Initial Environmental Examination

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IND: Bihar Urban Development Investment Program — Gaya Water Supply Phase 2 (GWSP2) Subproject

Prepared by Urban Development and Housing Department, Government of Bihar for the Asian Development Bank.

ABBREVIATIONS

ADB	—	Asian Development Bank
BPLE	—	Bihar Public Land Encroachment Act
BSPCB	—	Bihar State Pollution Control Board,
BUIDCo	—	Bihar Urban Infrastructure Development Corporation
BUDIP	—	Bihar Urban Development Investment Program
C & P	—	Consultation and Participation
CBO	—	Community-based organization
CFE	—	Consent for Establishment
CFO	—	Consent for Operation
CGWB	—	Central Ground Water Board
CITES	—	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	—	Convention on Migratory Species of Wild Animals
CWR	—	Clear water reservoirs
DFO	—	Divisional Forest Officer
DSC	—	Design and Supervision Consultants
EAC	—	Expert Appraisal Committee
EARF	—	Environmental Assessment Resettlement Framework
EIA	—	Environmental Impact Assessment
EMP	—	Environmental Management Plan
EPA	—	Environmental Protection Agency
FAM	—	Facility Administration Memorandum
GLSR	—	Ground Level Storage Reservoir
GMC	—	Gaya Municipal Corporation
GRC	—	Grievance Redress Committee
GSHAP	—	Global Seismic Hazard Assessment Program
H and S	—	Health and safety
IEE	—	Initial Environmental Examination
IUCN	—	International Union for Conservation of Nature and Natural Resources
JNNURM	—	Jawaharlal Nehru National Urban Renewal Mission
MFF	—	Multi-tranche financing facility
MLD	—	Million liters per day
MOEFCC	—	Ministry of Environment, Forests and Climate Change
NAAQS	—	National Ambient Air Quality Standards
NGO	—	Nongovernmental organization
NOC	—	No Objection Certificate
NRRP	—	National Resettlement and Rehabilitation Policy
NRW	—	Nonrevenue water
O&M	—	Operation and maintenance
OHSA	—	Occupational Health and Safety Administration
OHSR	—	Overhead storage reservoirs
OHT	—	Overhead Tank

OMC	—	Operations and Maintenance Contractors
PHED	—	Public Health Engineering Department
PIU	—	Project Implementation Unit
PMC	—	Program Management Consultant
PMU	—	Program Management Unit
ROW	—	Right of way
SEAC	—	State Environment Assessment Committee
SEIAA	—	State Environment Impact Assessment Authority
SPS	—	Safeguard Policy Statement
STP	—	Sewage treatment plant
TDS	—	Total dissolved solids
TOR	—	Terms of reference
UFW	—	Unaccounted for water
ULB	—	Urban local body
USEPA	—	United States Environmental Protection Agency
WHO	—	World Health Organization
WTP	—	Water treatment plant

WEIGHTS AND MEASURES

cm	-	centimeter
crore	–	100 lac = 10,000,000
cumec	–	cubic meter per second
lac	–	100 thousand = 100,000
Kanal	–	505.39 square meter
km	–	kilometer
kph	-	kilometer per hour
lpd	–	liters per day
m	–	meter
m^2	–	square meter
mg/l	–	milligrams per liter
mm	–	millimeter
mld		million liters per day
msl	-	mean sea level
µ	-	micro = 10^{-6}
$\mu g/m^3$	–	micrograms per cubic meter

NOTE{S}

In this report, "$" refers to US dollars.
“INR” refers to Indian rupees

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EXECUTIVE SUMMARY

1. The first loan under the program, Tranche 1 or Loan 2861-IND, amounting to $65 million, was signed on 25 March 2013 and became effective on 6 June 2013.[1] Project 1, supported by Tranche 1 of BUDIP, included subprojects for improvement of infrastructure, operations and sustainability of water supply in Bhagalpur. The project has four outputs: (i) water supply infrastructure rehabilitated and newly constructed in Bhagalpur, (ii) staffing and skills for water supply operations improved in Bhagalpur, (iii) systems for water supply service delivery management improved in Bhagalpur, and (iv) subproject implemented on time within the budget in a transparent manner.

2. The proposed Project 2 will include physical and non-physical investments in water supply improvements in Bhagalpur and Gaya. Bhagalpur and Gaya were selected for financing under Project 2 based on the implementation capacity, project readiness and sector priorities of the Government, in accordance with the agreed framework financing agreement (FFA) for BUDIP. Project 2 is aligned with improved environment and well-being of residents in the program cities as defined by the Investment Program. It aims to improve access to sustainable water supply services in Gaya and Bhagalpur.

3. **Scope of Initial Environmental Examination**. The subproject comprises of the following (i) construction of 24 tube wells, with 58 MLD combined capacity; (ii) installation of around 24 flow meters; (iii) laying of around 17.06 km of rising main; (iv) construction of pump house and 5 control rooms; (v) construction of water storage reservoirs; and (vi) construction of one operator office cum customer service center.

4. **Screening and Categorization.** An environmental assessment of the GWSP2 subproject was conducted using ADB's Rapid Environmental Assessment (REA) checklist for Water Supply (**Appendix 1**). Results of the assessment show that the subproject and its components are unlikely to cause significant adverse environmental impact. Thus, GWSP2 subproject is categorized as environmental category B as per ADB SPS, 2009 and this draft IEE has been prepared in accordance with ADB SPS requirements for environment category B projects. Based on the Government of India EIA Notification 2006, GWSP2 subproject does not require an environmental clearance from the government**.**

5. This draft IEE has been prepared using the detailed design. This draft IEE will be updated in case of change in location of project components or change in scope This IEE, (i) provides information on the project and its environmental requirements; (ii) provides the necessary baseline conditions of the physical, ecological, physical cultural and socio-economic environments and/or resources in and surrounding the project's area of influence; (iii) identifies and assesses potential impacts arising from the implementation of the project on these environments and/or resources; (iv) recommends measures to avoid, mitigate, and compensate for the adverse impacts; (v) presents information on stakeholder consultations and participation during project preparation; (vi) recommends a mechanism to address grievances on the environmental performance of the project; and (vii) provides an EMP which includes an environmental monitoring program, and the responsible entities for mitigation and monitoring. In particular the EMP will, (i) ensure that the activities are undertaken in a responsible non-detrimental manner; (ii) provide a pro-active, feasible and practical working tool to enable the

[1]Upon request from Government of Bihar and Government of India, savings from Tranche 1 of $8 million were cancelled from Tranche 1 in December 2014.

measurement and monitoring of environmental performance on site; (iii) guide and control the implementation of findings and recommendations of the environmental assessment conducted for the subproject; (iv) detail specific actions deemed necessary to assist in mitigating the environmental impact of the subproject and (v) ensure that safety recommendations are complied with. The IEE will be made binding on all GWSP2 contractors and a copy is required to be kept on site always.

6. **Institutional and Implementation Arrangements**. The Urban Development and Housing Department (UDHD) of the state government of Bihar is the executing agency, which is responsible for management, coordination, and execution of all activities funded under the loan. A Program Steering Committee (PSC) will assist UDHD in providing policy guidance and coordination across all towns and subprojects. Bihar Urban Infrastructure Development Corporation (BUIDCo) will serve as the implementing agency and Project Management Unit (PMU) of the subproject. The Project Management Consultant (PMC) and the Design and Supervision Consultants (DSC) will assist the PMU on various tasks under the subproject. The project implementation unit (PIU) will be formed within Gaya city level, which will oversee the day-to-day implementation of the subproject, including implementation of the safeguards plans. The PIU will have a Safeguards Officer who will be responsible for (i) data collection for IEE and other safeguard document preparation and implementation, (ii) obtaining right of way clearances and prepare progress reports with respect to IEE implementation, and (iii) obtaining statutory clearances and no-objection certificates (NOCs) from government agencies or other entities and entering into agreements with them for use of their land. The Contractor will be responsible for the following: (i) compliance with all applicable legislation and the requirements of the Environmental Management Plan (EMP), (ii) ensuring that any sub-Contractors or suppliers, who are utilized within the context of the contract, comply with the environmental requirements of the EMP. The Contractor will be held responsible for non-compliance on their behalf, (iii) supplying method statements for all activities requiring special attention as specified and/or requested by the Engineer or Environmental Specialist during the duration of the Contract, (iv) providing environmental awareness training to staff, (v) shouldering the costs of any damages or compensation resulting from non-adherence to the EMP or written site instructions, (vi) conducting all activities in a manner that minimizes disturbance to directly affected residents and the public in general, and foreseeable impacts on the environment, (vii) ensuring that the engineer is informed in a timely manner of any foreseeable activities that will require input from the Environmental Specialist, (viii) appointing one full time Environment & Safety Officer for implementation of EMP, community liaising, reporting and grievance redressal on day to day basis, and (ix) receiving complaints or grievances from the public, immediately implementing the remedial measures and reporting to the Engineer (DSC) and PIU within 48 hours.

7. **Environmental Management Plan.** The EMP forms part of this IEE. It will guide the environmentally sound construction of the subproject and ensure efficient lines of communication among the DSC (Engineer), Contractors, and PIU or PMU or PMC. The EMP identifies three phases of development as: (i) site establishment and preliminary activities; (ii) construction phase; and (iii) post construction or operation phase.

8. The purpose of the EMP is to ensure that the activities are undertaken in a responsible non-detrimental manner with the objectives of: (i) providing a pro-active, 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 subproject; (iii) detailing specific actions deemed necessary to assist in mitigating the environmental impact of the subproject; and (iv) ensuring that safety recommendations are complied with.

9. Anticipated impacts during planning stage include impact on sensitive receptors including common property resources due to planning of distribution mains and rising mains. Mitigation has been considered after review of design and modification.

10. **Consultation, Disclosure and Grievance Redress**. The public participation process included identifying interested and affected parties (stakeholders); informing and providing the stakeholders with sufficient background and technical information regarding the proposed development; creating opportunities and mechanisms whereby they can participate and raise their viewpoints (issues, comments and concerns) with regard to the proposed development; giving the stakeholders feedback on process findings and recommendations; and ensuring compliance to process requirements with regards to the environmental and related legislation. The IEE includes the activities undertaken during project design to engage the stakeholders; and planned information disclosure measures and process for carrying out consultation with affected people and facilitating their participation during project implementation.

