Initial Environmental Examination

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IND: Karnataka Integrated Urban Sector Development Investment Program – Tranche 1: Davanagere City Bulk Water Supply Subproject

Package Number: 01WS01

Prepared by Karnataka Urban Infrastructure Development and Finance Corporation, Government of Karnataka for the Asian Development Bank.

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IND: Karnataka Integrated Urban Water Management Investment Program (KIUWMIP)

Improvement of Bulk Water Supply for Davangere City Package number 01WS01

Prepared by Karnataka Urban Infrastructure Development and Finance Corporation (KUIDFC), Government of Karnataka for the Asian Development Bank

The initial environmental examination (IEE) prepared based on preliminary designs was reviewed and approved by KUIDFC and ADB in April 2013. It has been disclosed in KUIDFC and ADB's website (https://www.adb.org/projects/documents/kiuwmip-davangere-uwss-subproject-iee)

This IEE is updated to the version submitted earlier dated April 2013 and limited to Bulk water supply for Davanagere City.

ABBREVIATIONS

ADB	Asian Development Bank
AM	Accountability Mechanism
ASI	Archaeological Survey of India
CAGR	Compounded Annual Growth Rate
CBO	Community Based Organizations
CFE	Consent for Establishment
CFO	Consent for Operation
CPHEEO	Central Public Health and Environmental Engineering Organization
CRO	Complaint Receiving Officer
CSS	Construction Supervision Specialist
CGWB	Central Ground Water Board
CC	City Corporation
CPCB	Central Pollution Control Board
CWSS	Combined Water Supply Scheme
DC	Deputy Commissioner
DI	Ductile Iron
DPD	Deputy Project Director
DPR	Detailed Project Report
DSC	Design and Supervision Consultant
EA	Executing Agency
EC	Environmental Clearance
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ERP	Emergency Response Plan
ES	Environmental Specialist
GLSR	Ground Level Storage Reservoir
GoI	Government of India
GoK	Government of Karnataka
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
HDPE	High Density Polyethylene
H&S	Health and Safety
IA	Implementing Agency
IEE	Initial Environmental Examination
IFC	International Finance Corporation
INR	Indian Rupee
INRM	Indian Resident Mission
IPS	Intermediate Pumping Station
IWRM	Integrated Water Resource Management

KIUWMIP	Karnataka Integrated Urban Water Management Investment Programme
KPCL	Karnataka Power Transmission Corporation Limited
KSPCB	Karnataka State Pollution Control Board
KUIDFC	Karnataka Urban Infrastructure Development & Finance Corporation
KUWS&DB	Karnataka Urban Water Supply and Drainage Board
KPTCL	Karnataka Power Transmission Corporation Limited
LPA	Local Planning Authority
MFF	Multi tranche Financing Facility
MID	Minor Irrigation Department
MoEFCC	Ministry of Environment, Forest and Climate change
MoU	Memorandum of Understanding
MS	Mild Steel
NGO	Non-Government Organisation
NH	National Highway
NKUSIP	North Karnataka Urban Sector Investment Programme
NRW	Non Revenue Water
NWKRTC	North-West Karnataka Road Transport Corporation
O.E	Over Exploited
OHT	Over Head Tank
O&M	Operations & Maintenance
PIU	Program Implementation Unit
PMDCSC	Project Management and Design Construction Supervision Consultant
PMU	Program Management Unit
PPE	Personal Protection Equipment
PPTA	Project Preparatory Technical Assistance
PSC	Pre Stressed Concrete
PUC	Pollution Under Control
REA	Rapid Environmental Assessment
RoW	Right of Way
RP	Resettlement Plan
SC	Scheduled Caste / Steering Committee
SEIAA	State Environment Impact Assessment Authority
SH	State Highway
SOP	Standard Operating Procedures
SPS	Safeguard Policy Statement
ST	Scheduled Tribe
TMP	Traffic Management Plan
ULB	Urban Local Body
USD	US Dollars
UWSS	Urban Water Supply & Sanitation
WTP	Water Treatment Plant

WEIGHTS AND MEASURES

^{O} C	Degree Centigrade
dB	Decibels
ha	Hectares
km	kilometre
kmph	kilometre per hour
lpcd	litres per capita per day
M	million
m	metre
ML	Million Litres
MLD	million litres per day
mm	millimetre
m3/hr	cubic meter per hour
ppm	Parts per million
sq.km	Square Kilometer

NOTE{S}

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

CURRENCY EQUIVALENTS

(as of November 2016)

Currency unit	–	Equivalent
Rs1.00	=	$ 0.015
$1.00	=	Rs68.16

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EXECUTIVE SUMMARY

1. The Karnataka Integrated Urban Water Management Investment Program (KIUWMIP, the programme) aims to improve water resource management in urban areas in a holistic and sustainable manner. Investment support will be provided to modernize and expand Urban Water Supply and Sanitation (UWSS) while strengthening relevant institutions to enhance efficiency, productivity and sustainability in water use.

2. Davangere city bulk water supply subproject is one of the subprojects proposed in Tranche-1. 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). This Initial Environmental Examination (IEE) addresses bulk water supply components proposed under Tranche 1.

3. **Categorization.** Davangere city bulk water supply subproject is classified as Environmental Category B as per the SPS as no significant impacts are envisioned. Accordingly this Initial Environmental Examination (IEE) has been prepared, and assesses the environmental impacts and provides mitigation & monitoring measures to ensure no significant impacts as a result of the subproject.

4. **Subproject Scope.** The subproject formulated under this Investment Program to improve the water supply system particularly bulk water supply and treatment which includes, i) construction of new intake and jack well of 120 MLD, ii) construction of new Water Treatment Plant of 40 MLD at Bathi, iii) laying of 13.405 km raw water transmission main from intake to WTP, iv) construction of RCC bridge of 150 m for pipeline crossing over Sulekere nallaha and v) construction of clear water reservoir and pumping main of 612 m MS pipe of 1118 mm dia..

5. **Implementation Arrangements.** Karnataka Urban Infrastructure Development & Finance Corporation (KUIDFC) is the Executing Agency (EA) responsible for implementing the Investment Program. Investment Program implementation activities is monitored by KUIDFC through a separate Investment Program Management Unit (PMU) for the IWRM Project, which set-up within KUIDFC. At the Executing Agency (i.e. KUIDFC), environmental issues coordinated centrally by an Environmental Specialist (Designated as Assistant Executive Engineer–Environment), reporting to the Task Manager, Assistant Executive Engineer– Environment will ensure that all subprojects comply with environmental safeguards. The IEE/ EIA reports prepared by the Consultant, and will be reviewed by the Assistant Executive Engineer–Environment as per the ADB's Environmental Guidelines and forwarded to ADB for review and approval. The consultant (Program Management design construction supervision consultant, PMDCSC) includes an environmental specialist to supervise the implementation of environmental safeguards. The consultant team also includes a Construction Supervisor at each ULB/CMC responsible for the supervision of project implementation including environmental safeguards at the ULB/CMC level. Like other town/city, in Davangere Program Implementation Unit (PIU) there is one Assistant Executive Engineer (AEE) responsible for safeguard implementation and environment specialist of PMDCSC assist AEE for environmental compliance. The contractor shall appoint one supervisor (environment & safety officer) who will be responsible on a day-to day basis for ensuring implementation of EMP, coordinating with RE and environment specialists(all

levels), community liaison, consultation with interested/affected parties and grievance redressal and necessary reporting.

6. **Description of the Environment**. Subproject components like intake and WTP are located outside the city area, specifically at village area. All are located within government land. Pipeline will be passing through existing right of ways (RoWs) and government-owned land within the village. Project surroundings areas are mostly used for agricultural purpose and there is no natural habitat left at these sites. There are no mangroves, or estuaries in or near the subproject location. Traffic management will be necessary during pipe-laying along the busy highways. New intake well will be constructed in River Tungabhadra near the existing intake well and new jack well will be constructed adjacent to the existing jack well on the bank of Tungabhadra near the intake well. New WTP will be constructed within the existing WTP campus, where there is adequate vacant land to accommodate the unit.

7. **Environmental Management.** An Environmental Management Plan (EMP) is included as part of this IEE, which includes (i) mitigation measures for environmental impacts during implementation; (ii) an environmental monitoring program, and the responsible entities for mitigating, monitoring, and reporting; (iii) public consultation and information disclosure; and (iv) a grievance redress mechanism. A number of impacts and their significance have already been reduced by amending the designs. The EMP will be included in civil work bidding and contract documents.

8. Locations and siting of the proposed infrastructures were considered to further reduce impacts. These include (i) locating all facilities on government-owned lands, to avoid the need for land acquisition and relocation of people; and (ii) laying of pipes in RoWs along main/access roads and other facilities on government vacant lands, to avoid acquisition of land and the impacts on livelihoods.

9. Potential impacts were identified in relation to location, design, construction and operation of the improved infrastructure. . Existing source, Tungabhadra River will be continued as source and project will augment the abstraction from current 80 MLD to ultimate 160 MLD by 2046. Available river flow data shows sufficient water in the river throughout the year, and the abstraction is about 7%-11% of the minimum flow recorded in the years of 2009, 2010 and 2011 (for which river flow data is available). In terms of maximum flow, the abstraction is in the range of 0.2%-0.3%. Considering this no notable impacts on downstream users or river flow envisaged.River has adequate flow to meet the demand of all the nearby water supply schemes of other towns (Byadgi, Harihar and Ranebennur). No notable location specific impacts were noticed. All the sites are selected adjacent to the existing facilities.

10. During the construction phase, impacts mainly arise from intake construction in the river, bridge construction for pipeline; need to dispose of moderate quantities of waste soil and disturbance to residents, businesses, and traffic. These are common temporary impacts of construction in rural or urban areas, and there are well developed methods for their mitigation. Measures such as conducting work in dry season when water level of the river reduced, lean season and minimizing inconvenience by best construction methods will be employed. 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.

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

12. The stakeholders were involved in developing the IEE through discussions on-site and public consultation, after which views expressed were incorporated into the IEE and in the planning and development of the subproject. The IEE will be made available at public locations in the city and will be disclosed to a wider audience via the ADB and KUIDFC websites. The consultation process will be continued and expanded during project implementation to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation.

13. The citizens of the Davangere city will be the major beneficiaries of this subproject. With the improved water supply, they will be provided with a constant supply of better quality water, piped into their homes. In addition to improved environmental conditions, the project will improve the over-all health condition of the city. People would spend less on healthcare and lose fewer working days due to illness, so their economic status should also improve, as well as their overall health.

14. The most noticeable net environmental benefits to the population of the city will be positive and large as a result of improved water efficiency and security through expansion and rehabilitation of water supply infrastructure.

15. **Consultation, Disclosure and Grievance Redress.** Public consultations were done in the preparation of the project and IEE. On-going consultations will occur throughout the project implementation period with the assistance of the NGOs. A grievance redress mechanism is described within the IEE to ensure any public grievances are addressed quickly.

16. **Monitoring and Reporting.** The PMU, PIU, and PMDCS consultant will be responsible for monitoring. The PMDCSC will submit monthly monitoring reports to PMU, and the PMU will send semi-annual monitoring reports to ADB. ADB will post the environmental monitoring reports on its website.

17. **Conclusions and Recommendations**. The proposed subproject is unlikely to cause significant adverse impacts. The potential impacts that are associated with design, construction and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures. Based on the findings of the IEE, there are no significant impacts and the classification of the subproject as Category “B” is confirmed. No further special study or detailed environmental impact assessment (EIA) needs to be undertaken to comply with ADB SPS (2009) or GoI EIA Notification (2006).

I. Introduction

A. BACKGROUND

1. The Karnataka Integrated Urban Water Management Investment Program (KIUWMIP) aims to improve water resource management in urban areas in a holistic and sustainable manner. Investment support will be provided to modernize and expand urban water supply and sanitation (UWSS) while strengthening relevant institutions to enhance efficiency, productivity and sustainability in water use. The Program focuses on priority investments and institutional strengthening in water supply and sanitation within an IWRM context.

2. The Program will be implemented over a four-year period beginning in 2014, and will be funded by a loan via the Multi tranche Financing Facility (MFF) of Asian Development Bank (ADB). The Executing Agency is the Karnataka Urban Infrastructure Development Finance Corporation (KUIDFC) and implementing agencies for the Investment Program will be respective Urban Local Bodies (ULBs). Byadgi, Harihar, Ranebennur and Davangere are the four towns chosen to benefit from the first tranche of the investment.

3. The expected outcome will be, improved water resource planning, monitoring and service delivery in 4 towns of the Upper TungaBhadrasub basin. Tranche 1 will have 3 outputs; (i) Expanded efficient UWSS infrastructure in 4 towns of the Upper TungaBhadra sub basin; (ii) Improved water resource planning, monitoring and service delivery in Karnataka; and (iii) KUIDFC strengthened capacity. This IEE is based on an assessment water supply projects within the project area i.e., Davangere City.

B. BACKGROUND OF IEE

4. The Davangere City Bulk Water Supply Scheme sub project is proposed in Tranche -1 of the KIUWMIP. The existing water supply system is not covering the entire city and not adequate to meet the full demand of the city. The efficiency of many components is poor or not working. Hence this project component is proposed.

5. The subproject formulated under this Investment Program to improve the water supply system particularly water source and treatment which includes, i) construction of new intake and jack well of 120 MLD, ii) construction of new Water Treatment Plant of 40 MLD at Bathi, iii) laying of 13.405 km raw water transmission main from intake to WTP iv) construction of RCC bridge of 150 m to for pipeline crossing over Sulekere ***nallaha***(v) Construction of clear water reservoir and clear water pumping main of 612 m.

6. ADB's Safeguard Policy Statement, 2009, requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for Environmental Assessment are described in detail in ADB Environmental Assessment Guidelines, 2003. This states that ADB requires environmental assessment of all project loans, programme loans, sector loans, sector development programme loans, financial intermediary loans and private sector investment operations.

7. This IEE, for the Davangere City Bulk Water Supply Subproject, discusses the environmental impacts and mitigation measures relating to the location, design, construction and operation of all physical works proposed under this subproject. IEE relies mainly on secondary sources of information and site reconnaissance surveys including on-site informal discussions with the local people. The IEE follows the process and documentation as per the ADB's Safeguard Policy Statement (SPS, 2009). The Rapid Environmental Assessment Checklists are presented in **Appendix 1**.

C. ENVIRONMENTAL REGULATORY COMPLIANCE

8. **Table 1** presents a summary of environmental regulations and mandatory requirements applicable to the sub project

Table 1: Applicable Environmental Regulations

Law	Description	Requirement
EIA Notification	The EIA Notification of 2006 and 2009 (replacing the EIA Notification of 1994), set out the requirement for environmental assessment in India. This states that Environmental Clearance (EC) is required for certain defined activities/projects, and this must be obtained before any construction work or land preparation (except land acquisition) may commence. Projects are categorized as A or B depending on the scale of the project and the nature of its impacts. Categories A projects require Environmental Clearance from the Ministry of Environment, Forest and Climate change (MoEFCC). Category B projects require Environmental Clearance from the State Environmental Impact Assessment Authority (SEIAA).	Sub project is not a listed activity in Schedule I of this notification and hence environmental clearance is not required.
Water (Prevention and Control of Pollution) Act of 1974, Rules of 1975, and amendments	Control of water pollution is achieved through administering conditions imposed in consent issued under provision of the Water (Prevention and Control of Pollution) Act of 1974. These conditions regulate the quality and quantity of effluent, the location of discharge and the frequency of monitoring of effluents. Any component of the Project having the	The proposed sub component is not a listed activity hence CFE / CFO not required.

Law	Description	Requirement
	potential to generate sewage or trade effluent will come under the purview of this Act, its rules and amendments. Such projects have to obtain Consent For Establish (CFE) under Section 25 of the Act from Karnataka State Pollution Control Board (KSPCB) before starting implementation and Consent For Operate (CFO) before commissioning. The Water Act also requires the occupier of such projects to take measures for abating the possible pollution of receiving water bodies.	
Air (Prevention and Control of Pollution) Act of 1981, Rules of 1982 and amendments.	The projects having potential to emit air pollutants into the atmosphere have to obtain CFE under Section 21 of the Air (Prevention and Control of Pollution) Act of 1981 from KSPCB before starting implementation and CFO before commissioning the project. The occupier of the project/facility has the responsibility to adopt necessary air pollution control measures for abating air pollution.	For the project, CFE and CFO will required from KSPCB if the following are installed for construction: (i) diesel generators; (ii) wet mix plants; and (iii) stone crushers, All relevant forms, prescribed fees and procedures to obtain the CFE and CFO can be found in the KSPCB website (www.kspcb.gov.in).
Environment (Protection) Act, 1986 and CPCB Environmental Standards.	Emissions and discharges from the facilities to be created or refurbished or augmented shall comply with the standards notified.	**Appendix 2** provides applicable standards for ambient air quality which should be followed during construction phase.
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.	**Appendix3**provides applicable noise standardswhich should be followed during construction phase.
Ancient Monuments and Archaeological Sites and Remains Rules of 1959	The Rules designate areas within a radius of 100 meters (m) and 300 m from the “protected property” as “protected area” and “controlled area” respectively. No development activity (including mining operations and construction) is permitted in the	There are no protected properties near project area in Davangere. However, in case of chance finds, the contractors will be required to follow a protocol as defined in the Environmental

Law	Description	Requirement
	"protected area" and all development activities likely to damage the protected property are not permitted in the "controlled area" without prior permission of the Archaeological Survey of India (ASI). Protected property includes the site, remains, and monuments protected by ASI or the State Department of Archaeology.	Management Plan (EMP).
Land Acquisition Act of 1894	Private land acquisition is guided by the provisions and procedures in this Act. The District Collector or any other officer designated will function as the Land Acquisition Officer on behalf of the Government. There is a provision for consent award to reduce the time for processing if the land owners are willing to agree on the price fixed by the Land Acquisition Officer.	All the project components are in government or public land. No land acquisition is required as a part of this sub project
Labor Laws	The contractor shall not make employment decisions based upon personal characteristics unrelated to job requirements. The contractor shall base the employment relationship upon equal opportunity and fair treatment, and shall not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment or retirement, and discipline. The contractor shall provide equal wages and benefits to men and women for work of equal value or type.	**Appendix 4** provides applicable labor laws including amendments issued from time to time applicable to establishments engaged in construction of civil works.
Biodiversity Act of 2002	The Biodiversity Act 2002 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	Not applicable to Davangere Bulk Water Supply Sub-project as no mentioned activities are involved in the project

Law	Description	Requirement
	and knowledge to the country and the people.	
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.	Not applicable to Davangere Bulk Water Supply Sub-project as no wetlands presents in the project area.
Wildlife Protection Act, 1972	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 to Davangere Bulk Water Supply Sub-project as none of the project component will have any impact on wildlife or protected areas.
Forest (Conservation) Act, 1980	The Forest (Conservation) Act prevents the use of forest land for non-forest uses without the clearance from Ministry of Environment and Forests (MoEF), Govt. of India	Not applicable to Davangere Bulk Water Supply Sub-project as there is no forest area within or adjacent to the project area.
Karnataka Forest Act, 1963 and Karnataka Forest Rules, 1969	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 to Davangere Water Supply Sub-project as there is no forest area within or adjacent to the project area.
Karnataka Preservation of Trees Act, 1976 and Karnataka Preservation of	This Act has put restriction on felling of trees in the State unless until permitted by the Tree Officer. Any person desiring to fell a tree shall apply in writing to the tree officer for	Tree cutting is required for construction of Jack well, pump house at intake point , therefore, prior permission should be obtained

Law	Description	Requirement
Trees Rules, 1977	permission in that behalf. It further defines clauses for planting adequate number of trees, planting in place of fallen/destroyed trees, preservation of trees and adoption of trees.	

9. The ADB guidelines, on the other hand, stipulate addressing environmental concerns, if any, of a proposed activity in the initial stages of project preparation. For this, the ADB SPS categorizes the proposed components into various categories (A, B or C) to determine the level of environmental assessment required to address the potential impacts. Level of environmental assessment required for each category is presented below.

(i) Category A: Project components with potential for significant adverse environmental impacts. An Environmental Impact Assessment (EIA) is required to address significant impacts.

(ii) Category B: Project components judged to have some adverse environmental impacts, but of lesser degree and/or significance than those for Category A. An Initial Environmental Examination (IEE) is required to determine whether significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.

(iii) Category C: Project components unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are still reviewed.

10. The environmental impacts of Davangere Water Supply sub project have been identified and assessed as part of the planning and design process. Environmental assessment using ADB's Rapid Environmental Assessment Checklists for Water Supply was conducted, and results of the assessments show that the project 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.

D. SCOPE OF IEE

11. The IEE was based mainly on secondary sources (India Meteorological Department, Central Ground Water Board, Census Department of India etc.) of information and field reconnaissance surveys; limited field monitoring (environmental) survey was conducted. Stakeholder consultation was an integral part of the IEE.

E. REPORT STRUCTURE

12. This Report contains Eight (8) sections including this introductory section: (i) Introduction; (ii) Description of Investment Project components; (iii) Description of the environment; (iv) Screening of potential environmental impacts and mitigation measures; (v) Public consultation and information disclosure; (vi) Institutional requirements and EMP; (vii) Finding and recommendation; and (viii) Conclusions. .

II. DESCRIPTION OF THE PROJECT COMPONENTS

13. Davangere City is located at a latitude of 14°28′ N and longitude of 75°59′E, at an average altitude of 602.5 m above the mean sea level (MSL). It is the headquarter city of Davangere District, and is located at about 260 km from Bangalore.

A. EXISTING WATER SUPPLY SYSTEM IN DAVANGERE CITY

14. River Tungabhadra is the only source available for the town. Davangere city has four water supply existing schemes namely (i)Old Tungabhadra River Water Supply System,(ii) New Tungabhadra River Water Supply System, (iii) BhadraHarihar Branch Canal Water Supply System and (iv) Kundawada Water Supply System. Presently these systems together with local bore wells provide water to the entire Davangere city.

15. Out of these, the Old Tungabhadra River Water Supply System is not in use. BhadraHarihar Branch Canal Water Supply System is used as standby system and is operated only when Tungabhadra River Water Supply System is shut down for repairs. An overview of the existing water supply systems in Davangere City Corporation is presented in the **Table 2.**

Table 2: Existing Water Supply Systems in Davangere

System	Design Capacity (MLD)	Present Supply (MLD)	Remarks
Old Tungabhadra River Water Supply System	4.5	-------	Defunct
New Tungabhadra River Water Supply System		-	
KUWS&DB Scheme	60	40	
NKUSIP Scheme	40	40	
BhadraHarihar Branch Canal Water Supply System	19	19	
Kundwada Water Supply System	20	-------	Source changed under NKUSIP as New Tungabhadra River Water Supply System.
Total	**143.5**	**99**	

Source- Davangere City Corporation

16. The brief description of above mentioned water supply system is as under:-

17. **Old Tungabhadra River Water Supply System**: This scheme was implemented in the year 1917 initially for a population of 15,000. At present this system is not in use and abandoned.

18. **New Tungabhadra River Water Supply System**: The source works is located near Rajanhalli village, upstream of new NH-4. All the civil structures are in good condition. There are presently two schemes running parallel from Tungabhadra River as source.

- **Scheme-1 (40MLD) commissioned by Karnataka Urban Water Supply and Drainage Board (KUWS&DB) in the year 2004**. Under this scheme presently only 36 MLD is extracted due to reduced efficiency of pumps installed.
- **Scheme-2 (40MLD) commissioned by North Karnataka Urban Sector Investment Program (NKUSIP) in the year 2014**. Under this scheme additional 40 MLD raw water is extracted from the source using the same intake work and jack well.

19. **BhadraHarihar Branch Canal Water Supply System**: This scheme was commissioned in the year 1972 and is designed to supply 20 ML/D. The present source of supply is 19 ML/D. BhadraHarihar Branch Canal, located at a distance of about 0.5 km from the city is the source of water supply. This canal runs continuously from June to December, but runs for only 10 days in a month during the period January to May.

20. **Kundawada Water Supply System**: Kundawada Water Supply System is used as stand by system and is operated only when Tungabhadra River Water Supply System is shut down for repairs. It is basically similar to the earlier Bhadra Canal System and has been designed to supply 20 ML/D water to the city.

21. **Intake and Jack Well.** Under Tungabhadra Stage-II Water supply Scheme an Intake Well with a Jack well was constructed on the bank of River Tungabhadra in the year 2004. The Intake well is of 6 m diameter and about 4 m depth whereas the Jack well is 10 m diameter and 15.40 m depth. Two 1200 mm diameter RCC NP3 pipes connects the Intake from Jack well. For Raw water pumping three vertical turbines pumps of capacity 500 HP were installed. In the year 2014 under NKUSIP scheme another two pumps of capacity 1000 HP were installed in the same Jack well for pumping 40 MLD of addition raw water to Davangere City.

22. **Raw Water Transmission Main**. Schematic diagram of existing Raw Water transmission main in the city is as shown below in **Figure 1.**

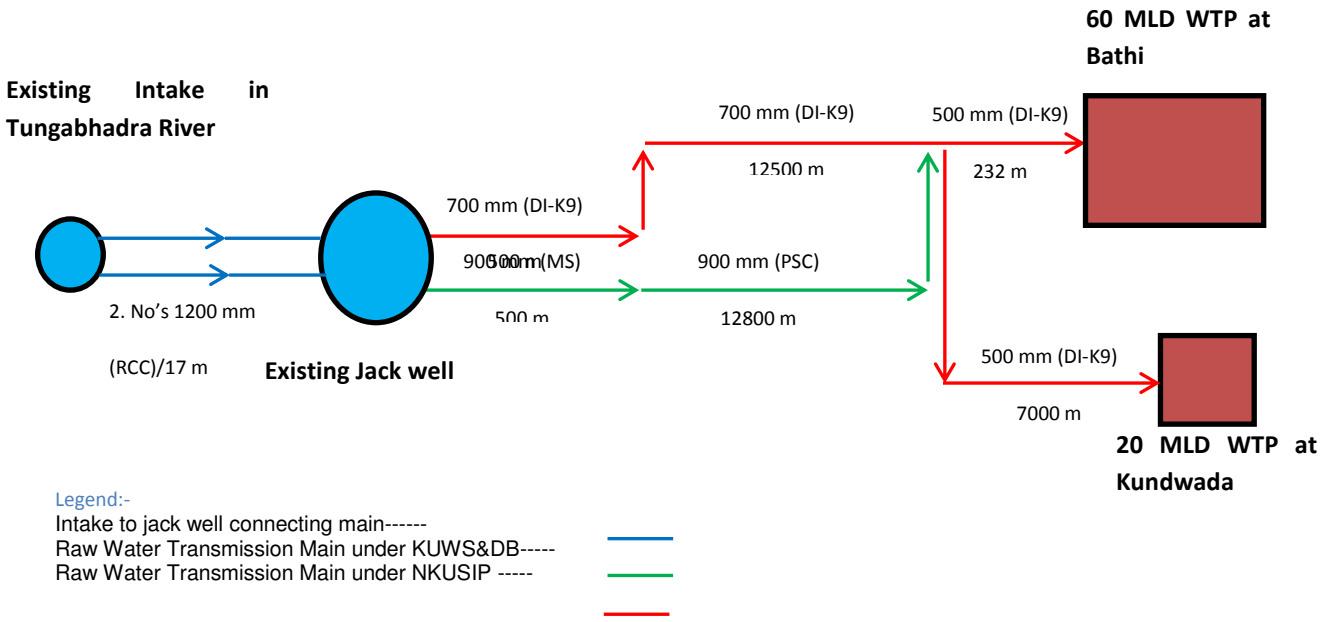


Figure 1: Schematic diagram of Raw Water Transmission Main

B. EVALUATION OF EXISTING BULK WATER SUPPLY COMPONENTS

23. **Evaluation of existing Bulk water supply components**. The existing Bulk water supply components and requirement of additional are evaluated in detail.

Sources of Water Supply

24. The Tungabhadra River is formed by the confluence of the Tunga River and the Bhadra River at Koodli which flow down the eastern slope of the Western Ghats in the state of Karnataka. The Two Rivers originate in Chikmagalur District of Karnataka along with the Nethravathi (west-flowing River, joining the Arabian Sea near Mangalore), the Tunga and the Bhadra rise at Gangamoola, in VarahaParvatha in the Western Ghats at an elevation of 1198 m. The Bhadra River flows through the industrial city Bhadravathi. More than 100 tributaries, streams, creeks, rivulets and the like contribute to the two rivers. The journey of the Tungaand the Bhadra is 147 km and 171 km respectively, till they join at Koodli, at an elevation of about 610 metres near Holehonnur, about 15 km from Shivamogga, areca granary of the country. It is a confluence of both the Dwaitha and the Adwaitha philosophies. From there, the Tungabhadra meanders through the plains to a distance of 531 km and mingles with the Krishna at Gondimalla, near the famous Alampur in Mahaboobnagar District of Telangana

25. **Figure 2** shows the location of Davangere in the Krishna River Basin of which Tungabhadra River is a tributary.

Figure 2: Map showing the Krishna River basin and its tributaries (Source-Google)

26. The Tungabhadra River is located at about 15 Km in the North West of Davangere which is the only perennial source for many towns of Karnataka including Davangere. For more closure look of the River a Google image of the Tungabhadra River near Rajanahalli Village is shown below:-

Figure 3: Google image of Tungabhadra River near Rajanahalli village (Source-Google Earth)

27. The Table below shows the raw water requirement for Davangere city for future design year:-

Table 3: Raw water requirement of Davangere City

Year	Water requirement in MLD	Present withdrawal from Tungabhadra River in MLD	Gap in MLD
2016	89	80	9
2031	120	80	40
2045	157	80	77

28. From the above table it can be seen that there is a deficit of 9 MLD of Raw water for the city and which will rise to 40 and 77 MLD in the year 2031 and 2046 respectively. Hence it can be concluded that the city requires a comprehensive water supply system to cater this demand in the upcoming years.

29. During field investigation, it is found that Tungabhadra River is a reliable and sufficient source. There is sufficient flow within the Tungabhadra River throughout the year and hence Tungabhadra River is sustainable source for Davangere 24 x 7 Water supply scheme. **Appendix 5** shows sustainable water source analyses. Source analyses study indicates that the river flow discharge is regulated by the Bhardra dam discharge. Based on the Bhardra dam discharge seasonal water level variations are noted.

Intake and Jack well

30. From Table above it can be seen that the city requires another 77 MLD say 80 MLD to meet its future demand. Hence a new intake and jack well has been proposed under the present scheme near the existing head works.

31. Location and capacity of different water abstraction structure at upstream and downstream of Davangere intake at Rajanahalli.

Table 4: Nearby water abstraction structure at upstream and downstream of Rajanahalli intake point

Sr. No.	Type of water abstraction structure	Name of the location	Capacity – period of abstraction	Supply area after intake	Distance from proposed Rajanahalli intake for Davangere
1	Jackwell	Mudenur	42.64 MLD for 20 Hrs a day	Ranibennur and Byadgi town	8.10 km Upstream.
2	Jackwell	Makanur	Below 1 MLD	Makanur and surrounding villages – supply not strated	1.24 km Downstream
3	Jackwell	Kavalettu	32.7 MLD for 20 Hrs a day	Harihara Town	3.02 Km Downstream

4	Polyfibers Industry use	Nearby Polyfibers plant Kumarapatnam	25 MLD to 30 MLD depending on usage and plant run. Specifically intake at monsoon season and followed by storage	For factory Use	7.64 Km Downstream

32. Based on the dependability study which already included in **Appendix 5,** the water requirement for the four towns (Davangere, Harihar, Byadgi and Ranibenur) is less than 10% of water available based on the 95% dependability. Hence there is no impact is expected on Harihara intake point. At about 4.6 km Harihara intake point there is one intake for Polyfiber factory. They generally pumping water from the river during rainy season and water impounded in the tank inside their premises.

33. Above table and water availability analyses indicates that at downstream ,Intake of water will be not affected due to abstraction of water at Rajanhalli for Davangere city. **Figure 4** shows the all existing intake

Figure 4: Different intake at Tungbhadra river at upstream and downstream of proposed intake at Rajanahalli

Mudenur intake

Makanur intake

Kavalettu intake

Grasim polyfibers factory intake

Figure 5: Individual intake upstream and downstream of Rajanahalli

Raw Water Transmission Mains

34. The existing raw water transmission main from Rajanahalli head works to Bathi WTP under 2nd stage Tungabhadra scheme was commissioned in the year 2002. The pumping main was designed for 60 MLD but currently pumping only 40 MLD of raw water. Davangere City Corporation has informed that they are facing problems of frequent bursts in the pipeline for the present pumping quantity of 40 MLD to Bathi WTP.

35. The raw water pumping main under NKUSIP was commission in the year 2014. This pumping main is currently pumping 40 MLD of raw water i.e. 20 MLD to Bathi WTP and 20 MLD to Kundwada WTP. This pumping main is running in good condition and can serve upto the design year 2046.

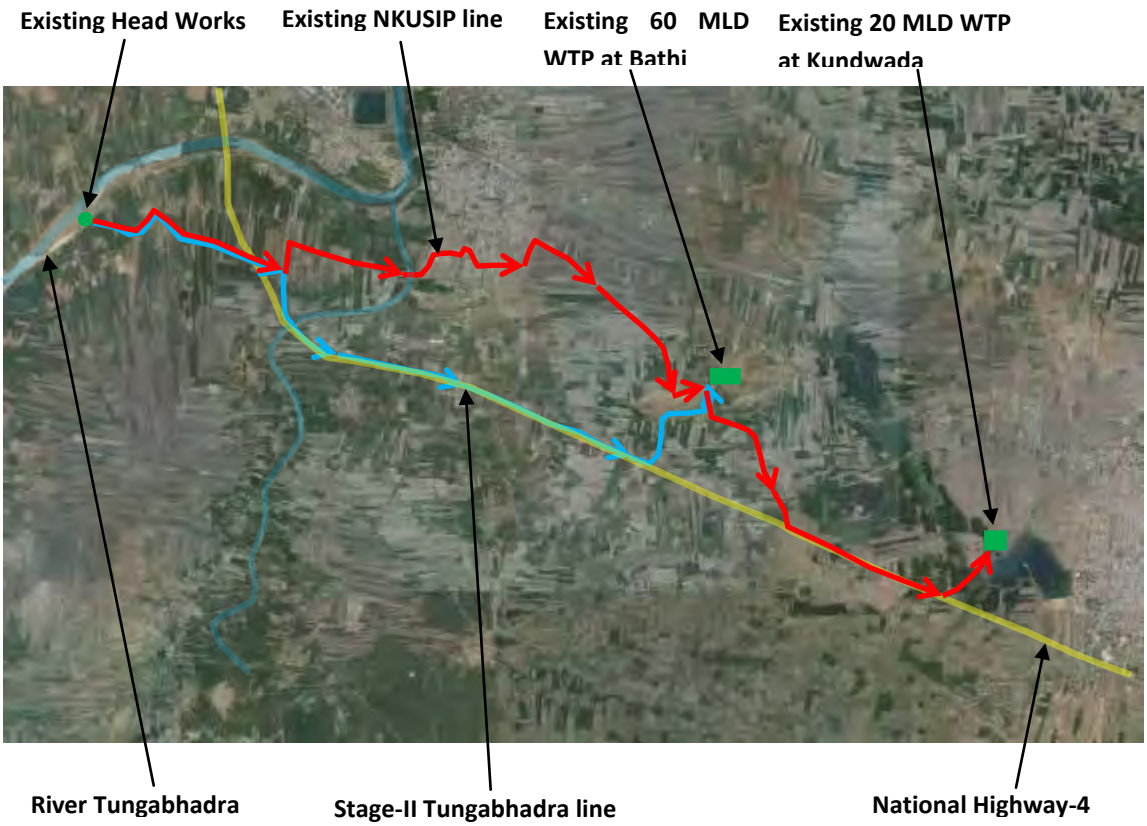


Figure 6: Existing Alignment of Raw Water Main

Water Treatment Plant

36. As mentioned above that Davangere city as three WTP of which only one WTP does not have perennial source i.e. TV station WTP. Hence this WTP of 19 MLD is proposed to be discarded under the present scheme. Also the life of this WTP is over as it was commissioned in the year 1972 under the BhadraHarihar Branch Canal Water Supply System.

37. 60 MLD WTP at Bathi and 20 MLD WTP at Kundwada have been retained under the present scheme as both the WTP has the same perennial source of River Tungabhadra. No renovation is considered for these WTP within the proposed work component.

38. However there is a deficit of 40 MLD in supply for the design year 2031 and 80 MLD for the design year 2046.

39. All WTPs are Conventional Water Treatment Plants and having the following components.

- Cascade Aerator
- Raw water channel with flow meter.
- Flash mixer.
- Clariflocculator.

- Rapid sand gravity filter.
- Chemical House
- Clear water storage sump
- Back wash water tank
- Gravity feed chlorinators
- Clear water reservoir
- Clear water pump house.

C. DESCRIPTION OF THE SUBPROJECT

The components related to the Bulk Water supply for achieving the 24x7 water supply system goal for Davangere City are proposed and discussed below.

Intake Well

40. The Existing Intake well is utilized to extract 80 MLD of Raw water at present against a demand of 160 MLD for design year 2046. Hence 80 MLD additional is required to meet the demand for design year 2046. Also as per the evaluation of the existing intake well it is suggested to shift either NKUSIP or KUWS&DB pumps and hence 120 MLD of Intake well is proposed under the present scheme. This Intake well will be constructed near to the existing Intake well i.e. in Rajanahalli village near River Tungabhadra. There is no pollution source/ discharge of industrial effluent into river at upstream of intake point at Rajanahalli. Upstream and downstream of intake are mostly villages. Only one renowned industry at downstream of proposed intake is Grasim Polyfiber plant located at Kumarapatnam, discussed in earlier paragraph.

