrial
Elephas maximus	Asian Elephant	MAMMALIA	EN	Decreasing	Terrestrial
Manis crassicaudata	Indian Pangolin	MAMMALIA	EN	Decreasing	Terrestrial
Melanochelys tricarinata	Tricarinate Hill Turtle	REPTILIA	EN	Decreasing	Terrestrial
Morenia petersi	Indian Eyed Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater

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Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Moschus leucogaster	Himalayan Muskdeer	MAMMALIA	EN	Decreasing	Terrestrial
Panthera tigris	Tiger	MAMMALIA	EN	Decreasing	Terrestrial
Nilssonia hurum	Indian Peacock Softshell Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Axis porcinus	Hog Deer	MAMMALIA	EN	Decreasing	Terrestrial, Freshwater
Oxyura leucocephala	White-headed Duck	AVES	EN	Decreasing	Terrestrial, Freshwater
Rynchops albicollis	Indian Skimmer	AVES	EN	Decreasing	Terrestrial, Freshwater
Sterna acuticauda	Black-bellied Tern	AVES	EN	Decreasing	Terrestrial, Freshwater
Haliaeetus leucoryphus	Pallas's Fish-eagle	AVES	EN	Decreasing	Terrestrial, Freshwater
Neophron percnopterus	Egyptian Vulture	AVES	EN	Decreasing	Terrestrial, Freshwater
Aquila nipalensis	Steppe Eagle	AVES	EN	Decreasing	Terrestrial
Falco cherrug	Saker Falcon	AVES	EN	Decreasing	Terrestrial, Marine, Freshwater
Tor putitora		ACTINOPTERYGII	EN	Decreasing	Freshwater
Trillium govanianum	Himalayan Trillium	LILIOPSIDA	EN	Decreasing	Terrestrial

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Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Rucervus duvaucelii	Barasingha	MAMMALIA	VU	Decreasing	Terrestrial, Freshwater
Crocodylus palustris	Mugger	REPTILIA	VU	Stable	Terrestrial, Freshwater
Cyprinus carpio	Common Carp	ACTINOPTERYGII	VU	Unknown	Freshwater
Melursus ursinus	Sloth Bear	MAMMALIA	VU	Decreasing	Terrestrial
Panthera pardus	Leopard	MAMMALIA	VU	Decreasing	Terrestrial
Rhinoceros unicornis	Greater One-horned Rhino	MAMMALIA	VU	Increasing	Terrestrial, Freshwater
Tetracerus quadricornis	Four-horned Antelope	MAMMALIA	VU	Decreasing	Terrestrial
Ursus thibetanus	Asiatic Black Bear	MAMMALIA	VU	Decreasing	Terrestrial
Dalbergia latifolia	Indonesian Rosewood	MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Rusa unicolor	Sambar	MAMMALIA	VU	Decreasing	Terrestrial
Aonyx cinereus	Asian Small-clawed Otter	MAMMALIA	VU	Decreasing	Terrestrial, Marine, Freshwater
Pangshura tecta	Indian Roofed Turtle	REPTILIA	VU	Decreasing	Terrestrial, Freshwater
Nanorana minica	Small Paa Frog	AMPHIBIA	VU	Decreasing	Terrestrial, Freshwater
Wallago attu		ACTINOPTERYGII	VU	Decreasing	Freshwater

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Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Bagarius yarrelli		ACTINOPTERYGII	VU	Decreasing	Freshwater
Barilius dimorphicus		ACTINOPTERYGII	VU	Unknown	Freshwater
Ophiophagus hannah	King Cobra	REPTILIA	VU	Decreasing	Terrestrial
Anacyclus pyrethrum	Atlas Daisy	MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
Tragopan melanocephalus	Western Tragopan	AVES	VU	Decreasing	Terrestrial
Catreus wallichii	Cheer Pheasant	AVES	VU	Decreasing	Terrestrial
Marmaronetta angustirostris	Marbled Teal	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
Aythya ferina	Common Pochard	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
Mulleripicus pulverulentus	Great Slaty Woodpecker	AVES	VU	Decreasing	Terrestrial
Buceros bicornis	Great Hornbill	AVES	VU	Decreasing	Terrestrial
Grus antigone	Sarus Crane	AVES	VU	Decreasing	Terrestrial, Freshwater
Gallinago nemoricola	Wood Snipe	AVES	VU	Decreasing	Terrestrial, Freshwater
Sterna aurantia	River Tern	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater

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Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Clanga clanga	Greater Spotted Eagle	AVES	VU	Decreasing	Terrestrial, Freshwater
Aquila rapax	Tawny Eagle	AVES	VU	Decreasing	Terrestrial, Freshwater
Aquila heliaca	Eastern Imperial Eagle	AVES	VU	Decreasing	Terrestrial, Freshwater
Leptoptilos javanicus	Lesser Adjutant	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
Chaetornis striata	Bristled Grassbird	AVES	VU	Decreasing	Terrestrial, Freshwater
Ploceus megarhynchus	Finn's Weaver	AVES	VU	Decreasing	Terrestrial
Clanga hastata	Indian Spotted Eagle	AVES	VU	Decreasing	Terrestrial
Oryza malampuzhaensis		LILIOPSIDA	VU	Decreasing	Terrestrial
Lissemys punctata	Indian Flapshell Turtle	REPTILIA	VU	Decreasing	Terrestrial, Freshwater
Bovista paludosa	Fen Puffball	AGARICOMYCETES	VU	Decreasing	Terrestrial
Capricornis sumatraensis	Mainland Serow	MAMMALIA	VU	Decreasing	Terrestrial
Paris polyphylla	Love Apple	LILIOPSIDA	VU	Decreasing	Terrestrial