11. The subproject's Grievance Redressal Mechanism provides the citizens with a platform for redressal of their grievances and describes the informal and formal channels, time frame and mechanisms for resolving complaints about environmental performance.

12. **Monitoring and Reporting.** The PMU and PMC will be responsible for environmental monitoring and reporting. During the construction phase, the Contractor will undertake internal monitoring and submit monthly EMP implementation reports to PMC and PIU. These reports will be used by PMC or PIU in preparing the semi-annual environmental monitoring reports for ADB. PMC or PIU will forward the draft report to PMU and subsequently, PMU will submit the final draft semi-annual environmental monitoring reports to ADB. PMU or PIU will disclose the reports on the project website and ADB will also disclose said reports on its website.

13. **Recommendations and Conclusions**. The process described in this document has assessed the environmental impacts of all elements of the proposed GWSP2 subproject. Potential negative impacts were identified in relation to pre-, construction and operation of the improved infrastructure, but no environmental impacts were identified. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. The public participation processes undertaken during project design ensured stakeholders are engaged during the preparation of the IEE. The planned information disclosure measures and process for carrying out consultation with affected people will facilitate their participation during project implementation. The subproject's Grievance Redressal Mechanism will provide the citizens with a platform for redressal of their grievances and describes the informal and formal channels, time frame and mechanisms for resolving complaints about environmental performance.

14. 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.

15. Based on the findings of this IEE and as per ADB SPS 2009, the subproject's environmental category "B" is confirmed. Therefore, the subproject does not require any further study or detailed Environmental Impact Assessment.

I. INTRODUCTION

1. The first loan under the program, Tranche 1 or Loan 2861-IND, amounting to $65 million, was signed on 25 March 2013 and became effective on 6 June 2013.[2] Project 1, supported by Tranche 1 of BUDIP, included subprojects for improvement of infrastructure, operations and sustainability of water supply in Bhagalpur. The project has four outputs: (i) water supply infrastructure rehabilitated and newly constructed in Bhagalpur, (ii) staffing and skills for water supply operations improved in Bhagalpur, (iii) systems for water supply service delivery management improved in Bhagalpur, and (iv) sub-project implemented on time within the budget in a transparent manner.

2. The proposed Project 2, supported by the proposed tranche 2 of BUDIP, will include physical and non-physical investments in water supply improvements in Bhagalpur and Gaya. Bhagalpur and Gaya were selected for financing under Project 2 based on the implementation capacity, project readiness and sector priorities of the Government, in accordance with the agreed framework financing agreement (FFA) for BUDIP. Project 2 is aligned with improved environment and well-being of residents in the program cities as defined by the Investment Program. It aims to improve access to sustainable water supply services in Gaya and Bhagalpur.

3. The impact will be increased access to better quality and sustainable urban infrastructure and services by the people, especially vulnerable households, in Bhagalpur and Gaya. The expected outcome will be water supply infrastructure operations and sustainability is improved in Bhagalpur and Gaya.

4. Project 2 will have three outputs: (i) water supply infrastructure constructed and rehabilitated; (ii) staffing and skills for water supply operations improved; and (iii) systems for water supply service delivery management improved.

5. Under Output 1, Project 2 includes the following works packages: (i) Gaya Water Supply Project, Package 1 (GWSP 1); (ii) Gaya Water Supply Project, Package 2 (GWSP 2); and (iii) Bhagalpur Water Supply Project 2 (BWSP 2). The detailed description and outputs from Project 2 are as follows:

6. **Water supply subproject in Gaya**. Under the first output on “water supply infrastructure constructed and rehabilitated”, Project 2 includes the Gaya Water Supply Project (GWSP). The overall objective of GWSP is to deliver a continuous, pressurized supply of safe water to the entire population of Gaya. The GWSP will be executed under two separate contracts for two packages, namely: Gaya Water Supply Project, Package 1 (GWSP1) and Gaya Water Supply Project, Package 2 (GWSP2).

7. Infrastructure component of GWSP1 includes rehabilitation of the existing water source works and construction of water distribution system including transmission mains and distribution network, storage reservoirs, standpipes and metered household connections. Infrastructure component of GWSP2 will provide new water source and transmission mains for the supply of bulk water to the Gaya water distribution system. The construction periods of Packages 1 and 2 are expected to be coterminous, such that bulk water extracted from the new

[2] Upon request from Government of Bihar and Government of India, savings from Tranche 1 of $8 million were cancelled from Tranche 1 in December 2014.

water source works under Package 2 will be supplied to the water supply system developed under Package 1. As a part of the Package 1 works, certain supply points are identified to connect to the Package 2 transmission.

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II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. ADB Policy

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

12. **Screening and Categorization.** The nature of the environmental assessment required for a project depends on the significance of its environmental impacts, which are related to the type and location of the project; the sensitivity, scale, nature and magnitude of its potential

impacts; and the availability of cost-effective mitigation measures. Projects are screened for their expected environmental impacts and are assigned to one of the following four categories:

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

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

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

(i) for environmental category A projects, draft EIA report at least 120 days before Board consideration;
(ii) final or updated EIA and/or IEE upon receipt; and
(iii) environmental monitoring reports submitted by PMU during project implementation upon receipt.

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

B. National and State Laws

16. The implementation of the subprojects will be governed by Government of India and State of Bihar environmental acts, rules, regulations, and standards. These regulations impose restrictions on the activities to minimize or mitigate likely impacts on the environment. It is the responsibility of the project executing and implementing agencies to ensure subprojects are consistent with the legal framework, whether national, state or municipal or local. Compliance is required in all stages of the subproject including design, construction, and operation and maintenance.

17. **Environmental Impact Assessment Notification.** The government's Environmental Impact Assessment (EIA) Notification of 2006, which replaces the EIA Notification of 1994, requires environmental clearance for certain defined activities or projects[3]. This Notification classifies the projects or activities that require environmental clearance into 'A' and 'B' categories depending on the impact potential and/or scale of project. For both category projects, prior environmental clearance is mandatory before any construction work, or preparation of land except for securing the land, is started. Clearance provisions are as follows:

(i) Category 'A' projects require prior environmental clearance from the Ministry of Environment Forest and Climate Change (MoEFCC)[4];
(ii) Category 'B' projects require prior environmental clearance from the State Environmental Impact Assessment Authority (SEIAA)[5].

18. This Notification provides that, any project or activity specified in Category 'B' will be treated as Category A, if located in whole or in part within 10 km from the boundary of: (i) protected areas notified under the Wild Life (Protection) Act, 1972, (ii) critically polluted areas as notified by the CPCB from time to time, (iii) notified eco-sensitive areas, (iv) inter-state boundaries and international boundaries. In the case where an SEIAA does not exist, Category B project will be reviewed by the MoEFCC and reclassified as Category A.

19. The proposed subproject is not listed in the EIA Notification of 2006 "Schedule of Projects Requiring Prior Environmental Clearance". Thus, environmental clearance is not required.

20. **Water (Prevention and Control of Pollution) Act of 1974, Rules of 1975, and amendments.** This Act covers any component of the subprojects having the potential to generate sewage or trade effluent. Under Section 25 of the Act, such subprojects have to obtain from State Pollution Control Board (SPCB) (i) Consent for Establishment (CFE) before starting implementation, and (ii) Consent for Operation (CFO) before commissioning the facility. The Water Act also requires the occupier of such subprojects to adopt measures for abating any possible pollution of receiving water bodies. The following types of projects require CFE and CFO from SPCB:

(i) New or augmentation of water treatment plants;
(ii) New or augmentation of sewage treatment plants.

21. The proposed subproject is not included in the lists of activities requiring CFE and CFO under the Water Act. Emissions and discharges shall comply with standards notified by the Central Pollution Control Board.

22. **The Air (Prevention and Control of Pollution) Act 1981, amended 1987 and The Air**

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[3] EIA Notification of 2006 —Schedule of Projects Requiring Prior Environmental Clearance

[4] Category A projects - based on preliminary details provided by the project proponent, the MoEFCC Expert Appraisal Committee (EAC) would determine comprehensive terms of reference (TOR) for the EIA studies. This TOR will be finalized within 60 days. On the recommendation of the EAC based on EIA studies, MoEFCC provides the environmental clearance.

[5] Category B projects – to be further divided by State Level Expert Appraisal Committee (SEAC) into B1 (require EIA studies) and B2 (do not require EIA studies). The SEAC will determine TOR for EIA studies for B1 projects within 60 days. On the recommendation of the SEAC based on EIA studies, SEIAA provides the environmental clearance.

(Prevention and Control of Pollution) Rules, 1982. This Act covers any component of the subprojects having potential to emit air pollutants into the atmosphere. Under Section 21 of the Act, such subprojects have to obtain from SPCB (i) CFE before starting implementation, and (ii) CFO before commissioning the facility. The Air Act also requires the occupier of the project or facility to adopt necessary air pollution control measures for abating air pollution. Application for CFE and CFO can be done online through the website[6] of SPCB. The following types of emission sources require CFE and CFO from SPCB:

(i) Diesel generators; and
(ii) Hot mix plants, wet mix plants, stone crushers etc., if installed for construction.

23. Emissions and discharges shall comply with standards notified by the CPCB.

24. **Noise Pollution (Regulation and Control) Rules, 2000, as amended.** This Rules states that the State Government shall take measures for abatement of noise including noise emanating from vehicular movements and ensure that the existing noise levels do not exceed the ambient air quality standards specified under the Rules. All development authorities, local bodies, and other concerned authorities, while planning developmental activity or carrying out functions relating to town or city and country planning, shall take into consideration all aspects of noise pollution as a parameter of quality of life to avoid noise menace and to achieve the objective of maintaining the ambient air quality standards in respect of noise. Based on the Rules, an area comprising not less than 100 meters around hospitals, educational institutions and courts may be declared as silence areas or zones.