41. The Design of Intake well is shown in the Table below:-

Table 5: Hydraulic Design of Intake Well

Design of River Intake				
A	**Data**			
1	RL of River bed	=	522.50	M
2	RL of Lowest Water Level	=	522.70	M
3	RL of High Flood Level	=	534.00	M
4	Average flow	=	120.00	MLD
B	**Design of Intake well**			
1	Pumping hour per day	=	20.00	hr/day
2	Peak flow	=	6000.00	m^3/hr
		=	1.67	m^3/sec
3	Provide a Circular shaped inlet well, with openings provided at just below the minimum river water level. These openings shall be fitted with bar screens			
4	Provide Steel bars of diameter	=	20	Mm
5	Provide width of openings	=	50	Mm
6	Assume Velocity through the bar screens	=	0.13	m/sec

Design of River Intake				
7	The area of openings required	=	12.53	m^2
8	Provide the height of screen openings	=	1.5	M
9	Clear Length of the openings	=	8.35	M
10	No. of openings required	=	167.00	No's
	Say,	**=**	**167**	**No's**
11	No. of bars required	=	166	no.s
12	Length occupied by steel bars	=	3.32	M
13	Therefore, the total length of screen	=	11.67	M
		=	**11.70**	M
	Let us provide 5 ports below LWL. Therefore the size of each will be: 1.5 m x 2.3 m			
15	Provide the diameter of the Intake Well	=	9	M
	Say,	**=**	**9.0**	**M**
	Scour depth level	**=**	519.00	**M**
16	Provide the depth of well below the Scour depth level	=	1.00	M
17	Hence, provide the Invert Level of outlet pipe	=	521.00	M
18	Bottom level of intake well	=	520.50	M
18	RL of intake well top	=	527.50	M
18	The height of the Inlet Well	=	7.0	M
	Hence size of the intake well=9 m dia and 7 m height			
C	**Design of Gravity Pipe (Connecting Intake well & Jack Well)**			
1	No. of pipes proposed	=	2	No's
2	Diameter of each RCC NP3 pipe proposed	=	1400	Mm
3	Slope of each pipe	=	1 in 1400	
4	Actual Velocity through the pipe	=	1.02	m/sec
5	Area of each pipe	=	1.54	m^2
6	Discharge from the pipes	=	3.14	m^3/sec
		=	>1.67 m3/sec	
7	Distance between intake well and jack well	**=**	25.00	M
8	Invert level of outgoing pipe from intake well	=	520.50	M
9	Invert level of outgoing pipe to jack well	=	520.48	M

Jack Well and Pumps

42. Similar to Intake Well, the existing Jack well is also not sufficient to meet the demand of 160 MLD for ultimate year. Hence a new jack well of 120 MLD capacity has been proposed just beside the existing one in Rajanahalli Villagenear River Tungabhadra.

43. The Design of Jack well is shown in the Table below:-

Table 6: Hydraulic Design of Jack Well

Design of Jack Well				
1	Invert level of connecting pipe at Jack Well as above	=	520.48	M
2	Existing G.L	=	529.40	M
3	Peak flow	=	100.20	m3/min
4	Minimum storage in Jack well between connecting pipe and suction of pump is maximum of 5 min of Pumping rate	=	501	m3
5	Considering diameter of jack well =	=	10	M
6	Storage depth in jack well between connecting pipe and suction of pump	=	6.38	M
7	Free board	=	0.50	M
8	Submergence	=	2.00	M
9	Storage depth in well from invert of intake pipe to bottom of well =	=	8.88	M
	Say,	=	8.90	M
10	Suction level (strainer level) of pump=	=	513.58	M
11	Floor Level of Pump House considering HFL level	=	535.48	M
12	Bottom level of Jack well	=	511.58	M
13	Total Depth of Jack well from floor	=	23.90	M
14	Total Depth of Jack well from ground	=	17.82	M

44. The Exact Location of Proposed Intake well and Jack well near the Existing Head works at Rajanahalli Village near River Tungabhadra is shown in the figure below:-

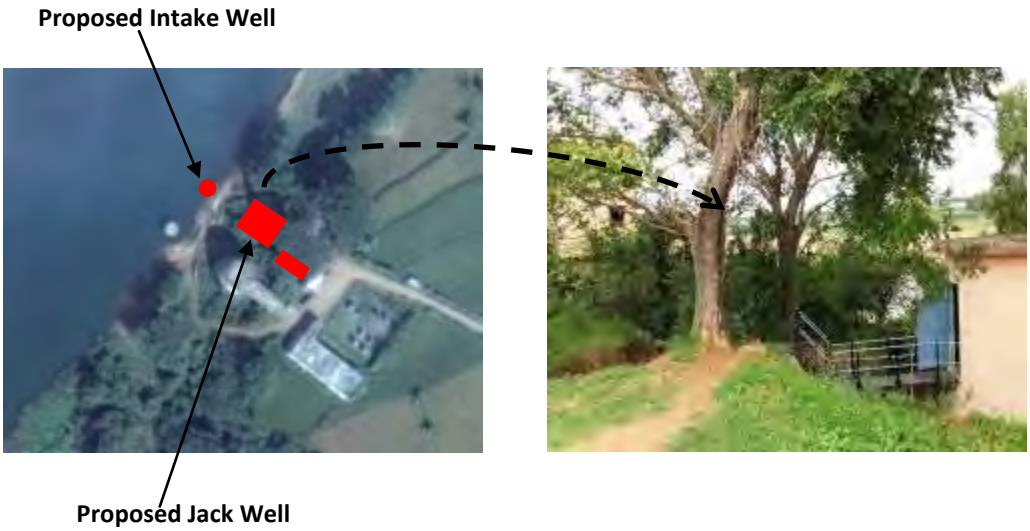


Figure 7: Location of Proposed Head works for Davangere city

45. As per Hydraulic design to meet the intermediates raw water requirement 3 nos. of vertical turbine pumps (2 working + 1 standby), each of capacity 1000 m^3/hr. with

88m dynamic head is proposed to be installed. Space for installation of three more pumps has been provided considering the NKUSIP/KUWS&DB pumps to be shifted. The size of Jack well to house the pumps has been decided considering pump centre line distances and side clearances as per recommendations of IS:15310 and guidelines laid down in American National Standard Institute (ANSI)/ Hydraulic Institute Standard (HIS) and recommendations of the pump manufacturer. Sump bottom level will be governed by the invert level of the connecting pipe from Intake well to Jack well and minimum submergence & bottom clearance requirement as per the recommendations of the pump manufacturer and as per guidelines of IS:15310/ ANSI-HI Standard/ pump manufacturer.

Raw Water Transmission Main

46. A new raw water transmission main of 1100 mm (OD) diameter Ductile Iron (DI) K9 pipe of 13405m length from Proposed Head works at Rajanahalli to proposed WTP at Bathi is proposed. The design capacity of the rising main is consider as 80 MLD i.e. for the ultimate demand. However after consultation with the DCC it was found that the pipe length of existing 900 mm (ID) MS pipe commissioned under Stage-II Tungabhadra scheme which is running along the National Highway i.e. NH-4 is required to be shifted in future due to widening of National Highway. Till now DCC has not finalized any land to shift the existing raw water line and therefore assuming that DCC will be shifting the pipe line in near future, the proposed raw water transmission main has been design accordingly. Also the existing pipe has served only 12 years of its life so it cannot be discarded. **Figure 8** shows proposed alignment of raw water transmission main. **Figure 9** shows that proposed pipeline mostly aligned along existing raw water pipeline upto WTP at Bathi.

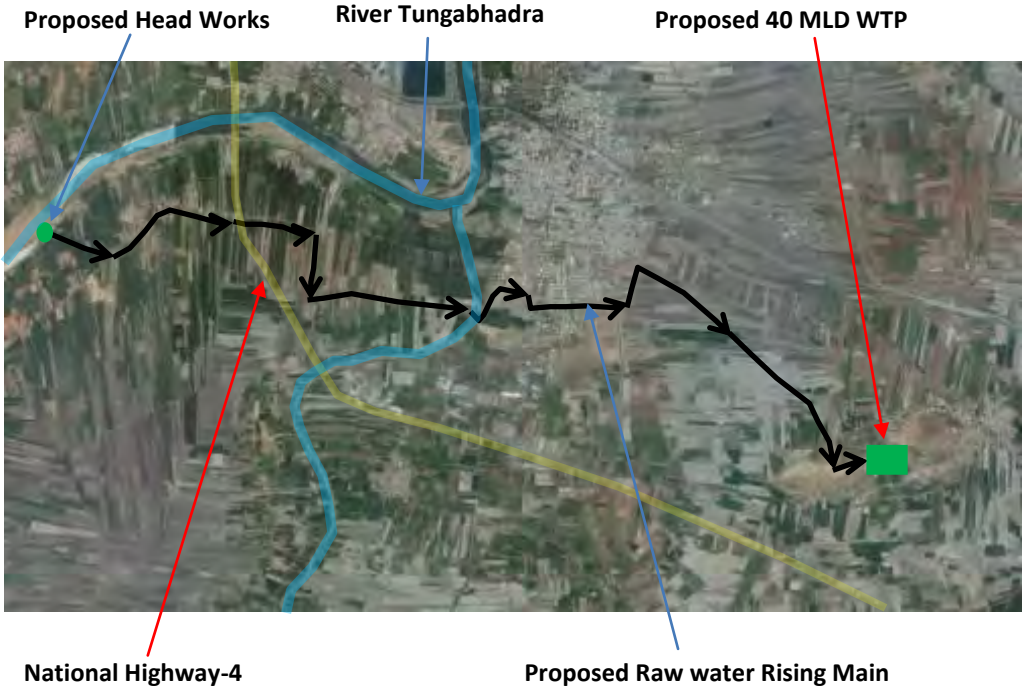


Figure8: Proposed Alignment of Raw Water Transmission Main

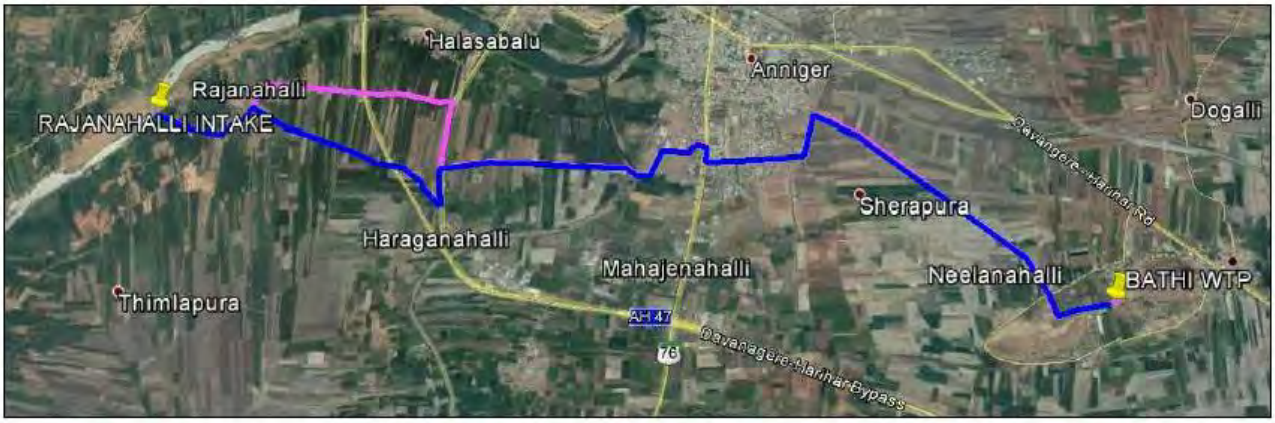


Figure 9: Raw water – existing and proposed raw water pipeline

47. Description of alignment of raw water pipeline: From Jack well (Point 1), the Proposed Pipeline passes along the existing Pipelines of 900mm dia and 700mm dia up to Rajanahalli Village (Point 2).

48. From Rajanahalli Village, the existing pipelines are laid in the pipeline road whereas the proposed Pipeline Passes through Rajanahalli Village up to PB Road (Point 3).

49. From this point, the Proposed Pipeline passes along the existing 700mm dia DI Pipeline on minor Irrigation road up to SulekereHalla(Point 4).

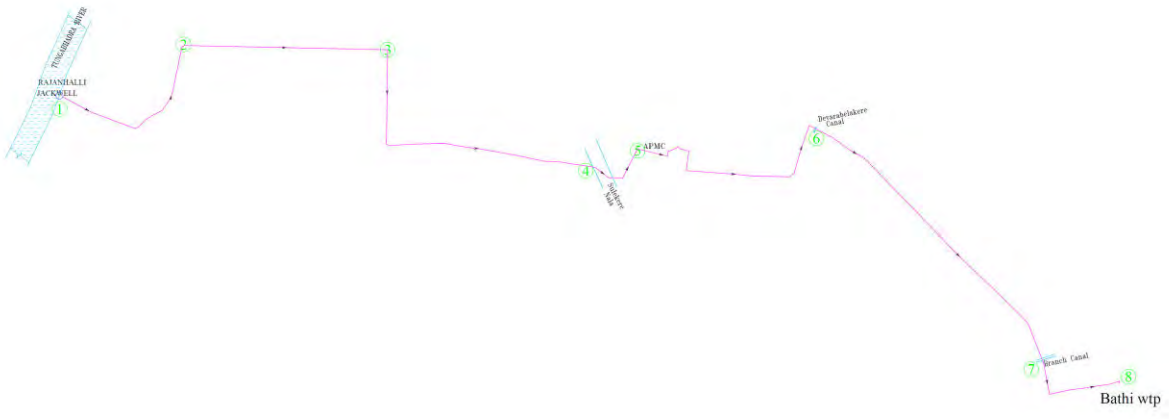
50. To Cross the SulekereHalla(Point 4), another Pipe carrying bridge is constructed parallel to the existing bridge for a length of 150m.

51. From here, the Proposed Pipeline Passes along Existing Pipeline besides APMC up to HariharaShimoga PWD Road (Point 5). The Pipeline has to cross HariharaShimoga PWD Road and needs to be laid in Harihara Municipality in Vidyanagara Main road up to Devarabelekere Canal in Prashantnagara (Point 6) along existing Pipeline in Minor Irrigation road. The Pipeline has to cross the canal for 12.5m.

52. From here, the Pipeline will be laid in minor Irrigation road along the Existing 700mm dia Pipeline up to Devarabelekere Branch Canal (Point 7). The Pipeline has to cross the Canal for 5m.

53. From this point, the Pipeline is laid up to WTP (Point 8) along the existing 700mm dia Pipeline.

54. All reference points are included in the figure below



River, Nallaha and Highway Crossings

55. The proposed raw water transmission lines need to cross canal, local ***nallah,*** National highway etc. at different locations.

Nallaha/Canal Crossings

56. Suitable pipe bridges will be provided at the locations where the proposed raw water transmission main will cross nallah/Canal. The bottom level of the pipe will be kept above the maximum water level in the water course. Below figure shows canal and nallaha crossing.

57. Details of the nallaha and canal crossing given in Table below.

Location chainage	**Location name**	**Name of the nallah/ canal**
Chainage -- 6370 to 6520 m	Near APMC wet well	Sulekere***nallaha***
Chainage 9260- 9272 m	Prasanthnagar, Sugar factory road crossing	Devarabelekere canal
Chainage 12500 – 12505 m	Near sugar factory Bathi	Devarabelekere branch canal

58. Location photo and Google map at canal and nallaha crossing is shown below.

Sulekerenallaha at APMC, chainage --6370 to 6520 m

Devarabelekere canal at sugar factory road, Prasanth nagar canal crossing, chainage – 9260- 9272 m

Devarabelekere canal near sugar factory Bathi, chainage- 12500 – 12505 m

Figure 10: Canal and Nallaha crossing – raw water transmission route

National Highway Crossing

59. The proposed raw water transmission main will have to cross the National Highway at two locations i.e. one near Rajanahalli underpass and the other will be near old bypass. Wherever such crossings are necessary and cut & cover method for pipeline is not possible considering importance of the road, Jack Pushing technology is proposed to be adopted.

Other Road Crossings

60. Municipal road crossings shall be done with open excavation. Minimum cover over the pipes at such crossings shall not be less than 1.0m. For roads with heavy traffic, the cushion above the pipe top may be increased to 1.5m.

Road Side Drain Crossings

61. The clear water transmission mains need to cross the road side drains at number of places. In general the width of the road side drains varies from 1.0 to 1.5m. The pipelines are proposed to be laid with pipe top about 0.45m below the drain foundation/ invert level. Excavation below the drain shall be done by carving/ caving method just adequate to push the pipe through. Alternatively, the drain section may be dismantled to facilitate laying of pipe and immediately restored to their original sections.

62. **Statutory Clearance.** There is major National Highway (NH-4), PWD roads etc. running through the entire Davangere city limit. There is one National Highway crossing for 1100 mm raw water transmission main of length 100 m which needs permission from National Highway Authority of India.

63. Similarly there are two PWD road crossing for 1100 mm raw water transmission main of length 0.8Km and 0.2 Km respectively for which permission will be required from State PWD. Apart from the above there are few other permission required from

different departs like Rajanahalli Grampanchayat, APMC, Harihara CMC, Minor irrigation department, Major irrigation department etc.. A proper statutory clearance is to obtain from the above mentioned Authorities.

Permission required from National Highway for Crossing of raw water main at 14°30'30.98"N&75°46'19.13"E

Permission required for laying of raw water main along the PWD road and crossing at 14°30'0.81"N&75°46'48.64"E.

Permission required from Major irrigation, APMC and PWD road for crossing of raw water main at 14°29'54.33"N&75°47'58.24"E.

Water Treatment Plant

64. After analysing the demand for clear water with the existing WTP capacity, it was found that there is a shortfall of 9 MLD in the present year considering 19 MLD WTP at TV station to be discarded and 40 MLD in the intermediate design year. Hence a new WTP of 40 MLD capacity is proposed near the existing WTP at Bathi.

65. The location of 40 MLD WTP is proposed to be near the existing 60 MLD WT at Bathi. The total area of land available with Davangere CC at Bathi is 3 Ha of which 1.6 Ha of land is utilized for the existing 60 MLD WTP. The total area required for the proposed 40 MLD is 0.8 Ha and rest 0.6 Ha is sufficient for the water demand of additional 40 MLD since several units of proposed 40 MLD has been designed for 80 MLD like cascade aerator, flash mixer etc..

Proposed Units within the Water Treatment Plant

66. The water treatment technology to be used is proposed to be of conventional type consisting of the unit processes viz. coagulation, flocculation, clarification and filtration, followed by disinfection. Schematic representation of the proposed water treatment technology to be adopted is given below:

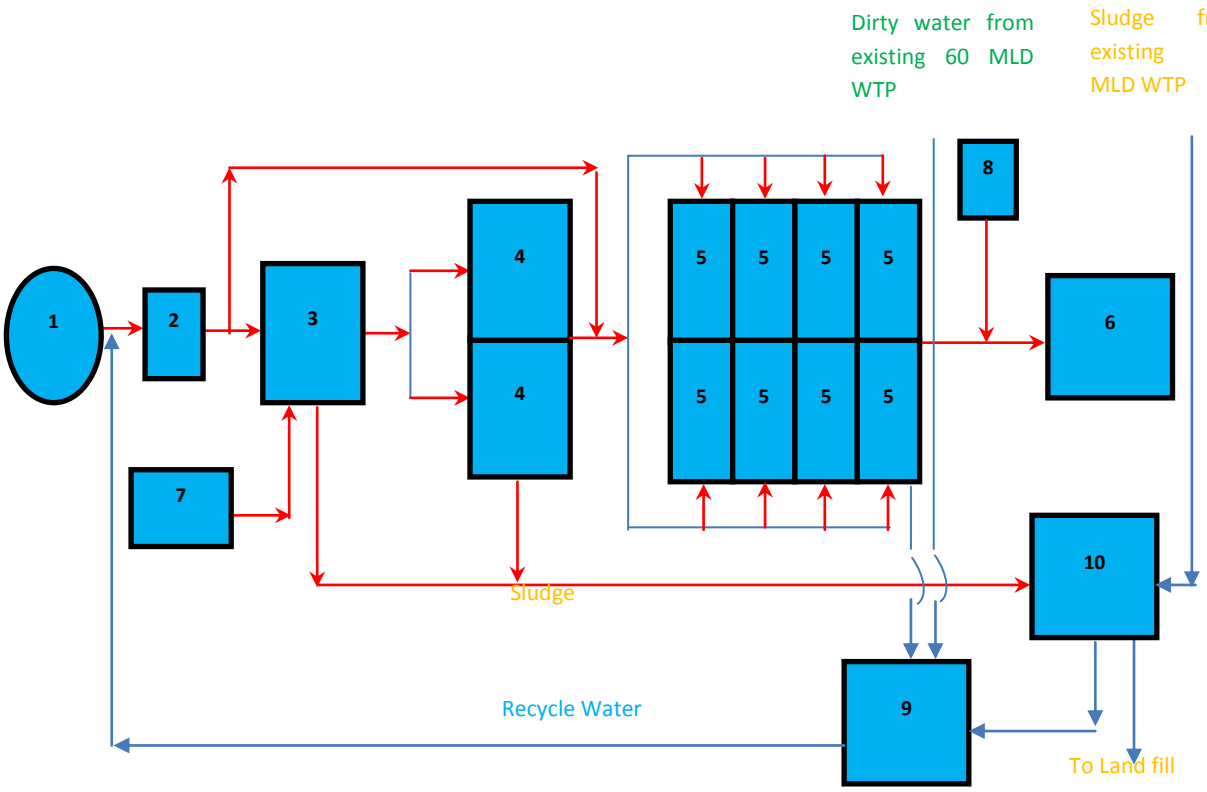


Figure 11: Schematic diagram of proposed 40 MLD WTP at Bathi

67. Location map of proposed WTP is given below


Figure 12: Location of WTP in Google map and Picture

68. The Major units envisaged in WTP are given below:

- Cascade Aerator with Parshall flume including approach channel
- Flash mixers
- Flocculator
- Plate Settler-2 No's
- Rapid Sand Filter with 8 No's Twin Bed.
- Clear Water Reservoir
- Chemical House
- Chlorine House
- Dirty Water Tank
- Centrifuge

69. The proposed 40 MLD WTP is suitably design for the recycle of back wash dirty water and sludge management system by considering the additional load from the existing 60 MLD WTP.

70. The detail of major equipment proposed in the laboratory for the proposed 40 MLD WTP are:-

- Chloroscope- 1 no.
- pH Meter- 1 no.
- Digital display Nephelometric turbidity meter- 1 no.
- Digital display Conductivity meter – 1 no.
- Stainless steel, electrically operated water still of 4 litres capacity- 1 no.
- Hot Air oven with thermostat with SS inner Chamber 45 x 45x 45 Cm.
- Magnetic stirrers with hot plate 2 litres – 1 no.
- Analytical Electronic Balance of (0.01 gm-600 gm) - 1 no.
- Flocculator -6 Jar Apparatus- 1 no.
- Bacteriological incubator with thermostat with SS inner Chamber 45 x 45x 60 Cm – 1 no.
- Refrigerator (Single door -165 ltr. to 200 ltr.)- 1 no.

71. Operation philosophy of water treatment plant is shown in **Appendix 6.** The existing WTP at Bathi does not have any sludge management system. Hence effective sludge disposal system will be made within the proposed 40 MLD WTP which will be synchronized with the existing one. Effort will be made to recycle wastewater of WTP from various outlet points within the WTP complex. Details are discussed in **Appendix 6.**Chlorination system for disinfection is discussed under operation philosophy. 80 kg chlorine will be utilized per day for disinfection at the rate of 2 mg/ L.

72. Layout plan for headwork and Water Treatment Plant are enclosed in **Figure14 and 15** respectively.

Clear Water reservoir, Pumping Station and clear water main

73. The proposed clear water reservoir is designed for 80 MLD for the year 2046 due to space constrains. A detail mass curve analysis was carried out to estimate the capacity of the tank and it was found that the capacity of the reservoir is 2 ML and which is square shape.

74. The proposed reservoir will act as balancing reservoir and from this reservoir clear water will be pumped to the existing 1.5 ML GLSR at Bathi hill. Economical analysis of the carried out to select the diameter of clear water pumping main. Due to undulating terrain of the clear water pumping main alignment, Mild steel pipe has been adopted for its ease in laying in such terrains. Pipeline alignment is passing through vacant land upto hillock clear water reservoir. **Figure 13**shows clear water main alignment from WTP to GLSR at Bathi hill.

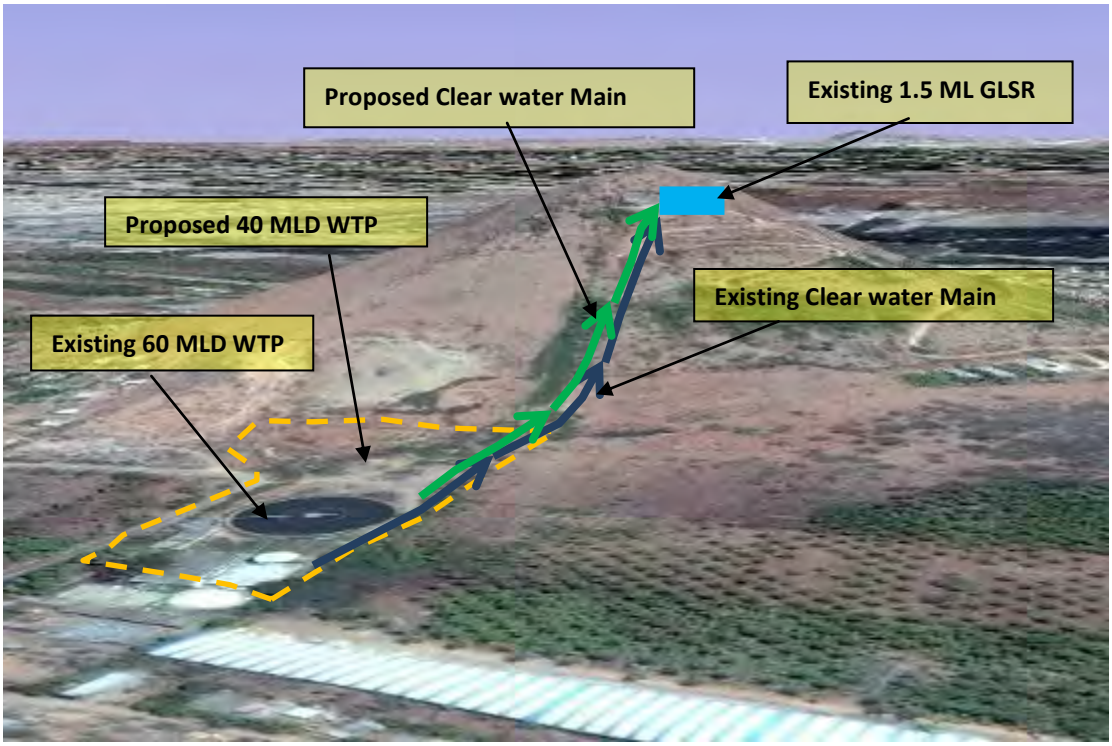
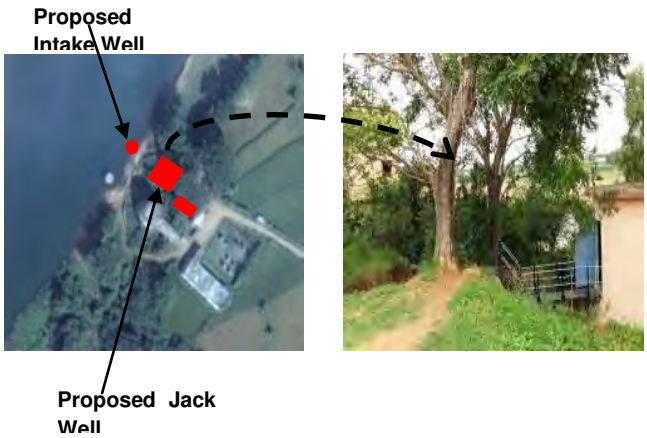


Figure 13: Proposed alignment of clear water pumping main

75. Length of the Clear water rising main is 600 m with MS pipe of 1118 mm (OD)

76. Summary of proposed work components are shown in **Table 7** below.

Table 7: Proposed Subproject Components

Infrastructure	Function	Description	Location
River head works – intake & jack well near Tungabhadra	Draw water from river and provide pumping energy to convey raw water to WTP.	Intake well: 9 m diameter & 7.0m height. Jack well: 10 m dia& 24.13m height. 3 nos. vertical turbine pumps (2 working + 1 standby) Each capacity 1000 m3/hr. with 88m dynamic head	Tungabhadra river left bank at Rajanahalli; intake will be constructed in the river, and jack well on the bank.Pumps will be installed in jack well 
Raw water main	Convey raw water from intake to WTP	13.4 km length 1100 mm diameter ductile iron (DI) pipe	Pipeline will be laid from Rajanahalli Jack well to Bathi WTPalong the following existing roads within the right of way: Rajanahalli road, National Highway 4, village road towards APMC Harihara, Vidyanagara main road (Harihara) and Bathi road. Pipeline crosses Sulekere nallaha. A bridge will be constructed over nallah for laying the pipe.
WTP and clear water reservoir within WTP	Treatment of water to meet drinking water standards	40 MLD capacity Treatment process: conventional type with coagulation, flocculation, clarification and filtration, followed by disinfection Clear water reservoir (2	WTP and clear water reservoir will be constructed within the existing WTP campus located in the outskirts at Bathi Village. Sufficient land is available to accommodate the new WTP.

		ML) Back wash recirculation system Sludge collection, drying and disposal Water quality testing laboratory	
Clear water transmission main	Convey treated water from WTP to service reservoir for supply	612 m MS pipe of 1118 mm diameter	Pipe will be laid along Bathi Hillock besides existing pipelinefrom WTP to existing GLSR on Bathi hill. Pipe will be laid along the hill face from the ground to hill top

D. IMPLEMENTATION SCHEDULE

77. As per the suggested schedule, preparation of detailed project report and bids for this subproject commenced in 2016-17. After bid invitation and evaluation, contract is likely to be awarded in April 2017. The construction is likely to start on May 2017, and should be completed in 27 months. The Operation and Maintenance period is for 5 years. The tentative schedule proposed is given in below:

Completion of DPR	-	November 2016
Tender issue	-	December 2016
Contract Award	-	April 2017
Commencement of work	-	May 2017
Completion of work	-	August 2019
O & M Period(5 Years)	-	After September 2019 (Operator)

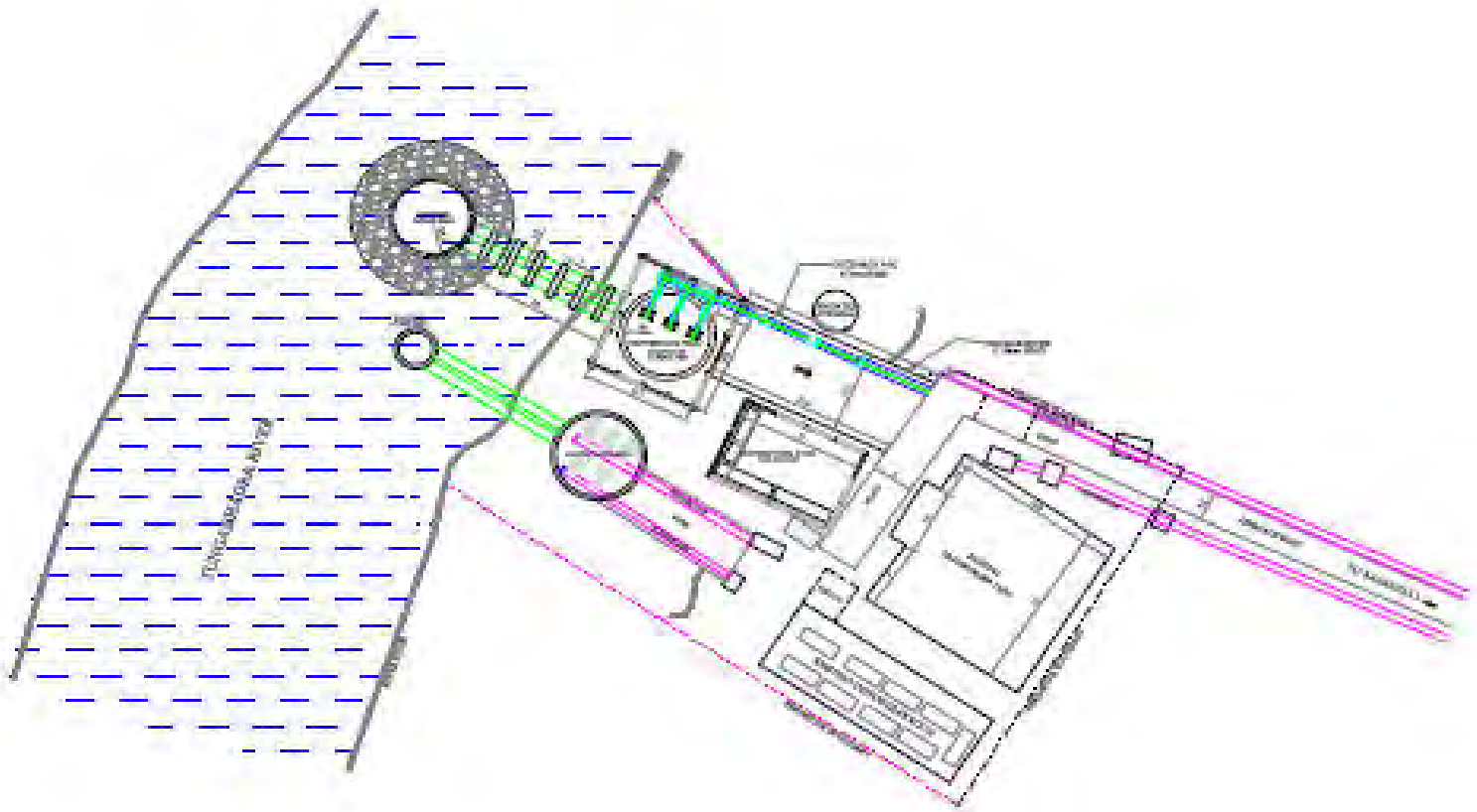


Figure 14: Layout plan of headwork for Davangere

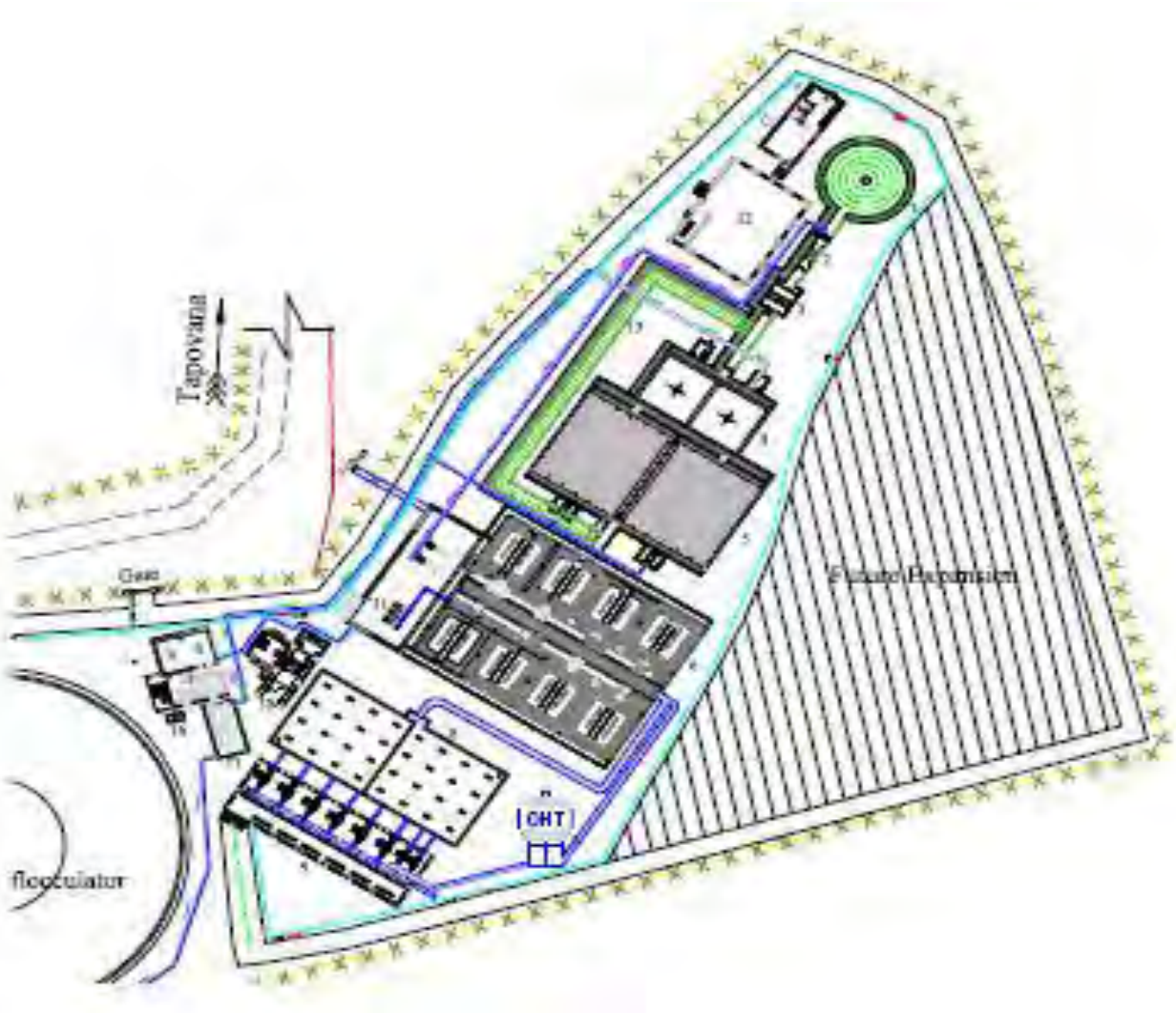


Figure 15: Layout plan from proposed WTP

III. Description of the environment

A. Environmental Profile of Davangere

Location

78. Geographically, Davangere city is located at latitude of 14°28′ N and longitude of 75°59′E, at an average altitude of 602.5 m above the mean sea level (MSL). It is the headquarter town of Davangere District, and is located at about 260 km from Bangalore. Davangere is primarily an educational and commercial centre for the vast hinterland. It is located on the main trade route that connects northern part of the country to the southern peninsula. Extending to an area of 66.08 sq km, the town's population is 435,128. National Highway No. 4 (NH 4) connecting Bangalore – Pune/ Mumbai passes through the City.

Topography, Soil & Geology

79. Situated in the Deccan Plateau and close to River Tungabadhra (15 km), the topography of the town is almost flat and slopes gently towards north and west. The north eastern and south eastern part of the city drains towards north, to Beturhalla, whereas the western and south western part drains towards west to Bathi Tank. Red and black cotton soils are predominant in the region, which favours the growth of cotton, paddy and oil seeds. Red Sandy soil comprises of red loams, red sandy, sandy loams and medium black soils.

80. Predominant geological formation in the region consists of Granites, Gneiss & Schist. As per the seismic zoning map of India, Davangere City falls under Zone II, which is the lowest earth quake risk zone in India. This zone is termed as "low damage risk zone".

Climate

81. Davangere enjoys semi-arid climate, dryness in the major part of the year and hot summer. In general, southwest monsoon contributes 58% of total rainfall and northeast monsoon contributes 22% rainfall. The remaining 20% rainfall is received as sporadic rains in summer months. It receives low to moderate rainfall. The district falls under central dry agro-climatic zone of the Karnataka state and is categorized as drought prone. Normal climatic parameters of Davangere are increasing temperature from March to May, usually maximum in May month and minimum temperature that is coldest month during month of December.