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Recommended citation

IBAT Proximity Report. Generated under licence 6274-16621 from the Integrated Biodiversity Assessment Tool on 24 May 2021 (GMT). www.ibat-alliance.org

How to use this report

This report provides an indication of the potential biodiversity-related features - protected areas, key biodiversity areas and species - close to the specified location. It provides an early indication of potential biodiversity concerns, and can provide valuable guidance in making decisions. For example, this information can be helpful when assessing the potential environmental risk and impact of a site, categorising investments/projects, preparing the terms of reference for an impact assessment, focusing attention on key species of conservation concern and sites of known conservation value, and reviewing the results of an impact assessment.

The report does not provide details of potential indirect, downstream or cumulative impacts. Furthermore, the report should be regarded as a "first-step", providing a set of conservation values sourced from global data sets, and is not a substitute for further investigation and due diligence, especially concerning national and/or local conservation priorities.

Appendix 8: Application by UUSDA for Obtaining Permission from Central Groundwater Board for Installation of Tube wells for Water Supply Purpose in Dehradun

Office of the Program Director
Uttarakhand Urban Sector Development Agency
(Urban Development Department, Government of Uttarakhand)
Address :- 777, Saatvik Tower, Kaulagarh Road, Rajender Nagar, Dehradun
Telephone +91-135-2753894, Tele-fax +91-135-2754895 Email: uusdip@gmail.com

Ref: UUSDA/ A-378/ 163 Date: 23 /02/2021

To,

Regional Director,
Central Ground Water Board (CGWB),
Uttarakhand Region,
149A-kanwali Road, Dehradun, Uttarakhand.

SUBJECT: PERMISSION FOR INSTALLATION OF TUBE WELLS FOR WATER SUPPLY PURPOSE IN DEHRADUN MUNICIPAL LIMITS.

Ref : This office letter no. UUSDA/A-378/497 dt. 27.11.2020

Sir,

Please refer this office letter cited under reference wherein, permission for installation of tube wells was sought. As you are aware that Uttarakhand Urban Sector Development Agency (UUSDA) under Urban Development Department, Government of Uttarakhand is negotiating for a project loan for Uttarakhand inclusive urban development project for Naintial and Dehradun from Asian Development Bank (ADB). As part of the process ADB requires the concurrence from CGWB for the installation of tube wells for use of the ground water for drinking purpose. In this regard it is pertinent mentioned here that we have received such a permission from your office letter no. 4(65)/CGW/UR/Tech-15-84 dt. 2nd Feb, 2016.(copy attached).

Therefore your good office requested to grant permission for installation of Tube wells as per the details annexed herewith.

Early action the subject matter will be highly solicited.

Thanking you.

Encl : As stated above

Yours faithfully

(Vinay Mishra)
Additional Project Director (T)
UUSDA, Dehradun

C:C: 1- Additional Project Director, UUDSA for information.
2- Sh. Suresh Khanduri, Environment Specialist Design and Supervision Consultant, UUSDA for coordination and necessary follow-up

Additional Project Director (T)
UUSDA, Dehradun

DETAILS OF THE PROPOSED WATER SUPPLY TUBE WELLS

Tube well No.	Location	Block/ District	Yield (lpm)	Land Ownership	Co-ordinates	Proposal
1	Saket farm, Banjarawala	Raipur / Dehradun	1000	Uttarakhand Peyjal Sandhan Nirman and Vikas Nigam Dehradun	30°17'17.09"N 78° 1'4.29"E	Old, capacity to be enhance
2	Near Bindal river, Banjarawala	Raipur / Dehradun	1800		30°16'58.46"N 78° 0'59.44"E	New
3	Shivpuri near Tikona park	Raipur / Dehradun	1500		30°16'40.56"N 78° 2'6.12"E	New
4	Near PNB ATM, Banjarawala	Raipur / Dehradun	1500		30°16'58.17"N 78° 1'56.87"E	New
5	Intercollege, Banjarawala.	Raipur / Dehradun	1000		30°16'59.58"N 78° 1'51.67"E	New
6	Near Geetanjali Enclave	Raipur / Dehradun	1000		30°15'52.81"N 78° 2'35.15"E	New
7	Mothorowala	Raipur / Dehradun	1500		30°16'3.83"N 78° 2'2.21"E	Old, capacity to be enhance
8	New Basti	Raipur / Dehradun	1500		30°15'20.89"N 78° 1'55.28"E	New

Appendix 9: Application by UUSDA to Obtain NOC for Utilization of Tube well and OHT Land from Nagar Nigam, Dehradun

UUSDA

Office of the Program Director
Uttarakhand Urban Sector Development Agency
(Urban Development Department, Government of Uttarakhand)
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उत्तराखण्ड सरकार

पत्रांकः यू0यू0एस0डी0आई0पी0/A-357/135 दिनांक : 22/06/2020

सेवा में,
नगर आयुक्त,
नगर निगम,
देहरादून।

विषय– यू0यू0एस0डी0ए0 के अन्तर्गत नवीन ए0डी0बी0 ऋण में प्रस्तावित ऊर्ध्वाधर जलाशय (OHT) एवं ट्यूबवैल हेतु देहरादून शहर में उपलब्ध भूमि का अनापत्ति प्रमाण पत्र (NOC) निर्गत के सम्बन्ध में।