25. **The Indian Forest Act of 1927.** This Act empowers State of Bihar to declare any forestland or wasteland, which is the property of government or over which the government has proprietary rights or to the whole or any part of the forest produce of which the government is entitled, a reserved forest or protected forest. State of Bihar may assign to any village-community the rights of the government over a reserved forest - called the village-forest. The Forest Act also allows government control over forests and lands not owned by the government.

26. For reserved forests and village-forests, activities like clearing or breaking up of any land for cultivation or for any other purpose, damage to vegetation or trees and quarrying or removing any forest produce are prohibited. For protected forests, State of Bihar makes rules to regulate activities like cutting of trees and removal of forest produce; clearing or breaking up of land for cultivation or any other purpose; and for protection and management of any portion of protected forest.

27. **Forest (Conservation) Act of 1980 (amended in 1988).** This Act restricts the deforestation of forests for use for non-forest purposes. Accordingly, State of Bihar requires prior approval of MoEFCC for the use of forest land for non-forest purposes (which means the breaking up or clearing of any forest land) or for assigning lease to any private person or agency not controlled by government. The Forest (Conservation) Rules of 2003 issued under this Act provides specific procedures to be followed for conversion of forestland for non-forest purposes.

28. Conversion of forestlands that are part of National Parks or Sanctuaries and Tiger Reserve areas (notified under Indian Wildlife [Protection] Act of 1972) is not permitted. In exceptional case, State of Bihar requires consent of the Indian Board of Wildlife for obtaining

[6] http://bhocmms.nic.in/.

approval of the State Legislature for de-notification of the area as a sanctuary. The State or National Wildlife Board under MoEFCC is the authority, which will grant a No Objection Certificate (NOC) for any construction within a sensitive area. Every user agency, which proposes to use any forestland for non-forest purposes and use buffer zone of the wildlife protected areas for other purposes, must apply for forest and/or wildlife clearance.

29. **The Bihar Forest (Amended) Act, 1990 and Bihar Public Land Encroachment Act, 1956.** This Act provides that encroachment of forest land is a cognizable and non-bailable offense. If any Forest Officer, not below the rank of the Divisional Forest Officer (DFO), has reasons to believe that forest land has been encroached, the Officer can evict the encroachers and can use all power conferred on a Magistrate under the Bihar Public Land Encroachment Act, 1956. The Indian Forest Act, 1927 provides realization of royalty and compensation for damages of forest produce and forest land from the encroachers.

30. **Ancient Monuments and Archaeological Sites and Remains Rules, 1959.** This Rules designates areas within a radius of 100 meters and 300 meters from a "protected property" as "protected area" and "controlled area", respectively. No development activity (including mining operations and construction) is permitted in the "protected area" and all development activities likely to damage the protected property are not permitted in the "controlled area" without prior permission of the Archaeological Survey of India (ASI). Protected property includes the site, remains, and monuments protected by ASI or the State Department of Archaeology.

31. **World Bank Environmental, Health, and Safety Guidelines –** The Environmental, Health and Safety (EHS) Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines, which provide users on EHS in specific industry sectors[7]. Whereas, the EHS Guidelines for Water & Sanitation provides information relevant and specific to the operation and maintenance of (i) potable water treatment and distribution systems, and (ii) collection of sewage in centralized systems (such as piped sewer collection networks) or decentralized systems (such as septic tanks subsequently serviced by pump trucks) and treatment of collected sewage at centralized facilities[8]. Project 2 will follow these World Bank EHS Guidelines.

32. Employers and supervisors are obliged to implement all reasonable precautions to protect the health and safety of workers. Preventive and protective measures should be introduced according to the following order of priority:

(i) Eliminating the hazard by removing the activity from the work process. Examples include substitution with less hazardous chemicals, using different manufacturing processes, etc;
(ii) Controlling the hazard at its source through use of engineering controls. Examples include local exhaust ventilation, isolation rooms, machine guarding, acoustic insulating, etc;
(iii) Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work

[7] https://www.ifc.org/wps/wcm/connect/554e8d80488658e4b76af76a6515bb18/Final+-+General+EHS+Guidelines.pdf?MOD=AJPERES
[8] http://www.ifc.org/wps/wcm/connect/e22c050048855ae0875cd76a6515bb18/final+-+water+and+sanitation.pdf?mod=ajperes

procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc.

(iv) Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE.

33. The application of prevention and control measures to occupational hazards should be based on comprehensive job safety or job hazard analyses.

C. Conventions, Treaties and Protocols

34. In addition to national and state rules and regulations, Government of India is a party and signatory to international conventions such as the International Union for Conservation of Nature and Natural Resources, Convention on Migratory Species of Wild Animals, Convention on International Trade in Endangered Species of Wild Fauna and Flora, and Ramsar Convention on Wetlands of International Importance are applicable in the selection and screening of some subprojects under BUDIP. However, these international environmental agreements are not applicable for GWSP2 subproject.

35. The summary of environmental regulations and mandatory requirements for the proposed subproject is shown in **Table 1**. Permission will be required from railways for crossing of pipeline near Cotton mill, Naryan nagar Kharkhura.

Table 1: Applicable Environmental Regulations and Status

Applicability of Acts or Guidelines	Compliance Criteria
The EIA notification, 2006 (and its subsequent amendments in 2009) provides for categorization of projects into category A and B, based on extent of impact	The subproject is not covered by the EIA notification as this is not covered under either Category A or Category B of the notification. Environmental Clearance is not required for the proposed GSWP2 subproject.
Wild Life (Protection) Act 1972, Amendment Act, 1993 and 2002 and Wildlife (Protection) Rules, 1995	Clearance from state and national wildlife boards, Central Empowered Committee of Hon'ble Supreme Court of India and the State Wildlife Department, as applicable. The wildlife protection act is not applicable for the proposed subproject.
The Indian Forest Act, 1927; Forest (Conservation) Act, 1980, amended 1988; Forest (Conservation) Rules, 1981 amended 1992 and 2003	No forest land will be required Clearance from Forest Department for cutting of trees, if any. – At ITI Polytechnic water reservoir site one tree will remove and permission will be taken from DFO Gaya. It will take three months to get an NOC.
Ancient Monuments and Archaeological Sites and Remains Rules, 1959. Bihar Ancient Monuments and Archaeological Sites, remains And Art Treasures Act, 1976 provide guidance for carrying out activities, including conservation, construction and reuse in and around the protected monuments.	There is no requirement of clearance from ASI, Govt. of India and state archeological dept.
The Air (Prevention and Control of Pollution) Act 1981, amended 1987 and The Air (Prevention and Control of Pollution) Rules, 1982 and Noise Pollution	Consent for Establishment (CFE) and Consent for Operation (CFO) from the Bihar Pollution Control Board for setting up of hot mix plants, wet mix plants,

Applicability of Acts or Guidelines	Compliance Criteria
(Regulation and Control) Rules, 2000, as amended.	stone crushers and diesel generators (if any). To be obtained by the Contractor, prior to construction, if needed.

III. DESCRIPTION OF THE PROJECT

A. The Project Area

36. Gaya is the district headquarter city in the Gaya District located in the southern part of Bihar State. The city is situated at the banks of Phalgu river. The city is located at an altitude of about 110 meters above the MSL.

B. Existing Conditions

37. **Water Sources.** The water sources of Gaya consist of underground water extracted through tube wells located on both sides of the Phalgu river, Manpur and Gaya main. The Phalgu river divides Gaya city into two parts, Manpur and Gaya main. There are 39 tube wells in the city at present, of which two are in standby, three are not yet commissioned and two are not working. The tube wells are distributed in four locations, namely: Manpur side, Dandibagh side, Panchayati Akhara side, and the main city area. The tube wells in Manpur, Dandibagh and Panchayati Akhara areas are bored in the bed or bank of Phalgu river and the other tube wells are bored at various locations in the city away from the river bank. The water from tube wells in Manpur side is being pumped directly to the distribution system in Manpur area. The water from tube wells in Dandibagh side is being pumped to the reservoirs located on Brahmayoni hills. The water from tube wells in Panchayati Akhara is being pumped to the reservoirs located on Ramshila hills and Murli hills. The water from the tube wells in the city area is being pumped directly to the distribution system in the city.

38. The Design and Supervision Consultant (DSC) has performed flow measurements at all tube wells in Gaya and the results indicate that expected total yield of water from all running tube wells is 61 MLD. However, it has been further assessed that actual total volume of water received from the tube wells is less compared to the expected total yield due to low voltage, power supply interruptions and old pumping machineries.

39. The tube wells are also not equipped with measuring instruments (e.g. ampere meters, volt meters, pressure gauges, flow meters, water level measuring instruments, etc.). In the absence of these instruments, the present level of production and performance level of electro-mechanical equipment are not known.