82. The normal annual rainfall is 680 mm. However in the last decade (1996-2005) the average rainfall was just 589 mm much below the long term average. Year 2003 was the worst rainfall year, receiving just 388.6 mm.

83. The temperature varies between 35^{O}C to 38^{O}C during summer and 16^{O}C to 20^{O}C during winter. The hot summer season starts in early March and last till the beginning of June when the district comes under the influence of southwest monsoon.

Figure 16: Average Monthly Rainfall & Temperature in Davangere

Air Quality and Noise Level

84. The major sources of sound pollution in the city are from the vehicles. Karnataka State Pollution Control Board (KSPCB) monitors air and noise pollution in the State in line with Air (Prevention and Control of Pollution) Act, 1981. KSPCB have monitoring stations located at various places across the state; however covers major cities, and industrial locations. There are no regular monitoring stations in Davangere.

85. Dust pollution in the city appears to be high, especially in areas such as Azad Nagar and Mandakki Bhatti due to presence of puffed rice factories and movement heavy goods vehicles and traffic. Poor quality roads and dry weather is compounding the dust problem in the city. As per a report of KSPCB (2005-06), suspended particulate matter (SPM) and respirable suspended particulate matter (RSPM) in the ambient air is well above the permissible (SPM value of 280 µg/m^3 along the main corridor of the tow – PB Road. National Ambient Air Quality Standard is given in **Appendix 2.**

86. Location of bulk water supply project components intake- jack well and WTP are located at open area no chance of air and noise pollution. Even transmission main pipeline will pass though vacant part (edge of the road). Before starting of construction base line data will be generated.

Surface Water

87. There are no notable rivers and streams in and around the city. Tungabhadra River flows at a distance of 15 km from the town. Kunduwada kere (lake) situated in the south western part of the town is an important water body in the town. This is one of the water supply sources to the city besides river Tungabhadra. Bathi tank is a small lake in the western part. Located on the downstream side of Kunduwada lake, this tank receives outflow from Kunduwada, and the sewage/wastewater from western part of the city. Presently, a wastewater treatment plant is under construction near Bathi tank to treat the sewage from eastern parts of the town.

88. Besides these, there are irrigation channels outside the city, originating from a reservoir at Budihal, about 15 km southwest of the town.

89. Water quality monitoring of Tungabhadra River is conducted by Karnataka State Pollution Control Board (KSPCB) in Karnataka. The Tungabhadra water quality is classified as Category C "Drinking water source after conventional treatment and disinfection". Following table shows the water quality of the river near intake location.

Table 8: Tungabhadra River Water Quality

Parameters	Waterqualitycrite		Kudli	Honnal	Haralahal	Ullanu
			u/sof	Harihar	d/sof	Harihar
		Min	25.0	22.0	22.0	26.0
Temp,oC	-	Max	27.0	32.0	32.0	31.0
		Mean	26.0	25.5	25.1	28.0
		Min	5.2	7.3	7.	6.0
DO,mg/l	>4mg/l	Max	7.0	7.5	7.	8.0
		Mean	6.0	7.4	7.	7.2
		Min	7.5	7.3	7.	7.6
pH	6.5–8.5	Max	8.3	8.2	8.	8.4
		Mean	8.0	7.9	8.	7.9
		Min	116	120	136	270
Conductivity,µmhos/	<2250	Max	400	500	560	1240
		Mean	259	330	381	847
		Min	2.3	1.2	1.	1.7
BOD,mg/l	<3mg/l	Max	3.1	3.4	3.	5.2
		Mean	2.7	2.6	2.	3.1
		Min	0.21	0.08	0.	0.2
Nitrate,mg/l	-	Max	0.54	0.7	0.63	1.4
		Mean	0.33	0.33	0.36	0.54
		Min	-	-	-	-
Nitrite,mg/l	-	Max	-	-	-	-
		Mean	-	-	-	-
	<2500MPN/100ml	Min	80	30	40	1100
FeacalColiform,MPN		Max	240	170	170	9000
		Mean	155	114	82	6872
	<5000MPN/100ml	Min	110	50	60	2200
TotalColiform,MPN		Max	3000	2220	1300	16000
		Mean	1928	1176	932	13109

Source: PHED data source 2013

90. River water quality at Harihar, near proposed intake has been studied by B. Suresh (2015). Results of analyses shown in **Table 9** below. Quality of river water is suitable for use as drinking water after conventional treatment.

Table 9: Average values of physical-chemical parameters at 4 stations of Tungabhadra River from May 2008 to April 2009

Sl. No	Parameters	Station S1	Station S2	Station S3	Station S4
1	Temperature, ^{0}C	29.00	28.50	30.00	29.50
2	pH	8.10	7.98	7.57	7.86

Sl. No	Parameters	Station S1	Station S2	Station S3	Station S4
3	Turbidity, NTU	5.00	10.00	18.00	8.00
4	Electrical Conductivity µmohs/cm	235.04	332.23	595.76	294.60
5	Dissolved Oxygen, mg/l	8.10	7.70	6.80	7.60
6	Biological Oxygen Demand, mg/l	5.28	4.50	4.80	5.10
7	Chemical Oxygen Demand, mg/l	66.92	81.33	186.42	94.50
8	Nitrates, mg/l	8.46	4.86	9.00	2.71
9	Chlorides, mg/l	35.22	45.94	146.94	51.00
10	Sulphates, mg/l	7.67	9.25	14.82	8.45
11	Total Dissolved Solids, mg/l	129.27	199.32	357.45	162.03
12	Phosphates, mg/l	0.46	0.68	1.13	0.56
13	Total hardness as $CaCo_3$,mg/l	83.75	80.58	89.42	97.00
14	Calcium as Ca,mg/l	52.70	580.00	141.40	50.00
15	Magnesium as Mg,mg/l	31.00	36.00	48.00	47.00

Station(S_1): The site of this habitat is located at the upstream of Harihara city before the river enters into city., **Station(S_2):**This station is located on the main stream of river Tungabha drain a place just near the confluence point of Sulekere stream(Tributary), **Station(S_3):**This station is located at the downstream of Harihara Polyfibers effluent discharge (near Harlapura), **Station (S_4):**This sampling station is located about 2km away from confluence point (S_2)

B. Suresh (2015) Multiplicity of phytoplankton diversity in Tungabhadra River near Harihar, Karnataka (India)
International Journal of Current Microbiology and Applied Sciences ISSN: 2319-7706 Volume 4 Number 2 (2015) pp. 1077-1085**http://www.ijcmas.com**

Ground Water

91. In Davangere fractured granitic-gneisses, gneisses and hornblende-schists are the main water bearing formations. Ground water occurs within the weathered and fractured rocks under water-table conditions and semi-confined conditions. Aquifers are encountered between the depths of 8.46 and 32 m below ground level (bgl). Bore wells are drilled from a minimum depth of 35 to a maximum of 200 m bgl. Depth of weathered zone ranges from 5.5 mbgl to 30 mbgl. Yield ranges from 1.5 to 4.0 lps. Transmissivity ranges from 5.27 to 110.67 m^2/day. Specific capacity ranges from 4.54 to 36.0 lpm draw down. The main source of ground water occurring in the district is through precipitation

and return flow from applied irrigation. During May 2006 (pre-monsoon season) the minimum and maximum depth to water level was 4.28 mbgl and 7.65 m bgl respectively. During November 2006 (post-monsoon) water level ranged from 5.30 m bgl to 10.20 m bgl. Although overall groundwater development in DavangereTaluk is 61%, major parts including Davangere City fall under over exploited category (Central Ground Water Board, 2008).

92. The Ground Water Quality in the district is generally potable and suitable for irrigation and domestic purposes. Electrical conductivity of ground water in general ranges from 584 to 2720 micro mhos /cm at 25 °C. Fluoride ranges from 0.2mg/l to 2.41 mg/l. Nitrate ranges from 10 to 352 mg/l.

Table 10: Groundwater Water Development in Davangere City

Particulars	Details (in hectare meter)
Net annual ground water availability	10576.79
Existing gross ground water draft for all uses	6439.13
Allocation for domestic and industrial use for next 25 years	1032.85
Net ground water availability for future irrigation development	4827.88
Balance ground water irrigation potential available (ha)	5905.66

B. Ecological Resources

93. Davangere is an urban area surrounded by land that was converted for agricultural use many years ago. There are no forest areas within or near Davangere. Owing to fertile lands and availability of irrigation facilities, the land around the city is extensively cultivated. The outer areas within the CC limits also under cultivation.

94. There are 2 trees located at headwork area, which need to fell. Intake, Jack well, raw water main and WTP are located at village environment. Other than intake- jack well there will be no impact on terrestrial ecology.

C. Economic Development

Land Use

95. Davangere/Harihar Urban Development Authority (DHUDA) has formulated a development plan for Davangere outlining the land-use pattern up to the year 2021. The area usage under the suggested Land Use pattern in the City is presented below.

Table 11:Proposed Land Use for Davangere

Land-Use Pattern	Area (Km^2)	Percentage Use
Residential	27.80	45.08%
Commercial	2.90	4.70%
Industrial	6.37	10.33%

Land-Use Pattern	Area (Km^2)	Percentage Use
Public & Semi-Public	4.18	6.78%
Parks, Play-ground and Open Space	5.34	8.66%
Public Utilities	0.46	0.74%
Transport and Communication	12.95	21.04%
Water Shed	1.65	2.68%
Total	**61.65**	

Industry & Agriculture

96. Until recently the city was known as the "Manchester of Karnataka" because of its many cotton mills and supporting trades and businesses. Although these mills contributed to the industrial and commercial development of the city many of them were closed in the 1990's. Currently, the major agro-industrial activity in Davangere revolves around rice and sugarcane, with a number of rice mills and sugar mills in and around the city. There are vast agriculturally rich lands around the town, cultivated by Tungabhadra water. Sugar cane, paddy, jowar and cotton are the major crops grown in and around Davangere,

97. There is an industrial estate in Davangere developed by Karnataka Small Scale Industries Development Corporation (KSSIDC) and spread over an area of 19.35 acres. 14 units are working in this area and are mostly engineering fabrication units. There is another industrial area on Lokikere road, developed by Karnataka Industrial Area Development Board (KIADB), spread over 93.08 acres with 52 working units at present. The industrial mix is mainly engineering, fabrication and garment making. Besides these there are few rice, sugar industries and distilleries in and around the city.

98. Davangere has a large Agriculture Produce Marketing Committee (APMC) yard that caters to the surrounding cities/ towns and villages which mainly deals with cotton, paddy and oil seeds. Due to good connectivity by roads and railway line with other parts of the region, it has become a focal point for trade and commerce.

Infrastructure

99. **Water Supply.** Currently water supply within Davangere is intermittent and varies across the town. The reported duration and frequency is 1-2 hours every 3 days. The current per capita volume made available to customers is assessed at 86litres/head/day, compared with the norm of 135litres/head/day. Tungabhadra River and Kunduwada Lake are the main sources of water supply to the town

100. **Sewerage and Sanitation.** Davangere is partially covered with underground sewerage – this old system covers about 25% of the city in the central part. The sewerage system in Davangere is divided into three major districts 1, 2 & 3 and a smaller sub-district 1A. This existing sewerage system is mostly in District1 and District 2, coverage in District 3 is very limited. Under NKUSIP, it is proposed to improve the sewerage system in District 1 including the treatment works. However, due to lack of adequate funds, the project will not cover entire District 1. The capacity of the existing wastewater treatment plant (WWTP) is 19.45 MLD (stabilization pond based).

101. **Storm Water Drainage**. Due to the absence of a properly functioning sewerage system, the open drains are mostly catering to wastewater except during monsoon which carries both wastewater and surface runoff. These open drains dispose waste into Bathi Tank in the west, BeturNala in the east and Avaragere Lake in the southeast.

102. **Transportation.** The National Highway No. 4 connecting Bangalore and Pune/Mumbai is the major regional road running in the midst of the city. The city has direct rail connectivity with a broad gauge line connecting Bangalore–Hubli/Mumbai. This railway line contributes a major share in passenger and goods transportation. With a total length of over 1000 km, internal road network in the city is well developed, however are not in good in condition. Most of the roads in the central part are congested.

103. **Power Supply**. Hydal power is the main source of energy in Karnataka, with 61% of total installed capacity. Remaining is mostly from thermal power stations. Contribution of wind and solar energy, although increasing, is negligible. Government run Karnataka Power Corporation Limited (KPCL) is responsible for power generation while Karnataka Power Transmission Corporation Limited (KPTCL) is responsible for power transmission. The distribution to users in Davangere is provided by regional company – Bangalore Electricity Supply Company Limited. 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 in Davangere is poor; there are frequent outages in warmer months, and fluctuations in voltage.

D. Socio Cultural Resources

104. **Demography.** During the last decade the population of Davangere City had increased from 363,780 in 2001 to 435,128 in 2011 indicating a decadal growth rate of 19.6 percent. This growth is much less than the last decadal growth rate of 26.6%.

Table 12:Population Growth of Davangere City

Year	Population	Decadal Growth Rate
	Nos.	%
1991	287,233	-
2001	363,780	26.6
2011	435,128	19.6

105. **Sex Ratio**. The sex ratio (female population per 1,000 of male population) in Davangere City, as per 2011 census, is 972, which is lower than the district and state urban average figures of 975 and 973 respectively.

106. **Literacy.** The literacy rate of the city is 84.89 percent (2011 census). Largest proportion of population comprises Hindus followed by Muslims and then Christians. Almost all speak in Kannada followed by Hindi.

107. **History, Culture & Tourism**. Davangere was originally a small village, forming one of the suburbs of Betur. Sultan Haiderali gave it as jagir to a Maratha chief named Apoji Ram, who encouraged merchants to settle there. While Appoji Ram died without heirs, the place continued to grow, favoured by Tippu Sultan. After the fall of

Tippusultan's regime, a European firm stepped in and started a cotton mill. These mills flourished as cotton was grown in plenty, in and around Davangere, as well as the adjacent town of Harihar. Climatic conditions and the nature of the soil (black gypsum) favoured its growth. Davangere Cotton Mills is a well-known name in the region.

108. City has some locally important religious places. Durgambika Temple, said to be around 200 years old, attracts good number of devotees throughout the year. Subramanya Temple is another important temple in the City. Kundavada Lake, Sulekere Lake and Bathi Gudda (hill) are the local tourist spots.

109. Majority of people in Davanagere are Hindus and the remain are mainly Muslims and Jains. Kannada is the native language. A good proportion can speak Hindi and a few can converse in English.

E. Environmental Settings of Investment Program Component Sites

110. There are no significant environmental sensitive features in the proposed area. The proposed components are not expected to cause any long term or major environmental impacts. Headwork area and WTP location is vacant, mostly agricultural land nearby. Only 2 trees are located at head work area, which need to be fallen.

Table 13:Project Site Environmental Features

Infrastructure	Location & Environmental Features	Site Photographs
Head works (Intake & jack well)	Intake well will be constructed within Tungabhadra river near the existing well near to its left bank at Rajanahalli. Jackwell cum pump house will be constructed on left bank of the river. Bushes and some trees need to be cut for the construction of Jackwell There is no sensitive area near the proposed Jackwell. The location is far away from the Rajanahalli village. During construction no as such environment impact is expected. There are four notable water abstraction points in Tungabhadra River upstream (u/s) and downstream (d/s) of the intake point. Ranebennur/Byadgi	

Infrastructure	Location & Environmental Features	Site Photographs
	intake is 8 km upstream, and in the d/s there are 4 intakes within 10 km: • at Makanur (1.24 km d/s); intake for surrounding villages • at Kavalettu (3 km d/s); intake for Harihara town • at Kumarapatnam (7.6 km d/s) intake for Polyfibre Industry There are no notable pollution sources near the intake. There are no wastewater disposal points in the upstream vicinity of the intake. Water quality of river is suitable for supply after conventional treatment.	
Raw water main	From head works to WTP site at Bathi; 1100 mm dia DI pipes of length 13.4km Raw water transmission lines needs to cross canal, nallaha and National highway. Most of the section of new pipeline will be passing through existing raw water transmission line upto Bathi. These all are discussed in section II along with representation in Google map Out of the 13.4 km pipeline 1.1 km will be passes through Rajanahalli village along the road. About 2.3 km of pipeline will be passes through semi urban area of APMC Vidhyanagar, along the road. Land use status visualized as mostly agricultural – cultivated or fallow about 70%. About 10% is vacant barren or permanent fallow land, 1-2% water body, 1-2% plantation area, rest 15-18%	 Just after intake passing through agricultural land  Passing through Rajanahalli village

Infrastructure	Location & Environmental Features	Site Photographs
	village and semi urban area. There is no sensitive and archeological protected area nearby the pipeline alignment. Tress are there along the alignment but sufficient ROW is available, therefore, it is expected that no trees need to be fell for laying of the pipe. Section II of the present report shows map of pipeline indicating cultivated land, plantation, vacant land and habitation areas.	 Passing through Rajanahalli village  Passing below Road bridge  Crossing nallaha at APMC  Passing through semi urban area of Vidhyanagar  Passing through semi urban area of Vidhyanagar

Infrastructure	Location & Environmental Features	Site Photographs
		 Canal crossing  Passing through vacant area  Agricultural land besides  Canal crossing near sugar factory  On the way to Bathi WTP- vacant land

Infrastructure	Location & Environmental Features	Site Photographs
Water Treatment Plant	New WTP including the clear water reservoir will be constructed within the existing WTP campus at Bathi. Sufficient land for the new WTP and clear water reservoir is available. Site is presently vacant, and there is no notable tree cover; site is surrounded by agricultural lands. There is no habilitation nearby. The site is situated about 1 km away from the village.	 Existing WTP at Bathi  Proposed WTP location – vacant land
Clear water pumping main	Clear water pumping main is proposed from WTP to Bathi Hillock GLSR besides the existing pipeline. 612 m MS pipe of 1118 mm diameter is planned to carry treated water. Pipeline alignment is totally vacant land. No village residence and sensitive area nearby. There will be no environmental impact expected.	 Vacant land from Bathi WTP to clear water reservoir at Bathi hill  Vacant land from Bathi WTP to clear water reservoir at Bathi hill

Infrastructure	Location & Environmental Features	Site Photographs
		 Hilly area towards reservoir  Proposed pipeline alignment along existing pipeline

IV.SCREENING OF POTENTIAL Environmental Impacts & Mitigation Measures

A. INTRODUCTION

111. 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.

112. As a general practice, an IEE should evaluate impacts due to the location, design, construction and operation of the project. Construction and operation are the two activities in which the project interacts physically with the environment, so these are the two activities during which the environmental impacts occur. In assessing the effects of these processes therefore, all potential impacts of the project should be identified, and mitigation is devised for any negative impacts. Following sections evaluate impacts of the proposed Water Supply project in Davangere.

i) **Location Impacts**: Includes 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 Impact**: Includes impacts arising from Investment Program Design, including technology used, scale of operation / throughput, waste production, discharge specifications, pollution sources and ancillary services.

iii) **Construction Impacts**: Includes impacts caused by site clearing, earthworks, machinery, vehicles and workers. Construction site impacts include erosion, dust, noise, traffic congestion and waste production.

iv) **O & M Impacts**: Include impacts arising from the operation and maintenance activities of the infrastructure facility. These include routine management of operational waste streams and occupational health and safety issues.

113. 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).

114. Proposed work components are construction of intake and Jack well, laying of transmission pipeline and construction of WTP. The proposed components are not falling in any environmentally sensitive area. **Table 13** above shows land use feature in and around the project locations.

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

B. Location Impact

116. Location. These Impacts are associated with planning particularly on the site selection. They include impacts due to encroaching on sensitive areas and impacts on the people who might lose their homes or livelihoods due to the development of the proposed site.

117. Proposed subproject sites are carefully selected to avoid encroachment into sensitive areas and minimise the impacts on people livelihoods and homestead. All the components in this sub project are located in government or public land and no private land is required. Most of the project locations are situated within rural environment; hence impact on urban setup is not much expected. New intake well will be constructed in River Tungabhadra near the existing intake well and new jack well will be constructed adjacent to the existing jack well on the bank of Tungabhadra near the intake well. Intake well is a small structure (Diameter 9 m), and therefore there are no significant impacts on the river due to this. Similarly, jack well will be a structure of 10 m diameter, and will be constructed near the bank of River. This site is adjacent to the existing jack well. There are few trees, shrubs and bushes, which will be cleared. There may be temporary impacts during construction; these are discussed under the construction impacts.

118. New WTP of 40 MLD will be constructed within the existing WTP campus at Bathi. Site is currently vacant and is sparsely covered with shrubs and bushes. Site is surrounded by agricultural fields. So no significant impacts are likely to WTP development at this site. Also WTP is being developed with proper green buffer further to enhance the aesthetics and to buffer the noise from running pumps and motors. Proposed raw water and clear water pipelines mostly traverse rural areas. Roads within village have sufficient ROW and no habitation close to pipe alignment, hence no major impact is expected Only during pipeline work within APMC and Vidhyanagar, some impact may be expected on semi urban set up, like, movement of vehicle, public access, temporary dust and noise impact.

119. There is no other cultural heritage sites, protected area, wetlands, or mangroves within or adjacent to the project subproject locations.

120. **Utilities.** Existing telephone lines, electric poles, and wires within the proposed subproject locations may require to be shifted in few cases, specifically at urban area. To mitigate the adverse impacts due to relocation of the utilities, IA will:

(i) Identify and include locations and operators of these utilities in the detailed design documents to prevent unnecessary disruption of services during construction phase;

(ii) Conduct detailed site surveys with the construction drawings and discuss with the respective agencies during the construction phase, before ground clearance;

(iii) Require construction contractors to prepare a contingency plan to include actions to be done in case of unintentional interruption of services. In case of disruption of water supply, alternative supply, through tankers, shall be provided.

121. The PIU has to obtain necessary clearances before starting the work. The proposed raw water transmission line will cross highways and river, which needs permission.

122. **Site selection of construction work camps, stockpile areas, storage areas, and disposal areas.** Priority is to locate these near the subproject locations. However, if it is deemed necessary to locate elsewhere, sites to be considered will not result in destruction of property, vegetation, irrigation, and drinking water supply systems. Residential areas will not be considered for setting up camps to protect the human environment (i.e., to curb accident risks, health risks due to air and water pollution and dust, and noise, and to prevent social conflicts, shortages of amenities, and crime). Extreme care will be taken to avoid disposals near the water bodies, swamps, or in areas which will inconvenience the community. All locations would be included in the design specifications and on plan drawings. Construction work camps shall be located at least 200 m from residential areas. Material stockpiles shall be protected by bunds during the monsoon to arrest the silt laden runoff into drains. The subproject is likely to generate soil from excavations, which needs to be disposed safely or utilized locally. The following measures should be considered for disposal of surplus/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 transportation.

iii) Soil transportation should not be done during peak hours and should be avoid narrow and heavy traffic routes and important religious or tourist sites etc.

123. **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 included in the design specifications and on plan drawings. Priority would be sites already permitted by Mines and Geology Department. If other sites are necessary, these would to be located away from population centers, drinking water intakes and streams, cultivable lands, and natural drainage systems; and in structurally stable areas even if some distance from construction activities.

124. For Davangere subproject, the quarry material required will be sand and stone aggregate, and the nearest quarries are at ChikkaKuruvatti, Harihar and Medleri (sand quarries along River TungaBhadra) and Chatra at Motebennur and Hunasikatte in Ranebennur Taluka for stone aggregate. These are existing quarries and are licensed by Mines and Geology Department. The material from the existing quarries will be adequate for the subproject construction, and therefore no new quarry sites will be developed for the purpose.

C. Design Impact

125. These impacts arise from the design of the subproject including the technology used, scale of operation/throughput, waste production, discharge specification, pollution sources, and ancillary services.

126. **Design of the Proposed Components**. The Central Public Health and Environmental Engineering Organization (CPHEEO) manual suggests a design period of 15/30 years[1] in general while designing the system for water supply components. Since, the packages are proposed to be implemented sequentially; theoretically, each of the system components should have a different design year.

127. However, in order to maintain unanimity in the design period and design population, it is proposed to consider 2048 as the design year for all the system components. Accordingly, 2018 shall be the base year and 2033 the intermediate year to cross check the designs pertaining to intermediate demand.

128. As per the proposed project design, the Tungabhadra River is continued to be the source of water supply to Tungabhadra, a perennial river. Water abstraction at Rajanahalli intake point of Tungabhadra River will increase from the current 80 MLD to 89 MLD (2016), 120 MLD (2031), and 160 MLD (2046) with the project development.

[1]As per CPHEEO, pumps, motors, storage reservoirs are to be designed for a life of 15 years.

129. **Water availability in the river**. River Tungabhadra is a perennial and an important river of Karnataka. This is formed north of Shimoga Town, by the union of two rivers, the Tunga and the Bhadra, which rise in the Western Ghats at an elevation of about 1200 metres. The Tunga River emerges from the hills surrounding Varaha Parvata, at a place called Ganga Mula. The river flows through seven districts in Karnataka - Chikmagalur, Shimoga, Davangere, Haveri, Chitradurga, Bellary and Raichur. The river has a dam built across it at Gajanur. After traversing a distance of 147 km long merges with the Bhadra River at Koodli at about 610 m above MSL, a small town in Shimoga District. There is a dam acrossriver Bhadra, 15 km upstream of Bhadravathi Town. Tungabhadra Dam was built across the Tungabhadra River after it traverses 265 km from the origin in Western Ghats. Then the river merges with the Krishna River in Andhra Pradesh state. It has a drainage area of 71417 km2 out of which 57671 km2 lies in Karnataka State, and the length of river in the state is 293 km.

130. River flow fluctuates between very high during monsoon months to very low during summers. Almost all the towns and villages in the basin depend on the river for water supplies. Water for Davangere is abstracted from the river at Rajanahalli,20 km from Davangere. There is no water retaining structure at this point; water is collected in a intake well in the river bed and pumped to the WTP.

131. As per the River flow and sustainability analysis provided in **Appendix 5** based on the river flow data of 2009-12, the minimum/lean flow in the river is observed in the months of April and May with a maximum flow of 4263 million litre per day (MLD) and minimum flow of 2369 MLD. The total ultimate abstraction at Rajanahalli intake will be 160 MLD. As per the river flow data available at Honnali gauge station (~50 km upstream of Rajanahalli) for the years of 2009, 2010 and 2011, river carries high flows during monsoon and least flows during the winters and summers. The lowest flow recorded in the period was in January 2011 (1436 MLD) and highest was in July 2009 (98,395 MLD). Minimum flow in 2009 was recorded in February (2268 MLD), and 2010 was in March (2083 MLD). The ultimate demand is about 7%-11% of the lowestyearly flow and about 0.2% - 0.3% of highest yearly flow recorded in that period. Therefore the river flow is sufficient to meet the demand of the project.

132. Harihara is an important town located downstream of intake point. Harihara also depends on river Tungabhadra, and its intake is about 3.5 km downstream of Rajanahalli intake. Given that nearly 90% of lowest flow goes downs, and small water requirement of Harihara compared to Davanagere, no impacts envisaged. The other downstream users are mainly village water schemes and agricultural users. Given that flow reduction is not very significant, no major impacts envisaged on the downstream flow, users or river, aquatic life.

133. Byadgi / Ranebennur intake is located upstream of Rajanahalli, while intake serving some villages, and an industry water abstraction point is located in the downstream. Polyfiber factory mainly depends on the rainy season flow- pump water from the river during rainy season and water impounded in the tank inside their premises. Based on flow datagiven in Appendix 5, the water requirement for the four towns (Davangere, Harihar, Byadgi and Ranibenur) is less than 10% of water available based on the 95% dependability. Hence there is no impact is expected on any of the existingwater intakes.

134. **River water quality.**There are no major pollution sources like industries in the upstream side of the intake at Rajanahalli. Most of the villages and towns, however, along the river discharge domestic wastewater into the river without any treatment, although there is no such disposal point in the proximity of intake. The river water quality meets the “Category C quality that make is appropriate as “Drinking water source after conventional treatment and disinfection”. A grab sample was collected from the intake and tested for pesticides residues. The results indicated that there are no pesticide residues in the raw water. The subproject includes capacity augmentation of existing water treatment plant, so the raw water will be treated to drinking water standards and supplied to the consumers.

135. **Socio-Economic:** The Water Supply system will cover entire population including the rural and semi urban / urban poor; hence there will be no disproportionate impacts on the poor, women or children. In fact, it will have positive health impact due to improved sanitation and environmental conditions.

136. **WTP**. Water treatment process generate sludge from sedimentation of particulate matter in raw water, flocculated and precipitated material resulting from chemical coagulation, residuals of excess chemical dosage, plankton etc.,; and waste from rinsing and back washing of filter media containing debris, chemical precipitates, straining of organic debris and plankton. Following are included in the subproject design to dispose the sludge and back wash from existing WTPs:

- Provision of recirculation system for backwash water – backwash water from filter beds will be re circulated to WTP inlet and mixed with raw water; this arrangement will minimize wastage of water, which otherwise would have disposed to open drains, and also avoids the pollution of receiving water body
- Provision of sludge drying – accumulated sludge from clariflocculator will be flushed to sludge drying beds, for natural drying.
- Dried sludge will be used as soil conditioner if suitable. Periodic testing of dried sludge will be conducted to ensure that it does not contain heavy metals that make it unsuitable for any beneficial use.

137. In the WTP, water will be disinfected using chlorine. There is invariably a safety risk when considerable quantities of chlorine are handled at the WTP. (Chlorine cylinders will be brought by trucks to the site, installed and operated to disinfect the water supplies). WTP is located away from inhabited areas – nearest habitation is Bathi village about 0.5 km from WTP site.

138. With the present water supply 89 MLD, about 134 kg of chlorine is consumed daily. This will increase to 268 kg per day ultimately for design year 2046. Chlorine cylinders (called tonners, with capacity about 900 kg) will be procured from nearest manufacturing unit and stored at the site. Tonners sufficient for a month will be stored in the storage.

139. To avoid any risk to workers and public, the chlorination facility at the WTP is designed / developed with all appropriate safety features and equipment to meet with any accidental eventuality, which include

- Chlorine neutralization pit with a lime slurry feeder
- Proper ventilation, lighting, entry and exit facilities
- Facility for isolation in the event of major chlorine leakage
- Personal protection and safety equipment for the operators in the chlorine plant
- Visible and audible alarm facilities to alert chlorine gas leak
- Laboratory facility shall not be housed within the chlorination facility
- Provide training to the staff in safe handling and application of chlorine; this shall be included in the contract of Chlorinator supplier
- Develop an emergency response system for events like chlorine leakage.
- Supplier of Chlorinator equipment shall provide standard operating manual for safe operation and as well as maintenance and repairs; preferably these shall be provided both in English and Kannada Languages

D. Construction Impacts

i) Construction Method

140. As detailed above, except linear components like pipes, construction activities of all other components will be confined to selected isolated sites. However, the material and waste transport to and from the site will use public roads.

141. The sequence & methodology of construction of RCC Intake Well is proposed to be as follows:

(i) Construct a coffer dam around the proposed intake well location.
(ii) After completion of coffer dam work, install a custom made sacrificial steel formwork system with minimum height of 1.0m above the LWL. Make the formwork leakage proof by sealing the joints.
(iii) Pump out the water from inside.
(iv) Install pre-fabricated reinforcement cage inside the shuttering box.
(v) Erect the inside formwork adequately supported, braced with struts & props. Tie rods to be used to maintain the wall profile.
(vi) Check reinforcement & formwork for correctness & water tightness.
(vii) Pour concrete of design grade.
(viii) Allow curing time till next step of construction and remove the earth inside the well as the work progresses
(ix) Remove formwork and fix reinforcement bars for next lift of concreting.
(x) Fix the formwork for next lift concreting
(xi) Pour concrete, allow curing time and remove formwork.
(xii) Repeat the cycle of operation till the top of well and pour concrete for plugging the bottom of the well

(xiii) Fix temporary steel brackets and beams to support the top slab of the well.

(xiv) Lay the shuttering plates, reinforcement and complete the concreting.

With this the Intake Well structure is completed.

142. Out of the total working components moderate impact will be resulted during construction of intake structure within River Tungabhadra Detail impact and mitigation will be covered in respect to,

- Impact on aquatic ecosystem due to construction of intake
- Impact on water quality- temporary turbidity during construction of intake
- Impact on river bed sediment- removal of part of sediment within intake structure.

143. Some mitigation measures may be considered, (i) install intake facilities during low flow periods and tidal stage; (ii) incorporate appropriate erosion and sediment control best management practices such as turbidity curtains, silt barriers, or silt curtains; and (iii) have an equipment spill and containment plan and appropriate materials on-site.

144. **Construction method for WTP**: These works will be conducted adjacent to existing WTP facility at Bathi. The WTP will be constructed in reinforced concrete structure and fixed with mechanical parts imported in ready-to-fix state. Most of the structure will be developed above ground except the clear water storage facility which will be constructed below the ground. Work will involve excavation for foundations, concreting, fixing of mechanical elements, finishing and fixing of electrical instrumentation items. Excavated soil will be used in the site for leveling and excess soil will be transported to disposal site. Material (sand, aggregate) will be procured from local quarries, and brought to the site on trucks and stored temporarily. Concrete will be mixed using a mixer at the site, and concrete will be transported by manual labour. The work will be conducted by a team of 50-60 workers and works will be confined to WTP facility compound.

145. Small brick rooms will be built alongside WTPs to house the chlorination plant. The foundation will be dug and aggregate and concrete poured in to create the floors, after which the brick walls and roof materials will be added by hand. Chlorine cylinders and other equipment (including flow-meters) will be brought in on trucks and offloaded and attached by hand. A small cavity for the chlorination sump and trenches for pipe-work will also be dug, and the sump will constructed from concrete and brick.

146. Although construction of the pipelines involves quite simple techniques of civil works, the invasive nature of excavation will result to impacts to the sensitive receptors of sub project locations such as residents, business and community in general. Since most of the locations of pipe laying area within rural environment and vacant area with sufficient ROW, expected impact will be much less. In compared to urban set up.

147. The pipe line has to cross nallaha or water bodies, it must be ensured that the natural course and geometry of the water bodies are not affected due to the construction work and pipe laying works. The construction works should be ideally scheduled during the dry periods.

148. These anticipated impacts are temporary and for short duration. Physical impacts will be reduced by the method of working and scheduling of work, whereby the project components will be (i) constructed by small teams working at a time; (ii) any excavation done near sensitive area like school, religious places and house will be protected as per standard construction practices. These are discussed in detail in the following sections.

149. Prior to starting of work, the contractor should prepare a method statement for pipeline, WTP and intake. This should be simple and explain the contractor's work process that is actually conducted on site, with safety and safeguard concerns. Method Statement is very important, particularly for pipeline works along the roads. Method Statement can be prepared for each stretch (say 1 km) /specific site based on the project area. Method Statement should be in a Table format with appended site layout map and cover the following:

- Work description
- No. of workers (skilled & unskilled)
- Details of Plant, equipment & machinery, vehicles
- Work duration (total, and activity-wise, for example for pipe laying, from excavation to road resurfacing/testing)
- PPE (helmet, gloves, boots, etc.) details for each type of work
- Details of materials at each site (type & quantity)
- Risks/hazards associated with the work (for example, Trench excavation will have risks such as trench collapse, persons/vehicles falling into trench, structural risk to nearby buildings, damage to buildings, infrastructure etc.)
- Construction waste/debris generated (details & quantity)
- Detail the sequence of work process (step-by-step) including specific details of each work
- Contractor's supervision & management arrangements for the work
- Emergency: Designate (i) responsible person on site, and (ii) first aider
- Typical site layout plan including pipe trenching, placement of material, excavated earth, barricading etc.
- The pipeline are to be laid along the roads. The excavated soil, placed along the trench may get disturbed due to wind, rain water and the movement of workers, vehicles and pedestrians, and spill onto road way – disturbing road users, creating dust, road safety issues, etc., and also into nearby open drains. The following should be included in the site layout plan:
    - Provide barricading/security personnel at the site to prevent entry/trespassing of pedestrian/vehicles into the work zone
    - Location of temporary stockpiles and provision of bunds

- Separation of stockpiles areas with workers/vehicle movement paths to avoid disturbing the stockpiled soil
- Wetting of soil to arrest dust generation by sprinkling water

- Waste/surplus soil utilization and disposal plan – indicate expected duration of temporary stockpiling along the trench at each site and identify final surplus soil utilization/disposal site in consultation with PIU

150. Prior to starting of work, the contractor should prepare Construction Management Plan. The Construction Management Plan should be site specific and has to submit every month before starting the work. The Construction Management Plan will include the method statement for construction works, Utility Management and Contingency Plan, Traffic Management Plan, Work camp and Labour Camp details, Safety measures taken for the workers and the public. etc.

ii) Impact on Physical Resources

151. **Topography, Soils & Geology.** Subproject activities are not large enough to affect these features; so there will be no impacts. However movement of heavy construction vehicles may disturb and consolidate the soil, which will negatively affect soil environment. The following measures will be required:

(i) Prepare a plan for use and movement of construction vehicles within the area based on the nature of soil;

(ii) Vehicles/equipment movement shall be confined to dry areas with hardened soil; no vehicle/equipment shall enter the damp areas, water areas, vegetative areas and areas with soft soil.

152. **Sources of Materials**. Significant amount of gravel, sand and aggregate, will be required for this subproject. The construction contractor will be required to:

(i) Use quarry sites and sources permitted by Mines & Geology Department only

(ii) No new quarry sites shall be developed for the subproject

(iii) Verify suitability of all material sources and obtain approval of implementing agency

(iv) Submit on a monthly basis documentation of sources of materials.