महोदय,

शहरी विकास विभाग, उत्तराखण्ड शासन के अन्तर्गत उत्तराखण्ड शहरी क्षेत्र विकास निवेश एजेंसी (यू0यू0एस0डी0ए0) द्वारा उत्तराखण्ड राज्य के शहरी क्षेत्रों में विभिन्न बाह्य सहायतित परियोजनाओं के माध्यम से विकास कार्य सम्पादित कराये जाते है। वर्तमान में यू0यू0एस0डी0ए0 के अन्तर्गत नवीन Asian Development Bank (ADB) से वित्तीय सहायक/ऋण प्राप्त कर राज्य के विभिन्न शहरों में शहरी संरचनाओं के विकास/निर्माण कार्य कराये जाने प्रस्तावित है। देहरादून शहर के बंजारावाला क्षेत्र में नवीन ऋण के अन्तर्गत कार्य कराये जाने प्रस्तावित है, जिस हेतु यू0यू0एस0डी0ए0 द्वारा परियोजना की आवश्यकतानुसार उपलब्ध भूमि का चयन किया गया है जो कि आपके विभाग के स्वामित्व में है, जिसका विवरण निम्न है:–

SN	Name of Site	Purpose of Land Utilization	Cordinates	
			Longitute	Latitude
1.	Saket farm, Banjarawala	Existing TW	78° 1'4.29"N	30°17'17.09"E
2.	Near Bindal river, Banjarawala	OHT & TW	78° 0'59.44''N	30°16'58.46''E
3.	Shivpuri near Tikona park	TW	78° 2'6.12"N	30°16'40.56"E
4.	Near PNB ATM Banjarawala	OHT & TW	78° 1'56.87''N	30°16'58.17''E
5.	Mothrowala	Existing OHT/TW	78° 2'2.21"N	30°16'3.83"E
6.	Near Geetanjali Enclave	OHT & TW	78° 2'35.15''N	30°15'52.81''E
7.	New Basti	OHT & TW	78° 1'55.28''N	30°15'20.89''E

अतः उपरोक्त के क्रम में अनुरोध है कि तालिका के अनुसार भूमि पर निर्माण हेतु आपके विभाग से अनापत्ति प्रमाण–पत्र निर्गत करने का कष्ट करें, जिससे कि परियोजना का कार्य शीघ्र–अतिशीघ्र प्रारम्भ किया जा सके। आपके सुलभ संन्दर्भ हेतु प्रस्तावित संरचनाओं को मानचित्र में अंकित कर संलग्न कर प्रेषित किया जा रहा है।

संलग्नकः–उपरोक्तानुसार।

भवदीय

(विनय मिश्रा)
अपर कार्यक्रम निदेशक

प्रतिलिपिः–

1. कार्यक्रम निदेशक, यू0यू0एस0डी0ए0, देहरादून को सादर सूचनार्थ प्रेषित।
2. जिलाधिकारी, देहरादून को सादर सूचनार्थ प्रेषित।
3. टीम लीडर, डी0एस0सी0–1, मै0 टाटा कंसलटेंसी इंजीनियर्स, देहरादून।

Appendix 10: Sample Chance find Protocol

Introduction

Project town being a heritage town, there are possibility of any chance finds (artefacts) recovery during excavations. Contractors working at heritage towns must take additional care not to destroy or damage historic features during excavations. There may be many buried historic features in heritage towns such as – idols, toys, wells, ancient drains, remains of buildings, other walls, grain pits, etc. Every care must be made not to destroy these during excavations.

Excavator drivers need to be instructed to be aware of hitting buried features and that they must be investigated before continuing work. When features are encountered during mechanical excavation, work should stop and the PIU/Consultants engineers must be informed immediately so that they can be inspected at the first opportunity.

When historic features such as walls, brick constructions and other features are encountered during excavation the excavation must be stopped immediately and the PIU/Consultants must be informed immediately.

***Contractors' instruction**:* As soon as contractor recovers any chance find during any excavation works for pipe laying, they should immediately inform PIU/Consultant present in town about the chance find recovery. Immediately stop the excavation activity near point of recovery. After PIU/consultants engineers come at site, contractor should follow cleaning and photography in supervision of PIU/Consultant engineers.

Cleaning - When a feature/chance find is discovered it must be defined by careful cleaning. Roots must be removed and dirt must be carefully cleaned away. The section or trench base should also be cleaned back for a little distance around the feature.

Record photography – When the feature is clean good photography should be taken – vertical and face-on shots and a few general shots of the feature, also showing its position in relation to surrounding features, buildings, etc. The photographed should be catalogued (date, location, direction of shot)

Drawn record - When features/chance finds are revealed a drawn record should also be made.

a. General location record – measuring its position and orientation within the protected site / in relation to surrounding structures
b. Record drawings – detail drawings made in plan and section/profile. The extent (edges) of the feature should be drawn and the level of the existing ground surface and the top and base of the feature should be recorded. These levels should be marked on the drawings. The drawings should include detail of the construction of the feature. Perspective sketches could also be made if necessary. Explanatory notes can also be put on the drawings.

Reporting finds - When finds are made these should be reported to PIU/Consultants. Photographs and record drawings should be sent.