40. The water district zones and wards of Gaya are shown in **Figure 1.**

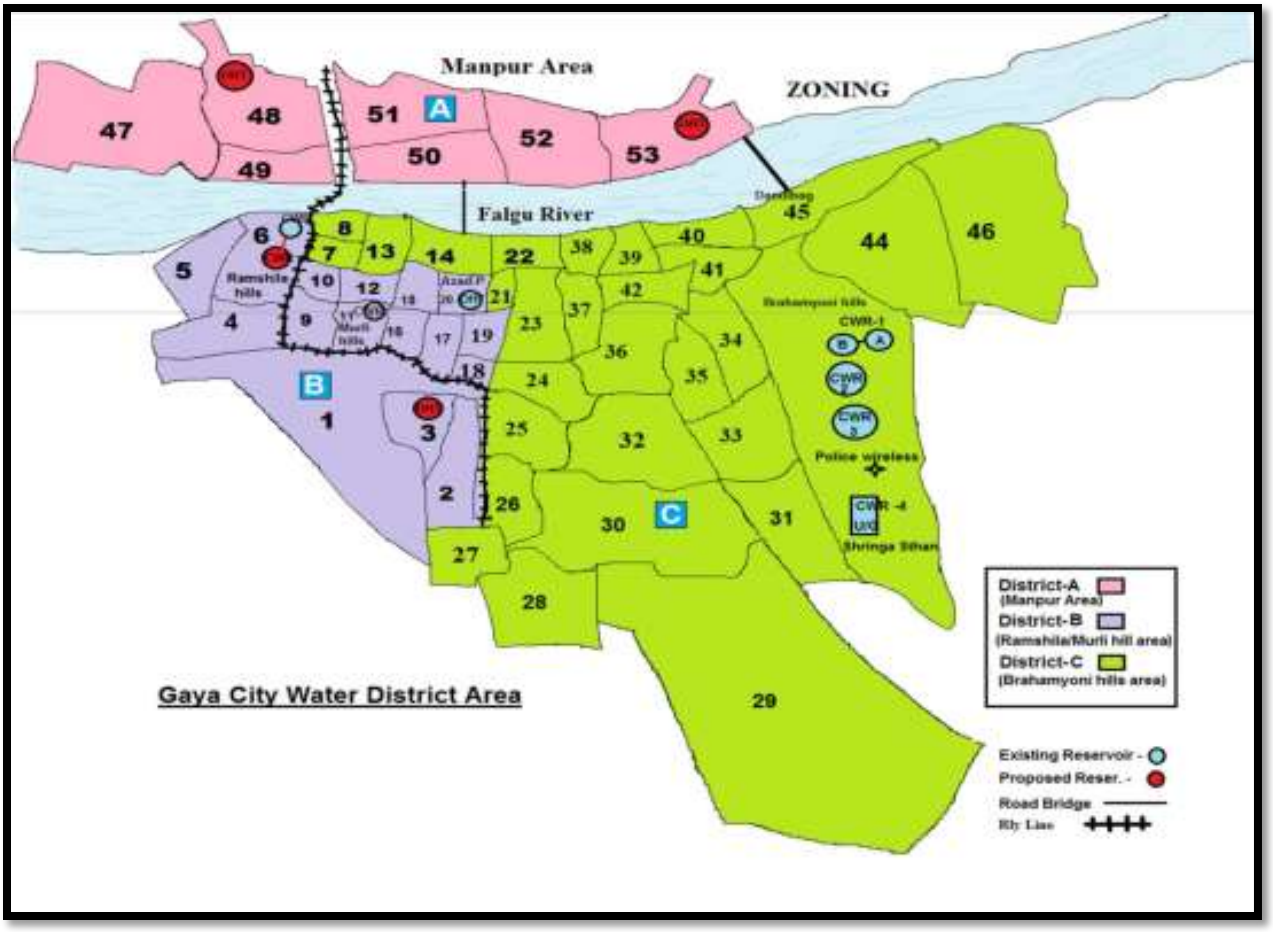


Figure 1: Ward wise Gaya city Water District Area

41. **Existing Water Distribution System**. The existing distribution system does not conform to basic engineering design and best practices. One part of system consists of transmission mains raising the water to one overhead tank (OHT) and seven ground level storage reservoirs (GLSR). Whereas, another part of the system does not have storage capacity wherein it operates by pumping the water from the tube wells directly to the distribution network.

42. **Transmission and Rising Mains.** There are three cast iron rising mains with 350 mm, 50 mm and 600 mm in diameters. Each of these rising mains has length of 3 km which extends from Dandibagh to Brahmayoni Hills reservoirs. There is also one DI rising main with 450 mm in diameter and length of 3.1 km which has been laid recently under the augmentation project of the 12th Finance Commission program.

43. **Water Storage Reservoir.** At present, there are seven GLSR and one OHT being utilized in the main city area. The total capacity of the reservoirs is 17,747 m^3. See details in **Table 2** below.

Table 2: Existing Storage Reservoirs

No.	ID	Location/Name	Type of storage	Capacity [m^3]	Staging	Present condition
1	7	Ramshila Hills	GLSR	227	No	50+ years old Needs replacement

No.	ID	Location/Name	Type of storage	Capacity [m³]	Staging	Present condition
2	9	Murli Hills	GLSR	1630	No	50+ years old. Roof and inside wall in very bad condition
3	10	Azad Park	OHT	454	12.2 m	Needs slight repair from inside
4	11a	Brahmayoni	GLSR	1816	No	70+ years old. Roof and inside wall in very bad condition
5	11b	Brahmayoni	GLSR	1816	No	70+ years old. Roof and inside wall in very bad condition
6	12	Brahmayoni	GLSR	3632	No	Needs slight repair from inside
7	13	Brahmayoni	GLSR	3632	No	Needs slight repair from inside
8	14	Shringh Sthan	GLSR	4540	No	Although recently constructed, it leaks from various places
Total						

Note: The ID corresponds to the marking on the Drawing mentioned above
Source: DPR for Gaya water supply

44. The GLSRs constructed on Ramshila hills, Murli hills and OHT at Azad Park are not functional at present due to lower capacity of the pumping stations compare to available storage capacity. Also, the water coming from some tube wells is already being pumped directly to the distribution network.

45. **Distribution Network. Table 3** summarizes the length of the existing distribution network sorted by pipe diameter.

Table 3: Existing Distribution Network Data

Description	Length [km]	Dia. [mm]	Length [m]
PHED		100	39,684
		150	16,422
		200	15,788
		250	2,050
		300	981
		350	2,140
		400	5,235
	85	450	2,594
		Sub-Total	84,894= Approx. 85 km
Before 1982		50	436
		63	3,930
		75	10,952
		100	8,065
		125	9,166
		150	12,790
		175	2,633
		200	6,986
		225	253
		250	3,811
		300	2,728
		400	2,325
	65	600	645
		Sub-Total	64,722= Approx. 65 km
Total	**150**		**149,616 = Approx. 150 km**

46. There is no zoning for the existing distribution system. Areas connected from one reservoir are served all together at the same time. The existing tube wells which are not connected to any reservoir provide simultaneous feed to the distribution system. Meaning, both the source and distribution system do not have an adequate control system in place. Further, there is no chlorination system that is functioning to disinfect the water being supplied, resulting to high health risk.

47. A part of the pipelines laid under the supervision of Public Health Engineering Department (PHED) is presently being used, but has not been handed over to the Gaya Municipal Corporation (GMC). It is expected that after its completion, the pipeline project will be transferred to the management of GMC. GMC will then be the owner of the distribution system and PHED will execute any civil works on behalf of GMC.

48. At present there are 1,074 public stand posts in the city, from which people (and households) who do not have water service connections get their drinking water. However, not all of these public stand posts are functional. After completion of the subproject, all stand posts will be transferred to the management of GMC.

49. **Service Connections.** There are around 12,500 registered consumers in the area. However, there is a large number of unauthorized and unidentified consumers connected to the existing distribution system. According to the information collected from Wards Counselors, the total number of connections is about 29,000. There is no metering of water supplied to consumers and there is no water billing system as well. Water charges are levied as part of the Holding Tax on properties by GMC.

50. **Recent and Ongoing Construction Work.** In 2007, Government of India sanctioned a project under the 12th Finance Commission program to augment water supply of the town. The project involved construction of a battery of tube wells on the bank of Phalgu river near Dandibagh and in various parts of the town. The aim was to increase water production by 16 MLD and provide distribution system for the newly developed areas like Manpur and AP Colony, among others. The work on the project is being executed by PHED on behalf of GMC, and is now at advanced stage of completion. The highlights of the works as communicated by PHED are as follows:

(i) Transformers – out of total five installed three are complete
(ii) Eight nos. of tube wells – completed
(iii) Eight nos. of Pump houses – completed
(iv) Pumps and motors – eight nos. provided, one currently working
(v) Rising Mains – laying of 2,500m completed
(vi) Gravity Mains – completed laying of 3,433m out of total 4,000m, the works of Sluice Valves and sluice valve chambers are 50% complete
(vii) Service reservoir – completed
(viii) Distribution Network – out of proposed total 59,335m, the length laid is 47,966m. Large portion of the total length laid was not commissioned to GMC.

51. The existing Gaya water supply system, particularly tube wells, rising mains, and reservoirs are shown in following figure.