153. **Air Quality**. It is most certain that work will be conducted during the dry season, so there is potential for creating dust from the excavation of dry soil, backfilling, transportation to disposal, and from the import and storage of sand/gravel for bedding. Emissions from construction vehicles, equipment, and machinery used for excavation and construction will also 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, sulphur oxides, particulate matter, nitrous oxides, and hydrocarbons) but temporary and during construction activities only. Since most of the project locations are within the village area dust will be generated even without project activity and concentration will be calibrated with base line concentration of the generated dust.To mitigate the impacts, construction contractors will be required to:

(i) Consult with PIU on the designated areas for stockpiling of clay, soils, gravel, and other construction materials;

(ii) Damp down exposed soil and any stockpiled on site by spraying with water when necessary during dry weather;

(iii) Bring materials (aggregates, sand, gravel, etc.) as and when required;

(iv) Use tarpaulins to cover sand and other loose material when transported by vehicles;

(v) Clean wheels and undercarriage of vehicles prior to leaving construction site

(vi) Fit all heavy equipment and machinery with air pollution control devices which are operating correctly; ensure valid Pollution Under Control (PUC) Certificates for all vehicles and equipment used in the construction activity

154. **Noise Levels.** The soils are shallow in some parts of the subproject area, and therefore activities like rock cutting for trenching will be required in those areas. This requires using of pneumatic drills and there will be high noise during the activity. Also, where the pipelines are required to be laid in the roadway, pneumatic drills will be used to break open the road surface. Pneumatic drills typically generate an equitant noise of 82-98 dBA, at 1 m distance from the activity. The sensitive receptors are the general population and socio-cultural institutions in the area. Noise will be for a short term (about 2-3 days at each location) thus impact is minimal and short-term. The construction contractor will be required to:

(i) Plan activities in consultation with the 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) Construction work shall be limited to day light hours (6 AM to 6 PM) for all the works located within the town; for facilities outside the town and habitations, the timings may be relaxed with the permission of Davangere CC and PIU, however no work should be conducted between 10 PM – 6 AM at any site.

(iii) Provide prior information to the local public about the work schedule;

(iv) Ensure that there are no old and sensitive buildings that may come under risk due to the use of pneumatic drills; if there is risk, cut the rocks manually by chiselling;

(v) Minimize noise from construction equipment/pneumatic drills by using silencers, fitting jackhammers with noise-reducing mufflers, and portable street barriers the sound impact to surrounding sensitive receptor; and

(vi) Maintain maximum sound levels not exceeding 80 decibels (dBA) when measured at a distance of 10 m or more from the vehicle/s.

155. **Surface Water Quality**. Davangere topography is primarily plain; the town receives low to moderate rainfall. Most of the rainfall occurs during southwest monsoon between July and September. Due to these reasons and also that excavation will not certainly be conducted during rains, there is no impact on drainage and surface water quality is envisaged. In unavoidable case of excavation during rains, there may be

temporary impacts like flooding of construction sites, mixing of construction waste and material within the runoff, etc. This may lead to silting and blockage of drains and water bodies. These potential impacts are temporary and short-term duration only and to ensure these are mitigated, construction contractor will be required to:

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

(ii) Prioritize re-use of excess spoils and materials in the construction works. If spoils will be disposed, consult with Implementing Agency on designated disposal areas. **Appendix 7** shows sample template for spoil management plan.

(iii) Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies like canal and nallaha

(iv) Provide temporary bunds for stockpiles and materials

(v) Place storage areas for fuels and lubricants away from any drainage leading to water bodies

(vi) Dispose any wastes (sediments due to intake structure construction) generated by construction activities in designated sites; and

(vii) Conduct surface quality inspection according to the Environmental Monitoring Plan (EMP)

156. Construction of intake well in the river, and construction of Pipeline Bridge to cross nallah may lead to degradation of water quality due to increase in turbidity and chemical contamination from fuels and lubricants used in construction work. Increase in silt content and water turbidity, chemical quality can affect the aquatic life, silting/chocking of spill ways/ canals etc., Though the work is small scale, to ensure that any negative impacts are mitigated, the contractor will be required to:

(i) Select a construction methodology that is least disturbing, and appropriate for the in-situ soil condition, and able to complete the construction work in minimum time

(ii) Schedule the construction works during low flow period and ensure that works are completed during the same period to prior to onset of monsoon

(iii) Erect temporary barriers to form enclosed construction area with least disturbance

(iv) Allow adequate time settle the distributed solids to prior to pumping out water; only clear/clarified water shall be pumped back into the water body/river; any silt laden water should be pumped to a silt pond

(v) Avoid/minimize use of fuels, chemicals and lubricants; ensure no spillage; and have an equipment spill and containment plan and appropriate materials on-site

(vi) Clean up the site after construction; excavated soil, debris, material shall be cleared from the river bed/bank properly

(vii) Conduct water quality inspection according to the Environmental Monitoring Plan (EMP)

157. **Groundwater.** Subproject activities do not interfere with groundwater regime, no groundwater abstraction proposed nor do the activities affect groundwater quality.

158. **Landscape and Aesthetics**. The construction work is likely to generate considerable quantities of waste soil. The pipe laying work will generate surplus soil; as small diameter pipes are proposed it will generate only 15-20% as surplus as most of the soil will be used for refilling after the pipe is laid in trench. Estimation indicates generation of 70,000 MT of surplus earth. The surplus soil needs to be disposed safely at landfill site. At village area top soil will be utilized for agricultural practice. No agricultural land/ cultivation will be affected. Practically no land use will be changed from the project activity. Indiscriminate disposal of the soil and waste may affect the local environment at the disposal location. These impacts are negative but short-term and reversible by mitigation measures. The construction contractor will be required to:

(i) Prepare and implement Waste Management Plan – it should present how the surplus waste generated will temporarily stocked at the site, transported and disposed properly

(ii) Avoid stockpiling of excess excavated soils as far as possible

(iii) Avoid disposal of any debris and waste soils in or near water bodies/rivers;

(iv) Coordinate with PIU for beneficial uses of excess excavated soils or immediately dispose to designated areas

(v) Preliminary estimate indicates that 39,000 Cubic meter of excess earth will be generated from the excavation during laying of pumping mains

159. **Existing Infrastructure and Facilities**. Excavation works can damage existing infrastructure/utilities located alongside roads. It is therefore important that construction contractors will be required to:

- Obtain from PMDCSC the list of affected utilities and operators (line agency);
- Prepare a contingency plan to include actions to be done in case of unintentional interruption of services

iii) Impact on Ecological Resources

160. Except intake site and WTP subproject sites are located within the village and city area and in the areas converted for agricultural use long back. There is no natural habitat left in these sites, and therefore no impacts on ecological resources envisaged. Only felling of 2 trees will be required at head works. Permission will be obtained from tree officer, and compensatory trees will be planted. Proper precautions will be required during the construction in river, the measures provided in the section of water quality will be adequate to minimize the impacts on aquatic life. Works in the WTP will be confined to the WTP campus, and therefore are no sensitive features.

161. Works in the river, water bodies may deteriorate water quality and may have negative impacts on aquatic life. Implementing the mitigation measures suggested in surface water quality will avoid / minimise the impacts on aquatic life. For laying of pipes no trees need to be cut since sufficient ROW is available even at village area.

iv) Impact on Economic Development

162. **Land Use.** Subproject activities will not affect the land use. All subproject activities are being conducted along the road ways within village and semi urban environment; and other facilities (WTP, Jack well) are being developed on government-owned vacant lands to the extent possible.

163. **Accessibility**. Transport infrastructure will be affected by the pipe laying work, as in the highway and semi urban areas. In village area traffic movement is comparatively less and risk from traffic is the minimum. The road itself may also be excavated. Traffic will therefore be disrupted. Potential impact is negative but short term and reversible by mitigation measures. The construction contractor will be required to:

(i) Plan pipeline work in consultation with the traffic police and Gramapanchyat.

(ii) Plan work such that trench excavation, pipe laying, and refilling including compacting, at a stretch is completed in a minimum possible time;

(iii) Provide for immediate consolidation of backfilling material to desired compaction - this will allow immediate road restoration and therefore will minimise disturbance to the traffic movement;

(iv) Do not close the road completely, ensure that work is conducted onto edge of the road; allow traffic to move on one line;

(v) In unavoidable circumstances of road closure, provide alternative routes, and ensure that public is informed about such traffic diversions;

(vi) At all work sites public information/caution boards shall be provided – information shall inter-alia include: project name, cost and schedule; executing agency and contractor details; nature and schedule of work at that road/locality; traffic diversion details, if any; entry restriction information; competent official's name and contact for public complaints.

(vii) Prepare a Traffic Management Plan –a template is provided for reference at **Appendix 8.**

v) Impact on Socio Cultural Resources

164. **Impacts on social sensitive areas**. Part of the work (except intake and WTP) is being conducted in an urban areas near schools, religious centre, the excavation of trenches and pipe laying activity will create nuisance and health hazard to children and people with ailments. The measures suggested under various heads in this section will minimize the impact in general in all areas; however, special attention is necessary at these locations. Following measures shall be implemented in and around the sensitive locations (schools, hospitals, and religious centres):

(i) No material should be stocked in this area; material shall be brought to the site as and when required

(ii) Conduct work manually with small group of workers and less noise; minimize use of equipment and vehicles

(iii) No work should be conducted near the religious places during religious congregations

(iv) Material transport to the site should be arranged considering school timings; material should be in place before school starts;

(v) Notify concerned schools, hospitals etc. 2 weeks prior to the work; conduct a 30 minute awareness program on nature of work, likely disturbances and risks and construction work, mitigation measures in place, entry restrictions and dos and don'ts

(vi) Implement all measures suggested elsewhere in this report – dust and noise control, public safety, traffic management, strictly at the sites.

165. **Socio-Economic – Income.** Excavation of trenches and pipe laying work in the city will obstruct access to residences/commercial buildings adjacent to the pipeline. Disruption of access to commercial establishments may affect livelihood. Since most of project areas are located at vacant/ open area and at village environment impact on the commercial establishment, offices are the minimum. The potential impacts are negative and moderate but short-term and temporary. The construction contractor will be required to:

(i) Leave space for access between mounds of excavated soil

(ii) Provide wooden planks/footbridges for pedestrians and metal sheets for vehicles to allow access across trenches to premises where required

(iii) Address livelihood issues, if any; implement the Resettlement Plan (RP) to address these issues

(iv) Provide sign/caution/warning boards at work site indicating work schedule and traffic information; prevent public entry into work sites through barricading and security; and

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

166. **Socio-Economic–Employment.** Manpower will be required during the 27-months construction period. This can result to generation of contractual employment and increase in local revenue. Thus potential impact is positive and long-term. The construction contractor will be required to:

(i) Employ at least 50% of the labour force, or to the maximum extent local persons if manpower is available; and

(ii) Secure construction materials from local market.

167. **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) Develop and implement site-specific Health and Safety (H & 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; (c) H & S Training[2] for all site personnel; (d) documented procedures to be followed for all site activities; and (e) documentation of work-related accidents;

(ii) All trenches deeper than 2 m shall be protected with wooden bracing to avoid safety risks to workers, public and nearby buildings/structures

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

(iv) Provide medical insurance coverage for workers;

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

(vi) Provide supplies of potable drinking water;

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

(viii) Provide H & S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protection, and preventing injuring to fellow workers;

(ix) 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;

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

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

(xii) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate; and

(xiii) Disallow worker exposure to noise level greater than 85 dBA for a duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively.

[2]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.

(xiv) Overall, the contractor should comply with IFC EHS Guidelines on Occupational Health and Safety (this can be downloaded fromhttp://www1.ifc.org/wps/wcm/connect/9aef2880488559a983acd36a6515bb18/2%2BOccupational%2BHealth%2Band%2BSafety.pdf?MOD=AJPERES)

168. Since during construction of intake worker should have to work within River, special precaution particularly using safety equipment and training on swimming and mitigation under emergency situation is necessary.

169. **Community Health and Safety.** Hazards posed to the public, specifically in high-pedestrian areas may include traffic accidents and vehicle collision with pedestrians. In most of the cases location of project sites are along the road ways, hence safety risk to community is to be considered. Potential impact is negative but short-term and reversible by mitigation measures. The construction contractor will be required to:

(i) Provide wooden bracing for all deep excavations that may require especially for pipe lines (>1m); identify buildings at risk prior to start of excavation work and take necessary precautions for safe conduct of work

(ii) Plan material and waste routes to avoid times of peak-pedestrian activities

(iii) Liaise with IA/Davangere CMC in identifying risk areas on route cards/maps

(iv) Maintain regularly the vehicles and use of manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure

(v) Provide road signs and flag persons to warn of dangerous conditions for all the work sites along the roads

(vi) Overall, the contractor should comply with IFC EHS Guidelines Community Health and Safety (this can be downloaded fromhttp://www1.ifc.org/wps/wcm/connect/dd673400488559ae83c4d36a6515bb18/3%2BCommunity%2BHealth%2Band%2BSafety.pdf?MOD=AJPERES)

170. **Work Camps.** Operation of work 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. Provision of proper living facilities and basic amenities (water, sanitation, fire safety, health and safety, etc.) shall be ensured.

171. The construction contractor will be required to comply with the following. Overall, the contractor should follow the IFC EHS guidelines specific to workers accommodation (this can be downloaded from http://www1.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/publications/publications_gpn_workersaccommodation).

(i) Consult with PIU before locating workers camps/sheds, and construction plants; as far as possible located within reasonable distance of work site.

(ii) Minimize removal of vegetation and disallow cutting of trees.

(iii) Living facilities shall be built with adequate materials, and should be in good condition and free from rubbish and other refuge.

(iv) The camp site should be adequately drained to avoid the accumulation of stagnant water.

(v) Provide water and sanitation facilities; water, meeting Indian drinking water standards shall be provided, in adequate quantities (supply of 60- 80 LPCD); all water storage structures must be cleaned regularly and covered properly to avoid any contamination.

(vi) Provide separate facilities for men and women; sanitary facilities shall be properly build and well maintained; toilet and bath facilities should be provided on basis of 1 per 15 or less number of persons.

(vii) Train employees in the storage and handling of materials which can potentially cause soil contamination;

(viii) Recover used oil and lubricants and reuse or remove from the site;

(ix) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas;

(x) Remove all wreckage, rubbish, or temporary structures which are no longer required; and

(xi) Report in writing that the camp has been vacated and restored to pre-project conditions before acceptance of work.

172. **Social and Cultural Resources – Chance Finds**. Subproject area is not a potential archaeological area and therefore no impacts envisaged.

E. Operational & Maintenance Impacts

173. Operation and Maintenance of the water supply system will be carried out by the CC. The system have 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 equipments 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.

174. Recurrence of pipe bursting and leakage problems can be managed by the leak detection and water auditing surveys. The CC will be required to ensure that the leakage rectification time is minimized.

175. Improper disposal of silt and debris removed from trenches could cause Inconvenience to public. Silt and debris shall be collected in trucks and transported to the Municipal Solid Waste Disposal Site and shall be used as covering material for the waste being landfilled.

176. Repair works could cause some temporary disruption of activities at locations of social and cultural importance such as schools, hospitals, churches, tourist sites etc, so the same precautions as employed during the construction period should be adopted.CC needs to:

(i) Identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity;
(ii) Complete work in these areas quickly;
(iii) 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.

177. City Corporation needs to require its O and M contractor to:

(i) Refill and re-compact trenches soil and backfilled sand will be removed to expose the leaking junction or pipe;

(ii) Conduct work during non-monsoon period; and

(iii) Cover or wet excavated material to prevent dusts.

178. **Recurrence of blockage and leakage problems**. Although impact is likely to be minimal due to new and well-designed efficient system, it should be ensured that leak detection and restoration time is minimized to the extent possible.

179. Operation of Water Treatment Plant (WTP). This involves various processes: pre-chlorination, alum dosing, flash mixing, flocculation, clarification, filtration, post-chlorination, wash water re-circulation and sludge disposal systems pre-chlorination, aeration, alum-mixing, flocculation, clarification, filtration, and disinfection. Chemicals such as Alum and chlorine will be used in the treatment processes.

180. The safety risk due to handling of large quantities of chlorine at the WTP should be negligible if all the 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:

- Chlorinator facility is operated only by trained staff and as per the standard operating procedures
- In case of any accident and/or maintenance activity, the staff should follow documented procedures only
- It is suggested to develop an Emergency Response System (ERS) for the chlorine leakage. A Template for ERS is provided in **Appendix 9.** Sensitize and train staff in implementation of ERS.

181. Guidelines and Emergency plan for handling and storing chlorine is attached as **Appendix 10.**

182. **Sludge Handling**. During operation of water treatment plant large volume of physical and chemical sludge will be generated. There will be 3 sludge/waste producing units. A part of existing settling tank/pond is proposed to be used as sludge settling/disposal tank from Pre-settling tank, for proposed WTP. Sludge cake, produced

from both WTP, is proposed to dump/stack in the areas within WTP campus. Approximate generation of sludge will be 5132 kg/day. Operation contractor will collect sludge from the treatment plant and dispose / use after due permission from CC. Before disposal testing will be carried out. All government permits on sludge disposal would be secured prior to the operation of the WTP

183. Environmental issues associated with the WTP include: (i) solid waste; (ii) wastewater; (iii) hazardous chemicals; and (iv) air emissions

184. **Solid Waste.** Solid waste residuals which may be generated by the WTP include process residuals, used filtration membranes, spent media and miscellaneous wastes. Process residuals primarily consist of settled suspended solids from source water and chemicals added in the treatment process, such as lime and coagulants/ polyelectrolyte. Pre-sedimentation, coagulation (e.g. with aluminium hydroxide [alum] or ferric hydroxide), and iron will produce sludge. Composition of the sludge depends on the treatment process and the characteristics of the source water, lime, and other organic compounds, microorganisms, etc. CC needs to require its O and M contractor to:

(i) Minimize the quantity of solids generated by the water treatment process through optimizing coagulation processes;

(ii) Dispose of lime sludge by land application if allowed, limiting application rates to about 20 dry metric tons per hectare (9 dry tons per acre) to minimize the potential for mobilization of metals into plant tissue and groundwater[3],

(iii) Dispose of ferric and alum sludge by land application, if allowed and if such application can be shown through modelling and sampling to have no adverse impacts on groundwater or surface water (e.g. from nutrient runoff); and

(iv) Potential impact on soil, groundwater, and surface water, in the context of protection, conservation and long term sustainability of water and land resources, should be assessed when land is used as part of any waste or wastewater treatment system

185. **Wastewater.** Wastewater from water treatment projects include filter backwash. These waste streams may contain suspended solids and organics from the raw water, dissolved solids, high or low pH, heavy metals, etc. CC needs to require its O and M contractor to:

(i) Land application of wastes with high dissolved solids concentrations is generally preferred over discharge to surface water subject to an evaluation of potential impact on soil, groundwater, and surface water resulting from such application;

(ii) Recycle filter backwash into the process if possible; and

(iii) Treat and dispose of reject streams, consistent with CPHEEO requirements.

[3] Management of Water Treatment Plant Residuals, Technology Transfer Handbook," EPA/625/R-95/008, April 1996.

186. **Appendix11**shows the Indian standard for discharge of effluent in environment.

187. **Hazardous Chemicals.** Water treatment may involve the use of chemicals for coagulation, disinfection and water conditioning. For WTP that will use chlorine gas, CC needs to require its O and M contractor to:

(i) Store chlorine gas cylinder in cool, dry, and dark conditions for no more than one month, and use equipment constructed of corrosion-resistant materials;

(ii) Minimize the amount of chlorination chemicals stored on site while maintaining a sufficient inventory to cover intermittent disruptions in supply;

(iii) Develop and implement a prevention program that includes identification of potential hazards, written operating procedures, training, maintenance, and accident investigation procedures; and

(iv) Develop and implement a plan for responding to accidental releases.

188. **Air Emissions.** Air emissions from water treatment operations may include gaseous or volatile chemicals used for disinfection processes (e.g., chlorine). Measures related to hazardous chemicals discussed above will mitigate risks of chlorine release.

189. The provision of an improved water supply system is expected to have indirect economic benefits from the expected improvement in the health, environment and economic well-being.

190. The citizens of the Davangere CC will be the major beneficiaries of the improved water supply, as they will be provided with a constant supply of better quality water, piped into their homes. In addition to improved environmental conditions, the project will improve the over-all health condition of the town as diseases of poor sanitation (such as diarrhoea and dysentery) will be reduced.

V. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Project Stakeholders

191. Most of the main stakeholders have already been identified and consulted during the preparation of this IEE and any others that are identified during the project implementation will be brought into the process in the future. Primary stakeholders are:

i. Residents, shopkeepers and business people near the work sites;

ii. Public representatives and prominent citizens of the town

iii. Davangere City Corporation

iv. KUIDFC, GoK

192. Secondary Stakeholders are:

i. Other concerned government institutions (utilities, regulators etc.)

ii. NGOs and CBOs working in the affected communities

iii. Other community representatives (prominent citizens, religious leaders, elders, women's groups)

iv. The beneficiary community in general and

v. ADB as the funding agency.

B. Consultation & Disclosure till Date

193. A series of public consultation meetings were conducted during the project preparation. Various forms of public consultations (consultation through ad hoc discussions on site) have been used to discuss the project and involve the community in planning the project and mitigation measures.

194. A public consultation workshop was conducted on October 3, 2012 at Davangere for all the four project towns to discuss the proposed project and likely environmental issues and mitigation measures. Key stakeholders – public representatives, officials from various agencies, district level officers, from each project town, including Davangere, were participated in the workshop. Minutes of this consultation meeting is appended at **Appendix 12.**

195. Further public consultation has been conducted during preparation of design report. The outcome of public consultation is that local villagers are very much interested on proposed bulk water supply project.

196. Details of public consultation are enclosed in **Appendix 13.**

C. Future Consultation & Disclosure:

197. EA and IA shall extend and expand the consultation and disclosure process significantly during implementation of the Investment Program.

(i) Consultation during construction:

- Public meetings with affected communities (if any) to discuss and plan work programmes and allow issues to be raised and addressed once construction has started; and
- Smaller-scale meetings to discuss and plan construction work with individual communities to reduce disturbance and other impacts, and provide a mechanism through which stakeholders can participate in subproject monitoring and evaluation;

(ii) Project disclosure:

- Public information campaigns (via newspaper, TV and radio) to explain the project to the wider town population and prepare them for disruption they may experience once the construction programme is underway;

- Public disclosure meetings at key project stages to inform the public of progress and future plans, and to provide copies of summary documents in Kannada and
- Formal disclosure of completed project reports by making copies available at convenient locations in the town, informing the public of their availability, and providing a mechanism through which comments can be made.

198. Based on ADB requirements, the following will be posted on ADB website: (i) this IEE, upon finalization and approval of ADB; (ii) a new or updated IEE, if prepared, reflecting significant changes in the Project during implementation; (iii) corrective action plan prepared during Project implementation to address unanticipated environmental impacts and to rectify non-compliance to EMP provisions; and (iv) environmental monitoring reports. Documents will also be available on the websites of KUIDFC and Davangere CC.

D. Redress of Grievance

199. A project specific grievance redress mechanism (GRM) will be established to receive, evaluate and facilitate concerns of, complaints and grievances of the DPs in relation to project's social and environmental performances. The main objective of the GRM will be to provide time bound action and transparent mechanism to resolve social and environment concerns.

200. A project GRM will cover the project's towns for all kinds of grievances and will be regarded as an accessible and trusted platform for receiving and facilitating project related complaints and grievances. The multi-tier GRM for the program will have realistic time schedules to address grievances and specific responsible persons identified to address grievances and whom the DPs have access to interact easily.

201. Awareness on grievance redress procedures will be created through Public Awareness Campaign with the help of print and electronic media and radio. The resettlement NGO will ensure that vulnerable households/shops are also made aware of the GRM and assured of their grievances to be redressed adequately and in a timely manner.

202. There will be multiple means of registering grievances and complaints by dropping grievance forms in complaint/ suggestion boxes at accessible locations, or through telephone hotlines, email, post or writing in a complaint registrar book in ULB's project office. There will be complaint register book and complaint boxes at construction site office to enable quick response of grievances/ complaints for urgent matters. The name, address and contact details of the persons with details of the complaint / grievance, location of problem area, date of receipt of complaint will be documented. The RPMU's Social development / Resettlement Officer will be responsible at the project level for timely resolution of the environmental and social safeguards issues and registration of grievances, and communication with the aggrieved persons.

E. Grievance Redress Process

203. There will be several tiers for grievance redress process. Simple grievances for immediate redress will first be resolved at site by Contractor. If unaddressed for up to 7 days the complainants may go to PIU officer in ULB responsible for resettlement/social/ environmental issues. Project engineer and the resettlement NGO will assist in resolving the issues. Name, designation and contact number of personnel responsible for grievance redress at ULB and RPMU, will be posted at Contractor's and PMDSC's site office in full visibility of public. NGO will be involved in community mobilization and awareness campaign among the communities. Grievances of immediate nature should be resolved at site/ within ULB/PIU level within 15 days of registration of grievances.

204. All grievances that cannot be resolved by ULB/PIU within 15 days will be forwarded to RPMU's Social safeguards/R&R Officer and PMDSC specialist who will review and resolve within 15 working days of grievance registration with the assistance of the Resettlement NGO and concerned PIU/ULB personnel, if required.

205. The grievances of critical nature and those cannot be resolved at RPMU level should be referred to Grievance Redress Committee (GRC)/Steering Committee (SC) set up at district level to be settled within 30 days. All documents related to grievances, follow up action taken to resolve along with explanatory note on nature, seriousness and time taken for grievance redress shall be prepared by RPMU Social safeguard / R&R Officer and circulated to GRC/SC members at least a week prior to scheduled meeting. The decision taken at the GRC/SC level will be communicated to the DPs by RPMU Social safeguards/R&R officer through ULB/PIU and resettlement NGO.

206. For any issues that remain unresolved by the GRC or SC or the decision taken at such meetings are not acceptable, the complainants /DPs can approach the Court of Law as per Govt. of Karnataka legal procedure.

F. GRC / SC composition and selection of members

207. The GRC for the project will be headed by Special land acquisition officer/the Assistant Commissioner as chairman with members as followed: (1) DPD of the concerned subdivision (member secretary). (2) commissioner/chief officer of the ULBs. (3) The most affected beneficiary. (4) One vulnerable beneficiary. (5) Environmental officer. Appeals against the decision of the GRC are to be addressed to the Deputy Commissioner of the concerned district.

208. In the event when the established GRM is not in a position to resolve the issue, affected person can use the ADB Accountability Mechanism through directly contact (in writing) to the Complaint Receiving Officer (CRO) at ADB headquarters or to ADB Indian Resident Mission (INRM). The complaint can be submitted in any of the official languages of ADB's DMCs. The ADB Accountability Mechanism information will include in the Project Information Document (PID) to be distributed to the affected communities, as part of the project GRM. The PID will be prepared by the contactor in coordination with the PIU and consultant and get it approved by the EE/AEE in charge of the project .Grievance Redress Mechanism is shown in the **Figure 17.**

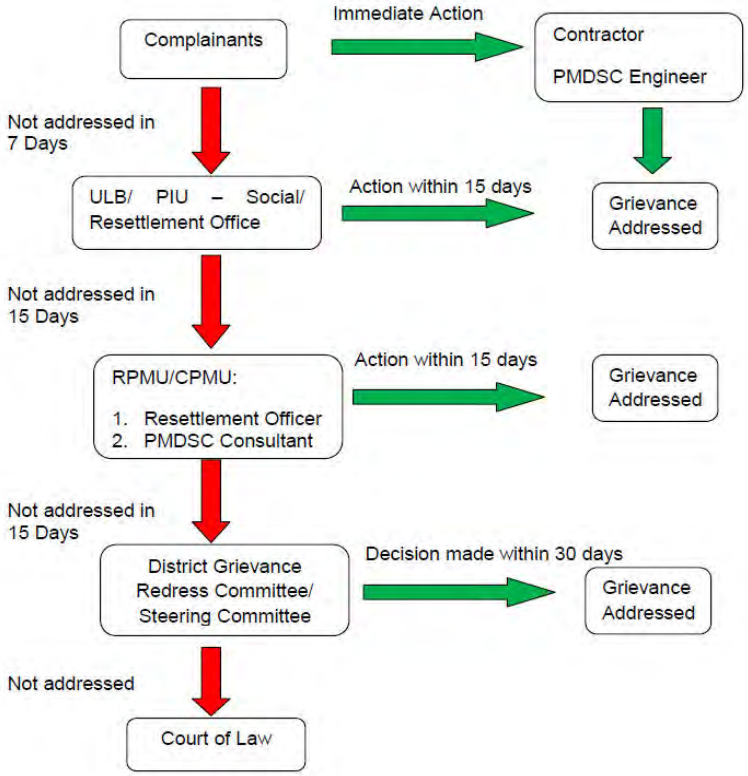


Figure 17: Grievance Redress Process

VI. Environmental Management Plan

A. Environmental Management Plan

209. 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.

210. A copy of the EMP must be kept on 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.

211. 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 a budget for compliance with these EMP measures, requirements and actions.

212. **Table 14 to 16** shows the potential adverse environmental impacts, proposed mitigation measures, responsible parties, and estimated cost of implementation. This EMP will be included in the bid documents and will be further reviewed and updated during implementation.

Table 14: Environmental Management Plan for Anticipated Impacts – Pre-Construction

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
Legislation, permits and agreements	Non-compliance on Environmental legislation – work will be stopped	• In all instances- covering Environment & Forest, implementation agency, contractors and consultants must remain in compliance with relevant local and national legislation. • Proof of compliance to Air Act & Noise Act must be forwarded by the contractor to PMU/PMDCSC / PIU (in relation to hot mixing, batch mix plants, stone crushers, diesel	PIU, PMU, PMDCSC	(i) Checking of all permit including tree felling if any (ii) Availability of EMP at site	PIU and contractor as per requirement

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
		generators, etc. if any) • Permission of tree felling if any from forest dept. • A copy of the EMP must be kept on site during the construction period			
Technical design of the project	Lack of sufficient planning to assure long term sustainability of the improvements and ensure protection of the assets created	Design will include provisions for ensuring effective maintenance and protection of the assets created so as to ensure the long term sustainability. Designs will be worked out and implemented in accordance with the provisions and will strictly conform to state rule	PMU, PMDCSC	Checking of technical design – considering sustainability of the project	Design preparation cost – PMU and PMDCSC
Utilities	Telephone lines, electric poles and wires, within	(i) Identify and include locations and operators of	Contractor in collaboration with ULB.	(i) List of affected utilities and operators;	No cost required. Mitigation

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
	proposed project area particularly at semi urban area	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 done in case of unintentional interruption of services. (iii) Require contractors to prepare spoils management plan (Appendix 6)and traffic management plan (Appendix 7)		(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 6), and traffic management plan (Appendix 7)	measures are part of ToR of PMU, design engineers, and supervising consultants.
Social and Cultural Resources	Ground disturbance can uncover and damage	(i) Consult Archaeological Survey of India (ASI) or concerned	Contractor, PIU &PMDCSC	Chance Finds Protocol	No cost required. Mitigation measures are

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
	archaeological and historical remains	dept. of Karnataka Govt. to obtain an expert assessment of the archaeological potential of the site; (ii) Consider alternatives if the site is found to be of medium or high risk; (iii) 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.			part of ToR of PMU, design engineers, and supervising consultants.
Construction work camps, hot mix plants, stockpile areas, storage areas, and disposal areas.	Disruption to traffic flow and sensitive receptors particularly at semi urban area	(i) Prioritize areas within or nearest possible vacant space in the project location; (ii) If it is deemed	PIU and Contractor to determine locations prior to beginning of construction	(i) List of selected sites for construction work camps, hot mix plants, stockpile areas, storage	No cost required. Mitigation measures are part of ToR of PMU, design

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
		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 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	works.	areas, and disposal areas. (ii) Written consent of landowner/s (not lessee/s) for reuse of excess spoils to agricultural land	engineers, and supervising consultants.

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
		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 50 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	(i) Prioritize sites already permitted by the Mining Department; (ii) If other sites are necessary, inform construction contractor that it is	ULB and Contractor to prepare list of approved quarry sites and sources of materials with the approval of PMDCSC/PIU	(i) List of approved quarry sites and sources of materials; (ii) Bid document to include requirement for verification of	No cost required. Mitigation measures are part of ToR of PMU, design engineers, and supervising consultants.

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
	natural drainage patterns, ponding and water logging, and water pollution.	their responsibility to verify the suitability of all material sources and to obtain the approval of PMU and (iii) If additional quarries will be required after construction is started, inform construction contractor to obtain a written approval from PMU.		suitability of sources and permit for additional quarry sites if necessary.	
Structural and seismic stability is to be ensured for the safety of people working in and living around these structures.	The failure of the structures can be catastrophic.	The design shall incorporate seismicity of the place and all other safety factors. All care shall be taken to ensure a safe and structurally sound construction.	PIU and PMDCSC	Incorporated in final design and communicated to contractors.	No cost required. Mitigation measures are part of ToR of PMU, design engineers, and supervising consultants.
Consents, permits, clearances, NOCs, etc.	Failure to obtain necessary consents, permits, NOCs, etc can	(i) Obtain all necessary consents, permits, clearance, NOCs,	ULB/PIU and PMDCSC	Incorporated in final design and communicated to contractors.	No cost required. Cost of obtaining all consents, permits,

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
	result to design revisions and/or stoppage of works	etc. prior to start of civil works. (ii) Acknowledge in writing and provide report on compliance all obtained consents, permits, clearance, NOCs, etc. (iii) Include in detailed design drawings and documents all conditions and provisions if necessary			clearance, NOCs, etc. prior to start of civil works responsibility of PMU. Mitigation measures are part of ToR of PMU, design engineers, and supervising consultants.
Asbestos Cement Pipes	Health risk due to exposure to asbestos materials	(i) Obtain details from ULB/CC of the nature and location of all water supply infrastructure (ii) Develop an AC pipe protocol (iii) Require all personnel (including manual labourers) to undergo training as per AC pipe	ULB/CMC and design engineers	(i) Detailed design drawings showing alignment of AC pipes (ii) AC pipe protocol (iii) Trainings as per AC pipe protocol	No cost required. Mitigation measures are part of ToR of PMU, design engineers, and supervising consultants.

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
		protocol			

Table 15:Environmental Management Plan for Anticipated Impacts – Construction

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
EMP Implementation Training	Irreversible impact to the environment, workers, and community	(i) Project manager and all key workers will be required to undergo 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 / PMU / PMDCSC	(i) Certificate of Completion (Safeguards Compliance Orientation) (ii) Posting of Certification of Completion at worksites (iii) Posting of EMP at worksites	Cost of EMP Implementation Orientation Training to contractor is responsibility of PMU. Other costs responsibility of contractor.
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	(i) Consult with PMU/ PIU/ PMDCSC on the designated areas for stockpiling of clay, soils, gravel, and other construction materials; (iii) Damp down exposed soil and any stockpiled on site by spraying with water when necessary during dry weather; (iv) Use tarpaulins to cover	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	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
	as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides, and hydrocarbons.	sand and other loose material when transported by trucks; and (v) Fit all heavy equipment and machinery with air pollution control devices which are operating correctly.		compliant with Air Act	
Surface water quality	Mobilization of settled silt materials, and chemical contamination from fuels and lubricants during installation of pipelines can contaminate nearby surface water quality.	(i) Prepare and implement a spoils management plan as the part of the Construction Management Plan.(Appendix 6) (ii) Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets; (ii) Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies; (iii) Place storage areas for fuels and lubricants away from any drainage leading to water bodies; (iv) Dispose any wastes generated by installation of pipeline in designated sites; and	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, nallahsor water bodies due to civil	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
		(v) Conduct surface quality inspection at intake construction site according to the Environmental Management Plan (EMP).		works	
	Degradation of water quality during construction in water bodies	(i) Select a construction methodology that is least disturbing, and appropriate for the in-situ soil condition, and able to complete the construction work in minimum time (ii) Schedule the construction works during low flow period and ensure that works are completed during the same period to prior to onset of monsoon (iii) Erect temporary barriers to form enclosed construction area with least disturbance (iv) Allow adequate time settle the distributed solids to prior to pumping out water; only clear/clarified water shall be pumped back into the water body/river; any silt laden water should be pumped to	Construction Contractor	(i) Records of water quality inspection (ii) Effectiveness of water management measures; (iii) No visible degradation to the water body where work is being implemented	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
		a silt pond (v) Employ appropriate erosion and sediment control management practices such as silt traps, barriers, or silt curtains; (vi) Avoid/minimize use of fuels, chemicals and lubricants; ensure no spillage; and have an equipment spill and containment plan and appropriate materials on-site (vii) Clean up the site after construction; excavated soil, debris, material shall be cleared from the river bed/bank properly (viii) Conduct water qualitymonitoring during construction phase			
Noise Levels	Increase in noise level due to earth-moving and excavation equipment, and the transportation of	(i) Plan activities in consultation with PMU/PMDCSC so that activities with the greatest potential to generate noise are conducted during periods of the day which	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Use of silencers in noise-producing equipment and	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, materials, and people	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) 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; and (iv) Maintain maximum sound levels not exceeding 80 decibels (dbA) when measured at a distance of 10 m or more from the vehicle/s.		sound barriers; (iii) Equivalent day and night time noise levels	
Landscape and aesthetics	Impacts due to excess excavated earth, excess construction materials, and solid waste such as removed	(i) Prepare and implement spoils management plan (Appendix 6); (ii) Avoid stockpiling of excess excavated soils; (iii) Coordinate with Grama Panchyat/ULB/CC for beneficial uses of excess	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Worksite clear of hazardous wastes such as oil/fuel (iii) Worksite clear	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
	concrete, wood, packaging materials, empty containers, spoils, oils, lubricants, and other similar items.	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/PMDCSC to report in writing that the necessary environmental restoration works has been adequately performed before acceptance of work.		of any excess excavated earth, excess construction materials, and solid waste such as removed concrete, wood, packaging materials, empty containers	
Existing Infrastructure and Facilities	Disruption of service and damage to existing infrastructure at specified project location	(i) Obtain from PIU/ PMDCSC 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	Construction Contractor	Existing Utilities Contingency Plan	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
		service iii) The public should be given notice at least three days in advance and any accidental breaking should be rectified immediately.			
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 Forest Department; and (iii) Plant two native trees for every one that is removed.	Construction Contractor	PIU/ PMDCSC to report in writing the no of trees cut and planted.	Cost for implementation of mitigation measures responsibility of contractor.
Ecological resources – Aquatic	Impact on aquatic fauna during intake construction, (i) Due to construction activity for intake structure, pipe bridge for raw water transmission (ii)Impact on water quality-temporary turbidity during	(i)Not to dispose any construction materials in river which may pollute the river water and aquatic fauna, (ii)Spoil Disposal Management Plan (SDMP) will be prepared and implemented to minimise the potential effects of sediment plumes on aquatic habitats, (iii) Use of slow speed boat/ vessel during transportation of materials (iv) Most of the construction	Construction Contractor	Site observation to see the arrangement and checking of documents	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
	construction of pipe bridge (iii)Impact on river bed sediment- removal of part of sediment within intake structure (iv) Impact due to generated noise and vibration – transportation of man and materials and use of construction equipment	should be carried out during dry period (v)Before commencing piling, carry-out 'soft-start' for pile driving, slowly increasing intensity of the driving hammer power			
Land use	Environmental Issues due to land use change	The impact due to change in land use will be negligible due to this project. No impact on agricultural land	Not applicable	Not applicable	Not applicable
Accessibility	Traffic problems and conflicts near project locations and haul road	Traffic Management Plan should be part of the Construction Management Plan. (i) Plan transportation routes so that heavy	Construction Contractor	(i) Traffic route during construction works including number of permanent signage's,	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
		vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites; (ii) Schedule transport and hauling activities during non-peak hours; (iii) Locate entry and exit points in areas where there is low potential for traffic congestion; (iv) Keep the site free from all unnecessary obstructions; (v) Drive vehicles in a considerate manner; (vi) Coordinate with Traffic Police for temporary road diversions and with for provision of traffic aids if transportation activities cannot be avoided during peak hours; (vii) Notify affected sensitive receptors 2 days in advance by providing sign boards informing nature and duration of construction works and contact numbers for		barricades and flagmen on worksite (Appendix 7); (ii) Complaints from sensitive receptors; (iii) Number of signage's placed at project location.	