Discovery of historic objects - When clearance and excavation takes place artifacts and

historic objects are sometimes found. These should be recovered and kept in a safe place. The place of discovery should be recorded and each find given a number and tag tied to the find with the same number on it. A list of the finds should be kept (with the find No. And place of discovery and date of discovery recorded).

PIU/Consultants responsibility- PIU/Consultants should inform in written to the State Archaeological Department at the earliest with photographs and request to Archaeology Department to visit the site and hand over the chance finds to them.

Appendix 11: Guidelines for Sewerage System Operations, Reuse of Treated Effluent and Sludge from STP for Beneficial Purposes

(Source: Manual on Sewerage and Sewage Treatment Systems, CPHEEO, Ministry of Urban Development, Govt. of India)

Health Hazards during Sewage Operations

Laborers working on the sewage treatment and operations may suffer from a number of aliments directly attributed to handling of sewage. In view of this it is desirable to disinfect sewage and where feasible mechanize sewage operations.

The staff of sewage operations must be well educated in the sanitary rules on the utilization of sewage for irrigation as well as with personal hygiene. All persons working in sewage farms must undergo preventive vaccination against enteric infections and annual medical examination for helminthiases and be provided treatment if necessary.

Sewage treatment plants should be provided with adequate space for canteens with proper sanitation, wash-stands and lockers for irrigation implements and protective clothing. Safe drinking water must be provided for the workers and for population residing within the effective range of the sewage treatment plants.

All workers should be provided with gum boots and rubber gloves, which must compulsorily be worn while at work. They should be forced to observe personal hygiene such as washing after work as well as washing before taking food. The use of antiseptics in the water used for washing should be emphasized. The farm worker should be examined medically at regular intervals and necessary curative measures enforced.

Mitigation measures to avoid Health

Hazards Personal Hygiene against Pathogen

The worker should take precautions because a large number of coliform groups, various kinds of micro-organisms, and egg parasites exist in sewage. The workers should strive to maintain good health by taking care of the following points:

- Wear clean uniform, work boots, etc.
- After work and before having a meal, always wash hands and disinfect them.
- After work, take a shower if possible.
- Do not enter the offices and lounges wearing dirty clothes.
- If necessary, take vaccinations against tetanus, leptospirosis fever and so on

Maintaining Cleanliness The worker should maintain each facility in a clean and neat condition.

- The flors of workrooms, stairs and corridors should be cleaned at the appropriate frequency to maintain them in a clean condition
- Disinfection of relevant locations is to be carried out periodically.

Health Check Workers should receive health check once a year to maintain their health, and prevent illnesses or detect them at an early stage. The results of the health check should be

maintained as records. Recommended items to be inspected during the health check are as given below.

- Examine medical history.
- Examine subjective symptoms and other objective symptoms.
- Check height, weight, vision and hearing ability.
- Chest X-ray examination.
- Blood pressure measurement.
- Check for anaemia.
- Check for liver functions.
- Check for lipids in blood.
- Check blood sugar level
- Urine analysis.
- Electrocardiogram analysis

Welfare Measures The Sanitation Workers (Regulation of Employment and Conditions of Service) Act 2012 proposes constitution of a Sanitation Workers State Welfare Board to exercise powers conferred on it and to perform welfare functions such as the following for sanitation workers:

- Provide immediate assistance to a beneficiary in case of an accident
- Sanction of loan and advances
- Medical expenses for treatment of major ailments
- Financial assistance for education of children
- Payment of maternity benefits
- Make provision and improvement of welfare measures and facilities as may be prescribed

Corrective Measures When a worker has symptoms of an illness listed above, the plant engineer should ensure that the worker is checked-up by a specialist doctor and receives proper treatment and care and should take the following actions considering the content of work done by the worker:

- Change the workplace if necessary
- Change the content of the work
- Shorten the working hours
- Perform relevant measurements of the working environment
- Maintain the facility or equipment

Risks in use of treated effluent and sludge in agriculture practices

Cultivation of crops that are eaten raw should be banned. Cultivation of paddy in bunded fields is likely to give rise to sanitation problems and hence is undesirable. Growing of non-edible commercial crops like cotton, jute, fodder, milling varieties of sugarcane and tobacco would be suitable. Cultivation of grasses and fodder legumes, medicinal and essential oil yielding plants like menthol and citronella may be allowed. Cultivation of cereals, pulses, potatoes and other crops that are cooked before consumption may be permitted, if sewage is treated and care is taken in handling the harvests to ensure that they are not contaminated. Cultivation of crop exclusively under seed multiplication programmes would be advantageous as these are not consumed. As an additional safeguard, sewage irrigation should be discontinued at least two

months in advance of harvesting of fruits and berries, one month for all kinds of vegetables and a fortnight for all other crops. Direct grazing on sewage irrigated farms should be prohibited.

Risks of Nutrient Loading in Agriculture

Crops receiving excessive dosage of nitrogen show superflous vegetative growth and decrease in grain or fruit yield. The phosphate deficit of sewage, therefore, should be made good by supplementing with phosphate fertilizers, the extent of phosphate fortification depending upon the nature of crop and its phosphate requirements. As the availability of phosphate is low in the Irrigation water it would be desirable to apply the required quantity of phosphatic fertilizer at the time or even (about a fortnight) before the sowing or planting of the crop. Even when sewage nutrients are balanced by fortification, irrigation with such sewage may supply excessive amount of nutrients resulting in waste or unbalanced growth of plants with adverse effects on yields. It may therefore be necessary to dilute the sewage. Dilution also helps in reducing the concentration of dissolved salts and decomposable organic matter in the sewage thus, decreasing hazards to the fertility of the soil. It is desirable to limit the BOD and total suspended solids of sewage to be disposed on land for irrigation, as per relevant standards. There is a need to take caution on describing nutrient supply capacity of sewage particularly in the case of availability of phosphorus because there is a possible conversion of available phosphorus in unavailable mode in the presence of heavy metals present in the sewerage. This happens commonly in high as well as low pH soils.