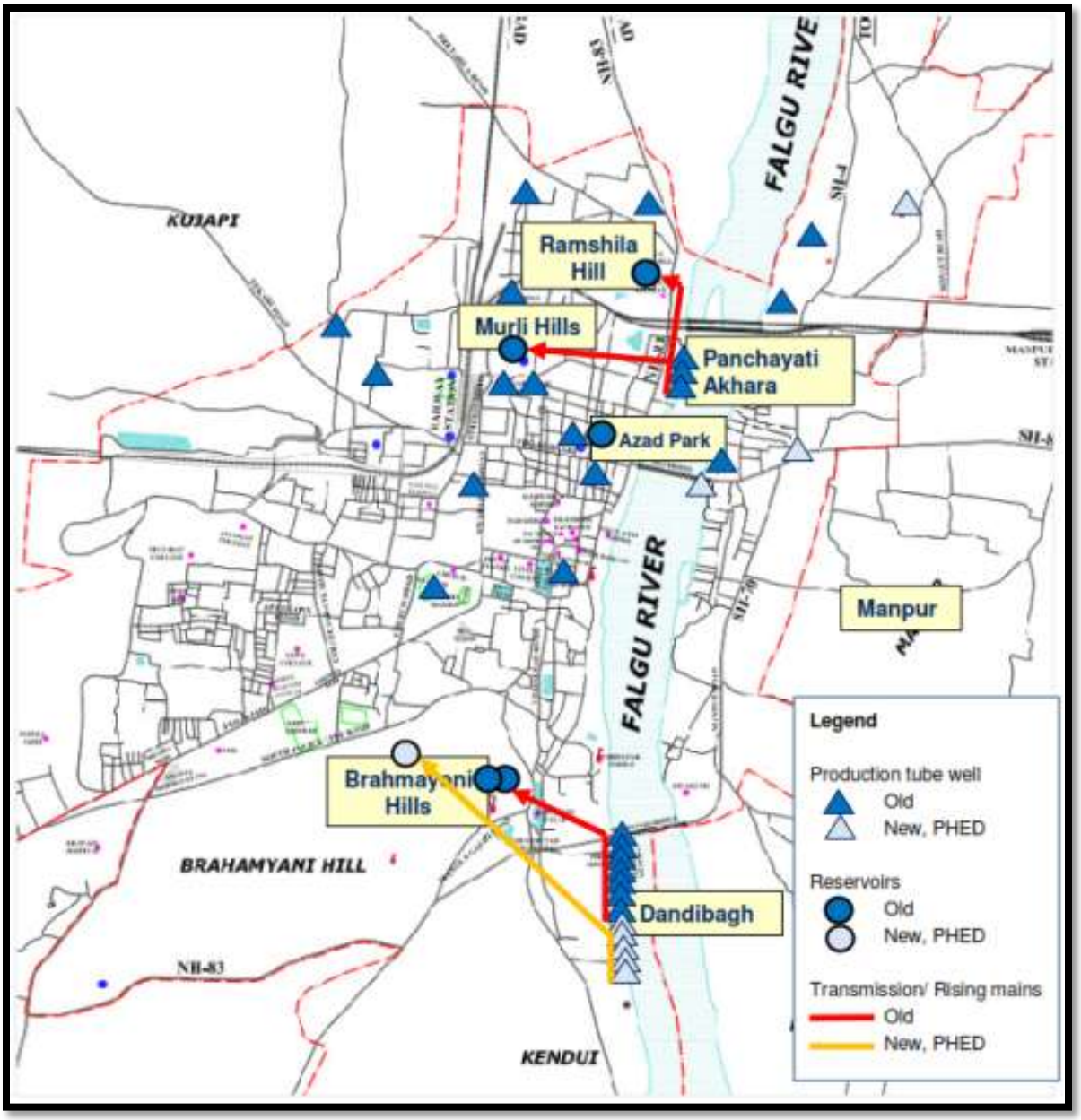


Figure 2: Gaya existing water supply system: wells, rising mains, reservoirs

C. Justification of the proposed GWSP

52. The proposed GWSP has been planned after analyzing the present situation in Gaya and justifying its need. In particular, GWSP2 subproject is necessary because the present water supply system of Gaya is inadequate for the needs of the growing population. Per capita supply is low at 40 lpcd which is below the required 135 lpcd. The unaccounted for water (UFW) is at around 40%. The storage and distribution network is insufficient and old to meet even present requirements. Improvement and rehabilitation in the water supply system has been identified as a major priority for Gaya. Therefore, the objective of GWSP2 subproject is to provide continuous (24x7), pressurized, and safe water to the entire population at 135 lpcd through household

connections, where feasible, at the required minimum pressure head. In other words, the water service will aim to meet the Indian National Service Level Benchmarks.

D. Proposed Subproject and Components

53. **Water sustainability**. Hydrogeological study has been conducted at Gaya in the year 2014. Based on the hydrogeological assessment studies of the ground water potential zone of Gaya, it is observed that present ground water abstraction of 24,000 m^3/day for 75 days (when the Phalgu river is dry) is hardly 31.50 % of the total sub-surface water storage (5.70 mcm) within 2 meters of aquifer in 14.25 km^2 of the ground water potential zone during summer months.

54. Similarly, with the ground water abstraction of 124 MLD for 75 days of 9.30 mcm from the sub-surface water storage of 25 m thick aquifer of 53.43 mcm will be 17.40 % and it will lower the water level by 4.35 meters, still keeping the aquifer thickness of 20.65 meters which is considered as sufficient to sustain the yield of tube wells.

55. It is concluded from the study that despite lowering of water level by 4.35 meters during summer months, the tube wells will sustain the yield and will restore original yield as soon as Phalgu river starts flowing after the first rainfall in mid -June.

56. The impact of pumping 124 MLD during the summer months (75 days) can be further reduced if the well fields are increased instead of having only one well field of Dandibagh. Two more well fields can be developed, one near village Kendui and another near Kendua on the left bank and fourth near Manpur - Buniyadgunj on the right bank. By having four different well fields, there will be less pumping from a small area of a well field, thereby creating a small ground water depression and less lowering of water level around it.

57. **Appendix 2** shows section related to water sustainability study and impact related to water abstraction from Phalgu river bed.

58. The design of the subproject has been developed considering the future demand based on the population projections. **Table 4** shows the total water demand and water balance up to year 2048.

Table 4: Demand Projection

Description	2013 (Present)	2018	2021	2033	2048
Total Demand [MLD]	*55.84*	89.26	103.92	126.05	163.21
Total Demand [l/s]	*646.28*	1,033.08	1,202.82	1,458.88	1,889.02
Needed Water Production [MLD]	*68*	90	104	130	165
NRW [%] of production	*33%*	15%	19%	19%	23%
(+) Water Balance [MLD]	*12.16*	**0.74**	**0.08**	**3.95**	**1.79**

In the above table the figures in the row containing the "Water Production" are based on the assumption that water sources are or will be made available for the respective target year. Producing (pumping) higher volumes of water will result in the increase of the NRW.
Source: DPR for Gaya water supply

59. There are 31 tube wells (one kept for use in fire fighting and another is defunct) of GMC and eight tube wells constructed by PHED which are yet to be transferred to GMC. The condition of tube wells of GMC is not very good as they are quite old (ranging from 6 years to 50 years). It would be appropriate to undertake redevelopment of these tube wells to improve their efficiency and ensure the discharge of sand-free water. It was decided that after commissioning of the tube wells, these will be transferred to GMC for operation & maintenance.

Table 5: Status of Existing Tube Wells and Appurtenances

ID	Name	Transformer		In	Remark
		kVA	Available	Operation	
1	Dandibagh No. 1*	500 & 300	Yes	Yes	Pump no 1 will be installed after replacing with 125 hp pump-2
2	Dandibagh No. 2*			Yes	Will be changed with 125 hp motor, No room for pump
3	Dandibagh No. 3*			Yes	Poor condition of electrical equipment, No room for pump
4	Dandibagh No. 4*			Yes	Poor condition of electrical equipment
5	Dandibagh No. 5*			Yes	Poor condition of electrical equipment
6	Panchayati Akhara No. 1*	200	Yes	Yes	Needs maintenance(new starters provided of electrical systems)
7	Panchayati Akhara No. 2*			Yes	Needs maintenance(new starters provided) of electrical system
8	Azad Park*	200	Yes	Yes	Below overhead reservoir, needs maintenance of electrical system
9	Dhobighat*	100	Yes	Yes	Poor condition of Electric system
10	Central School*	200	No	Yes	Poor condition of Electric system
11	Nigam Store*	200	Yes	Yes	Valve not visible, no proper approach
12	Gurudwara*	100	Yes	Yes	Poor condition of Electrical system
13	Fire Station	200	No	Yes	Poor condition of Electric system
14	New Godown*	100	Yes	Yes	No proper approach, needs maintenance
15	Baba Dyalunath*	250	Yes	Yes	Needs maintenance for electrical equipment
16	Delha*	63	No	Yes	Poor Condition of Electrical system
17	Panchayati Akhara No. 3*	63	Yes	No	Poor Condition, Pump out of order
18	Janata Colony*	200	No	Yes	Needs maintenance of Electric system
19	Janata Colony*	100	No	Yes	New constructed, cabling laid above floor
20	Pilgrim Hospital*	100	Yes	Yes	Poor condition of Electrical system
21	Visnupad*	63	Yes	Yes	Needs maintenance
22	Bypass*	100	Yes	Yes	Needs maintenance for stators & pumps
23	Bairagi Powerganj*	63	Yes	Yes	Poor condition of electrical system
24	Bageshwari Pachim*	63	Yes	Yes	Needs maintenance
25	Pitamaheshwar*	100	Yes	Yes	Needs maintenance

ID	Name	Transformer		In	Remark
		kVA	Available	Operation	
26	Kauvasthan*	63	Yes	Yes	Poor condition of Electric system
27	Hata Godown*	200	No	Yes	Poor condition of Electric system
28	Manpur*	100	Yes	Yes	Pumps operated by local people also.
29	Manpur - Buniydiganj*	100	Yes	Yes	Pump house to be repaired
30	Khadigramodyog Lakhibagh*	300	Yes	Yes	Needs maintenance
31	Cotton Mill				Non functional
32	New TW Kirloskar-1			Yes	
33	New TW Kirloskar-2		Yes	Yes	
34	New TW Kirloskar-3	300	Yes	No	
35	New TW Kirloskar-1	500	Yes	Yes	Newly constructed
36	New TW Kirloskar-2			Yes	Newly constructed
37	New TW Kirloskar-3			No	Not commissioned
38	New TW Kirloskar-4			No	Not commissioned
39	New TW Kirloskar-5	63	Yes	No	Not commissioned

(Note: Marked * -29 tube wells considered for refurbishment)

60. The pumping machinery installed on tube wells is generally old and frequently experiencing breakdowns. There are also no measuring devices installed on the delivery pipelines (e.g. flow meters, pressure gauges, depth gauges and non return valves).

E. Proposed Subproject and Components – Gaya Water Supply Package 2

61. The subproject GWSP2 is complementary to GWSP1 and concerns the construction of new production tube wells, transmission mains, two reservoirs and associated pumping stations. The package is also proposed to include a new Operator Office to be constructed at the Dandibagh Water Works compound. In addition, the package will include operation of the new GWSP2 facilities by the contractor to be engaged for the works.

62. Core element of the subproject is the development of a new water source. For that purpose extensive investigations have been carried out under BUDIP.

63. **Tube wells**. The designer has assessed the city's water demand for the medium term (year 2033) at 126 MLD. Of this 68 MLD will be provided from 39 existing production tube wells that will be rehabilitated under GWSP1. The balance 58 MLD is proposed to be provided under the present subproject GWSP2 by the construction of 24 new tube wells. The new tube wells will tap the aquifer of the Phalgu riverbed at various locations as shown in **Figures 3 and 4A to 4D.** Several of the tube wells, each having an expected yield of 100 to 130 m^3/h, will be constructed as batteries of wells, space relatively closely. It must be noted that the capacities of the wells have not yet be fixed. This will be done by drilling and construction of exploratory wells and adjacent observations well, and carrying out long-duration pumping tests to determine aquifer characteristics and safe yields for each well. It is possible that the allowable yields per well are more than the 100 to 130 m^3/h and that less than 24 wells are required. **Table 6** summarizes the proposed well locations, the water production capacities and the reservoirs they will be feeding.