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		concerns/complaints. (viii) Plan and execute the work in such a way that the period of disturbance/ loss of access is minimum. (ix) Provide pedestrian access in all the locations until normalcy is restored.			
Socio-Economic – Income.	Impede the access of residents and customers to nearby shops	(i) Prepare and implement spoils management plan (Appendix 6) (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's, 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 contractual employment and increase in local revenue	(i) The use of labour intensive construction measures will be used where appropriate; (ii) Employ local (unskilled) labor if possible; (iii) Training of labour to benefit individuals beyond completion of the subproject; (iv)The training of unskilled or previously unemployed persons will add to the skills base of the area. and (v) Recruitment of labours will take place offsite.	Construction Contractor	(i) Employment records; (ii) Records of sources of materials (iii) Compliance to core labor laws (See appendix 4 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 4of this IEE) (ii) Develop and implement site-specific occupational health and safety (OH&S) Plan, and include in the Construction Management plan. The OH & S plan will	Construction Contractor	(i) Site-specific OH&S Plan; (ii) Equipped first-aid stations; (iii) Medical insurance coverage for workers; (iv) Number of accidents;	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
		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 mask and ear plugs; (c) OH&S Training for all site personnel; (d) documented procedures to be followed for all site activities; and (e) documentation of work-related accidents; (ii) Ensure that qualified first-aid can be provided at all times. Equipped first-aid stations shall be easily accessible throughout the site; (iii) Provide medical insurance coverage for workers; (iv) Secure all installations from unauthorized intrusion and accident risks; (v) Provide supplies of potable drinking water; (vi) Provide clean eating		(v) Supplies of potable drinking water; (vi) Clean eating areas where workers are not exposed to hazardous or noxious substances; (vii) record of H&S orientation 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	

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		areas where workers are not exposed to hazardous or noxious substances; (vii) Provide H&S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers; (viii) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted; (ix) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas; (x) Ensure moving equipment is outfitted with audible back-up alarms; (xi) Mark and provide sign		areas for storage and disposal. (xii) Compliance to core labor laws (See appendix 4 of this IEE)	

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate; and (xii) Disallow worker exposure to noise level greater than 85 dBA for a duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively. (xiii) During work within the river special precaution particularly using safety equipment/ belt and training on swimming and mitigation under emergency situation is necessary.			
Asbestos	Health risks	(i) Left AC pipes in-situ.	Construction	(i) Site-specific	Cost for

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
Cement (AC) Materials	associated with AC pipes	(ii) 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; (iii) Reporting procedures to inform management immediately if AC pipes are encountered; (iv) Development and application of a detailed OH&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.	Contractor	OH&S Plan including AC pipe protocol (iii) record of OH&S orientation on AC Cement Materials Protocol (iv) personal protective equipment for AC materials (v) Sign boards for pipe alignment identified as AC pipes.	implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
Community Health and Safety.	Traffic accidents and vehicle collision with pedestrians during material and waste transportation	(i) Plan routes to avoid times of peak-pedestrian activities. (ii) Liaise with PIU/PMDCSC in identifying high-risk areas on route cards/maps at urban area mainly. (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. (v) Provide protective fencing around open trenches, and cover any open trench with metal planks during non-construction hours. Potentially causes oil contamination; and (vi) Recover used oil and lubricants and reuse or remove from the site; (vii) Manage solid waste	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
		according to the following preference hierarchy: reuse, recycling and disposal to designated areas; (viii) Develop and implement a traffic management plan			
Work Camps and worksites	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/PMDCSC 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) Ensure conditions of livability at work camps are maintained at the highest standards possible at all times; Prohibit employees from poaching wildlife and cutting of trees for firewood; (v) Train employees in the storage and handling of materials which can	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
		potentially cause soil contamination; (vi) Recover used oil and lubricants and reuse or remove from the site; (vii) Manage solid waste according to the preference hierarchy: reuse, recycling and disposal to designated areas; (viii) Ensure unauthorized persons especially children are not allowed in any worksite at any given time.			
Social and Cultural Resources	Risk of archaeological chance finds	(i) Strictly follow the protocol for chance finds in any excavation work; (ii) Request PIU/PMDCSC or any authorized person with archaeological field training to observe excavation; (iii) Stop work immediately to allow further investigation if any finds are suspected; (iv) Inform PIU/ PMDCSC if a find is suspected, and take any action they require ensuring its removal or	Construction Contractor	Records of chance finds	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
		protection in situ.			
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. (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	Construction Contractor	PIU/PMDCSC report in writing that (i) worksite is restored to original conditions; (ii) camp has been vacated and restored to pre-project conditions; (iii) all construction related structures not relevant to O&M are removed; and (iv) worksite clean-up is satisfactory.	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
		removed, and the area shall be top soiled and regressed 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/PMDCSC to report in writing that worksites and camps have been vacated and restored to pre-project conditions before acceptance of work.			

Table 16: Environmental Management Plan for Anticipated Impacts – Operation

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
General	General impact	(i) Refill and re-compact trenches soil and backfilled sand will be removed to expose the leaking junction or pipe; (ii) Conduct work during non-monsoon period; and	Operator /Davangere CC	Complaints from sensitive receptors	-

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		(iii) Cover or wet excavated material to prevent dusts. (iv) Contractor will ensure compliance with conditions of the environmental permit/clearance during its operation.			
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	Operator /Davangere CC	(i)Complaints from sensitive receptors (ii) Field checking	CC cost
Asset management	Reduction in NRW Increased efficiency of the system	Preparation of O & M Manual	Davangere CC	Complaints from receptors	CC cost
Emergency Response Plan	Non availability of Emergency Response Plan affect water supply system	- An Emergency Response Plan for emergencies such as indications of terrorism or acts of terrorism; Major disasters such as earthquakes, fires, flood, or explosion and Catastrophic incidents that leave extraordinary levels of mass casualties, damage, and disruption severely affecting the population,	Operator / Davangere CC	Operator	CC cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		infrastructure, environment, economy, etc. shall be developed - Emergency Response Plan shall be prepared to address the eight core elements such as • System Specific Information; • Community Water System - Roles and Responsibilities; • Communication Procedures: Who, What and When; • Personnel Safety; • Identification of alternate water sources in emergencies; • Replacement equipment and chemical supplies; • Property protection and • Water sampling and Monitoring - Appropriate safety measures like fencing, notice boards to prevent entry of unauthorized persons shall be provided			

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		All guide and hand railings shall be maintained in a safe and firm condition with WTP to ensure the safety of Personnel working at the plant.			
Solid Wastes	Environmental pollution - Potential impact on soil, groundwater, and surface water nearby the disposal site	(i)Minimize the quantity of solids generated by the water treatment process, (ii)Dispose of lime sludge by land application, (iii)limiting application rates of sludge to minimize the potential for mobilization of metals into plant tissue and groundwater, (iv)Dispose of ferric and alum sludge by controlled land application not near water body, (v)Assessment of soil, ground water and surface water nearby solid waste disposal	Davangere CC	(i)Complaints from sensitive receptors (ii) Field checking (iii) Testing of soil, surface and ground water nearby	CC cost
Wastewater	Discharge into water causing water pollution	(i) Land application of wastes with high dissolved solids concentrations (ii) Recycle filter backwash into the process (iii) Treat and dispose of reject streams as per CPHEEO norm	Davangere CC	(i)Complaints from sensitive receptors (ii) Field checking (iii) Testing of soil, surface and ground	CC cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
				water	
Hazardous Chemicals	Release to nature causing air, water and soil pollution	(i)Store of chlorine gas in cool, dry, and dark conditions for no more than one month, (ii)Use equipment constructed of corrosion-resistant materials, (iii)Minimize the amount of chlorination chemicals stored on site, (iv)Develop and implement a prevention program that includes identification of potential hazards, written operating procedures, training, maintenance, and accident investigation procedures; (v)Develop emergency plan for responding to accidental releases	Davangere CC	(i)Complaints from sensitive receptors (ii) Site checking (iii) Checking of awareness and emergency training document	CC cost
Air Emissions	Air pollution from gaseous or volatile chemicals used for disinfection processes	Proper storage and scientific utilization of chemicals utilized in treatment process Collection of air samples as per EMP	Davangere CC	Complaints from sensitive receptors	CC cost
Social and Cultural Resources	Temporary disruption of activities	(i) Complete work insensitive areas quickly; (ii) Consult Municipal authorities, custodians of	Davangere CC	Complaints from sensitive receptors	CC cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		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.			
Land Uses	• With augmentation of water supply system, the presently water scarce areas can be put to their utmost possible use. • The proposed project is expected to facilitate an integrated development approach to the area thereby improving the overall quality	Regular maintenance of the water supply infrastructure so as to ensure that its functional capacity and efficiency does not reduce.	Davangere CC	Complaints from sensitive receptors	CC cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
	of life. • The proposed development is expected to bring about positive economic benefits in the medium- to long- term. • Local businesses and educational facilities, etc. are likely to benefit from the subproject.				
Health and Safety	• Improvement of water supply system is expected to significantly enhance the quantity and quality of the supplied water.	• Undertake regular monitoring and maintenance of water supply infrastructure. • Carry out water quality monitoring	Davangere CC	Complaints from sensitive receptors	CC cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
	• Reduction in leakages will ensure adequate supply of potable drinking water minimizing contamination risks with correspondin g reduction in health risks to the citizens.				
Ecological Resources	Affect on aquatic biodiversity – particularly aquatic fauna due to production of noise, movement of boat for repairing job, disposal of waste	(i)Continued protection plan application during any repairing job as per design mitigation (ii)Non allow of direct disposal of liquid wastes and leakage of oil and lubricants may affect the downstream river water quality, particularly, during dry season (iii)Proper training to the work force for scientific disposal of solid and liquid wastes (iv)Regular maintenance of pumping machinery	Davangere CC	(i) Records of complain from sensitive receptors; (ii) Conservation plan for terrestrial flora and aquatic animal	CC cost

B. Institutional Arrangements

213. **Executing Agency (EA):** Karnataka Urban Infrastructure Development & Finance Corporation (KUIDFC) is the executing agency (EA) responsible for implementing the Investment Program. Investment Program implementation activities will be monitored by Program Management Unit (PMU) of KIUWMIP, headed by Task Manager KIUWMIP, Head Office Bangalore.

214. A new Regional Program Management Unit (RPMU) established at Davangere. A Consultant Team (PMDCSC) appointed by EA and the team work under the Deputy Project Director (DPD) and they involved in project planning, preparation of subproject and cost estimates, co-ordination, technical guidance and supervision, financial control, training and overall subproject management**.**

215. Interactions with GoK, GoI and ADB shall be conducted through the KUIDFC office at Bangalore.

216. **Implementing Agency (IA):** The ultimate implementation responsibility lies with respective ULBs (in this case Davangere City Corporation). A Programme Implementation Unit (PIU) established in each ULB.

217. Other than the above institutional setup, District Level Implementation Committee set up in each district to monitor implementation of subprojects and institutional reforms. The District Level Implementation Committee shall consist of Deputy Commissioner of District, Deputy Project Director from concerned RPMU, City Corporation Commissioner/Municipal Commissioners' / Chief Officers of ULB and PMDCSC representative.

218. At the Executing Agency (i.e. KUIDFC), environmental issues coordinated centrally by an Environmental Specialist (designated as Assistant Executive Engineer-Environment), reporting to the Task Manager. Assistant Executive Engineer – Environment will ensure that all subprojects comply with environmental safeguards. The IEE/EIA reports prepared by PMDCSC and will be reviewed by the Assistant Executive Engineer-Environment as per the ADB's Environmental Guidelines and forwarded to ADB for review and approval. The Assistant Executive Engineer-Environment, KUIDFC, Head office will be assisted by an Environment Specialist of PMDCSC.

219. The responsibility fulfilling environmental requirements of GoI/GoK and conducting required level of environmental assessment as per ADB guidelines lies with the implementing agency, i.e. Davangere CC. The PIU/PMDCSC will assist the CC in this regard.

220. The mitigation measures identified through IEE/are incorporated into the Investment Program cycle. Mitigation measures, which are to be implemented by the Contractor, shall form part of the Contract Documents. The other mitigation measures are undertaken by the IA (itself or in assistance with the Consultant Team) as specified in the IEE. During the construction phase, environmental Consultant team will monitor the implementation of the EMP and report to the PMU. The Implementation of EMP and other environmental related measures and the results of environmental monitoring conducted during implementation will be reported to ADB through semi-annual

Environmental Monitoring Reports. These will also be made available on executing agency (KUIDFC) website for wider public access.

221. Consultants: Deputy Project Director is being assisted by a consultant team (PMDCSC) in project planning, preparation of project and cost estimates, coordination, technical guidance and supervision, financial control, training and overall project management. The consultant team includes an environment specialist to supervise the implementation of environmental safeguards at the RPMU level. The consultant team also includes a Resident Engineer (RE) at each ULB/CC/CMC/TMC responsible for the supervision of project implementation including environmental safeguards at each ULB/CC/CMC/TMC level.

222. Contractor: The contractor shall appoint one supervisor who will be responsible on a day-today basis for i) ensuring implementation of EMP ii) Coordinating with the RE and environment specialists (all levels) iii) community liaison, consultation with interested / affected parties and grievance redressal and iv) reporting.

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

224. The following figure and table summarizes the institutional responsibility of environmental safeguards at all stages of the project.

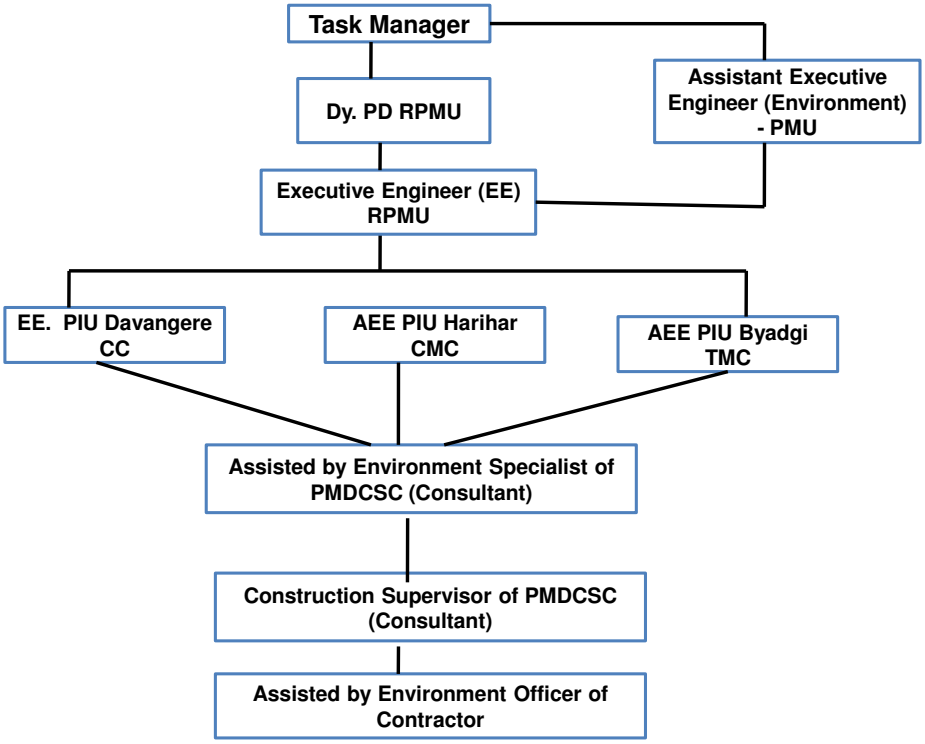


Figure 18: Environmental Safeguard Implementation Arrangements

Table 17: Institutional Roles and Responsibilities

Investment Program phase	Activity	Details	Responsible Agency
Pre construction phase	Investment Program Categorization	Conduct Rapid Environmental Assessment (REA) for each subcomponents using REA checklists	ULB
		Reviewing the REA and assigning Investment Program category (A/B/C) based on KIUWMIP Environmental Assessment Guidelines and ADB Guidelines	PMU
	Conducting EA	Conducting IEE/EIA based on the Investment Program categorization Conducting Public Consultation and information disclosure Preparation of IEE/EIA	Investment Program Consultants
	Investment Program clearances	Fulfilling GoK / GoI requirement such as clearances from other Government Agencies	ULB
	Review of EIA/IEE	Reviewing the EIA/IEE Reports to ensure compliance of the report as per ADB Guidelines and approval of the same	PMU
	Disclosure of	Information disclosure –I EE/EIA reports should be made available to the	ULB

Investment Program phase	Activity	Details	Responsible Agency
	EIA/IEE	public, and on request IEE/EIA also made available.	
	Incorporation of mitigation measures in to Investment Program design	Incorporation of necessary mitigation measures identified in IEE/EIA in Investment Program design and in contract documents.	Investment Program Consultants
	Review of design documents	Review of design and contractual documents for compliance of mitigation measures	PMU
Construction Phase	Implementation of mitigation measures	Implementation of necessary mitigation measures	Contractor
	Environmental Monitoring	Environmental monitoring as specified in monitoring plan during construction stage; monitoring of implementation of mitigation measures	Investment Program Consultants
	Preparation of progress reports	Preparation of monthly progress reports to be submitted to PMU including a section on implementation of the mitigation measures	Investment Program Consultants
	Review of progress reports	PMU to review the progress reports, consolidate and send to ADB review	PMU
Operation Stage	Environmental Monitoring	Conducting environmental monitoring, as specified in the environmental monitoring plan.	ULB/ Contractor
	Compliance Monitoring	Compliance monitoring to review the environmental performance of sub-project component, if required and as specified in Monitoring Plan	KSPCB

C. Training Needs

225. The following table (**Table18**) presents the outline of capacity building program to ensure EMP implementation. The estimated cost (under PMU cost) is Rs.6, 00,000.00 (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 skills after assessing the capabilities of the target participants and the requirements of the project.

Table 18: Outline of Capacity Building Program on EMP Implementation

Description	Target Participants	Estimate(INR) –(Lump sum)	Cost and Source of Funds
1.Introduction and sensitization to environment issues(1day) - ADB Safeguards Policy Statement - Government of India and Karnataka applicable safeguard laws, regulations and policies including but not limited to core labour standards, OH&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	Rs.75,000.00	PMU cost
2.EMP implementation(3days) - Roles and responsibilities - OH&S planning and implementation - Wastes management (water, hazardous, solid, excess construction materials, spoils, etc.) - Working in congested are as, - Public relations - Consultations - Grievance redress - Monitoring and corrective action planning - Reporting and disclosure - Post-construction planning	All staff and consultants involved in the project All contractors prior to award of contract	Rs.2,25,000	PMU cost
3.Plans and Protocols(3days) -Construction site standard Operating procedures(SOP) -AC pipe protocol -Site-specific EMP - Traffic management plan - Spoils management plan - Waste management plan - Chance find protocol - O&M plans - Post-construction plan	All staff and consultants involved in the project All contractors Prior to award of contractor during mobilization stage.	Rs.2,25,000 Rs.75,000	PMU cost Contractors cost as Compliance to Contract provisions on EMP implementation(refer to EMP tables)
4.Experiencesandbestpracticessharing - Experiences on EMP implementation - Issues and challenges - Best practices followed	All staff and consultants involved in the project All contractors All NGOs	Rs.75,000	PMU Cost

Description	Target Participants	Estimate(INR) –(Lump sum)	Cost and Source of Funds
5.Contractors Orientation to Workers on EMP implementation (OH&S, core labor laws, spoils Management, etc.)	All workers (including manual laborers)of the contractor prior to dispatch to worksite	Rs.40,000	Contractors cost as Compliance to Contract provisions On EMP implementation (refer to EMP tables)

D. Monitoring and Reporting

226. Prior to commencement of the work, the contractor will submit a compliance report to ULB/CC ensuring that all identified pre-construction environmental impact mitigation measures as detailed in the EMP will be undertaken. ULB/CC with the assistance of the consultant environment specialist will review the report and thereafter PMU will allow commencement of works.

227. During construction, results from internal monitoring by the contractor will be reflected in their weekly EMP implementation reports to the Construction Engineer. These weekly report will be retained in PMDCSC office for reference. Environmental Specialist of PMDCSC will review and advise contractors for corrective actions if necessary. Monthly report summarizing compliance and corrective measures taken will be prepared by Construction Resident Engineer to be reviewed and endorsed by ULB/CC to PMU.

228. Based on monthly reports and measurements, PMU will draft, review, and submit to ADB, 6-monthly (twice a year) EMP implementation progress report. Once concurrence from the ADB is received the report will be disclosed in the Project website.

229. ADB will review project performance against the KUIDFC's 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.

230. Monitoring and reporting format is attached as **Appendix 14.**

Table 19: Environmental Monitoring Plan

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
Pre-Construction						
All mitigation measures related to project site, location and design	-	PIU / PMDCSC	DPR Review	As needed	PMU	
• In all instances- covering Environment & Forest, implementation agency, contractors and consultants must remain in compliance with relevant local and national legislation. • Proof of compliance to Air Act & Noise Act must be forwarded by the contractor to PMU/PMDCSC/ PIU (in relation to hot mixing, batch mix plants, stone crushers, diesel generators, etc. if any) • Permission of tree felling if any from forest dept./ ULB • A copy of the EMP must be kept on site during the construction period	-	PIU / PMDCSC	Review & check the inclusion/ provision in DPR, as appropriate rules	Once before start of construction and continued	PMU	Civil Work Contract
• Identify and include locations and operators of the utilities in the detailed design documents	-	PIU / PMDCSC	Review & check the inclusion/ provision in DPR, as appropriate	Once before DPR approval	PMU	Civil Work Contract
• Require construction contractors to prepare a contingency plan and make it part of the Construction Management plan	-	Contractor	Review the contingency plan	Once prior to the relocation of utilities	PIU	Civil Work Contract
• Review previous water supply 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;		PIU / PMDCSC	Review & check the inclusion/ provision in DPR, as appropriate	Once before DPR approval	PMU /PMDCSC	Civil Work Contract

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
• Develop Emergency Response Plan for all emergencies such as leaks, overflows, bursts; a template of ERP for the system is provided at Appendix 8 and Guidelines and ERP for handling and stocking chlorine is given in Appendix 9						
Construction						
Prepare and submit a Method Statement for pipeline works in a Table format with appended site layout map • Method Statement can be prepared for each stretch (say 1 km) /specific site based on the project area.	At each work site	Contractor	Review and approve method statement Site observations during construction	Approve statement before start of work Weekly during construction	PIU/PMDCSC	Civil Work Contract
• Conduct detailed site surveys with the construction drawings and discuss with the respective agencies during the construction phase before ground clearance;	-	Contractor	Check contractor records Random checks on site, drawings and interactions with respective agencies	Once prior to the start of ground clearance for construction	PIU/PMDCSC	Civil Work Contract
• Prepare a contingency plan to include actions to be done in case of unintentional interruption of services.	-	Contractor	Review the plan	Once prior to start of construction	PIU/PMDCSC	Civil Work Contract
• In case of disruption of water supply, alternative supply, through tankers, shall be provided; water may be made available by the CMC, but it will the responsibility of contractor to supply to affected people	Utility relocation site	Contractor	Site observations Informal public consultations	Weekly Once	PIU/PMDCSC	Civil Work Contract
Prioritize areas within or nearest possible vacant space in the subproject location	Sites for worker	Contractor	Site observations	Before &after such	PIU/PMDCSC	Civil Work Contract

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
Construction work camps shall be located at least 200 m from residential areas • Do not consider residential areas for stockpiling the waste/surplus soil; • No worker camp shall be set up in north/western outskirts of the town, which are located close to sanctuary • The Contractor shall take all necessary precautions to prevent his workers from entering into sanctuary/forest area; removing, disturbing and damaging any trees/vegetation for fire wood and/or hunting animals; the contractor will be severely penalized if there are any violations by workers. • Appropriate signage/caution/warning boards have to be installed on the site indicating the proximity of the sanctuary and prohibitory orders on entering sanctuary area and also on collecting the fuel-wood. This signs should be in Kannada, Hindi and English.	camp, material store			establishment		
• Material stockpiles shall be protected by bunds during the monsoon to arrest the silt laden runoff into drains	Stockpile sites	Contractor	Site observations	Weekly	PIU/PMDCSC	Civil Work Contract
• Contractor should obtain material from existing mines approved/licensed by Mines and Geology Department/ Revenue Department. • Verify suitability of all material sources and obtain approval of implementing agency • No new quarry sites shall be developed for the subproject purpose	-	Contractor	Check sources & approvals	Prior to approval of quarry for material	PIU/PMDCSC	Civil Work Contract
• Submit a monthly statement of construction material procured indicating	-	Contractor	Record check	Monthly	PIU/PMDCSC	Civil Work Contract

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
material type, source and quantity.						
• Consult with PIU on the designated areas for stockpiling of clay, soils, gravel, and other construction materials;	Stockpile site	Contractor	Site check & approval	Prior to approval	PIU/PMDCSC	Civil Work Contract
• Damp down exposed soil and any stockpiled on site by spraying with water when necessary during dry weather • Bring materials (aggregates, sand, etc gravel) as and when required • Use tarpaulins to cover sand and other loose material when transported by vehicles; • Clean wheels and undercarriage of vehicles prior to leaving construction site	Work site	Contractor	Site observations Informal public consultations	Weekly	PIU/PMDCSC	Civil Work Contract
• Fit all heavy equipment and machinery with air pollution control devices which are operating correctly; ensure valid Pollution Under Control (PUC) Certificates for all vehicles and equipment used in the construction activity	Work site	Contractor	Check valid PUC	Prior to start and quarterly there after	PIU/PMDCSC	NA
• Plan activities in consultation with the PIU so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance; • Construction work shall be limited to day light hours (6 AM to 6 PM) for all the works located within the town; for facilities outside the town/habitation the timings may be relaxed with the permission of Davanagere CC and PIU, however no work should be conducted between 10 PM – 6 AM at any site. • Provide prior information to the local public about the work schedule;	Work site	Contractor	Check work schedule of contractor; public consultation records	Prior to start of work	PIU/PMDCSC	NA

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
• Ensure that there are no old and sensitive buildings that may come under risk due to the use of pneumatic drills; if there is risk, cut the rocks manually by chiselling;	Work site	Contractor	Site observations	Weekly	PIU/PMDCSC	NA
• 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; and	Work site	Contractor	Site observations	Weekly	PIU/PMDCSC	NA
• Maintain maximum sound levels not exceeding 80 decibels (dbA) when measured at a distance of 10 m or more from the vehicle/s	Work site	Contractor	Noise monitoring	Quarterly	Contractor	NA
• Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets • Stockpiles shall be provided with temporary bunds • Prioritize re-use of excess spoils and materials in the construction works. If spoils will be disposed, consult with PIU on designated disposal areas • Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies • Place storage areas for fuels and lubricants away from any drainage leading to water bodies • Dispose wastes generated by construction activities in designated sites	Work site	Contractor	Site observations	Weekly	PIU/PMDCSC	NA
• Select a construction methodology that is least disturbing, and appropriate for the in-situ soil condition, and able to complete the construction work in minimum time • Schedule the construction works during	Intake and bridge work sites in water	Contractor	Site observations	Weekly	PIU/PMDCSC	NA

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
low flow period and ensure that works are completed during the same period to prior to onset of monsoon • Erect temporary barriers to form enclosed construction area with least disturbance • Allow adequate time settle the distributed solids to prior to pumping out water; only clear/clarified water shall be pumped back into the water body/river; any silt laden water should be pumped to a silt pond • Employ appropriate erosion and sediment control management practices such as silt traps, barriers, or silt curtains; • Avoid/minimize use of fuels, chemicals and lubricants; ensure no spillage; and have an equipment spill and containment plan and appropriate materials on-site • Clean up the site after construction; excavated soil, debris, material shall be cleared from the river bed/bank properly • Conduct water quality monitoring during construction phase	bodies					
• Avoid stockpiling of excess excavated soils as far as possible • Avoid disposal of any debris and waste soils in the forest areas and in or near water bodies/rivers; • Coordinate with PIU for beneficial uses of excess excavated soils or immediately dispose to designated areas • Prepare and implement Waste Management Plan – it should present how the surplus waste generated will temporarily stocked at the site, transported and disposed properly	-	Contractor	Waste Management Plan review & approval	Once prior to start of construction	PIU/PMDCSC	NA

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
• Plan pipeline work in consultation with the traffic police particularly at semi urban area • Plan work such that trench excavation, pipe laying, and refilling including compacting, at a stretch is completed in a minimum possible time; • Provide for immediate consolidation of backfilling material to desired compaction - this will allow immediate road restoration and therefore will minimise disturbance to the traffic movement • Do not close the road completely, ensure that work is conducted onto edge of the road; allow traffic to move on one line • In unavoidable circumstances of road closure, provide alternative routes, and ensure that public is informed about such traffic diversions; • Plan material and waste routes to avoid times of peak-pedestrian activities • Liaise with Davanagere CC in identifying risk areas on route cards/maps	Work site	Contractor	Work program review Site observations Informal public consultation	Once prior to start of construction Weekly during work	PIU/PMDCSC	NA
• At all work sites public information/caution boards shall be provided – information shall inter-alia include: project name, cost and schedule; executing agency and contractor details; nature and schedule of work at that road/locality; traffic diversion details, if any; entry restriction information; competent official's name and contact for public complaints.	Work site	Contractor	Site observations	Once prior to start of construction	PIU/PMDCSC	NA
• Prepare a Traffic Management Plan – a template is provided for reference at Appendix 7.	Work site	Contractor	Review, approval and on-site implementation	Once prior to start of construction; weekly	PIU/PMDCSC	NA

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
			of TMP	during work		
• No material should be stocked in this area; material shall be brought to the site as and when required • Conduct work manually with small group of workers and less noise; minimize use of equipment and vehicles • No work should be conducted near the religious places during religious congregations • Material transport to the site should be arranged considering school timings; material should be in place before school starts; • Notify concerned schools, hospitals etc 1 week prior to the work; conduct a 30-m awareness program on nature of work, likely disturbances and risks and construction work, mitigation measures in place, entry restrictions and dos and don'ts • Implement all measures suggested elsewhere in this report – dust and noise control, public safety, traffic management, strictly at the sites.	Work site	Contractor	Review, approval and on-site implementation of TMP	Once prior to start of construction; weekly during work	PIU/PMDCSC	NA
• Not to dispose any construction materials in river which may pollute the river water and aquatic fauna, (ii)Spoil Disposal Management Plan (SDMP) will be prepared and implemented to minimise the potential effects of sediment plumes on aquatic habitats, • Use of slow speed boat/ vessel during transportation of materials • Most of the construction should be carried out during dry period	Work site	Contractor	Review, site observation	Once prior to start of construction; weekly during work	PIU/PMDCSC	NA

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
• Before commencing piling, carry-out 'soft-start' for pile driving, slowly increasing intensity of the driving hammer power						
• Leave space for access between mounds of excavated soil • Provide wooden planks/footbridges for pedestrians and metal sheets for vehicles to allow access across trenches to premises where required • Consult affected businesspeople to inform them in advance when work will occur • Address livelihood issues, if any; implement the Resettlement Plan (RP) to address these issues • Provide sign/caution/warning boards at work site indicating work schedule and traffic information; prevent public entry into work sites through barricading and security; and • Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.	Work site	Contractor	Site observations Informal public consultation	Weekly	PIU/PMDCSC	NA
• The use of labour intensive construction measures will be used where appropriate; • Employ local (unskilled) labour if possible; • Training of labour to benefit individuals beyond completion of the subproject; • The training of unskilled or previously unemployed persons will add to the skills base of the area. and • Recruitment of labours will take place offsite.	Work site	Contractor	Review records Worker consultation	Weekly	PIU/PMDCSC	NA
• Develop and implement site-specific Environment, Health and Safety (EHS)	Work site	Contractor	Review and on-site	Once prior to start of	PIU/PMDCSC	Civil Work Contract

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
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) H and S Training for all site personnel; (d) documented procedures to be followed for all site activities; and (e) documentation of work-related accidents; • All trenches deeper than 2 m shall be protected with wooden bracing to avoid safety risks to workers, public and nearby buildings/structures • Ensure that qualified first-aid can be provided at all times. Equipped first-aid stations shall be easily accessible throughout the site; • Provide medical insurance coverage for workers; • Secure all installations from unauthorized intrusion and accident risks; • Provide supplies of potable drinking water; • Provide clean eating areas where workers are not exposed to hazardous or noxious substances • Provide H and 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; • Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted; • Ensure the visibility of workers through their use of high visibility vests when			implementation of EHS Plan	construction; weekly during work		

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
working in or walking through heavy equipment operating areas; • Ensure moving equipment is outfitted with audible back-up alarms; • Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate; • 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. • Overall, the contractor should comply with IFS EHS Guidelines on Occupational Health and Safety (this can be downloaded from http://www1.ifc.org/wps/wcm/connect/9aef2880488559a983acd36a6515bb18/2%2BOccupational%2BHealth%2Band%2BSafety.pdf?MOD=AJPERES) • During work within the river special precaution particularly using safety equipment/ belt and training on swimming and mitigation under emergency situation is necessary.						
• Provide road signs and flag persons to warn of dangerous conditions, in case of location near the road • Overall, the contractor should comply with	Work site	Contractor	Review and on-site implementation of EHS Plan	Once prior to start of construction; weekly	PIU/PMDCSC	Civil Work Contract

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
IFS EHS Guidelines Community Health and Safety (this can be downloaded from http://www1.ifc.org/wps/wcm/connect/dd673400488559ae83c4d36a6515bb18/3%2BCommunity%2BHealth%2Band%2BSafety.pdf?MOD=AJPERES)				during work		
• The contractor should establish and operate the temporary worker camps in compliance with IFC EHS Guidelines specific to workers accommodation ((this can be downloaded from http://www1.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/publications/publications_gpn_workersaccommodation), including the following: • Consult with PIU/ CC before locating workers camps/sheds, and construction plants; ; as far as possible located within reasonable distance of work site • Minimize removal of vegetation and disallow cutting of trees • Living facilities shall be built with adequate materials, and should be in good condition and free from rubbish and other refuge • The camp site should be adequately drained to avoid the accumulation of stagnant water • Provide water and sanitation facilities; water, meeting Indian drinking water standards shall be provided, in adequate quantities (supply of 60- 80 LPCD); all water storage structures must be cleaned regularly and covered properly to avoid any contamination	Workers camp site	Contractor	Site observations and facilities	Once prior to start of construction; monthly during work	PIU/PMDCSC	Civil Work Contract

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
• Provide separate facilities for men and women; sanitary facilities shall be properly build and well maintained; toilet and bath facilities should be provided on basis of 1 per 15 or less persons • Train employees in the storage and handling of materials which can potentially cause soil contamination; • Recover used oil and lubricants and reuse or remove from the site; • Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; • Remove all wreckage, rubbish, or temporary structures which are no longer required • Report in writing that the camp has been vacated and restored to pre-project conditions before acceptance of work.						
Operation						
• Refill and re-compact trenches soil and backfilled sand will be removed to expose the leaking junction or pipe; • Conduct work during non- monsoon period; and • Cover or wet excavated material to prevent dusts. • ,(iv) Contractor will ensure compliance with conditions of the environmental permit/clearance during its operation.	Work site	Davangere CC, O & M contractor	Site observation and document check	Monthly	Davangere CC	Davangere CC budget
• Effectiveness of leak detection and water auditing to reduce the water losses	Work site	Davangere CC, O & M contractor	Site observation and document check	Monthly	Davangere CC	Davangere CC budget

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
• Preparation of O & M Manual	-	Davangere CC, O & M contractor	Document review	Once	Davangere CC	Davangere CC budget
• Minimize the quantity of solids generated by the water treatment process, • Dispose of lime sludge by land application, • Limiting application rates of sludge to minimize the potential for mobilization of metals into plant tissue and groundwater, • Dispose of ferric and alum sludge by controlled land application not near water body, • Assessment of soil, ground water and surface water nearby solid waste disposal	Work site	Davangere CC, O & M contractor	Site observation and document check	Monthly	Davangere CC	Davangere CC budget
• Land application of wastes with high dissolved solids concentrations • Recycle filter backwash into the process • Treat and dispose of reject streams as per CPHEEO norm	Work site	Davangere CC, O & M contractor	Site observation and document check	Monthly	Davangere CC	Davangere CC budget
• Store of chlorine gas in cool, dry, and dark conditions for no more than one month, • Use equipment constructed of corrosion-resistant materials, • Minimize the amount of chlorination chemicals stored on site, • Develop and implement a prevention program that includes identification of potential hazards, written operating procedures, training, maintenance, and accident investigation procedures; • Develop emergency plan for responding to accidental releases	Work site	Davangere CC, O & M contractor	Site observation and document check	Monthly	Davangere CC	Davangere CC budget
• Proper storage and scientific utilization of chemicals utilized in treatment process • Collection of air samples as per EMP	Work site	Davangere CC, O & M contractor	Site observation and document	Monthly	Davangere CC	Davangere CC budget

Mitigation measures	Location	Responsible for Mitigation	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring	Cost of monitoring
			check			
• Complete work insensitive areas quickly; • Consult Municipal authorities, 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.	Work site	Davangere CC, O & M contractor	Site observation and document check	Monthly	Davangere CC	Davangere CC budget
• Regular maintenance of the water supply infrastructure so as to ensure that its functional capacity and efficiency does not reduce.	Work site	Davangere CC, O & M contractor	Site observation and document check	Monthly	Davangere CC	Davangere CC budget
• Undertake regular monitoring and maintenance of water supply infrastructure. • Carry out water quality monitoring	Work site	Davangere CC, O & M contractor	Site observation and document check	Monthly	Davangere CC	Davangere CC budget
• Continued protection plan application during any repairing job as per design mitigation • Non allow of direct disposal of liquid wastes and leakage of oil and lubricants may affect the downstream river water quality, particularly, during dry season • Proper training to the work force for scientific disposal of solid and liquid wastes • Regular maintenance of pumping machinery	Work site	Davangere CC, O & M contractor	Site observation and document check	Monthly	Davangere CC	Davangere CC budget

Table 20: Environmental Quality Monitoring

Sample	Sites	Responsibility	Parameter	Frequency	Agency
Pre-construction and Construction					
Ambient air quality and noise	5 points (intake, pipe laying and WTP)	Contractor	• PM10, PM2.5, SOx, Nox • Monitoring method as prescribed by CPCB	Once before start of construction Quarterly (yearly 4-times) during construction	Contractor
Noise Level	5 points (intake pipe laying and WTP)	Contractor	• Noise level • Day and night time noise (dBA) • Monitoring method as prescribed by CPCB	Once before start of construction Quarterly (yearly 4-times) during construction	Contractor
Water Quality	4 sites (intake,, pipeline crossing sites)	Contractor	CPCB standard parameters	Once before start of construction Quarterly (yearly 4-times) during construction	Contractor
Operation					
Source (raw) water quality	Intake in Tungabhadra River	Operator	Water quality parameters (all including pesticides, heavy metals)	Once prior to start of operation and monthly during operation	Davangere CC through accredited lab/ KSPCB
Monitoring of waste water quality	Back wash from WTP	Operator	Concentration of various parameters shall be within the specific limits by KSPCB	Quarterly	Davangere CC through accredited lab/ KSPCB
Monitoring of supply water	From treatment plant and city supply	Operator	CPCB standard parameters	Quarterly	Davanaere CC through accredited lab/ KSPCB

E. EMP Implementation Cost

231. 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. 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 ULBs/CMCs 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. The EMP cost includes the cost for providing water supply and sanitation facilities for the workers. In addition to this, hard barricades need to be provided at the work sites to prevent any entry of the public or animals into the worksite and to prevent any possible accidents.