Alternative Arrangement during Non-irrigating Periods

During rainy and non-irrigating seasons, agricultural practices may not need any water for irrigation. Even during irrigating season, the water requirement fluctuates significantly. Hence, satisfactory alternative arrangements have to be made for the disposal of sewage on such occasions either by storing the excess sewage or discharging it elsewhere without creating environmental hazards. The following alternatives are generally considered: a) Provision of holding lagoons for off-season storage. They enable irrigation of a fied area of land to varying rates of crop demand. They may also serve as treatment units such as aerated or stabilization lagoons, provided the minimum volume required for treatment is provided beyond the flow-balancing requirement. b) Provision of additional land where treated sewage is not required on the main plot of land c) Discharge of surplus treated sewage to river or into sea with or without additional treatment. Combining surface discharge facilities with irrigation system is quite common and often quite compatible. d) Resorting to artificial recharge in combination with an irrigation system where feasible.

Treated Sewage into Perennial Rivers

When sewage is treated and discharged into perennial flowing rivers and the blended river water is drawn downstream of the point of such blending as raw water for treatment in public water supply schemes. This is indirect potable use after blending. This is historical and ongoing all around. However, of late, the organic load due to the discharged treated, partially treated and non-point sewage becomes in excess of the self-purifying capacity of the river. Thus, the river water is not actually fresh water. The water quality of Yamuna river for Agra water supply scheme requires to be fist treated in MBBR to purify the river water to a level as raw water for the downstream WTP. When it passes through flowing surface water it has the potential disadvantages of contamination by human and animal activities adding organic matter and waterborne pathogens unless the river stretch is protected from such activities. The guiding

principle in such cases for the ULBs will be to at least intercept the sewage outfalls and provide adequate STPs and follow the recommended quality criteria for the treated sewage.

Treated Sewage into Non-Perennial / Dry River Courses

There are locations where the rivers are not perennial or almost dry throughout the year except some monsoon runoff. In this case the discharged treated sewage sinks into the aquifer zone and is extracted by infiltration wells or galleries. The advantage of direct dilution from surface water is lost, but the additional purification in the soil and dilution from the aquifer water are happening. An example is the case of the Palar river course in Tamilnadu. The surface water flow in this occurs only for about a week if the monsoon is normal and if the water spills beyond the upstream impoundments. The aquifer however supports the public water supply of over 30 habitations along its dry tract of nearly 80 km before the sea. The partly treated sewage of the en-route habitations does reach this river course as intervals. So far, no epidemics have been met with. This may be due to the above said additional purification in the soil and dilution by aquifer water. However, if these are exceeded by the contamination load, there can be immediate health problems. The guiding principle in such cases for the ULBs will be (a) to keep a check on the raw water quality from the infiltration wells to detect sudden increase in contaminants and (b) at least intercept the sewage outfalls and provide adequate STPs.

Appendix 12: Environmental Audit of The Existing Structures: Water Supply Components

Introduction

The objectives of this environmental audit of existing facilities of water supply sub-project are to (i) assess the compliance of the existing Overhead Tanks (OHTs) and Tube Wells (TWs) to be rehabilitated/augmented during the implementation of UUSDIP with environmental legislation; (ii) improve environmental performance through monitoring the effectiveness of the management system; and (iii) increase the Executing agencies knowledge of itself and its activities, thus increasing its ability to continually improve and minimize future potential liabilities.

The environmental audit was carried out for the existing facilities. The methodology adopted for this audit was to initially review existing plans and technical information and list various activities being carried out in the water supply system. Due diligence was carried out to physically check whether environmental performance, health and safety, etc. were in compliance with national and state prescribed standards and guidelines. Team visited the locations of existing facilities and observed operations. Meetings and discussions with key personnel were held in the various stages of the audit. Various documentations regarding the operational aspects were also checked.

Rehabilitation of existing Tube Wells

The water supply service area under this Package 2 is part of ward number 85 (Mothorwala). Currently, there is existing water supply in the area which is more than 25 years old with the average supply level of around 110 lpcd for 4 to 6 hours per day, not meeting the performance standard. The source of existing water supply system is ground water. Ground water is being extracted through two tube wells. There are two associated pump houses and two existing overhead tanks (OHTs) having 250 KL and 1000KL capacity. One set of tubewell, pumps and OHT is located in Udham Singh Park (under proposed district metering area (DMA) 6), whereas the other set is physically located under proposed DMA 3 that falls under Banjarawala Package 3. The details of tube well are as under:-

Sr. No.	Location	Existing Tube Well	Proposed
1	Near PNB ATM (DMA-4) [Co-ordinates: 30°16’58.17”N, 78°1’56.87”E]	One Tube well (500 lpm)	One new tube well with 1500 LPM in same vicinity of proposed OHT near PNB ATM
2	Near Nagar Nigam office, Mothorwala (DMA 6) [Co-ordinates: 30°16’3.83”N, 78°2’2.21”E]	One Tube well (700 lpm)	Proposed one new tube well with 1500 LPM in same vicinity of proposed OHT in Mothrowala

As discussed with Jal Sansthan, the yield from the tube wells at Mothrowala and Banjarawala (Near PNB ATM) was very less compared to water demand of covered areas, as such; the existing tube wells shall be replaced by new one with increased static head and higher efficiency.