64. **Flowmeter.** 24 flowmeters to be installed at all tube well sites

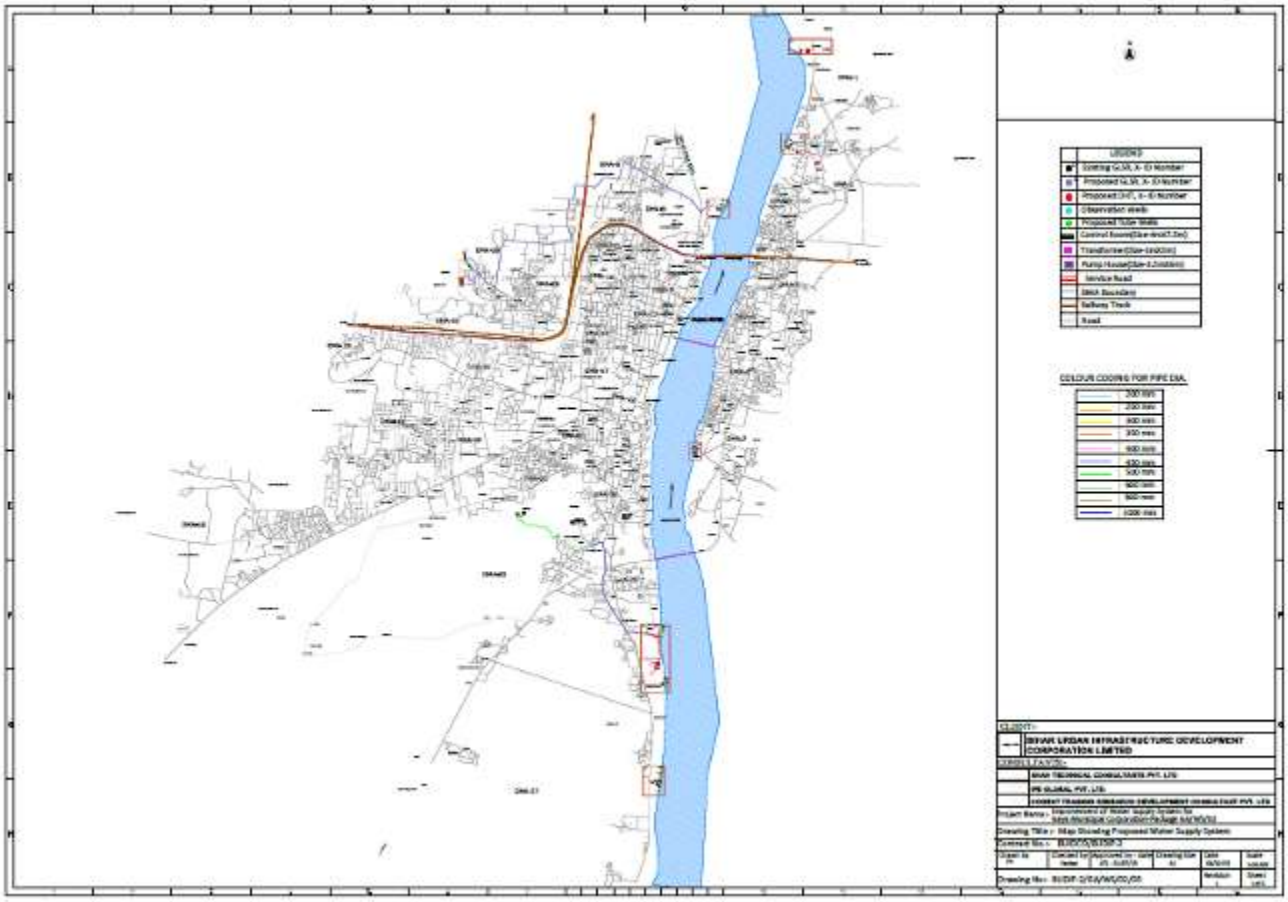


Figure 3: GWSP2, location of proposed production wells and transmission mains, reservoir (total)