Table 20:Cost Estimates to Implement the EMP

	Particulars	Stages	Unit	Number	Rate	Cost (INR)	Costs Covered By
A.	**Monitoring Measures**						
	Air quality monitoring	Pre construction and Construction (pipe laying, WTP area)	Per location	40	10000	4,00,000	Civil works contract
	Noise levels monitoring	Pre construction and Construction (Pipe laying, WTP area)	Per location	40	2500	1,00,000	Civil works contract
	Water quality	Pre construction, Construction and Operation (Treated water, supply water)	Per location	32	10000	3,20,000	Civil works contract
	Subtotal (A)					**8,20,000**	
B.	**Capacity Building**						
1	Introduction and sensitization to environment issues	Pre-construction	Lump sum			75,000	PMU
2	EMP implementation	Construction	Lump sum			225,000	PMU
3	Plans and Protocols	Construction	Lump sum			225,000	PMU
			Lump sum			75,000	Civil works contract
4	Experiences and best practices sharing	Construction/ Post-	Lump sum			75,000	PMU

		Construction					
5	Contractors Orientation to Workers on EMP implementation (OH&S, core labor laws, spoils management, etc)	Prior to dispatch to worksite	Lump sum			40,000	Civil works contract
	Subtotal (B)					**7,15,000**	
C.	**Civil Works**						
1	Construction of shelters for workers.	Construction	Lump sum			5,00,000	Civil works contract
2	Providing Water Supply Facility for the workers	Construction	Lump sum			2,00,000	Civil works contract
3	Providing Sanitation Facility for the workers	Construction	Lump sum			2,00,000	Civil works contract
4	Barricades at the worksite (MS Sheet of 20 gauge of size 5 x 3 meters, having vertical support by MS flat (65 x 65 x 6 mm) along the sides and at 1.5 m and 3.5m, horizontal support by MS flat (65 x 65 x 6 mm) along the sides and at the center, supported by 50mm MS hollow pies of 4 meter height at the ends and at the center.	Construction	Per unit	10	14,000	1,40,000	Civil works contract
5	Retro reflectorized Traffic Signs as per IRC:67, M 15 grade, 80 x 60 mm rectangular; fixed over Aluminum sheeting supported on MS angle iron.	Construction	Per unit	6	3500	21,000	Civil works contract
5	Retro reflectorized Traffic Signs as per IRC:67, M 15 grade, 60 x 60 mm square; fixed over Aluminum sheeting supported on MS angle iron.	Construction	Per unit	3	3000	18,000	Civil works contract
	Sub Total (C)					**10,79,000**	
	Total (A+B+C) (INR)					**26,14,000**	

VII. Findings and Recommendation

A. Findings and Recommendation

232. The process described in this document has assessed the environmental impacts of all elements of the infrastructure proposed under the Davangere bulk Water Supply Subproject. Potential negative impacts were identified in relation to design, location, construction and operation of the improved infrastructure. Mitigation measures have been developed in generic way to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result some measures have already been included in the outline designs for the infrastructure. This means that the number of impacts and their significance has already been reduced by amending the design.

233. All the subproject sites are either situated on government owned vacant land parcels or along the public roads. No private land acquisition is required for the project. Since most of the project locations are within the village environment expected impacts are comparatively less. Also lands near and within the project areas are vacant, impact on habitation is very less. Subproject sites are carefully selected to avoid encroachment into sensitive areas and minimise the impacts on people livelihoods and homestead. New intake well will be constructed in River Tungabhadra near the existing intake well and new jack well will be constructed adjacent to the existing jack well on the bank of Tungabhadra near the intake well. Intake well is a small structure (Diameter 9 m), and therefore there are no significant impacts on the river. There may be temporary impacts during construction. New WTP will construct within the existing WTP campus at Bath in a vacant land, and therefore no impacts envisaged. Proposed raw water and clear water pipelines are proposed along the roads, which are mostly in rural areas, where there are limited activities. There may be impacts during pipeline construction in semi urban areas, and along the main roads. Available Tungabhadra River flow data (2009-12) indicates, although it has significant seasonal flow fluctuations, the river carries adequate flows throughout the year to provide to meet the project demand of 160 MLD (which is about 7-11% of lean season flow). Flow is also adequate to provide supply other water supply schemes located in the vicinity (for towns of Harihar, Byadgi and Ranebennur and others villages that depend on this river). While monsoon season flows are very high, the lean season (winter and summers) is supplemented by discharge from the upstream Bhadra dam to provide adequate flow to meet the downstream requirements including that of river ecosystem. Therefore no significant impacts envisaged on the river.

234. During the construction phase, impacts mainly arise from the need to dispose waste soil and from the disturbance of residents, businesses, traffic and important buildings (within semi urban environment) by the construction work. These are common impacts of construction in urban areas, and there are well developed methods for their mitigation. Since the water lines are laid along the roads, this great potential to create disturbance. To minimize this, the contractor should develop a Construction Management Plan including Method Statement, which should be approved by the PIU prior to start of work, and should conduct the work strictly in line with the Method Statement.

235. There were limited opportunities to provide environmental enhancements, but certain measures were included. For example it is proposed that the project will employ in the workforce people who live in the vicinity of construction sites to provide them with a short-term economic gain and ensure that people employed in the longer term to maintain and operate the new facilities are residents of nearby communities.

236. Once the system is operating, the facilities will operate with routine maintenance, which should not affect the environment. As far the water supply network is concerned, the operation and maintenance will comply with the standard operating procedures. SOPs / O&M Manual will be developed during the construction stage and the staff will be provided with necessary training.

237. The citizens of the Davanagere City will be the major beneficiaries of this subproject. In addition to improved environmental conditions, the subproject will improve the over-all health condition of the town. With assured, adequate good quality water supply the water borne diseases will be reduced, the loss productive days will be reduced and over all community health and environmental conditions will be improved. So people should spend less on healthcare and lose fewer working days due to illness, so their economic status should also improve.

238. 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- and off-site, document checks and interviews with workers and beneficiaries and any requirements for remedial action will be reported to the PMU.

239. Finally, stakeholders were involved in developing the IEE through face-to-face discussions and on site meetings, after which views expressed were incorporated into the IEE and the planning and development of the project. The IEE will be made available at public locations in the city and will be disclosed to a wider audience via the ADB website. The consultation process will be continued and expanded during project implementation to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation.

VIII. Conclusion

240. The subproject is unlikely to cause significant adverse impacts. The potential adverse impacts that are associated with design, construction and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures.

241. Based on the findings of the IEE, the classification of the Project as Category “B” is confirmed, and no further special study or detailed EIA needs to be undertaken to comply with ADB SPS (2009) or GoI EIA Notification (2006).

APPENDICES

Appendix 1: REA Checklist

RAPID ENVIRONMENTAL ASSESSMENT (REA) CHECKLIST–Water Supply Subproject

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 / Karnataka Integrated Urban Water Management Investment Program
Sector /Division: Urban Development

Screening questions	Yes	No	Remarks
a. Project siting Is the project area			
▪ Densely populated?		√	Davangere is not densely populated
▪ Heavy with development activities?	√		Heavy development activity is noted at Davangere
▪ Adjacent to or within any environmentally sensitive areas?		√	No as such environment sensitive area nearby
• Cultural heritage site		√	Few religious places are located within Davangere city. No cultural heritage site is located nearby the project area
• Protected area		√	No protected area nearby
• Wetland		√	No designated wetland within the city

Screening questions	Yes	No	Remarks
• Mangrove		√	Not applicable
• Estuarine		√	Not applicable
• Buffer zone of protected area		√	Not applicable
• Special area for protecting biodiversity		√	No Special area for protecting biodiversity
• Bay		√	Not applicable
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 expected as per site conditions
▪ Impairment of historical/cultural monuments/areas and loss/damage to these sites?		√	No impact expected. No cultural monuments and historical sites near project location
▪ Hazard of land subsidence caused by excessive ground water pumping?		√	There is no ground water exploitation for proposed water supply improvements for Davangere CC. Water from the river to be used and with no risk of land subsidence
▪ Social conflicts arising from displacement of communities?		√	Project area is in government land and no displacement of communities is planned.
▪ Conflicts in abstraction of raw water for water supply with other beneficial water uses for surface and ground waters?		√	Sufficient water is available from perennial water source from Tungabhadra river There is no ground water abstraction as a part of this sub project
▪ Unsatisfactory raw water supply (e.g. excessive pathogens or mineral constituents)?		√	The existing raw water supply is supposed to continue. Water testing should be done before treatment and after treatment

Screening questions	Yes	No	Remarks
▪ Delivery of unsafe water to distribution system?		√	Regular water quality surveillance will be done so the delivery of unsafe water will be prevented. The water treatment plant will ensure all quality criteria set by CPCB for drinking water standards.
▪ Inadequate protection of intake works or wells, leading to pollution of water supply?		√	Proper design criteria will be implemented. Davangere CC will adequately protect water intake
▪ Over pumping of ground water, leading to salinization and ground subsidence?		√	There is no ground water exploitation required for the proposed improvements in Water supply.
▪ Excessive algal growth in storage reservoir?	√		The CMC has to ensure that the storage reservoir will be cleaned regularly to avoid excessive algal growth. This is not work component under bulk water supply
▪ Increase in production of sewage beyond capabilities of community facilities?		√	The proposal involves ensuring regular supply of 130 lpcd for the public which will not result in excess sewage production. New STP plant is proposed under ongoing works under same program.
▪ Inadequate disposal of sludge from water treatment plants?		√	The CC has to ensure that the sludge is removed from water treatment plants regularly to meet standards of treated water. A Sludge management plan will be prepared and followed.
▪ Inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities?		√	A green belt area will be developed surrounding the boundary wall of the treatment plant. Trees with thick canopy will be planted in order to reduce the noise levels reaching the nearby surroundings.
▪ Impairments associated with transmission lines and access roads?	√		Temporary impairments are anticipated along the new transmission line routes during construction stage. No new access roads are proposed.

Screening questions	Yes	No	Remarks
▪ Health hazards arising from inadequate design of facilities for receiving, storing, and handling of chlorine and other hazardous chemicals.		√	All the norms and guidelines for operation and maintenance of the treatment plan, including handling chlorine will be followed. Guidelines for handling and chlorine is added as a part of this IEE Chlorine dosing will be done through chlorinator and chlorine safety measures and facilities are proposed to be implemented as part of the subproject as per MSIHC rules, 1989 and its amendment in 2010.
▪ Health and safety hazards to workers from the management of chlorine used for disinfection and other contaminants?		√	Operation and Maintenance recommended by the manufacturers, and the existing norms and guidelines for ensuring the safety of workers will be followed.
▪ Dislocation or involuntary resettlement of people		√	There is no resettlement of people for project implementation.
▪ Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		√	The contractor will be utilizing the local labour force so there is no possibility for social conflict regarding employment opportunities during construction stage.
▪ Noise and dust from construction activities?	√		All the construction machineries employed have to comply with noise emission standards suggested by Central Pollution Control Board. Dust generation shall be suppressed with sprinkling of water along the construction area.
▪ Increased road traffic due to interference of construction activities?	√		A temporary phase of disturbance can arise during the construction activities. A traffic management plan will be prepared before the construction activities at site.
▪ Continuing soil erosion/silt runoff from construction operations?		√	The excavated soil will be stockpiled at appropriate locations and will be used for refilling with better compaction.

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?		√	A qualified Contractor with required experience is proposed to be selected through a competitive bidding process to ensure prudent industry standards for delivery of wholesome water to the customers. The Contractor shall prepare an O&M manual for approval of the Employer and training will be given to the staff operating the plant to ensure proper O&M.
▪ Delivery of water to distribution system, which is corrosive due to inadequate attention to feeding of corrective chemicals?		√	Online monitoring of process water is proposed as part of the subproject and ensured by the Contractor.
▪ Accidental leakage of chlorine gas?		√	Chlorine dosing will be done with the help of chlorinators of reputed makes. Continuous training in chlorine handling will be ensured for the operating staff. Adequate measures will be taken to prevent the exposure of workers to chlorine gas. Regular monitoring will be done to ensure the implementation of EMP in an efficient manner.
▪ Excessive abstraction of water affecting downstream water users?		√	Water availability at the proposed site of intake wells in River Tungabhadra is high and sustainable during all seasons and hence extraction will not affect any downstream users.
▪ Competing uses of water?		√	No as such impact is expected
▪ Increased sewage flow due to increased water supply	√		Sewage (wastewater) volume will definitely increase with the increase in water supply from new areas and continuous supply; but will decrease over time as users adjust.
▪ Increased volume of sullage (wastewater from cooking and washing) and sludge from wastewater treatment plant	√		CMC will put in place advance plans to improve the drainage in the city to meet the increased discharge of sullage. The scope of the present work does not involve wastewater treatment plant. Separate sewage treatment plant considered within the program under different package

Screening questions	Yes	No	Remarks
▪ Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	Hardly 50-60 labourers will be work during construction, therefore temporary burden to social infrastructure is insignificant In case of setting up of labour camp permission will be obtained from CC. Water supply and sanitation arrangement will be made as per hygienic norms
▪ Social conflicts if workers from other regions or countries are hired?		√	Preference will be given to the local workers in order to minimize the chances of such conflicts.
▪ 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?		√	No explosive will be used. Fuel and chemicals will be stored as per storage and import of hazardous chemical rules 1989 and safety norms
▪ 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?		√	No such impact is anticipated, in case of the proposed sub-project In case of pipe laying community safety will be considered as per EMP All structural design will be as per standard design for earthquake hazard

A Checklist for Preliminary Climate Risk Screening

Country/Project Title: India/ Karnataka Integrated Urban Water Management Investment Program

Sector: Urban Development

Subsector: Water Supply

Division/Department: Karnataka Urban Infrastructure Development and Finance Corporation (KUIDFC)

Screening Questions		Score	Remarks[4]
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?	0	
	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	
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	
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s) ?	0	
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	

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): Low Risk

[4] 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.

Appendix 2. National Ambient Air Quality Standards

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

Appendix 3. Applicable Noise Standards

Area code	Category of area/zone	Limit in dB (A)	
		Day time	Night time
1	Industrial area	75	70
2	Commercial area	65	55
3	Residential area	55	45
4	Silence zone	50	40

Appendix 4. Salient Features of Major Labor Laws

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

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

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

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

(ix) **Payment of Bonus Act, 1965 -** The Act is applicable to all establishments employing 20 or more workmen. The Act provides for payments of annual bonus subject to a minimum of 8.33 % of wages and maximum of 20 % of wages to employees

drawing Rs. 3,500/- per month or less. The bonus to be paid to employees getting Rs. 2,500/- per month or above up to Rs.3,500/- per month shall be worked out by taking wages as Rs.2,500/- per month only. The Act does not apply to certain establishments. The newly set up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of the Act.

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

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

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

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

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

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

Appendix 5: Source SUSTAINABILITY of River Tungabhadra

Source suistanability of River Tungabhadra

General Information

The Tungabhadra (TB) River is a composite river of two east flowing rivers namely – The Tunga andThe Bhardra. The Tunga rises at Gangamula in the Gangrikal hill ranges north of Kudremukh. TheBhadra rises near Samse in the Aroli Hill range of Kudremukh. The Tunga River initially flows northeast, turns north and subsequently takes an easterly course. The Bhadra River also initially flows easterly, changing course to north and joins the Tunga at KUDLI in Shimoga district. The Tungabhadra Riverflows up to 298 km and is formed by the confluences of the Tunga and Bhadra Rivers at Kudli of Shimoga district then flows through Karnataka and some parts of Andhra Pradesh and joins the Krishna River. The catchment and command area comprises 27 taluks of 7 districts and covers an area of48,000 Sq. km.

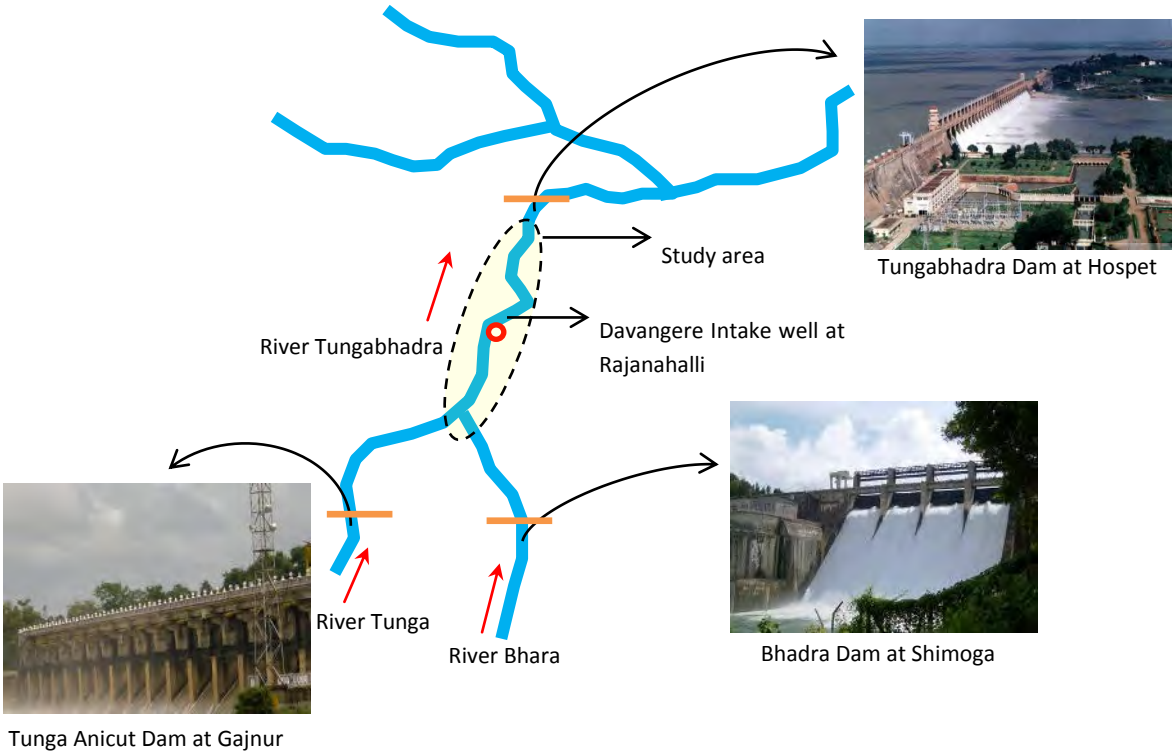


Figure **Error! No text of specified style in document.**: Map of study area, Tungabhadra River

Table 1: Details of various administrative units in TB basin

Bhadra Catchment/Comman	TungaCommand	Tungabhadracommand	ClosetoTBDam
Chikamagalore	Koppa	Honnali	Bellary
N.R.Pura	Sringeri	Channgiri	Hospet
Tarikere	Theerthahalli	Hanagal	Sirugoppa
		Haveri	Dadurga
		Harikerur	Gangavathi
		Ranebennur	Koppal

Bhadravathi	Shimoga	Shiggoan	Raichur
		Davangere	Sindhunur
		Harihar	
		H.B.Halli	
		Harappanahalli	

Source: Water Resource department

Ecology of the River

As per the study conducted by the Institute for Social and Economic Change (ISEC), the entire river stretch can be divided into three distinct regions, viz:

a) Region of Surplus

This area comprises the area from the point of origin to the Tunga Anicut and Badhra Reservoir Project.Somavahini River, draining the area inside the crater passes through a narrow gap in the mountain walland joins Bhadra River at Hebbe. Bhadra River is dammed up at BR project area forming a vast (about 200 sq. km) reservoir whose backwaters extend nearly 13 kms backwards. In addition to these majorwater sources, there are numerous streams and tanks scattered all over the area, some of them beingperennial sources.

b) Controlled Flow Region

This is the area from BRP till TBR at Hospet. During the monsoon period, this region has natural flowswhile in lean periods the flows are governed by agreement with the TB board. Intense cultivation ispracticed in this region. Return flows from urban settlements and Industrial units contribute to theriverin flow, but these Return flows are of poor quality, for instance, from Bhadravathi (firsturban settlement after Bhadra reservoir) to Kudli, confluence.

c) Region of Deficit

This region is marked from Tungabhadra reservoir till the confluence with River Krishna. Downstream TB Dam there is 12 anicuts on the left and right banks of the river to facilitate water extraction forirrigation.The water flow regime downstream hasundergone extreme changes and for some years it has had insignificant flow.

Flow status in the River Basin

From the Table below it can be ascertained that there is sufficient flow within the Tungabhadra River throughout the year and hence Tungabhadra River is sustainable source for Davangere 24 x 7 Water supply scheme.

Water Availability

The distance from Honnalli river gauging station to the Byadgi water supply intake point is about 32.5 Km, the distance from Honnalli river gauging station to the Davanagere water supply intake point is about 42 Km and distance from Honnalli river gauging station to the Harihara water supply intake point is about 45.5 Km.

The water available in difference months from the year 2009 to 2013 at the Honnalli river gauging station about 42 Km from the intake work at Rajanahally for Davanagere water supply scheme is provided in annexure 1. The details are downloaded from the Central water commission web site http://india-wris.nrsc.gov.in.

As seen from the annexure-1, the minimum average water available in the month of Apr-May based on daily discharge data is 2369 MLD and the maximum water available

at the station is 4263 MLD. The water supply requirement for the year 2046 for Davanagere is 160 MLD, Harihra is 32.7 MLD, Byadgi is 9.2 MLD and Ranebennur town is 33.50 MLD. The total water demand for the four towns is about 236 MLD only and this can be met from the river discharge flow.

Also based on the estimation of water availability at 50 %, 75 % and 95 % dependability at this nearest river gauging station for the month of April based on the data for the years 2010 to 2013 is 3116 MLD, 2679 MLD and 2328 MLD respectively.

The dependability is studied for the summer season months of April and May. Also based on the estimation of water availability at 50 %, 75 % and 95 % dependability at this nearest river gauging station for the month of May based on the data for the years 2010 to 2013 is 3193 MLD, 2689 MLD and 2398 MLD respectively. It is also to be noted that the distance from the river gauging station upto the final intake point of four towns is only 45 Km.

It is also to be noted that from the daily discharge data, that water is flowing on all the days showing that the river is sustainable source for Byadgi, Harihara and Davangere 24 x 7 Water supply scheme.

Table 2: Flow (MLD) measurement data of River Tungabhadra basin (Source: Water Resource Information System of India)

Gauge station	Year	June	July	August	September	October	November	December	January	February	March	April	May
Shimoga	2009	1,132	102,718	35,462	35,717	19,558	5,759	2,114	391	-	-	-	-
	2010	8,290	43,729	54,070	32,636	17,192	10,376	2,450	-	-	-	-	-
	2011	21,991	58,198	55,191	45,656	10,519	5,190	2,239	528	287	245	373	237
Honalli	2009	2,935	98,395	40,453	54,360	33,240	8,625	3,631	4,731	2,268	2,677	3,431	4,405
	2010	9,412	44,654	52,425	41,570	29,496	24,516	6,755	2,939	2,402	2,083	4,175	3,822
	2011	21,707	55,962	58,766	64,898	14,858	5,803	2,504	1,436	4,828	3,133	4,011	2,745
Holehonnur	2009	2,167	15,607	9,123	19,013	11,999	3,237	1,703	4,802	2,814	3,442	4,661	5,335
	2010	3,936	9,126	8,549	7,400	9,747	13,888	5,046	2,186	4,097	3,284	5,998	5,241
	2011	2,693	8,822	9,556	19,224	7,173	2,770	890	2,150	7,803	5,050	5,492	3,121
Haralahalli	2009	4,204	91,761	42,519	55,407	36,816	10,885	4,341	4,369	1,252	1,049	2,570	5,610
	2010	8,739	35,916	54,370	48,538	37,735	33,176	7,655	2,548	378	-	3,594	3,806
	2011	19,462	49,792	49,304	60,602	15,878	6,086	2,667	320	2,472	1,422	4,298	3,848

Note: Honnali is located at a distance of 42 Km from Rajanahalli on the upstream of River Tungabhadra.

Annexure 1

Tungabhadra River Discharge from (WRIS WebGIS-CWC WEB SITE)

Discharge Data: Honnali

Period: 2009-2010

Date/ Months	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Parameter	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)
1	2255040	2894400	78848640	50466240	62674560	9953280	6955200	15258240	2194560	2030400	3300480	4579200
2	2393280	3032640	96422400	49714560	50760000	11232000	5201280	16320960	2557440	2168640	3084480	4397760
3	2643840	3533760	56980800	61525440	55693440	9927360	4484160	7283520	2557440	2185920	2816640	4190400
4	2410560	50414400	40703040	55296000	179712000	7905600	4328640	3456000	2557440	1961280	2643840	4034880
5	1900800	66700800	51796800	78494400	154569600	5425920	3620160	4760640	2574720	1969920	2626560	4052160
6	1944000	75193920	51114240	280022400	81164160	5270400	3525120	7663680	2583360	2263680	2600640	4086720
7	1797120	99360000	37091520	182234880	36262080	7966080	3257280	6998400	2436480	2229120	2332800	4164480
8	1797120	69984000	30533760	98012160	30352320	8631360	3248640	7447680	2393280	2280960	2263680	4078080
9	2116800	72023040	32797440	64048320	21582720	5961600	4596480	7940160	2384640	2324160	2272320	4276800

10	8259840	99239040	37955520	46612800	20528640	7032960	4216320	6359040	2505600	2324160	2272320	4302720
11	7171200	92491200	26559360	32840640	18506880	11335680	3611520	4855680	2583360	2324160	2367360	4700160
12	4795200	61810560	19517760	8812800	14852160	13063680	2790720	3499200	2566080	2108160	2358720	4276800
13	3663360	69068160	31423680	15750720	11767680	18178560	2514240	2332800	2401920	2142720	2540160	4760640
14	2782080	67806720	16640640	22619520	45627840	9702720	2868480	1961280	2574720	1710720	2332800	4069440
15	2643840	133781760	5270400	23587200	28745280	8631360	2937600	1788480	2427840	3879360	4993920	3888000
16	3317760	270138240	3749760	28391040	22757760	7560000	3697920	1607040	2427840	3957120	4259520	3309120
17	2514240	315446400	18878400	32037120	20485440	6989760	3663360	2643840	2453760	4043520	4034880	2989440
18	4492800	271900800	54086400	11232000	16277760	6575040	3697920	3188160	2522880	3879360	4786560	7473600
19	2782080	232761600	35743680	60471360	10670400	10713600	3922560	3196800	2410560	3119040	4812480	5451840
20	3352320	141212160	43200000	70485120	9132480	11439360	3905280	3421440	2522880	2756160	4985280	7473600
21	2782080	89449920	30983040	34655040	12191040	7801920	3948480	3404160	2367360	2643840	4881600	6877440
22	2384640	73707840	17400960	42223680	12035520	5970240	3775680	3179520	2324160	2592000	3153600	5313600
23	2557440	81846720	28019520	55563840	11076480	5227200	3594240	2185920	2332800	2246400	2816640	4527360
24	2419200	70459200	36408960	63313920	7810560	11698560	2764800	2790720	2350080	2453760	2877120	3792960
25	2289600	52012800	28728000	48098880	8631360	15716160	1831680	2825280	2548800	2626560	3663360	3723840
26	2289600	39182400	92067840	25557120	8277120	9011520	1304640	3015360	2160000	2669760	4138560	3749760
27	1961280	34663680	53991360	20891520	10687680	6471360	1010880	2730240	2160000	2609280	4147200	3309120
28	1632960	29868480	47770560	13711680	8208000	4795200	976320	2453760	2160000	2643840	4881600	2868480
29	2177280	53654400	35233920	27907200	7456320	4432320	941760	2453760	0	2410560	4639680	2652480

30	2522880	108552960	39182400	26231040	8933760	4138560	1270080	2747520	0	2332800	4043520	2540160
31	0	119664000	34482240	0	9771840	0	10480320	2160000	0	3421440	0	2237760
Q(cubic meters per month)	2935008	95221161	39147840	54360288	32167835	8625312	3514250	4578364	2346207	2590606	3430944	4262865
Q (MLD)	2935	95221	39148	54360	32168	8625	3514	4578	2346	2591	3431	**4263**

Tungabhadra River Discharge from (WRIS WebGIS-CWC WEB SITE)

Discharge Data: Honnali

Period: 2010-2011

Date/Months	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**		**May**
Parameter	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**
1	3464640	8190720	1.08E+08	1.26E+08	42569280	9685440	9970560	4769280	1866240	2712960	2764800	4147200
2	2816640	4847040	78390720	57888000	39882240	10169280	9573120	4320000	1883520	2617920	3006720	5400000
3	3672000	3533760	57965760	48504960	55157760	10506240	9685440	4155840	1978560	2056320	3827520	5054400
4	3214080	34171200	38568960	36270720	1.01E+08	14299200	9650880	4302720	1961280	1840320	3741120	4466880
5	2782080	29514240	1.29E+08	50889600	79410240	16320960	9529920	4449600	1952640	1866240	3792960	4069440
6	2721600	31250880	74053440	33704640	1E+08	17297280	9547200	4596480	3049920	1883520	3836160	3628800
7	2574720	52937280	45195840	40651200	39493440	40219200	9573120	4138560	2877120	1840320	4207680	3248640

8	2376000	19491840	93312000	41057280	44608320	31008960	8700480	3300480	2903040	1719360	4570560	2980800
9	2185920	28512000	75902400	82088640	31942080	47796480	9236160	2617920	2626560	1442880	4579200	2833920
10	1944000	22109760	53766720	56358720	20321280	33445440	6315840	3024000	2617920	1512000	4406400	2652480
11	1814400	16865280	24865920	54432000	19535040	21738240	5736960	2220480	2894400	1918080	2877120	2678400
12	2894400	5520960	29764800	47485440	18092160	41757120	7093440	1944000	2669760	1944000	3689280	2773440
13	2142720	15102720	29833920	39242880	16450560	83842560	7957440	1874880	2687040	2013120	3300480	2859840
14	2384640	7482240	33955200	28788480	17504640	53352000	3888000	1883520	2833920	1909440	3041280	3706560
15	2471040	3931200	44219520	27216000	17599680	26334720	2462400	1814400	2868480	1857600	3689280	3905280
16	2946240	3326400	22127040	13789440	16614720	21384000	2574720	1641600	2617920	1874880	5460480	5132160
17	3153600	4881600	30395520	32892480	16502400	20113920	4147200	1831680	2566080	1598400	5460480	5011200
18	49127040	16148160	32158080	22101120	17755200	26576640	4121280	2427840	2678400	1451520	4345920	5201280
19	31000320	24287040	36305280	28391040	15292800	29514240	4147200	2557440	2617920	1356480	4043520	4708800
20	23267520	15655680	23284800	17081280	14722560	22282560	3939840	2574720	2410560	1468800	3222720	4199040
21	13754880	53714880	20736000	15327360	15621120	17599680	4311360	2566080	2687040	1382400	3248640	4060800
22	11136960	50431680	45187200	17677440	15197760	14437440	5391360	2574720	2704320	1391040	3741120	3507840
23	7957440	58449600	32952960	28209600	14402880	16675200	5304960	2548800	2609280	2626560	6281280	3265920
24	4423680	41506560	51926400	48833280	18541440	17435520	5857920	2609280	2609280	2643840	6791040	2903040
25	3170880	33575040	56851200	51278400	22559040	22455360	7594560	2635200	2617920	2799360	6307200	2592000
26	2496960	88637760	65439360	36936000	15206400	19275840	7292160	2756160	2687040	2168640	5037120	2557440
27	2479680	1.04E+08	51088320	48453120	14506560	14878080	6082560	2790720	2833920	2073600	4207680	3075840

28	49204800	82373760	41109120	48453120	9123840	11923200	5935680	2488320	2756160	2229120	4104000	3335040
29	25790400	1.65E+08	45187200	47675520	13435200	11957760	5918400	2505600	0	2583360	4026240	3196800
30	12985920	1.6E+08	47770560	19422720	10618560	11188800	5944320	2272320	0	2851200	3646080	3231360
31	0	1.54E+08	53369280	0	11335680	0	5166720	1978560	0	2851200	0	4268160
Averate Q(cubic meters per month)	9411840	43213099	50733523	41569632	28544052	24515712	6537135	2844232	2485043	2015628	4175136	3698477
Q (MLD)	9412	43213	50734	41570	28544	24516	6537	2844	2485	2016	4175	**3698**

Tungabhadra River Discharge from (WRIS WebGIS-CWC WEB SITE)

Discharge Data: Honnali

Period: 2011-2012

Date/Months	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**
Parameter	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**
1	4078080	21643200	36478080	110073600	18463680	9763200	4648320	872640	2842560	10722240	2056320	4803840
2	3991680	17642880	32158080	228026880	16657920	9244800	3913920	907200	2514240	10558080	2358720	3594240
3	4587840	13037760	64929600	190840320	14135040	8415360	6350400	924480	2410560	8095680	2514240	2617920
4	4311360	23016960	92741760	215913600	12018240	8259840	6514560	820800	2419200	4095360	2756160	2376000

5	3188160	16891200	80049600	147700800	11508480	8510400	3853440	622080	2393280	2963520	2609280	2410560
6	2419200	21548160	100396800	88197120	11197440	12251520	2393280	604800	2574720	2488320	3049920	2125440
7	1961280	22680000	101088000	67314240	9875520	13530240	2064960	613440	3300480	2548800	2859840	2229120
8	2168640	23803200	117158400	67659840	10730880	8372160	2816640	527040	2825280	2393280	2609280	2134080
9	4121280	24848640	89631360	78969600	7395840	9728640	2885760	397440	2833920	2263680	2522880	2160000
10	7948800	22066560	71305920	59996160	7119360	8354880	2825280	397440	3326400	2289600	2540160	2229120
11	10022400	8225280	62441280	63720000	4993920	8519040	2747520	622080	3343680	2255040	2712960	2471040
12	12882240	18368640	46578240	40184640	22222080	5374080	2790720	622080	2972160	2401920	2730240	2920320
13	15621120	16917120	63599040	46984320	15724800	4907520	2643840	673920	2998080	2445120	2756160	5158080
14	26213760	18420480	59071680	38983680	30084480	4622400	2609280	777600	3015360	2013120	2678400	5114880
15	22602240	37730880	46301760	42154560	27129600	4872960	2635200	872640	2859840	2039040	2540160	4656960
16	45351360	33523200	38871360	41662080	37869120	4665600	2643840	786240	2989440	2056320	2548800	3836160
17	28278720	91065600	26853120	99843840	19716480	3792960	2419200	673920	8095680	2151360	2280960	3144960
18	18100800	195480000	43070400	49325760	27950400	2911680	2324160	613440	8069760	2194560	2306880	2773440
19	16839360	164272320	31700160	36538560	19517760	2280960	2134080	786240	9573120	2168640	2505600	2419200
20	23137920	161161920	28062720	39476160	16545600	2272320	1382400	1373760	6410880	2496960	3352320	2056320
21	15785280	107118720	34706880	32719680	8199360	2298240	1088640	1494720	4872960	2488320	3473280	2134080
22	9521280	110324160	57196800	27250560	18636480	2635200	1010880	1805760	3265920	2203200	2825280	2082240
23	8009280	71297280	30862080	27388800	6177600	2626560	1010880	1702080	7931520	2194560	2738880	2099520
24	54216000	73206720	35700480	20381760	4259520	4389120	1097280	1831680	9408960	2237760	4570560	1952640

25	40927680	96396480	41152320	19353600	10627200	3879360	1391040	3231360	8268480	2324160	5149440	1840320
26	36123840	84196800	28581120	16735680	10333440	2851200	1373760	3283200	9573120	2177280	4708800	1702080
27	71383680	38378880	35648640	13763520	8648640	2911680	1382400	3637440	8216640	1823040	4734720	1503360
28	57214080	38612160	35268480	13443840	8121600	3360960	1391040	2894400	8069760	1831680	12856320	1805760
29	61076160	39329280	50518080	11767680	8035200	3913920	1123200	2825280	7464960	1935360	19344960	1952640
30	39139200	25211520	52721280	10558080	12726720	4561920	907200	2980800	0	1995840	7629120	2099520
31	0	42431040	128131200	0	9115200	0	751680	2894400	0	2125440	0	1935360
Averate Q(cubic meters per month)	21707424	54156356	56870152	64897632	14378632	5802624	2423381	1389368	4994516	3031525	4010688	2656103
Q (MLD)	21707	54156	56870	64898	14379	5803	2423	1389	4995	3032	4011	**2656**

Tungabhadra River Discharge from (WRIS WebGIS-CWC WEB SITE)

Discharge Data: Honnali

Period: 2012-2013

Date/Months	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**March**	**Apr**	**May**
Parameter	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**	**Q(cubic meter per day)**
1	1955578	20649600	30774125	57175114	11205907	4458499	1669334	640829	1305245	2371075	2492035	3390077

2	1657584	20046787	25591766	102729600	17383680	21485693	1632096	584755	1235779	2927578	2475706	3307478
3	1041984	18627062	26062301	61171373	12583469	34157722	1533859	591149	1188000	2974752	2350771	3022877
4	763776	66727584	40579229	72460397	11024813	27077760	1520554	664330	1576282	2773094	1948320	2767651
5	499133	26055043	138240000	77048323	14660870	13836614	3511987	691114	1827706	2765491	1773446	2906496
6	479434	21495802	86650387	59391187	6701270	7829309	3355344	729130	1694650	2217802	1464134	2623190
7	436493	19190822	174017117	44692128	6397056	7731504	2404166	634954	1224202	1704154	1355616	2787869
8	399946	17910720	270074045	35045050	8815824	12134016	1771373	572314	1199232	1554509	1354925	3074890
9	407981	12787632	186556003	34326720	7498397	8862134	1228608	545011	1581638	1563408	1345594	2362781
10	375754	8857728	127089562	20887805	5052931	8738496	960854	547344	1632096	1536192	1316909	1893888
11	430445	12269664	137225405	27600912	7409664	8024832	917395	1265414	2197843	1571875	1355616	2259014
12	385776	18164045	118022400	34239197	7668432	9288000	837821	1020211	2337379	1563322	1563062	1780704
13	390442	12469075	94172198	33865517	6083770	8942832	1256602	1033344	2321395	1641341	1806710	1391126
14	301882	6543590	60552835	41485046	5857056	7341235	2060208	996192	2486160	1653523	1832544	1181088
15	296179	18982080	21219840	31447094	5194973	7377523	2144362	1005350	2853878	2016835	1452816	1075939
16	295229	10758355	33031152	26870400	4612550	6034003	1937952	996451	3048970	2206051	1284250	1066781
17	264038	3929386	31454957	26256442	4202582	5064163	2207347	1010621	3113856	2102112	1273363	930614
18	298512	10317110	32004806	13903402	3494362	4004640	1442275	938822	3536525	2315866	1330560	1063152
19	306634	12624854	28157760	22567680	3382733	3444854	1340928	732326	4374950	2386973	1425600	1033344
20	507168	5265043	79030080	19474042	3397766	5868115	1082851	759802	4387219	2422915	6634310	2378678
21	514771	14058144	34160918	14230858	4649184	5008090	978307	652320	4042397	2300400	5961600	2933798

22	516845	35985600	25933997	8656330	9672912	4342810	923011	579571	4445366	2290637	3358368	15427238
23	536544	65838528	17213040	13901760	7788874	6599405	890784	544752	7524662	2296080	2459290	5848934
24	21219840	55942013	16581802	10744099	6507648	5917622	709171	548813	5658336	2158272	2454624	2836771
25	10839139	22750762	16879018	10374653	6482678	3741984	823565	925344	2825280	2136154	2455402	2158272
26	4841856	32342544	20649600	9120816	6075302	2461363	753667	1148256	2373494	2116973	2848003	1583712
27	25767418	44420141	31806000	11091427	5440608	2177798	703210	1228608	2385245	2292883	3106685	1427587
28	15232925	107350272	51272784	6810134	4094496	1812672	759456	1263168	2271024	2415830	3328992	2249424
29	9067939	98668800	35780832	10200038	3342211	2044138	1026778	1264637	0	2516832	3409344	2262125
30	6910186	91769155	74329056	10920960	3362170	1655078	856656	1519258	0	2525818	3857069	2131747
31	0	36808646	50027933	0	3351283	0	772157	1454803	0	2579040	0	1797984
Q(cubic meters per month)	3564714	30632471	68230353	31622950	6883725	8248764	1419764	873838	2737457	2190251	2369189	2675975
Q (MLD)	3565	30632	68230	31623	6884	8249	1420	874	2737	2190	2369	2676

Flow (MLD) measurement data of River Tungabhadra basin (Source: Water Resource Information System of India)

Gauge station	Year	June	July	August	September	October	November	December	January	February	March	April	May
Shimoga	2009	1,132	102,718	35,462	35,717	19,558	5,759	2,114	391	-	-	-	-
	2010	8,290	43,729	54,070	32,636	17,192	10,376	2,450	-	-	-	-	-
	2011	21,991	58,198	55,191	45,656	10,519	5,190	2,239	528	287	245	373	237
Honnali	2009	2,935	98,395	40,453	54,360	33,240	8,625	3,631	4,731	2,268	2,677	3,431	4,405
	2010	9,412	44,654	52,425	41,570	29,496	24,516	6,755	2,939	2,402	2,083	4,175	3,822
	2011	21,707	55,962	58,766	64,898	14,858	5,803	2,504	1,436	4,828	3,133	4,011	2,745
Holehonnur	2009	2,167	15,607	9,123	19,013	11,999	3,237	1,703	4,802	2,814	3,442	4,661	5,335
	2010	3,936	9,126	8,549	7,400	9,747	13,888	5,046	2,186	4,097	3,284	5,998	5,241
	2011	2,693	8,822	9,556	19,224	7,173	2,770	890	2,150	7,803	5,050	5,492	3,121
Haralahalli	2009	4,204	91,761	42,519	55,407	36,816	10,885	4,341	4,369	1,252	1,049	2,570	5,610
	2010	8,739	35,916	54,370	48,538	37,735	33,176	7,655	2,548	378	-	3,594	3,806
	2011	19,462	49,792	49,304	60,602	15,878	6,086	2,667	320	2,472	1,422	4,298	3,848

Note: Honnali is located at a distance of 42 Km from Rajanahalli on the upstream of River Tungabhadra.