Rehabilitation of existing tube wells are proposed to meet the functional parameters as per the hydrogeologists report for sustainability, including but not limited to

<table>
<tr><td></td><td>replacemnt of pipes, subbmersible pumps, cables, panels, vavles, flow meters and synchronization with SCADA enabled devices after assessment by audit of the existing TW condition and expected design life as per technical specification. Activities are to be executed in these works
▪ All the existing faulty/old cables shall be replaced with the appropriate rating new cable.
▪ All the existing leaked/worn out riser pipe of existing tube wells shall be replaced with GI pipe of appreciate size.
▪ All the existing old and damaged panel board shall be replaced with new panel board having all the necessary protection against motor burning.
▪ Depth of the tube wells will not be increased so no impact on groundwater withdrawal.

Flow meter shall be installed at each existing tube well for recording of tube wells discharge for calculation of NRW including non return valve.

UUSDA should collate all available information on the borehole and maintain a copy on site and in the office for future reference and management of the source. Information should include the hydrogeological report, borehole logs and construction details.

Contractor has to take precautions in handling and usage of chlorine to avoid any health hazard to workers from handling and management of chlorine used for disinfection No other hazardous chemicals are expected to be used during construction works</td></tr>
<tr><td>Overhead Tanks (OHTs).</td><td>There are two OHTs located in the present zone. One OHT is located in Mothrowala area and another one is located near PNB ATM in Banjarawala area.
The details are given below:

<table>
<tr><th>Sr. No.</th><th>Location</th><th>Capacity</th><th>Staging</th><th>OHT Status</th></tr>
<tr><td>1</td><td>Near PNB ATM</td><td>250 KL</td><td>Stg height of 21 m</td><td>In bad condition
• its capacity is very low
• Cracks are observed
• Being supplied to Banjarawala areas
• Flow meter is not installed at OHT outlet</td></tr>
<tr><td>2</td><td>Near Nagar Nigam Branch office, Mothorwala</td><td>1000 KL</td><td>Stg height of 24 m</td><td>In fair condition and required refurbishment

• Being supplied to Mothrowala areas</td></tr>
</table>

The existing 1000 Kl capacity overhead tank in Mothrowala is in good condition and hence is considered in the design and will be utilised. However, the overhead tank near PNB ATM is of lesser capacity and the condition of its civil structure is not good. Hence, it is proposed to be dismantled and a new OHT of 800 KL capacity will be constructed close to this location.</td></tr>
</table>

Debris and corrosion causing contaminants can create a sludge like material at the bottoms or on the sides of unclean tanks. Often resulting in oxidation, this can hinder storage tank efficiency. Worse yet, dirty and contaminated tanks can pose increased safety risks to the environment and employees.

All concrete and plastering works will be done using mix in higher proportion than the existing, to ensure proper adhesion and strength. It has to be ensured that the new material sticks to existing by using cement slurry and or epoxy/adhesive wherever required. All concrete cracks will be repaired by using pressure grouting as per specifications.

Wherever concrete cover has peeled off from concrete (Water retaining) structure, structure needs to be repaired with epoxy mortar with primer. All corroded reinforcement bar shall be replaced with new iron bars.

All repairable concrete cracks to be made good by pressure grouting. Removal of bushes and planting of trees in the vicinity of existing building/ structure with half brick circular tree guard (distance to be maintained from building/ structures) are proposed.

Subproject components are located away from settlements .Significant amount of demolition waste will be generated due to demolition of old buildings and existing OHT, excavation of existing road, which will be reused in construction and the remaining waste will be used for filling of low lying lands.

Present Condition of Existing Machinery

The pump sets installed at pump house have served their useful lives. These sets work at very low efficiency and design data's do not match with these pumps, therefore, proposed to be replaced.

Existing Mechanical Works

Location	Submersible pump Flow (m3/hr)	Status
Banjarawala (Near PNB ATM)	42	*In bad condition • In operating condition • Chlorine dosing system at Pump outlet is also provided
Mothrowala (Near Nagar Nigam branch office)	30	*In bad condition • In operating condition • Chlorine dosing system at Pump outlet is also provided

Existing controlled system at each pump houses are monitored & controlled manually i.e. all the motors are controlled by manual pressing start/stop button provided at each MCC panel and all the instruments provided are with local indication only. So existing system are not having any Automation system / PLC based control & SCADA system. So, present system is not compatible with DMA based water supply scheme from Instrumentation & control point of view. Presently, Jal Sansthan is responsible for O&M.

Near PNB ATM Pump with flow rate of 90 cum/hr & head 100m (45KW Motor Rating) and 200 mm dia DI Rising main is proposed and at Mothorowala Pump with flow rate of 90 cum/hr & head 100m (45 KW Motor Rating) and 150 mm dia Rising main are proposed.