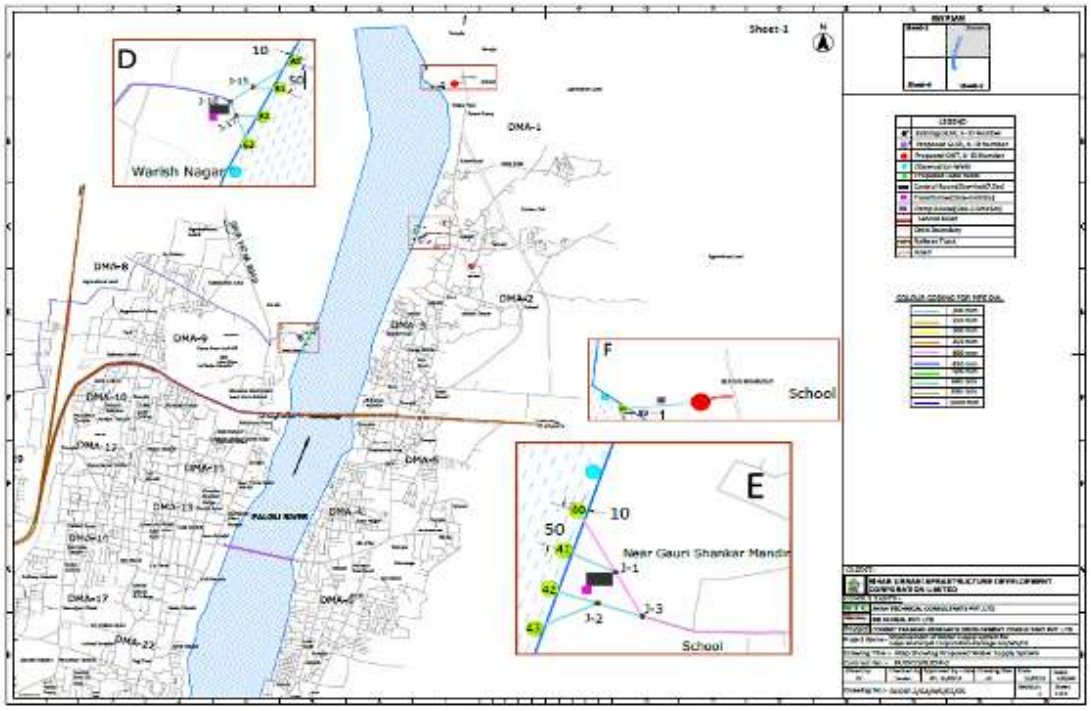


Figure 4A: Section drawing GWSP2

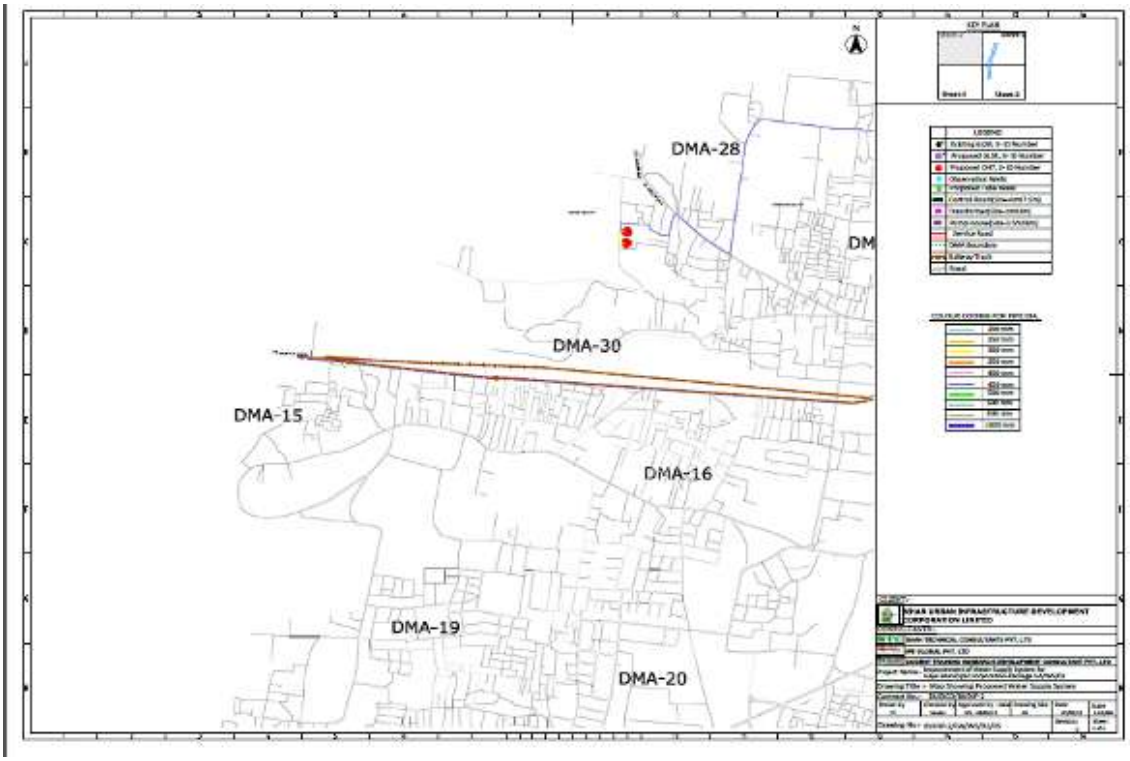


Figure 4B: Section drawing GWSP2

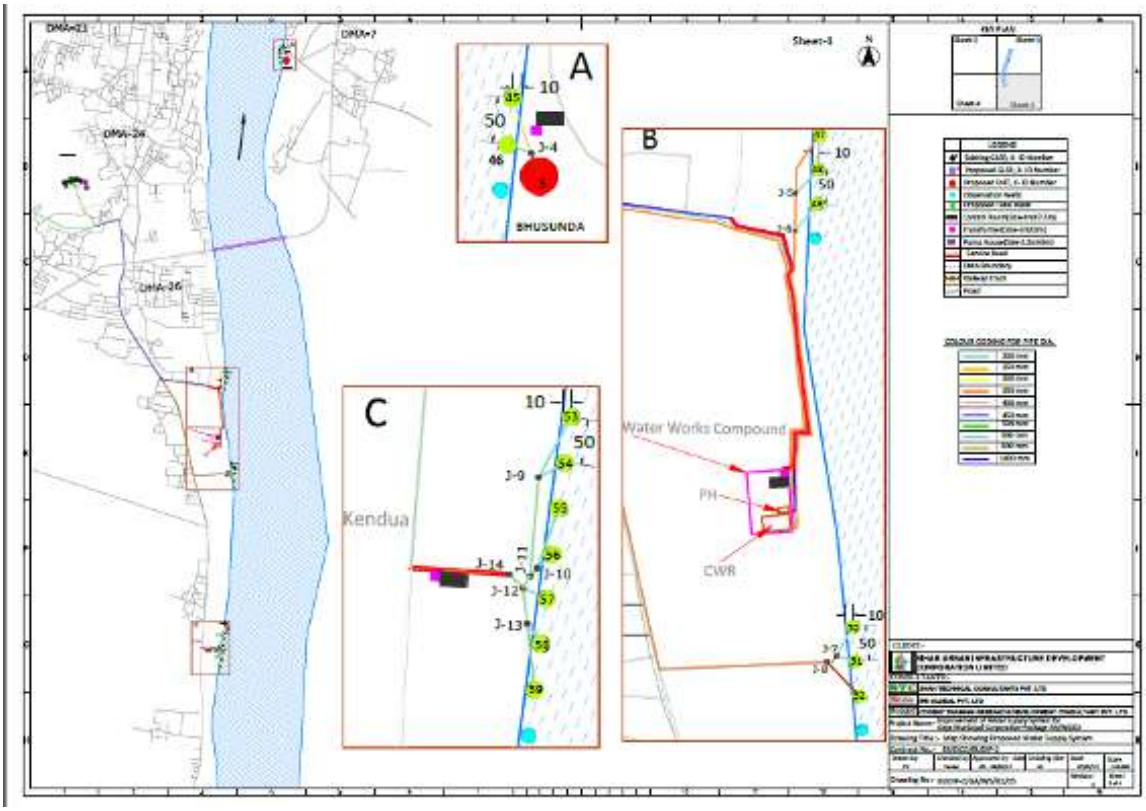


Figure 4C: Section drawing GWSP2

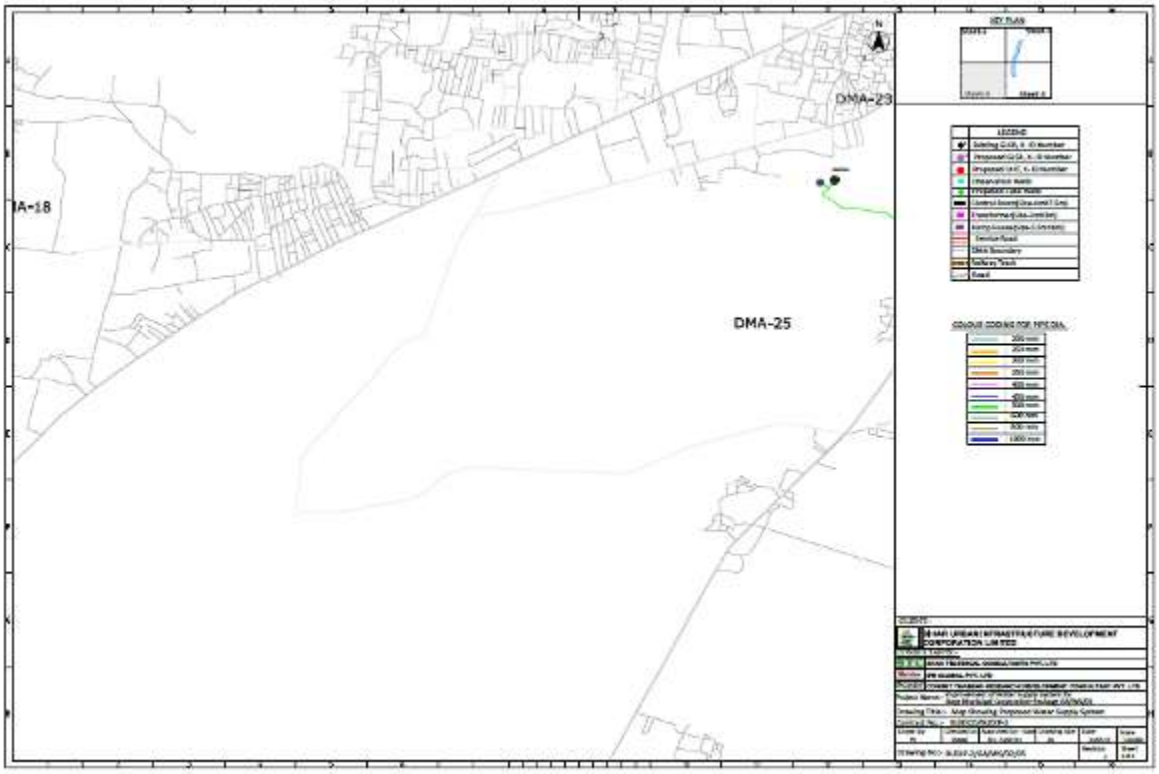


Figure 4D: Section drawing GWSP2

Table 6: Ground water potential zones and connecting reservoirs

S. No.	Tube well locations / Potential zones	Proposed TW ID No.	Tank ID.	Tank Location	Tank capacity ML	Land required (m x m)	DMA No.	Demand (MLD) 2033
1	River bed near School at Gauri Shankar Mandir	40, 41,42,43 (4 nos.)	1	Joda Maszid	2.15	10 x 10 for single TW Total= 400 m^2	2, 3	8.0
			2	Patan Toli (Phase-II)	*1.0	Phase-2		
2	River bed near Budhva Mahadev Mandir	44 (1 no.)	3	Budhva Mahadev	1	10x10	1	2.0
3	River bed near Bhusanda Mela	45,46 (2 nos.)	5	Bhusanda Mela	2.15	10 x 10 for single TW Total= 200 m^2	6, 7	4.0
4	River bed near Dharamshala	60, 61, 62, 63 (4 nos.)	14	Behind Delha PS 1A	1.5	10 x 10 for single TW Total= 400 m^2	29	8.0
			16	Behind Delha PS 1	2.15		28, 30	
5	Govt. Polytechnic College	47,48,49 (3 nos.)	17	CWR	4.00	CWR- 90 X 60 10 x 10 for single TW Total= 1300 m^2	11, 12, 13 part-2, 14 to 27	39
6	Kendui	50,51,52 (3 nos.)						
7	Kendua	53, 54, 55, 56, 57, 58, 59 (7 nos.)						

Source: DPR forGWSP2, July 2015

65. **Rising Mains.** It is proposed to supply water through OHTs or GLSRs on Hills. **Table 7** below details the lengths and sizes of pipe lines proposed to be provided to connect tube wells to respective Service Reservoirs. All pipes for pumping mains will be of Ductile Iron K9. The pipe sizes have been worked out on TW discharge capacity based on most techno-economic consideration over a period of 30 years. Inlet pipe to every reservoir is designed for water demand of year 2048.

Table 7: Proposed Rising Main Details

S. No.	Diameter of Pipe (mm)	Length (m)
1	200	1417
2	250	217
3	300	351
4	350	8086
5	400	21
6	450	157
7	500	89
8	600	4100
9	800	329
10	1000	2284
	Total	**17051**

Source: DPR for GWSP2, July 2015.

66. **Reservoirs**. In addition to the existing storage capacities and the storage reservoirs proposed in package-1, there is a ground level reservoir is proposed on SingraSthan hills to meet the required storage capacities. A break pressure tank or clear water reservoir is proposed in Govt. ITI college campus. The pumping mains from tube wells at ITI College, Kendui and Kendua are connecting to Clear water reservoir of 4.0 ML capacity. The proposed reservoir details are shown in **Table 8** and in **Figure 3** above.

Table 8: Proposed Reservoirs under GWSP2

Reservoir location	Capacity ML	Land required (m x m)	Connected water source TW No.	Connected DMA No.
Clear water Reservoir (CWR) at Govt. ITI	4.0	90 X 60	47,48,49,50,51,52,53,54,55, 56,57,58,59	11, 12, 13 (part-2) 14, 17, 21, 22, 23,24, 25, 26, 27,
GLSR on Singra Sthan hills	3.7	45 X 45		15, 16, 18, 19, 20

Source: DPR for GWSP2, July 2015

67. **Pumping Equipment**. The 24 proposed new tube wells with expected water production capacities of 100 to 130 m^3/h each, will be equipped with submersible pump sets ranging from 15 to 26 kW. The new CWR will be fitted with 6 numbers (4W + 2S) of 132 kW vertical pump sets.

68. **Construction of pump house and 5 control rooms** .One Pump house at Budva mahadev and 5 control rooms at Kendui, Kendua, Joda Masjid, Bhusunda Mela and Warish Nagar.

69. **Electrical Systems**. It is proposed to provide a dedicated 11kV power supply with 11/0.415kV transformers (1 W + 1S) at the following locations with transformer capacity as follows:

(i) CWR 1000kVA
(ii) Budhva Mahadev, 4 wells 200kVA
(iii) Kendui, 7 wells 250kVA
(iv) Joda Mazjid, 4 wells 250kVA

70. This will thus cater for 15 tube wells plus the CWR. The other 9 tube wells will be provided with 433V power supply directly from the Electricity Board.

71. **Operator Office**. One Operator Office is included to be constructed at Dandibagh Water Works compound. It shall serve the Contractor or Operator to be engaged under GWSP1 who will be responsible for developing and improving the overall operations and management of the city's water supply system. GMC staff deputed to the contractor will work from the same office, which will be handed back to GMC upon completion of the contract. A three-story building with a footprint of 500 m^2 is foreseen of which the first two floors will be constructed under GWSP2 to accommodate 60 people. **Figure 5** shows the location of the proposed office building within the water works compound, where an area of 1000m^2 is reserved.