Appendix 6. Operation Philosophy of the Water Treatment Plant for Davangere City

The operation of the plant shall be fully automated with PLC and SCADA system installed in place. The control of the PLC and SCADA system will be made from the administrative building located within the WTP area.

The extents of automation considered in the WTP are summarized below:

1. Ultrasonic flow meter will be provided in the Parshall flume to measure the flow and will display the flow in the PLC panel.
2. Dosing of alum and lime will be done through gravity from the chemical house. The dosing rate will be adjusted based on the turbidity in the raw water. The dosing rate may be controlled through PLC panel. All the drives for agitation shall start/ stop from the PLC panel.
3. Chlorination will be controlled depending on the residual chlorine in the clear water reservoir and adjustment can be done automatically from the chlorine control panel/ PLC panel.
4. The loss of head and rate of flow will be measured continuously for each filter bed and will display the status locally as well as in the PLC. When the loss of head of each bed exceeds the pre-determined value, the inlet gate of that particular filter bed will get close and initiate the bed to backwash mode.
5. Pumps inside the clear water reservoir will “start”/ “stop” automatically based on the level of water in the back wash tank.
6. All the valves will be operated with electrical actuator. However, the manual over-ride facility will also be made available in the system.
7. All the sludge lines will have to be operated manually depending upon the sludge accumulated in the various units, like flash mixer, flocculator, plate settler etc. The sludge accumulation will be assessed from the telescopic sludge bleeding arrangement. All the sludge line valves will also be provided with electrical actuator.
8. Turbidity meters shall be provided at outlet of Plate settler and rapid gravity filters.

In case of auto mode, entire operation will perform automatically through PLC panel and in case of manual mode operation will be performed locally through local push button station.

Sludge Disposal System from the Water Treatment Plant

The existing WTP at Bathi does not have any sludge management system. Hence effective sludge disposal system will be made within the proposed 40 MLD WTP which will be synchronized with the existing one. Effort will be made to recycle wastewater of WTP from various outlet points within the WTP complex.

Sludge from the water treatment plant will emanate mainly from flocculator and Plate settler. The sludge valve from flocculator and plate settler shall be motorized knife gate valve with timer operation (duration & interval). The timers will be set by operator

depending upon the raw water quality (mainly turbidity & suspended solids). The sludge will be collected in a sludge sump. The sludge will be pumped by means of positive displacement pumps (screw pumps) to centrifuge. Before entering the centrifuge polyelectrolyte will be dosed into the sludge. Polyelectrolyte dosing system with solution tank and dosing pumps shall be housed in centrifuge building. The solids which will come out of the centrifuge (located on the 1st floor of centrifuge building) will have concentration of 18 to 20% and shall be disposed off into low lying area for land filling. The centrate will be recycled to inlet of treatment plant.

The backwash waste water from filters shall be collected in a sump and shall be pumped back to cascade aerator of the WTP.

All other sludge lines from inlet chambers, flash mixer, and chemical tanks shall be drained into clarifier sludge sump, once in a while.

Disinfection System

Disinfection of treated water is proposed within WTP. Automation of chlorination system including automatic dosing & change-over, leak detection and neutralizing system is proposed to be provided.

Control Philosophy

The system is designed for 1-stream each working in pre & post chlorination system and 1-stream as standby in both pre & post chlorination system. In this system the following main equipments have been incorporated:-

- 2 nos. tonner manifold systems with pressure indicator, pressure switch and motorized valve.
- Ball valve on chlorine gas line
- Chlorine gas filter
- Pressure reducing valve
- Floor mounted vacuum type chlorinator with remote vacuum regulator, pressure relief valve, vacuum indicator, flow meter, automatic flow control valve, vacuum relief valve, drain valve, check valve and injector
- Electrical auto change-over device
- Pipes, fittings and valves
- Suitable booster pump with motor (1 working and 1 standby)
- Pressure indicator on booster pump delivery
- Common relay based starter cum control panel with annunciator for chlorination.

System Description

Chlorine gas will be drawn from the Ton Container. This system is equipped with pressure indicator, pressure switch and electrical auto change-over device. The pressure indicator will locally indicate the duty tonner pressure and pressure switch will

give a low alarm at the control panel indicating that the duty tonner is empty and also will enable auto change of tonner manifold with the help of motorized valve.

A pressure switch and motorized valve are provided on each manifold. When the system is started both manifold are full, but only one manifold will open as it is selected first which is referred as manifold - I. It shall remain open till the time the tonner connected to manifold - I is empty. As soon as the pressure on the manifold - I falls below the preset point, the motorized valve will close automatically on manifold - I and open the motorized valve on manifold - II. Meanwhile the operator should change manifold - I with fresh tonner. Once the manifold - I also become empty the control panel resets itself and open manifold - I.

The chlorine gas coming out of the tonner passes through gas filter and pressure reducing valve where the chlorine gas pressure is reduced to 2 to 2.5 kg/cm^2. The chlorine gas then enters the vacuum regulator. The vacuum is created by the water flowing through the injector. Water for the injector is supplied by the booster pump. The chlorine gas, under vacuum, flows through the flow meter, flow control valve to the injector. In the injector chlorine gas mixes with water and the concentrated chlorine solution is conveyed to the dosing point through diffuser. The flow is automatically adjusted as per the flow of water in the channel. For this 4 to 20 mA signal has to be provided from channel. A manual override is also provided for adjusting the flow manually.

Following safety features are provided in the system:

- Gas filters are provided in the gas line to filter any ferric chloride impurities in the chlorine gas.
- The remote vacuum regulator is incorporated for utmost safe operation. Unless vacuum is created on the downstream side, no chlorine gas would enter the chlorinator. If a leak develops between the downstream side of the system and the injector, the remote vacuum regulator will automatically shut the flow of chlorine gas in to chlorinator.
- A pressure relief valve is provided in the vacuum regulator/ chlorinator for venting of any pressurized chlorine coming into the chlorinator.
- A vacuum relief valve is provided in the chlorinator to release the excess vacuum in the system especially when the system is not working. This will avoid deformation of PTFE diaphragms in the system.
- A check valve provided in the vacuum line to prevent back flow of water into the chlorinator.
- A drain valve is provided on the check valve, which automatically drains out any water accumulated in the check valve.

Leak Absorption System

The main equipment of the chlorine leak absorption system are as under:

- Blower with motor and piping

- FRP frontal hood is provided in front of every tonner. The hood is in two halves. The bottom half is placed on the floor on top of the duct. The top half of the hood is placed on the bottom half.
- The duct is connected to the absorption system/ blower. When a tonner develops a leak the same will be sucked through the duct.
- Pumps will pump supply and spray caustic solution for absorption of chlorine from the gas and finally clean air free form chlorine will be discharge from top of the FRP absorption tower.
- A chlorine leak detector provided in the tonner/ chlorinator room shall detect a leak and give out a signal to the control panel.

The blower shall suck the leaked chlorine gas along with air and deliver the same to the caustic pit.

Appendix 7. Sample Outline of 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 8. Traffic Management Planning (TMP)

A. Principles for TMP around the Water Supply Scheme

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 every 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 the water supply lines along various types of roads.

C. Analyze the impact due to street closure

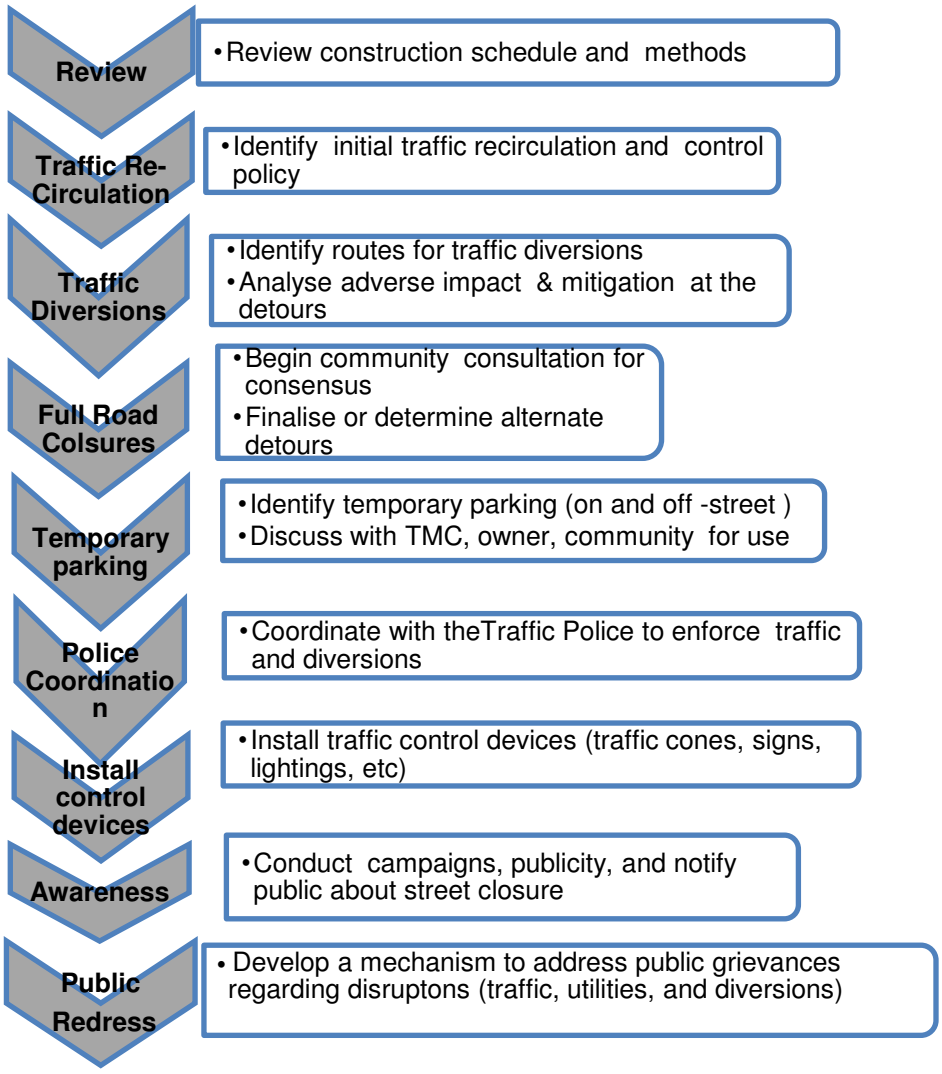
4. Apart from the capacity analysis, a final decision to close a particular street and divert the traffic should involve the following steps:

(i) approval from the Davangere CMC / 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

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

6. 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.

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

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

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

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

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

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

10. 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

11. 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 are narrow but carry very less 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”).

12**.** **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 road way, 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

13. 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.

14. 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.

Figure A2 & A3: Work on shoulder or parking lane & Shoulder or parking lane closed on divided road)

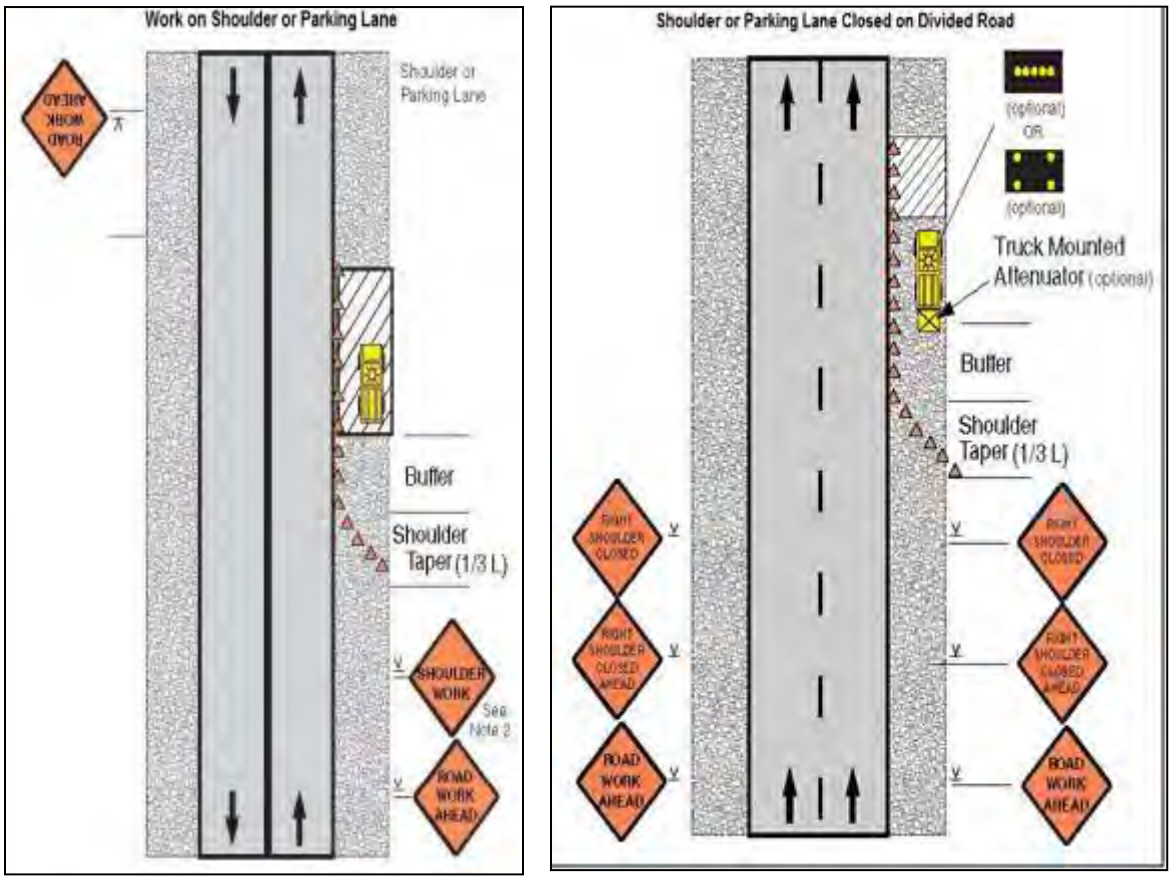
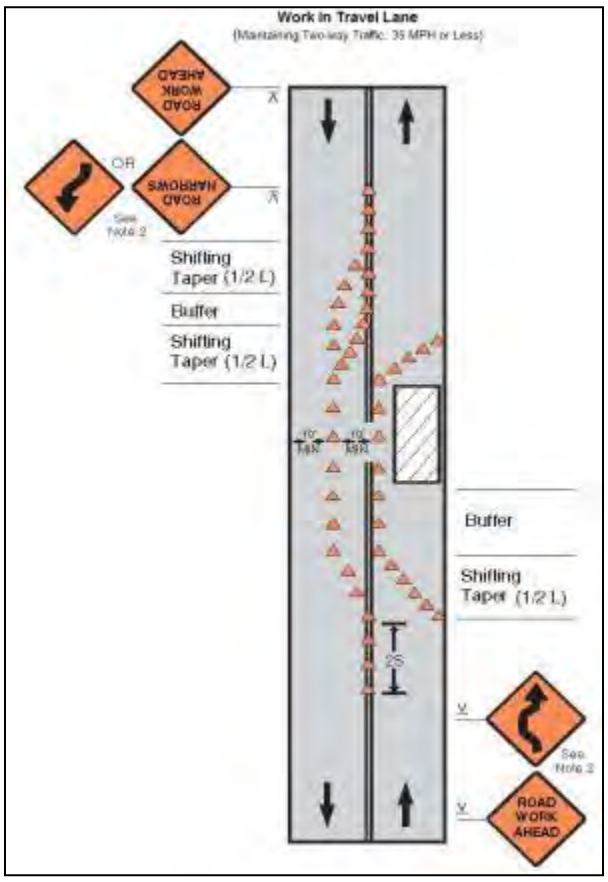


Figure A4 & A5: Work in Travel lane & Lane closure on road with low volume



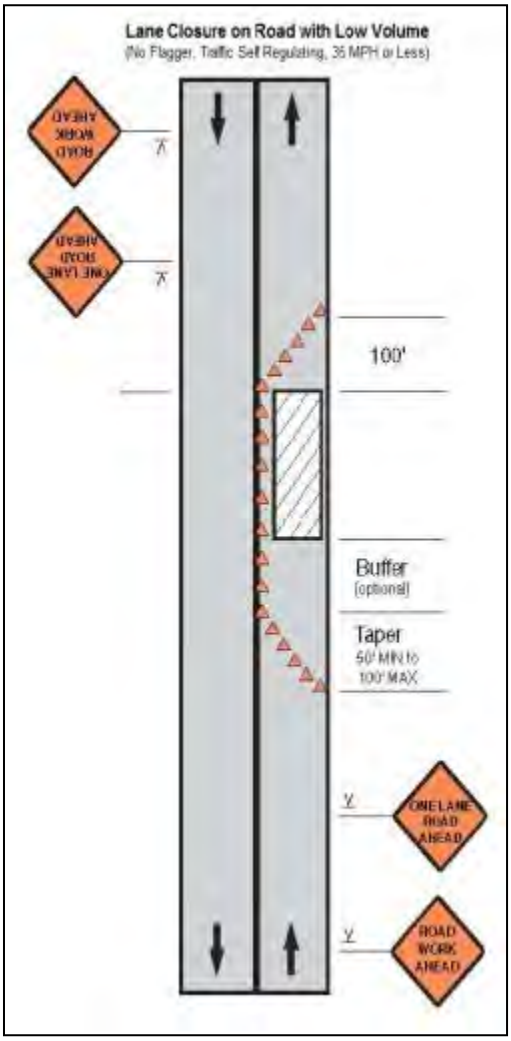
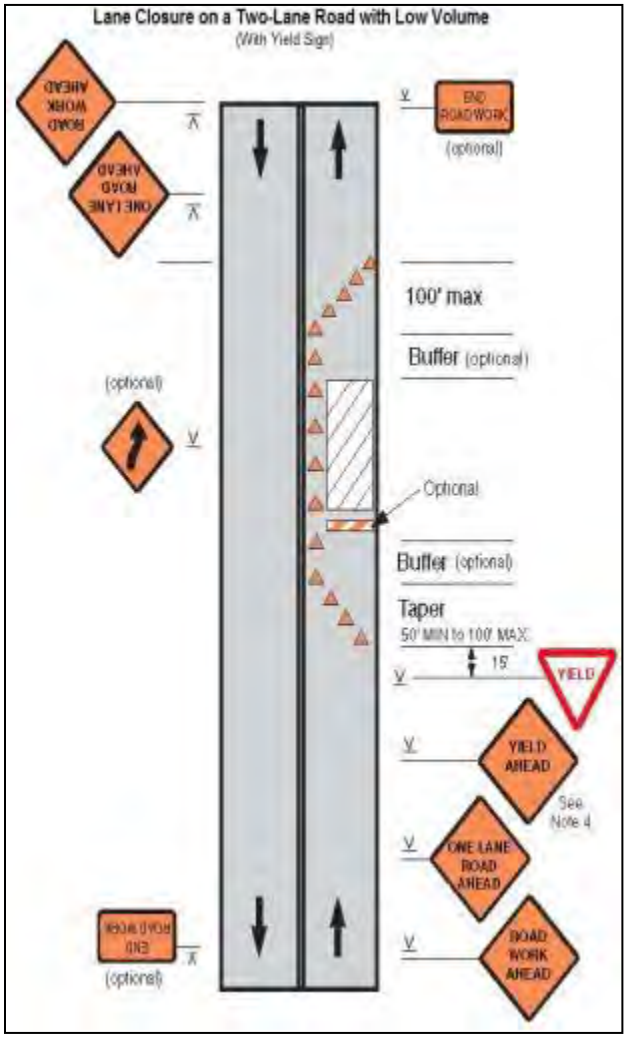


Figure A6 & A7: Lane closure on a two-line road with low volume (with yield sign)
&
Lane closure on a two-line road with low volume (one flagger operation)



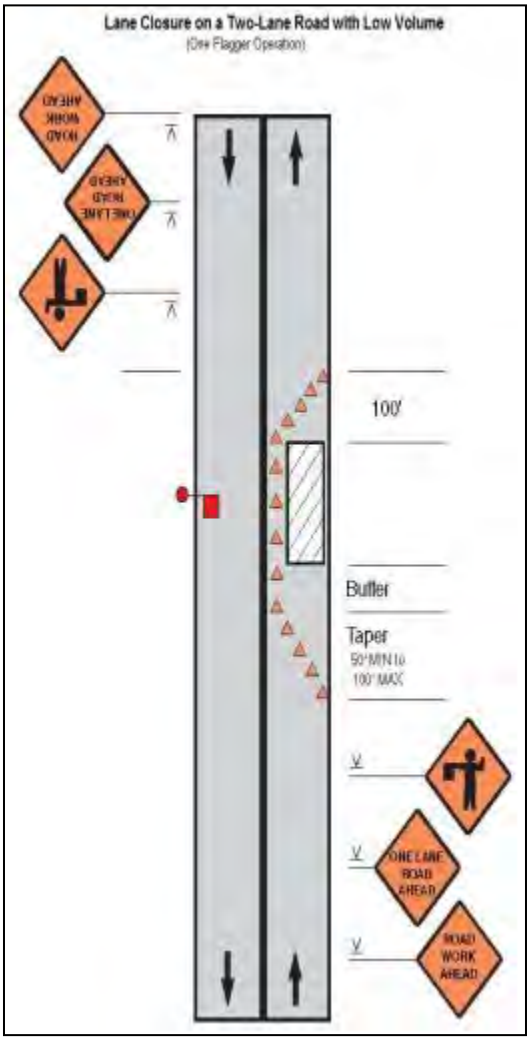
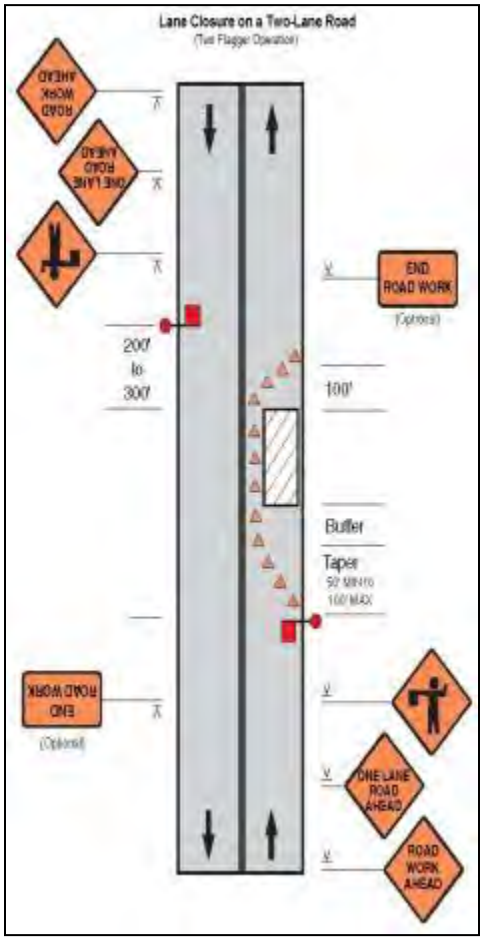


Figure A8 & A9: Lane closure on a two lane road (two flagger operation) & Lane closure on a four lane undivided Road



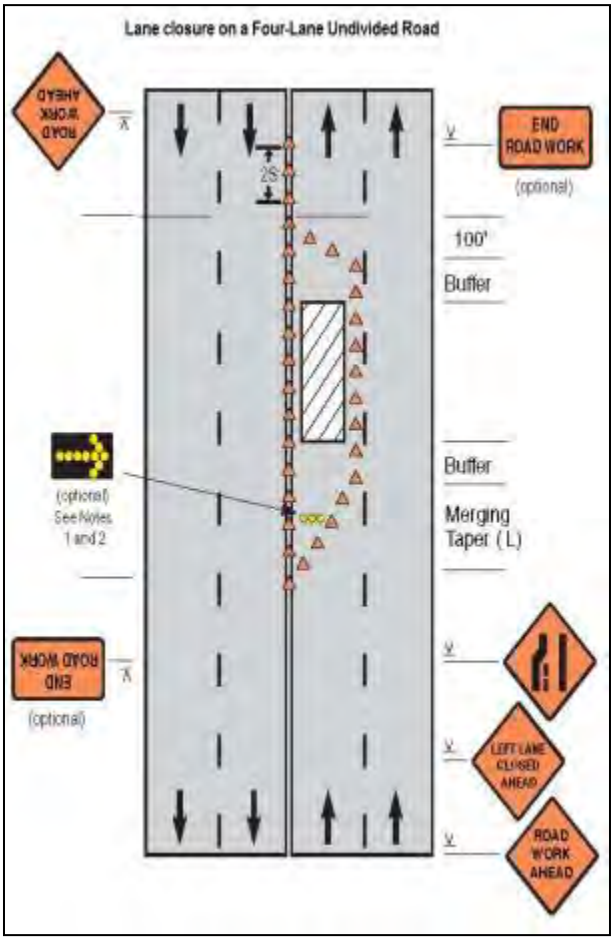
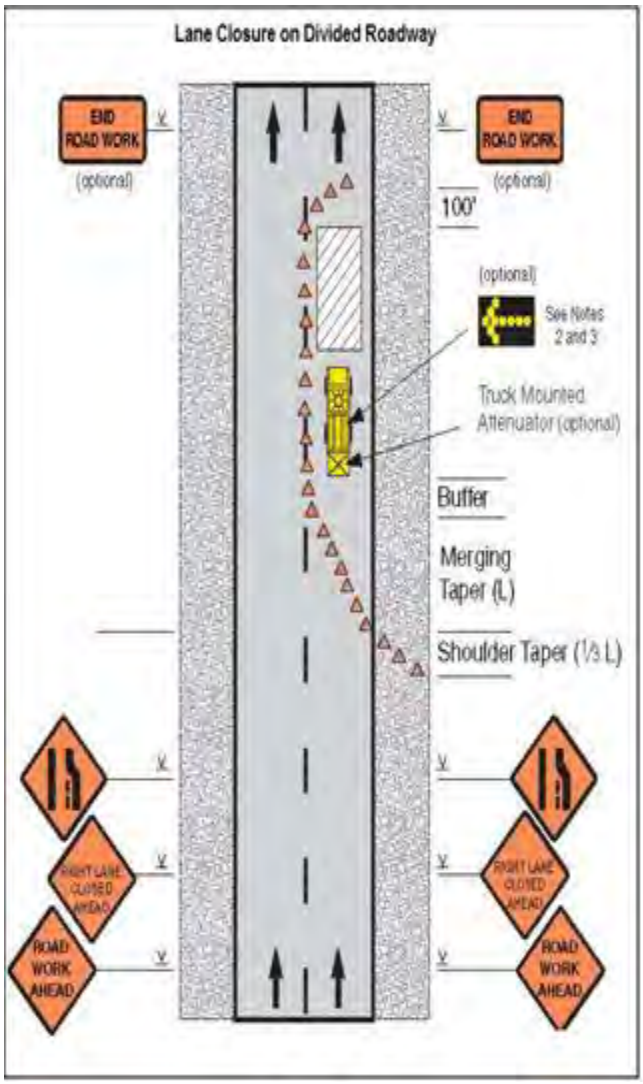


Figure A10 & A11: Lane closure on divided roadway &Half road closure on multi-lane roadway



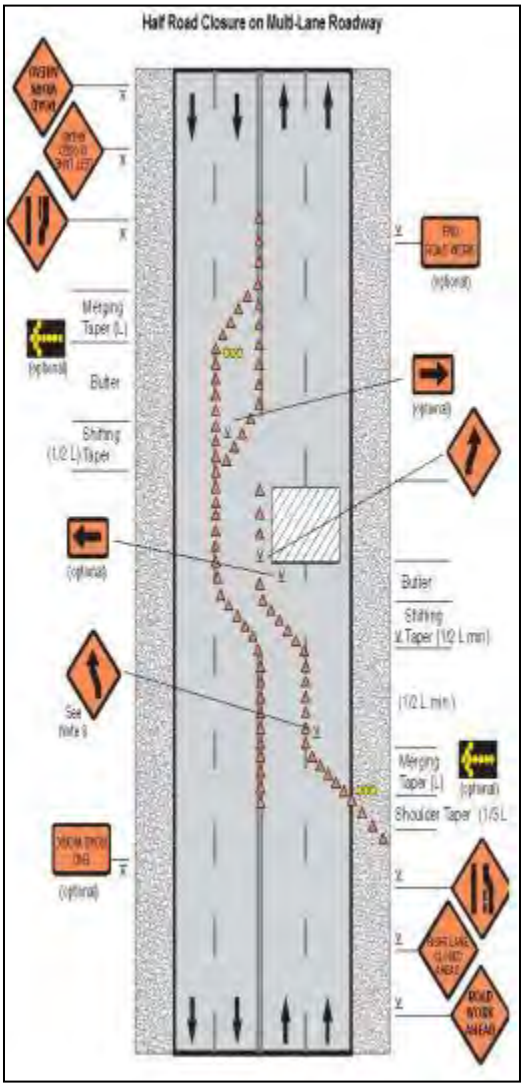
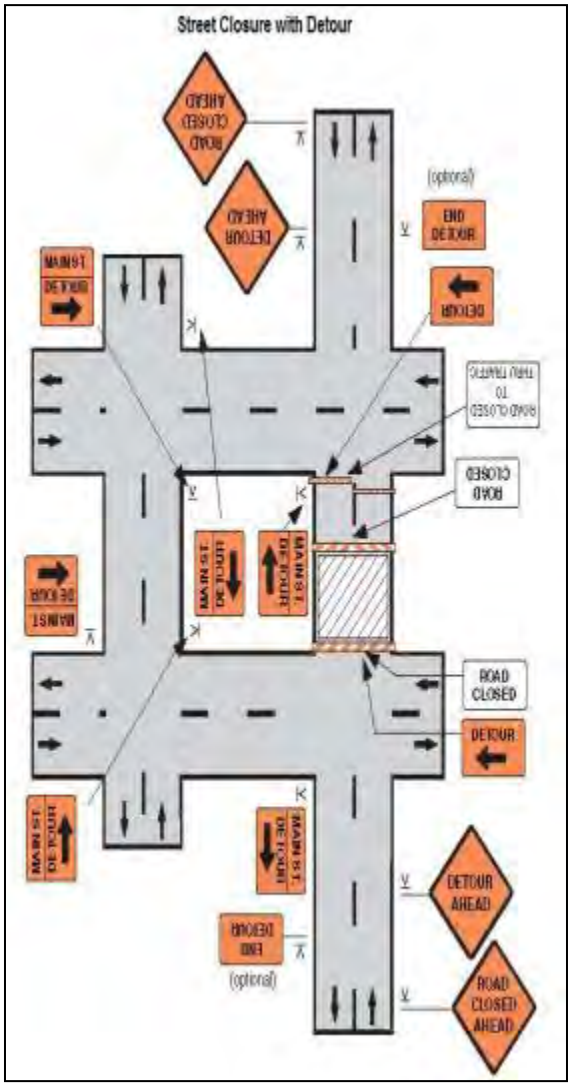


Figure A12: Street closure with detour



Appendix 9. Emergency Response Plan Template -Water Supply Project

Section 1.
System Information

Keep this basic information easily accessible to authorized staff for emergency responders, repair people, and the news media.

System information

System Name and Address	Davanagere City Water Supply Network	
Directions to the System		
Basic Description and Location of System Facilities		
Population Served and Service Connections	_____ people	_____ connections
System Owner	Davanagere CC	
Name, Title, and Phone Number of Person Responsible for Maintaining and Implementing the Emergency Plan		_____ Phone _____ Mobile

Section 2 .
Chain of Command – Lines of Authority

The first response step in any emergency is to inform the person at the top of this list, who is responsible for managing the emergency and making key decisions.

Chain of command – lines of authority

Name and Title (as required)	**Examples of Responsibilities During an Emergency**	**Contact Numbers**
Mr/Ms……. Asst. Executive Engineer (Water Supply Manager)	Responsible for overall management and decision making for the Water Supply Systems. The Manager is the lead for managing the emergency, providing information to regulatory agencies, the public and news media. All communications	Phone: Mobile:

Name and Title (as required)	Examples of Responsibilities During an Emergency	Contact Numbers
	to external parties are to be approved by the manager.	
Mr/Ms …….. (Junior Engineer) Water Supply System Operator	In charge of operating the Water Supply systems, performing inspections, maintenance and providing recommendations to the system manager.	Phone: Mobile:
Mr/Ms..... Water SupplyInspector (Water Supply Operator)	In charge of performing inspections, maintenance assessing facilities, and providing recommendations to the system manager.	Phone: Mobile:
Mr/Ms…….. Office Administrator	Responsible for administrative functions in the office including receiving phone calls and keeping a log of events. This person will provide a standard carefully pre-scripted message to those who call with general questions. Additional information will be released through the Water Supply system manager.	Phone: Mobile:
Mr/Ms…… Field Staff (crew)	Delivers door hangers, posts notices, and supports Water Supply system operator.	Phone: Mobile:

Section 3 .
Events that Cause Emergencies

The events listed below may cause Water Supply system emergencies. They are arranged from highest to lowest probable risk.

Events that cause emergencies

Type of Event	Probability or Risk (High-Med-Low)	Comments

Burst of water line		
Chlorine Leakage		
Contamination through leakages and cracks		

Section 4 .
Emergency Notification

Notification call-up lists - Use these lists to notify first responders of an emergency.