At present water supply system along with Pump House and overhead tank at different locations are having following Instrumentation & control items at existing Pump houses: Table

Existing Electrical & Instrumentation

Pumping Station (PS)	Details of instrumentation		Electrical
	No	Particular	
Banjarawala (Near PNB ATM)	1 4	Flow meter (Electromagnetic type) Manually operated Valve (main & bypass line) Motorized valves Pressure, level and flow monitoring instruments are not available at site. SCADA system is not in place.	• 415V Power Supply connection is available • There is one transformer • LT starter & control panel • Pump motor • Local Auto transformer starter panel with MCCB, Power contactor, Auxiliary Contactor, Overhead relay system, Control Transformer, indicator lamps for Start, Stop and trip.
Mothrowala (Near Nagar Nigam branch office)	- 4	Flow meter (Electromagnetic type) Manually operated Valve (main & bypass line) Motorized valves Pressure, level and flow monitoring instruments are not available at site. SCADA system is not in place.	• 415V Power Supply connection is available • There is one transformer • LT starter & control panel • Pump motor • Local Auto transformer starter panel with MCCB, Power contactor, Auxiliary Contactor, Overhead relay system, Control Transformer, indicator lamps for Start, Stop and trip.

The valves are generally provided at pump outlet, at bye pass lines, OHT inlet and OHT outlet. The flow meters are generally provided at pump outlet and OHT outlet

Summarized existing electrical & instrumentation part of the work

Location	Equipment/ instrument	Banjarawala area (Near PNB ATM)	Mothrowala
Tube well and Pumping station location			
Outlet of pump	Flow Meter	A	NA
	Pressure gauge	NA	NA
	Motorized valve	NA	NA
	Manual valve	A	A
	Chlorination	A	A
Bye-pass line	Motorised valve	NA	NA
	Manual valve	NA	NA
OHT location			
Inlet of OHT	Motorised valve	NA	NA

	Manual valve	A	A
At OHT	Level Indicator	NA	NA
Outlet of OHT	Flow Meter	A	NA
	Motorised valve	NA	NA
	Manual valve	A	A

Electrical systems are insufficient for proposed Water scheme due to change in load requirement as well as its location so new power supply system is proposed a at various Tube well / Pump Houses. In some cases, due to distant location of OHT from Tube well / Pump house, separate 415V, 3 Phase ,50Hz 4-Wire power supply shall be required near OHT for nearby Motorised valves, Chlorine Dosing system etc.

Electricity will be used for running equipment and sound proof/super silent diesel Generator set should be kept aside for emergency purpose. It will be ensured that no leakage of discharge of fuels like diesel, petrol, and Oil & Grease can effect human health and environment.

Short term accidental spills are possible. To avoid contamination from fuel/lubricants, all equipment to be maintained and examined regularly. Required precautions will be taken in storage and handling of hazardous materials, as per the Hazardous Waste (Management and Handling) Rules, 1989

Transmission main & Distribution system (Type/size/length of pipe

Currently, there is about 117 km existing water supply in the area but its pipeline network (GI) is more than 25 years old

Details of existing Rising mains are given below:

Sr. No.	Size of pipe line (mm)	Length of pipe line (Mt.)
1	150	100
	Total	**100**

Cast Iron (CI) pipe line is about 25 years old and due to calcium deposit in the pipe line the diameter of pipe has reduced and pipe erodes. Therefore the condition of CI pipe line is not satisfactory due to leakage and breakage. Hence proposed replacement by Ductile Iron (DI K-9) pipe.

The old pipe lines for rising mains are at present of GI material, which leak frequently result the pressure drop in the lines, therefore as per policy, the provision for replacement of these existing pipe lines by new Ductile Iron (DI K-9) pipelines have been taken as per design requirement.

Service area is provided with distribution system by gravity fed from respective OHTs up to the consumer end. The total length of existing distribution system is reported as below:-

Sr. No.	Size of pipe line	Length of pipe line (Mt.)
1	100	6825.22
2	125	706.94
3	150	180.3
4	200	1334.97
5	250	2607.99
	Total	**11655.42**

	The existing distribution lines pipes are very old with heavy leakages due to repeatedly breakages and joints leakages resulting heavy losses of clear water, therefore, need to be replaced by ductile iron pipe Class K7 (DI-K7)) pipes. After laying the lines, the provision of road repairs has also been proposed in the project. The World Health Organisation considered asbestos in drinking water arising from asbestos cement pipe in their 1993 edition of the Guidelines for Drinking Water Quality and it is no longer being used and because of the health risks these will be left in situ and replaced by new pipes. Given the dangerous nature of this material for both workers and citizens, additional measure should be taken to protect the health of all parties in the event (however unlikely) that AC pipes are encountered. This should be done prior to the start of construction works of water supply system, However, UUSDA has confirmed that there is AC pipes in the existing water supply system. For water distribution gravity network /pumping mains, DI-K7/K-9 Class pipes are recommended. Ductile iron pipe is a pipe made of ductile cast iron commonly used for potable water transmission and distribution. This type of pipe is a direct development of earlier cast iron pipe, which it has superseded. Ductile iron pipe in the developed world is normally manufactured exclusively from recycled material including scrap steel and recycled iron. The pipe can be recycled after use. In November 2012, ductile iron pipe manufactured in the United States received certification as a sustainable product from the Institute for Market Transformation to Sustainability. For house service connection, MDPE (Medium density polyethylene pipes are proposed in view of leakage prevention.The environmental benefits that accompany the use of MDPE in water a nd wastewater systems begin with its manufacturing. Pipe produced from MDPE res in uses significantly less energy to manufacture when compared to other materials su ch as iron and concrete. Transporting MDPE piping to municipal water and waste water jobsites requires far less fuel than competing materials which are much heavie r. MDPEis lightweight yet extremely durable. The flexible and lightweight makeup of MDPE/HDPE bring more environmental benefits through lowimpact installation practi ces such as horizontal directional drilling (HDD) and other trenchless operations. HD D is minimally intrusive and well suited for use in highly congested municipalities as well as crossings of environmentally sensitive areas.

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Site Photographs

Existing 250 KL OHT near PNB ATM, Banjarawala PNB ATM toTo be dismantled

Existing TW cum Pumping Station near to be rehabilitated

Existing TW and OHT near PNB ATM ,Banjarawala

Existing 1000KL OHT at Mothrowala to be utilized

Existing TW & Pumping station at Mothrowala to be rehabilitated

Appendix 13: Sample Outline Spoil Management Plan

- The Spoil Management Plan should be site specific and be part of the monthly Construction Management Plan.
- The contractor, in consultation with the ULB, has to find out appropriate location/s for the disposal of the excess soil generated. The spoils should be deposited only at these sites.
- Further precautions need to be taken in case of the contaminated spoils.
- The vehicle carrying the spoil should be covered properly.
- 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 14: Sample Outline Traffic Management Plan

A. Principles for TMP around the Water Pipes/Sewer Construction Sites

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

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

B. Operating Policies for TMP

2. 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 A2 to Figure A12** 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

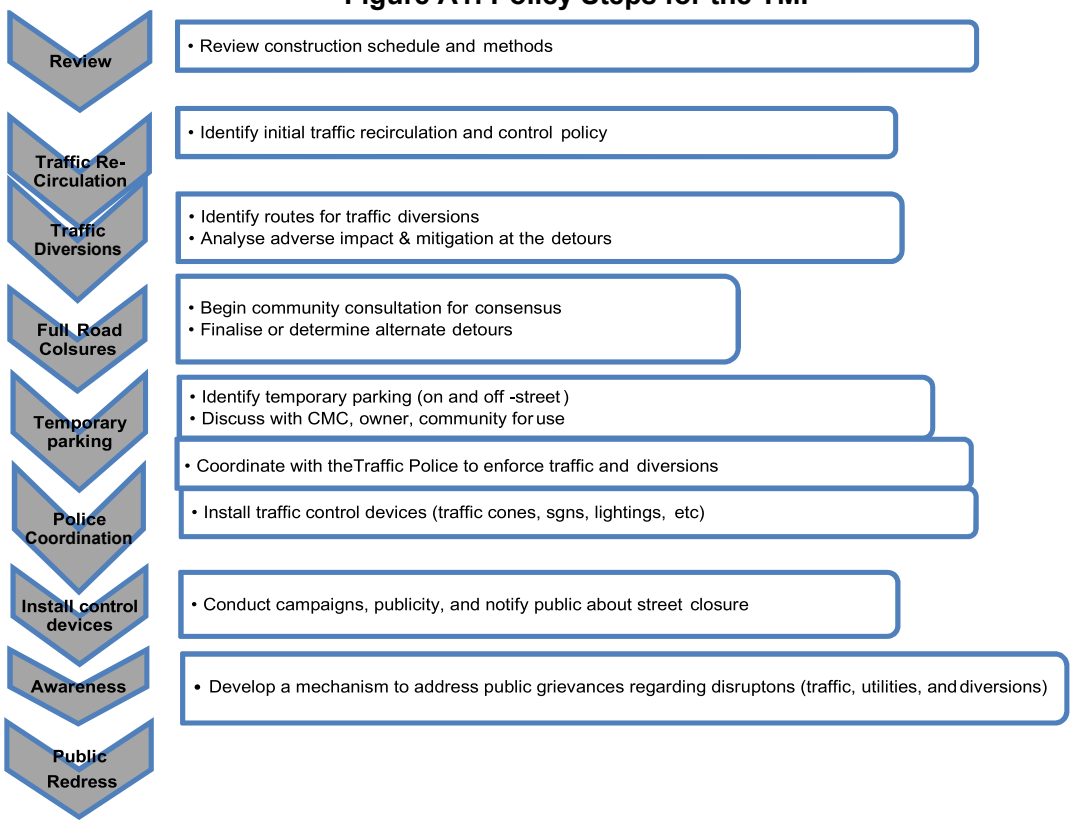
4. Apart from the capacity analysis, a final decision to close a particular street and divert the traffic should involve the following steps:

(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 A1: 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.

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.

6. 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 behavior along the work zones; and
(iii) Reduced speeds enforced at the work zones and traffic diversions.

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

8. 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 centers. 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 behavior 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

9. 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:

- Signs
- Pavement Markings
- Channelizing Devices
- Arrow Panels
- Warning Lights

10. 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”).

11. **Figure A2 to Figure A12** 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 roadway, and road geometrics:

- Work on shoulder or parking lane
- Shoulder or parking lane closed on divided road
- Work in Travel lane
- Lane closure on road with low volume
- Lane closure on a two-line road with low volume (with yield sign)
- Lane closure on a two-line road with low volume (one flagger operation)
- Lane closure on a two lane road (two flagger operation)
- Lane closure on a four lane undivided Road
- Lane closure on divided roadway
- Half road closure on multi-lane roadway
- Street closure with detour

12. 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.

13. 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. Flaggers/ 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.