Emergency Notification List				
Organization or Department	**Name & Position**	**Telephone**	**Night or Cell Phone**	**Email**
Davanagere, CC	..... Water Supply System Inspector			
Davanagere, CC	..... Junior Engineer			
Davanagere, CC	..... Asst. Exe. Engineer			

Priority Customers				
Organization or Department	**Name & Position**	**Telephone**	**Night or Mobile Phone**	**Email**
Hospitals or Clinic(s)				
Public or Private Schools				

Notification List				
Organization or Department	**Name & Position**	**Telephone**	**Night or Mobile Phone**	**Email**
Police				
Regulatory Agency				

Service / Repair Notifications

Organization or Department	Name & Position	Telephone	Night or Mobile Phone	Email
Hubli Electricity Supply Company				
Electrician				
Water Supply System operator/manager				
Plumber				
Pump Supplier				
“Call Before You Dig”				
Rental Equipment Supplier				
Pipe Supplier				

Notification procedures

Notify Water Supply system customers

Who is Responsible:	
Procedures:	

Alert local law enforcement, or regulatory officials, and local health agencies

Who is Responsible:	
Procedures:	

Contact service and repair contractors

Who is Responsible:	
Procedures:	

Procedures for issuing aannouncement / health advisory

Who is Responsible:	
Procedures:	

Other procedures, as necessary

Who is Responsible:	
Procedures:	

Section 5 .
Effective Communication

Designated public spokesperson

Designate a spokesperson (and alternate) and contact regulatory agency for delivering messages to the news media and the public.

Designate a spokesperson and alternates

Spokesperson	Alternate

Section 6 .
The Vulnerability Assessment

This is an evaluation of each Water Supply system component to identify weaknesses or deficiencies that may make them susceptible to damage or failure during an emergency. It also assesses facilities for security enhancements that may guard against unauthorized entry, vandalism, or terrorism.

Facility vulnerability assessment and improvements identification

System Component	Description and Condition	Vulnerability	Improvements or Mitigating Actions	Security Improvements
Collection System				
Pumping				
Distribution				
Other Considerations				

Section 7.
Response Actions for Specific Events

In any event there are a series of general steps to take:

1. Analyze the type and severity of the emergency;
2. Take immediate actions to save lives;
3. Take action to reduce injuries and system damage;
4. Make repairs based on priority demand; and
5. Return the system to normal operation.

The following tables identify the assessment, set forth immediate response actions, define what notifications need to be made, and describe important follow-up actions.

A. Power outage

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

B. Distribution system blockage or line break

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

C. Pumping facilities failure

Assessment	
Immediate Actions	
Notifications	

Follow-up Actions	

D. Vandalism or terrorist attack

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

E. Flood

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

F. Earthquake

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

G. Hazardous materials spill into distribution system

Assessment	

Immediate Actions	
Notifications	
Follow-up Actions	

H. Electronic equipment failure

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

I. Other

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

Section 8 .
Returning to Normal Operation

Returning to normal operations

Action	Description and Actions

Section 9 .

Plan approval

This plan is officially in effect when reviewed, approved, and signed by the following people:

Name/Title	Signature	Date

Section 10.

Certificate of Completion

I certify to the Government of Karnataka that this Water Supply system – Davanagere City Water Supply System, has completed an Emergency Response Plan (ERP).

I certify that this document was prepared under my direction or supervision.

_____

System Name: _____

Address: _____

Print Name of Person Authorized to Sign this Certification on behalf of the System:

_____ Title: _____

Signature: _____

Phone: _____ Fax: _____ Email: _____

Completion of the following:

☐ Security Vulnerability Assessment

☐ Emergency Response Plan

Source: www.rcap.org (modified)

Appendix 10.Guidelines and Emergency plan for handling and storing chlorine

1. Instructions for Storage and Handling of Chlorine Cylinders

(Based on the 'Manual on Operation and Maintenance of Water Supply Systems' ***published by the Central Public Health and Environmental Engineering Organization (CPHEEO) in 2005)***

1.1 Storage Area

a) Obtain storage license from controller of explosives under Gas Cylinder Rules 2004 if the quantity of Cl_2 containers to be stored is more than 5 Nos.
b) Storage area should be cool, dry, well ventilated, and clean of trash and protected from external heat sources. Please refer to Manual on "Water Supply and Treatment", (1999 Edition), for further details.
c) Ventilation must be sufficient to prevent accumulation of vapour pockets. The exhaust should be located either near the floor or duct be provided extending to the floor. All fan switches should be outside the storage area.
d) Do not store container directly under the sun.
e) Weather cock should be installed near the storage to determine wind direction.
f) The storage building should be of non-combustible construction with at least two exits opening outside.
g) Neutralization system should be provided.
h) Continuous monitoring of chlorine leak detection equipment with alarm should be installed in the storage area.
i) The area should be free and remote from elevators, gangways or ventilating system to avoid dangerous concentration of Chlorine during leak.
j) Two portable foam type fire extinguishers should be provided in the premises.
k) Corrosive substances shall not be stored nearby which react violently with each other.
l) Unauthorized person should not be allowed to enter into the storage area.
m) The floor level of storage shed should be preferably 30 cms (at least one foot) higher from the ground level to avoid water logging.
n) Ensure that all containers are properly fitted with safety caps or hooks.

1.2. Cylinder & Drum Containers

a. Store chlorine cylinders upright and secure them so that they do not fall.
b. Drum containers should be stored on their sides on rails, a few inches above the floor. They should not be stacked one upon the other. They should be stored such that the valves are in vertical plane.
c. Keep enough space between containers so as to have accessibility in case of emergency.

d. Store the containers in a covered shed only. Keep them away from any source of heat as excessive heat may increase the pressure in container which will result into burst.
e. Do not store explosives, acids, turpentine, ether, anhydrous ammonia, finely divided metals or other flammable material in the vicinity of Chlorine.
f. Do not store containers in wet and muddy areas.
g. Store filled and empty containers separately.
h. Protective covers for valves are secured even when the containers are empty, except during use in the system.
i. Never use containers as a roller to move other equipment.
j. Never tamper with fusible plugs of tonners.
k. Check leakages every day by means of ammonia torch. However, it should not be touched to brass components like valves of container for safety.
l. Never carry out any welding work on the chlorine system as combustion of steel takes place at 251^0C in presence of chlorine.
m. The boxes containing emergency kit, safety applications and self contained breathing apparatus should be kept in working order in an easily approachable area.

1.3. Use of Cylinders & Drum Containers in Process System

a. Use containers in the order of their receipt, as valve packing can get hardened during prolonged storage and cause gas leaks.
b. Do not use oil or lubricant on any valve of the containers.
c. Badly fitting connections should not be forced and correct tool should always be used for opening and closing valves. They should never be hammered.
d. The area should be well ventilated with frequent air changes.
e. Transport the cylinders to the process area by using crane, hoist or railings etc.
f. The drum containers should be kept in a horizontal position in such a way that the valves are in a vertical plane. The upper valve gives out gas and the lower one gives out liquid chlorine.
g. The cylinder should be kept in upright position in order to release gas from the valve. For liquid chlorine withdrawal, it should be inverted with the help of an inverted rack.
h. Connect the containers to the system by using approved accessories.
i. Use copper flexible tube, with lead washer containing 2 to 4% antimony or bonded asbestos or teflon washer. Use yoke clamp for connecting chlorine container.
j. Never use rubber tubes, PVC tubes etc. for making connections.
k. Use the right spanner for operating the valve. Always keep the spanner on the valve spindle. Never use ill fitting spanner.
l. After making the flexible connection, check for the leakage by means of ammonia torch but it should not come in contact with a valve.

m. Keep minimum distance between the container valve and header valve so that during change-over of the container, minimum amount of gas leaks.
n. The material of construction of the adopter should be same as that of valve outlet threads.
o. The valve should not be used as a regulator for controlling the chlorine. During regulation due to high velocity of Chlorine, the valve gets damaged which in turn can cause difficulty in closing.
p. The tools and other equipment used for operating the container should be clean and free of grease, dust or grit.
q. Wear breathing apparatus while making the change-over of the container from the process header.
r. Do not heat the container to withdraw more gas at faster rate.
s. Use pressure gauge and flow measuring device to control the flow and to know the quantity of gas left in the container.
t. Use an inverted U type barometric leg or vacuum breaking arrangement for connecting the container to the process piping.
u. Withdrawal of the gas should be stopped when the gas pressure inside the container is between 0.1 to 0.5 kg/cm2 approximately.
v. If withdrawal of the gas from the container connected to the process system has to be suspended for long intervals, it should be disconnected from the system, and the valve cap and hood replaced.
w. Gas containers should be handled by trained persons only.

1.4. Disconnecting Containers from Process System

a. Use breathing apparatus before disconnecting the container.
b. First close the container valve fully. After removal of chlorine the process valve should be closed.
c. Remove the flexible connection, plug the flexible connection in order to avoid entry of humid air. Replace the valve cap or hood on the container.
d. Put the tag on the empty container & bring it to storage area marked for empties.
e. Check for the leakage.

1.5. Loading and Unloading of Containers

a. The handling of containers should be done under the supervision of trained and competent person.
b. It should be done carefully with a crane, hoist or slanted ramp. Do not use magnet or sharp object for lifting the containers.
c. Small cylinders should not be lifted by means of valve caps as these are not designed to carry the weight.
d. The containers should not be allowed to strike against each other or against any hard object.

e. Vehicles should be braked and isolated against any movement.
f. After loading, the containers should be secured properly with the help of wooden wedges, rope or sling wire so that they do not roll away.
g. The containers should never be dropped directly to the ground or on the tyre from the vehicle.
h. There should be no sharp projection in the vehicle.
i. Containers must have valve caps and plugs fitted properly.
j. Check containers for leakage before loading/unloading.

1.6. Transportation of Container

a. The name of the chemical along with diamond pictorial sign denoting the dangerous goods should be marked on the vehicle.
b. The name of the transporter, his address and telephone number should be clearly written on the vehicle.
c. The vehicle should not be used to transport any material other than what is written on it.
d. Only trained drivers and cleaners should transport hazardous chemical
e. The driver should not transport any leaking cylinder.
f. The cylinder should not project outside the vehicle.
g. The transporter must ensure that every vehicle driver must carry “Trem Card” (Transport Emergency Card) and ‘Instructions in writing booklet’ and follow them.
h. Every driver must carry safety appliances with him, viz; Emergency kit, breathing apparatus etc.
i. The vehicles must be driven carefully, specially in crowded localities and on bumpy roads. Do not apply sudden brakes.
j. Check for the leakage from time to time.
k. In the case of uncontrollable leakage the vehicle should be taken to an open area where there is less population.

1.7. Emergency Kit

It consists of various tools and appliances like gaskets, yokes, studs, tie rods hoods, clamps, spanners, mild steel channels, screws, pins, wooden pegs etc. of standard sizes. Separate kits are used for cylinders and tonners. All the gadgets are designed for using in controlling or stopping the leakages from valves, fusible plug and side walls of cylinders and containers used for handling chlorine.

a. Leakage may occur through the valve. There are basically four types of valve leaks.
    I. Valve packing
    II. Valve seat
    III. Defective inlet thread
    IV. Broken valve thread
b. Leakage may occur through container wall. For controlling such leakages, clamps are used for cylinders and chain and yoke arrangement is used for tonner.

Sometimes wooden peg is used by driving into the leaking hole as a temporary arrangement.

c. Leakage may occur through fusible plug.
   i. If the leakage is through the threads of fusible plug, yoke, hood and cap nut arrangement is used to control the leak.
   ii. If fusible metal itself in the plug is leaking, yoke and stud arrangement is used to control the leak.

2. First Aid to be Provided for a Person Affected by Chlorine

a. General

Remove the affected person immediately to an uncontaminated area. Remove contaminated clothing and wash contaminated parts of the body with soap and plenty of water. Lay down the affected person in cardiac position and keep him warm. Call a physician for medical assistance at the earliest.

Caution: Never attempt to neutralize chlorine with other chemicals.

b. Skin Contact

Remove the contaminated clothes, wash the affected skin with large quantity of water. Caution: No ointment should be applied unless prescribed by the physician.

c. Eye Contact

If eyes get affected with liquid chlorine or high concentration of chlorine gas, they must be flushed immediately with running water for atleast 15 minutes keeping the eyelids open by hand.

Caution: No ointment should be used unless prescribed by an eye specialist.

d. Inhalation

If the victim is conscious, take him to a quiet place and lay him down on his back, with head and back elevated (cardiac position). Loosen his clothes and keep him warm using blankets. Give him tea, coffee, milk, peppermint etc. for making good effect on breathing system.

If the victim is unconscious, but breathing, lay him down in the position mentioned above and give oxygen at low pressure until the arrival of doctor. If breathing has stopped, quickly stretch him out on the ground or a blanket if available, loosen his collar and belt and start artificial respiration without delay. Neilson arm lift back pressure method is useful. Automatic artificial respiration is preferable if available. Continue the respiration until the arrival of the doctor. Amboo bag can also be used for this purpose.

3. On-Site Emergency Plan to Cover the Leakage of Chlorine

3.1. Introduction

As chlorine is a hazardous chemical, handling and storage of it demand adequate precautions to avoid possible hazards. Leakage of chlorine may develop into a major emergency. Therefore the emergency procedure to cover this eventuality is essential. It is drawn in the form of on-site emergency plan. The elements of onsite emergency plan are as follows:

3.2. Identification of Hazard Chart

In this case the site risk is evaluated by the expert and the extent of the probable damage is calculated on the basis of stored chlorine quantity, nearby population, wind direction, type of equipment failure etc. For this purpose hazard analysis is conducted in which case all the hazardous properties of chlorine are considered. If evacuation is required, the range of it is calculated.

3.3. Appointing Key Persons

In order to control the incident like chlorine leakage, it is essential to appoint various persons with their well-defined responsibilities. Taking into account the various activities likely to be involved, the following key persons are appointed (i) Site Controller, (ii) Incident controller, (iii) Shift Executive In charge, (iv) Communication Officer, (v) Safety Officer, (vi) Fire and Security Officer, (vii) Utilities and Services In charge, (viii) Traffic Controller, (ix) First Aider

3.4. Assembly Points

These points are set up where persons from the plant would assemble in case of chlorine leakage. At these points the in-charge for counting the heads will be available.

3.5. Emergency Control Center

The control centre is the focal point in case of an emergency from where the operations to handle the emergency from are directed and coordinated. It contains site plan, telephone lines, public address system, safety equipment, first aid boxes, loud speaker, torches, list of essential telephone numbers, viz. fire brigade, police, hospital, civil defence, collector, factory inspector, organizational authorities, chlorine suppliers, mutual aid group, social workers, list of key persons and their addresses, copy of chemical fact sheet, location plan of fire hydrant, details of dispersion model of chlorine gas, population distribution pattern, location of alarm system.

3.6. Procedure to Meet Emergency

The actions to be taken by the staff and authority are given below; Emergency Alarm: An audible emergency alarm system is installed throughout the plant. On hearing the alarm the incident controller will activate the public address system to communicate with the staff about the emergency and give specific instructions for evacuations etc. anyone can report the occurrence of chlorine leakage to section in-charge or incident controller through telephone or intercom or in person.

3.7. Communication

Communication officer shall establish the communication suitable to that incident.

3.8. Services

For quickness and efficient operation of emergency plan the plant is divided into convenient number of zones and clearly marked on the plan. These are emergency services viz. fire fighting, first aid, rescue, alternative source of power supply, communication with local bodies etc. The incident controller will hand over the charge to the site controller of all these coordinating activities, when the site controller appears on the site. The site controller will coordinate all the activities of the key persons. On hearing the emergency alarm system all the key persons will take their charge. Incase of their absence other alternatives are nominated.

The person nominated for personnel and administration purposes will be responsible for informing all statutory authorities, keeping account of all persons in the plant including contract labour, casual workers and visitors. He will be responsible for giving information to press or any outside agencies. He is also responsible for organizing canteen facilities and keeping informed the families of affected persons.

The person nominated as security officer should guide police, fire fighting and control the vehicle entries. The site controller or any other nominated person will announce resumption of normalcy after everything is brought under control.

The onsite emergency plan needs to be evaluated by mock drill. Any weaknesses noticed during such drills should be noted and the plan is modified to eliminate the weaknesses.

3.9. Emergency Measures

In case of leakage or spillage of Chlorine, the following emergency measures should be taken:

a) Take a shallow breath and keep eyes opened to a minimum.
b) Evacuate the area.
c) Investigate the leak with proper gas mask and other appropriate Personal protection.
d) The investigator must be watched by a rescuer to rescue him in emergency.
e) If liquid leak occurs, turn the containers so as to leak only gas.
f) In case of major leakage, all persons including neighbours should be warned.
g) As the escaping gas is carried in the direction of the wind all persons should be moved in a direction opposite to that of the wind. Nose should be covered with wet handkerchief.
h) Under no circumstances should water or other liquid be directed towards leaking containers, because water makes the leak worse due to corrosive effect.
i) The spillage should be controlled for evaporation by spraying chilled water having temperature below 9.4^{o}C. With this water crystalline hydrates are formed which will temporarily avoid evaporation. Then try to neutralize the spillage by caustic soda or soda ash or hydrated lime solution carefully. If fluroprotein foam is available, use for preventing the evaporation of liquid chlorine.
j) Use emergency kit for controlling the leak.
k) On controlling the leakage, use the container in the system or neutralize the contents in alkali solution such as caustic soda, soda ash or hydrated lime.

   Caution: Keep the supply of caustic soda or soda ash or hydrated lime available. Do not push the leaking container in the alkali tank. Connect the container to the tank by barometric leg.
l) If container commences leak during transport, it should be carried on to its destination or manufacturer or to remote place where it will be less harmful. Keeping the vehicle moving will prevent accumulation of high concentrations.
m) Only specially trained and equipped workers should deal with emergency arising due to major leakage.

n) If major leak takes place, alert the public nearby by sounding the siren.
o) Any minor leakage must be attended immediately or it will become worse.
p) If the leakage is in the process system, stop the valve on the container at once.

3.10. Safety Systems Required at Chlorination Plant

The following safety systems should be kept ready at the chlorination plant:

a. Breathing apparatus.
b. Emergency kit.
c. Leak detectors.
d. Neutralisation tank.
e. Siren system.
f. Display of boards in local language for public cautioning, first aid and list of different authorities with phone numbers.
g. Communication system.
h. Tagging system for equipments.
i. First aid including tablets and cough mixtures.
j. Exhaust fans.
k. Testing of pressure vessels, chlorine lines etc. every year as per factory act.
l. Training & mock drill.
m. Safety showers.
n. Eye fountain.
o. Personal protective equipments.
p. Protecting hoods for ton-containers.
q. Fire extinguishers.
r. Wind cock.

Appendix 11. Standard for discharge of waste water

Schedule VI of Environment (Protection) Rules, 1986

General standards for discharge of environmental pollutants: Effluents

Sl no	Parameter	Standards			
		Inland surface water	**Public sewers**	**Land of Irrigation**	**Marine/ coastal areas**
		(a)	**(b)**	**(c)**	**(d)**
1.	Colour and odour	remove as far as practicable			
2.	Suspended solids, mg/l. max.	100	600	200	(a) For process waste water100 (b) For cooling water effluent 10% above total suspended matter of influent.
3.	Particle size of suspended solids	shall pass 850 micron IS Sieve			(a)Floatable solids, max. 3mm. (b)Settable solids (max 850 micron)
4.	pH value	5.5. to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
5.	Temperature	shall not exceed 50°C above the receiving water temperature			shall not exceed 50°C above the receiving water temperature
6.	Oil and grease, mg./l, max.	10	20	10	20
7.	Total residual Chlorine, mg/l. max.	1.0			1.0
8.	Ammonical nitrogen (as N.) mg/l max	50	50		50
9.	Total Kjeldahl Nitrogen (as NH_3) mg/l. max	100			100
10.	Free ammonia (as NH_3), mg/l.max	5.0			5.0
11.	Biochemical oxygen demand (3 days at 27^0C), mg/l. max.	30	350	100	100
12.	Chemical oxygen demand, mg/l, max.	250			250
13.	Arsenic (as As) mg/l, max.	0.2	0.2	0.2	0.2
14.	Mercury (as Hg), mg/l, max.	0.1	0.1	0.1	0.1
15.	Lead (as Pb) mg/l, max	0.1	1.0		2.0
16.	Cadmium (as Cd) mg/l. max	2.0	1.0		2.0
17.	Hexavalent	0.1	2.0		1.0

Sl no	Parameter	Standards			
	chromium (as Cr. +6). Mg/l, max				
18.	Total Chromium (as Cr) mg/l, max	2.0	2.0		2.0
19.	Copper (as Cu) mg/l, max	3.0	3.0		3.0
20.	Zinc (as Zn) mg/l, max	5.0	15		15
21.	Selenium (as Se) mg/l, max	0.05	0.05		0.05
22.	Nickel (as Ni) mg/l, max	3.0	3.0		5.0
23.	Cyanide (as CN) mg/l, max	0.2	2.0	0.2	0.2
24.	Fluoride (as F) mg/l, max	2.0	15		15
25.	Dissolved phosphates (as P) mg/l, max	5.0			
26.	Sulfide (as S) mg/l, max	2.0			5.0
27.	Phenolic compounds (as C_6H_5OH) mg/l, max	1.0	5.0		5.0
28.	Radioactive materials: (a)Alfa emitters microcurie/ml, max. (b)Beta emitters micro curie/ml, max.	10^{-7} 10^{-6}	10^{-7} 10^{-6}	10^{-8} 10^{-7}	10^{-7} 10^{-6}
29.	Bio-assay test	90% Survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent
30.	Manganese (as Mn)	2 mg/l	2 mg/l		2 mg/l
31.	Iron (as Fe)	3 mg/l	3 mg/l		3 mg/l
32.	Vanadium (as V)	0.2 mg/l	0.2 mg/l		0.2 mg/l
33.	Nitrate Nitrogen	10 mg/l			20 mg/l

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

Appendix 12. Minutes of the Stakeholder Consultation Meeting

(October 3, 2012, Davangere)

The meeting was attended by key stakeholders from four project towns of Byadgi, Ranebennur, Harihar and Davangere including public/elected representatives from each town, ULB officials, officials from other line departments and executing agency KUIDFC, and NGOs/CBOs. The meeting was chaired by Davangere District Deputy Commissioner,

The PPTA consultants made detailed presentations – in Kannada and English on overall program, pilot towns, technical studies, poverty social development aspects, and environmental and social safeguard issues related to proposed subprojects in respective towns.

Ranebennur Town Meeting Session

- Chief Officer of Ranebennur CMC requested the PPTA Team to recheck the flows (demand calculations, losses and projections) shown in the reports/ presentations.
- Suggested to recheck the total length of sewer network proposed for the town.
- CO expressed concerns about delays in road restoration and back filling trenches. He stated that, the excavated soils are not stored properly and entering into the storm water drains.
- Workshop to be conducted in each town to apprisecouncillors of respective ULBs.

KUIDFC

- Task Manager (NKUSIP) stated that, the Draft Feasibility Studies (DFSs) are subject to change to address stakeholder comments and concerns.
- Task Manager (NKUSIP) suggested to use Ashraya Scheme Government Order(GO) for land acquisition in Byadgi and other ULB, if required. (GO states that, compensation for land acquisition can be paid at 3 times to the guidance value of the land)

Other discussions

- Provision for Sewer Connections – include connection cost as a separate item. Check with project staff of KMRP/KUIDFC.
- Surrounding areas of ULBs and gaps in the existing sewerage system of the town – Check whether the villages and settlements are within the ULB's jurisdiction/ boundary and also population densities.

- Demarcate the roads where larger diameter sewers and WS mains are proposed in all ULBs, to carryout sample surveys and to check impacts during construction. Identify streets where complete road closure is required?
- Maps or drawings to be prepared to show proposals/ options for water supply and wastewater system, sewerage network and public sanitation.
- Refine the cost estimates to show following items separately: Laying of sewer network: Road restoration cost; Construction of collection chambers and connections from individual properties to collection chambers; Land cost for STPs and Pumping Stations; Construction cost of STP
- Identify industrial demand and location for recycling treated wastewater
- Preparation of comparison table for the selection of pipe material for sewerage and water supply system
- Assess existing sewerage system (about 22 km) in Ranebennur to identify need for the sewer renovation or replacement.
- Plan awareness program for the sanitation in each ULB

Appendix 13.Public Consultation

Public consultation had been conducted extensively to assess the impact of proposed civil work on the livelihood of the people, local environmental set up and also to prepare Resettlement Plan (RP) and Initial Environmental Examination (IEE). The site verification reveals that, all the components of the water supply and distribution sub projects are either located on vacant government land or along the existing right-of-way (RoW) of the city as well as enroute villages. 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 the water supply project at Davangere. They are agreed to take up water supply connections from bulk water supply. Few environmental issues like availability of access during construction, generation of dust & noise are for short period and not a major concern for villagers.

The details of public consultation are as follows:

Name of the ULB: City Corporation Davanagere

Water supply subproject: Improvement of Bulk water supply in order to implementation of 24X7 water supply in Davanagere city

Date: 10.11.2016

Area: Rajanahalli, Harihara Taluk, Davanagere District

Sl. No	Name and address of the person consulted	Contact No	Present condition of water supply	What improvement is required in the present condition	Contacted person is the beneficiary of the proposed project Yes/ No	Proposed project cause any social and environmental issues? Yes/ No	Suggestions for the proposed project
1	Mr. Rajappa, SDA and Mr. Lakshmappa GP member Gram Panchayat Rajanahalli Harihara Taluk Davanagere District	08192-284888	Water supply from the Bore wells	24X7 water supply	Enroute villager	No	Water supply connection to be provided to their village under the proposed Bulk water supply
2	Mrs. P S Kenchamma, Teacher Anganawadi centre Rajanahalli Harihara Taluk Davanagere District	9480081821	Water supply from the Bore wells	24X7 Water supply	Enroute village Anganawadi	No	Water supply connection to be provided to their village under the proposed Bulk water supply
3	Mr. Raju B. S S/o Shivappa V	8884067477	Water supply from the Bore	24X7 water supply	Enroute villager	No	Water supply

Sl. No	Name and address of the person consulted	Contact No	Present condition of water supply	What improvement is required in the present condition	Contacted person is the beneficiary of the proposed project Yes/ No	Proposed project cause any social and environmental issues? Yes/ No	Suggestions for the proposed project
	Rajanahalli Harihara taluk Davanagere District		wells				connection to be provided to their village under the proposed Bulk water supply
4	Mr. Santhosh Kumar S/o Ajjappa Rajanahalli Harihara Taluk Davanagere District	8197570196	Water supply from the Bore wells	24X7 water supply	Enroute villager	No	Water supply connection to be provided to their village under the proposed Bulk water supply
5	Mr. Ramappa S/o Siddappa Rajanahalli Harihara Taluk Davanagere District	-	Water supply from the Bore wells	24X7 water supply	Enroute villager	No	Water supply connection to be provided to their village under the proposed Bulk water supply
6	Mr.Maanjappa S/o Dasappa Rajanahalli Harihara Taluk Davanagere District	-	Water supply from the Bore wells	24X7 water supply	Enroute villager	No	Water supply connection to be provided to their village under the proposed Bulk water supply
7	Mr.Hanumanthappa S/o Ningappa Rajanahalli Harihara Taluk Davanagere District	9901434238	Water supply from the Bore wells	24X7 water supply	Enroute villager	No	Water supply connection to be provided to their village under the proposed Bulk water supply
8	Mr.Hanumanthappa S/o Kenchappa Rajanahalli Harihara Taluk Davanagere District	7353191941	Water supply from the Bore wells	24X7 water supply	Enroute villager	No	Water supply connection to be provided to their village

Sl. No	Name and address of the person consulted	Contact No	Present condition of water supply	What improvement is required in the present condition	Contacted person is the beneficiary of the proposed project Yes/ No	Proposed project cause any social and environmental issues? Yes/ No	Suggestions for the proposed project
							under the proposed Bulk water supply
9	Mr. Harish S/o Chandrappa Rajanahalli Harihara Taluk Davanadere District	8152872933	Water supply from the Bore wells	24X7 water supply	Enroute villager	No	Water supply connection to be provided to their village under the proposed Bulk water supply
10	Mr. Jabiulla S/o Mohammed Ali Rajanahalli Harihara Taluk Davanagere District	-	Water supply from the Bore wells	24X7 water supply	Enroute villager	No	Water supply connection to be provided to their village under the proposed Bulk water supply
11	Mr. Parashuram S/o Huchangiappa Rajanahalli Harihara Taluk Davanagere District	-	Water supply from the Bore wells	24X7 water supply	Enroute villager	No	Water supply connection to be provided to their village under the proposed Bulk water supply
12	Mr. Ningappa S/o Basappa Rajanahalli Harihara Taluk Davanagere District	-	Water supply from the Bore wells	24X7 water supply	Enroute villager	No	Water supply connection to be provided to their village under the proposed Bulk water supply
13	Mr. Sannabasappa Goudar S/o Patel Narayanappa Rajanahalli Harihara Taluk Davanagere District	8722386473	Water supply from the Bore wells	24X7 water supply	Enroute villager	No	Water supply connection to be provided to their village under the proposed Bulk water supply

Sl. No	Name and address of the person consulted	Contact No	Present condition of water supply	What improvement is required in the present condition	Contacted person is the beneficiary of the proposed project Yes/ No	Proposed project cause any social and environmental issues? Yes/ No	Suggestions for the proposed project
14	Mr. Guddadaiah S/o Mylarappa Rajanahalli Harihara Taluk Davanagere District	9480082518	Water supply from the Bore wells	24X7 water supply	Enroute villager	No	Water supply connection to be provided to their village under the proposed Bulk water supply

Public Consultation in Vidya Nagar, Harihara, Davanagere District
Date: 15.11.2016

Sl. No	Name and address of the person consulted	Contact No	Present condition of water supply	What improvement is required in the present condition	Contacted person is the beneficiary of the proposed project Yes/ No	Proposed project cause any social and environmental Issues? Yes/ No	Suggestions for the proposed project
1	Syed Rafiq S/o Syed Abdul Jaleel Vidya Nagar 'C' Block Opp to APMC Harihara Davanagere District	-	Once in 2 days about 15 minutes water supply	24X7 water supply	Enroute area resident	No	Water supply connections to be provided to their area under the proposed Bulk water supply
2	K.E Jagadish S/o K. Eshwarappa Vidyanagar Opp to APMC Harihara Davanagere District	9448924029	Once in 2 days about 15 minutes water supply	24X7 water supply	Enroute area resident	No	Water supply connections to be provided to their area under the proposed Bulk water

Sl. No	Name and address of the person consulted	Contact No	Present condition of water supply	What improvement is required in the present condition	Contacted person is the beneficiary of the proposed project Yes/ No	Proposed project cause any social and environmental Issues? Yes/ No	Suggestions for the proposed project
							supply
3	Mr. Shivamurthy S/o Thammanna Vidya Nagar 'C' Block Opp to APMC Harihara Davanagere District	9886103996	Once in 2 days about 15 minutes water supply	24X7 water supply	Enroute area resident	No	Water supply connections to be provided to their area under the proposed Bulk water supply
4	Mr. Shashikanth S/o Nagendrappa Vidya Nagar 'C' Block Opp to APMC Harihara Davanagere District	8553130248	Once in 2 days about 15 minutes water supply	24X7 water supply	Enroute area resident	No	Water supply connections to be provided to their area under the proposed Bulk water supply
5	Mr. T. M Zahiruddin S/o Abdul Ganisab Vidya Nagar 'C' Block Opp to APMC Harihara Davanagere District	9611127387	Once in 2 days about 15 minutes water supply	24X7 water supply	Enroute area resident	No	Water supply connections to be provided to their area under the proposed Bulk water supply
6	Mr. B M Manjunath S/o Malleshappa Vidya Nagar 'C' Block Opp to APMC Harihara Davanagere District	9945221372	Once in 2 days about 15 minutes water supply	24X7 water supply	Enroute area resident	No	Water supply connections to be provided to their area under the proposed Bulk water supply
7	Mr. Shankar S/o Pushpanna Vidya Nagar 'C' Block Opp to APMC Harihara	9663508218	Once in 2 days about 15 minutes water supply	24X7 water supply	Enroute area resident	No	Water supply connections to be provided to their area under the

Sl. No	Name and address of the person consulted	Contact No	Present condition of water supply	What improvement is required in the present condition	Contacted person is the beneficiary of the proposed project Yes/ No	Proposed project cause any social and environmental Issues? Yes/ No	Suggestions for the proposed project
	Davanagere District						proposed Bulk water supply
8	Mr. Harish S/o Chinnappa B Vidya Nagar 'C' Block Opp to APMC Harihara Davanagere District	7760240119	Once in 2 days about 15 minutes water supply	24X7 water supply	Enroute area resident	No	Water supply connections to be provided to their area under the proposed Bulk water supply
9	Mr. Basavarajappa S/o Nagappa Vidya Nagar 'C' Block Opp APMC Harihara Davanagere District	9844181606	Once in 2 days about 15 minutes water supply	24X7 water supply	Enroute area resident	No	Water supply connections to be provided to their area under the proposed Bulk water supply
10	Mr. Santhosh S/o Ramanna Pawar Vidya Nagar 'C' Block Opp to APMC Harihara Davanagere District	99459717	Once in 2 days about 15 minutes water supply	24X7 water supply	Enroute area resident	No	Water supply connections to be provided to their area under the proposed Bulk water supply
11	Mrs. Kavya Ganesh Vagdevi Play Home Vidya Nagar 'C' Block Opp to APMC Harihara Davanagere District	9008052103	Once in 2 days about 15 minutes water supply	24X7 water supply	Enroute area resident	No	Water supply connections to be provided to their area under the proposed Bulk water supply

Photo Illustration


Proposed site for construction of Jack well and existing jack well site in Rajanahalli


Proposed site for construction of power station in Rajanahalli and ROW


Consultation with Gram Panchayat

Consultation with the local Anganwadi

Consultation with the local residents

Public consultation in the temple

Vidya Nagar Harihara Main Road and ROW

Public consultation at shops

Public consultation through door to door visit

Appendix 14. Monitoring and Reporting Formats

1. SAMPLE MONTHLY REPORTING FORMAT FOR CONSTRUCTION SUPERVISION SPECIALIST

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

a. Introduction
   - Overall project description and objectives
   - Description of sub Projects
   - Environmental Category of the sub projects.

- Details of site personnel and / or consultants responsible for environmental monitoring

  Overall project and sub project progress and status.

No.	Sub Project Name	Status of the Sub Project			List of works	Progress of works
		Pre-Construction	Construction	Operational Phase		

- Compliance Status with National / State / Local Statutory Environmental Requirements

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

- Compliance Status with Environmental Loan Covenants

No (List schedule and Paragraph Number of Loan Agreement)	Covenant	Status of Compliance	Action Required

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

Summary Monitoring Table

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

Overall Compliance with CEMP/ EMP

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

Approach and methodology for environmental monitoring of the project

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

Monitoring of environmental IMPACTS on PROJECT SURROUNDINGS(ambient air, water quality and noise levels)

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

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

Air Quality Results

Site	Date of Testing	Site Location	Parameters (Government Standards)		
			PM10 µg/m3	SO2 µg/m3	NO2 µg/m3
Site	Date of Testing	Site Location	Parameters (Monitoring Results)		
			PM10 µg/m3	SO2 µg/m3	NO2 µg/m3

Noise Quality Results

Site No.	Date of Testing	Site Location	LAeq (dbA) (Government Standard)	
			Day Time	Night Time
Site No.	Date of Testing	Site Location	LAeq (dbA) (Monitoring Results)	
			Day Time	Night Time

SUMMARY OF KEY ISSUES AND REMEDIAL ACTIONS

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

APPENDIXES

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

- Other

SAMPLE ENVIRONMENTAL SITE INSPECTION REPORT

Project Name

Contract Number

NAME: _____ DATE: _____

TITLE: _____ DMA: _____

LOCATION: _____ GROUP: _____

WEATHER CONDITION:

_____

_____

INITIAL SITE CONDITION: _____

CONCLUDING SITE CONDITION:

Satisfactory _____ Unsatisfactory _____ Incident _____ Resolved _____ Unresolved _____

INCIDENT:

Nature of incident:

_____

_____

Intervention Steps:

_____

_____

Incident Issues

Project Stage	Activity	
	Survey	
	Design	
	Implementation	
	Pre-Commissioning	
	Guarantee Period	

Inspection

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

Site Restored to Original Condition Yes ☐ No ☐

Signature

_____

Sign off

_____ _____

Name Name

Position Position

SAMPLE CHECKLIST FOR CONSTRUCTION SAFETY

Sl. No.	Safety Issues	Yes	No	Non-Compliance	Corrective Action	Penalty	Remarks
1	Appointment of qualified construction safety officers						
2	Approval for construction safety management plan by the SC						
3	Approval for traffic management/control plan in accordance with IRC: SP: 55-2001						
4	Maintenance of the existing road stretches handed over to the contractor.						
5	Provision of temporary traffic barriers/barricades/caution tapes in construction zones						
6	Provision of traffic signboards						
7	Provision for flags and warning lights						
9	Providing plastic crash barrier						
10	Provision of adequate staging, form work, and access (ladders with handrail) for works at a height of more than 3 m						
11	Provision of adequate shoring/ bracing/barricading/lighting for all deep excavations of more than 3 m depth.						
12	Demarcations (fencing, guarding, and watching) at construction sites						

Sl. No.	Safety Issues	Yes	No	Non-Compliance	Corrective Action	Penalty	Remarks
13	Provision for sufficient lighting, especially for nighttime work						
14	Arrangements for controlled access and entry to construction zones						
15	Safety arrangements for road users/pedestrians						
16	Arrangements for detouring traffic to alternate facilities						
17	Regular inspection of work zone traffic control devices by authorized contractor personnel						
18	Construction workers' safety - Provision of personnel protective equipment						
19	A. Helmets						
	B. Safety shoes						
	C. Dust masks						
	D. Hand gloves						
	E. Safety belts						
	F. Reflective jackets						
	G. Earplugs for labor						
20	Workers employed on bituminous works, stone crushers, concrete batching plants, etc. provided with protective goggles, gloves, gumboots, etc.						
21	Workers engaged in welding work shall be						

Sl. No.	Safety Issues	Yes	No	Non-Compliance	Corrective Action	Penalty	Remarks
	provided with welder protective shields						
22	All vehicles are provided with reverse horns.						
23	All scaffolds, ladders, and other safety devices shall be maintained in safe and sound condition.						
24	Regular health check-up for labour/ contractor's personnel						
25	Ensuring sanitary conditions and all waste disposal procedures and methods in the camps.						
26	The contractor shall provide adequate circuit for traffic flow around construction areas, control speed of construction vehicles through road safety and training of drivers, provide adequate signage, barriers, and flag persons for traffic control						
27	Provision of insurance coverage for the contractor's personnel						

Contractor Consultant