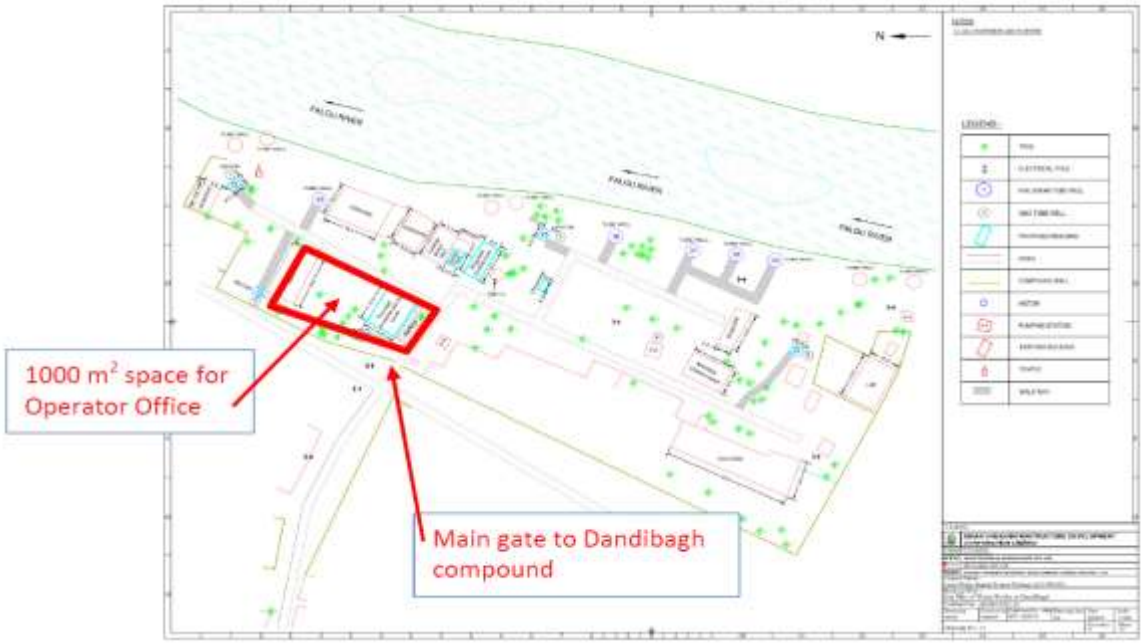


Figure 5: Proposed Operator Office Building at Dandibagh compound

72. Salient features of civil work:
   (i) Area of building 14 X 11 M
   (ii) About 60 people shall be accommodated in the Utility Office.
   (iii) In the future the number will or may increase, also with sewerage-related staff.
   (iv) The building is to be constructed in 2 stages:
      a. Stage 1 - 60 people,
      b. Stage 2 - 30 people. (later after this package)
   (v) This is to be realized by planning a 3-storey building, with the ground and first floor to be constructed in Stage 1. The first stage of 60 people includes both Contractor's and GMC operating staff.

73. **Appendix 3** shows photo illustration and location details of project components in Google map.

74. **Appendix 4** shows site management plan drawing for 2 water storage reservoirs site.

75. **Table 9** shows the components of the subproject based on the present proposals which are expected to be substantially correct, although certain details may change as development of the subproject progresses.

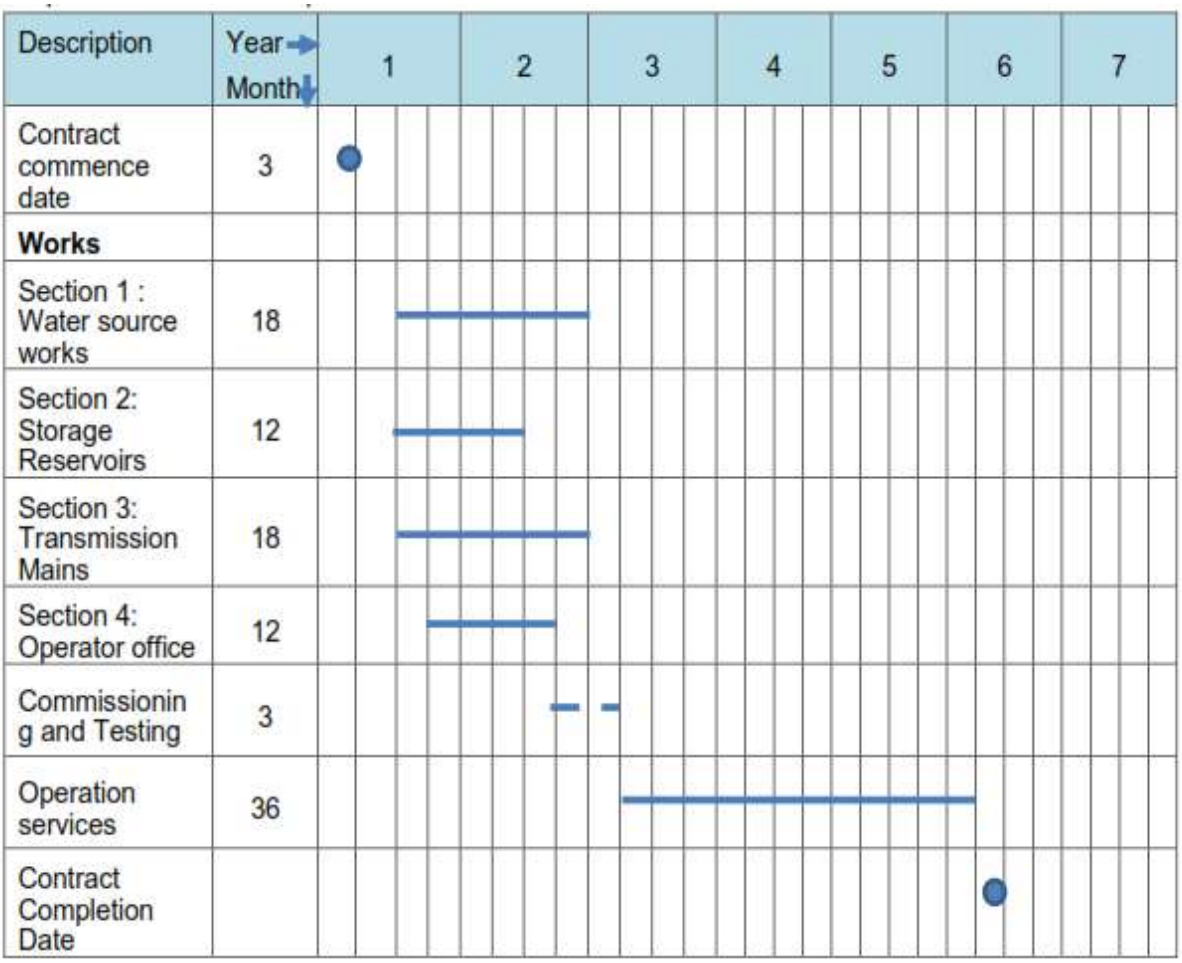
Table 9: Description of the proposed water supply subproject GWSP2

Component	Function	Description	Location
General	Improvement of water supply system in Gaya city	➢ Satisfy the future needs ➢ To supply quality water to new areas and existing area with sufficient quantity	Gaya city
Construction of tube well	Increase water quantity through construction of new tube well Quality of the supply water get improved through disinfection	Construction of 24 nos. tube wells Provision of one Electro Chlorinator at each Tube Well capable of producing 1kg/hour chlorine for disinfection at source	Locations are, Gauri Shankar Mandir Budhva Mahadev Mandir Bhusanda Mela Dharamshala (Warish nagar) Polytechnic College Kendui Kendua
Installation of flow meters	Know present level of flow of water	All tube wells (24Nos)	Scattered throughout Gaya
Laying rising/ transmission mains from tube wells to overhead tanks/ground level service reservoirs	Connecting tube wells with the existing/proposed storage tanks	Approx. Length-17.051 = 17.06 km	Corresponding to the location of tube wells
Construction of one Clear water Reservoir and one Ground Level Storage Reservoir	Storage of water	Capacity 4.0 ML (Polytechnic College) and 3.7 ML(Singrasthan)	CWR at Polytechnic College, and one Ground Level Service Reservoir (GLSR) on Singrasthan Hill.
Construction of pump house and 5 control rooms	Protection of pumps and motors within room	Pump house and 5 Nos. Control rooms	One Pump house at Budva mahadev and 5 control rooms at Kendui, Kendua, Joda Masjid, Bhusunda Mela and Warish Nagar
Construction of Operator Office	Office for overall operations and management of the city's water supply system	1000 m^2 space for office building	At Dandibagh Water Works compound

Source: DPR Gaya water supply, July 2015

F. Implementation Schedule

76. The proposed sequence of the works implementation under Gaya Water Supply Project, GWSP2 is as given in the **Figure 6.** This package (GWSP2) is item rate contract.



S.N.	Description	Date
1	DPR Completion	June 2014
2	Bid Invitation	May 2016
3	Contract Award	May 2017
4	Notice to Proceed	Feb 2017
5	Construction start date(Expected)	May 2017
6	Construction end date(Expected)	Nov 2018
7	O & M Start date(Expected)	Feb 2019
8	O & M end date(Expected)	Aug 2021

Figure 6: Implementation Schedule

IV. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

1. Administrative Boundaries

77. Gaya is located in south central Bihar on the banks of the River Phalgu, between 84.4^0and85.5^0 east longitude and 24.5^0 and 25.1^0north latitude. It is the district headquarters City of Gaya District and is situated at about 100 km south of State Capital Patna (**Figure 7**).Gaya is a prominent and most important religious center for Hindus. The City is well connected by road and railways with the State Capital Patna and other Cities in the State. Bodh Gaya, situated at 13 km south of Gaya, is a world famous Buddhist Center, which attracts significant number of international tourists. Gaya has an airport to serve for this purpose.

78. Gaya is a Municipal Corporation with an area of 50.17 sq km. It is divided into 53 wards and had a population of 4, 63,454 (Census 2011). The gross population density of the city is 78 persons per hectare. **Figure 8** shows Gaya city map.

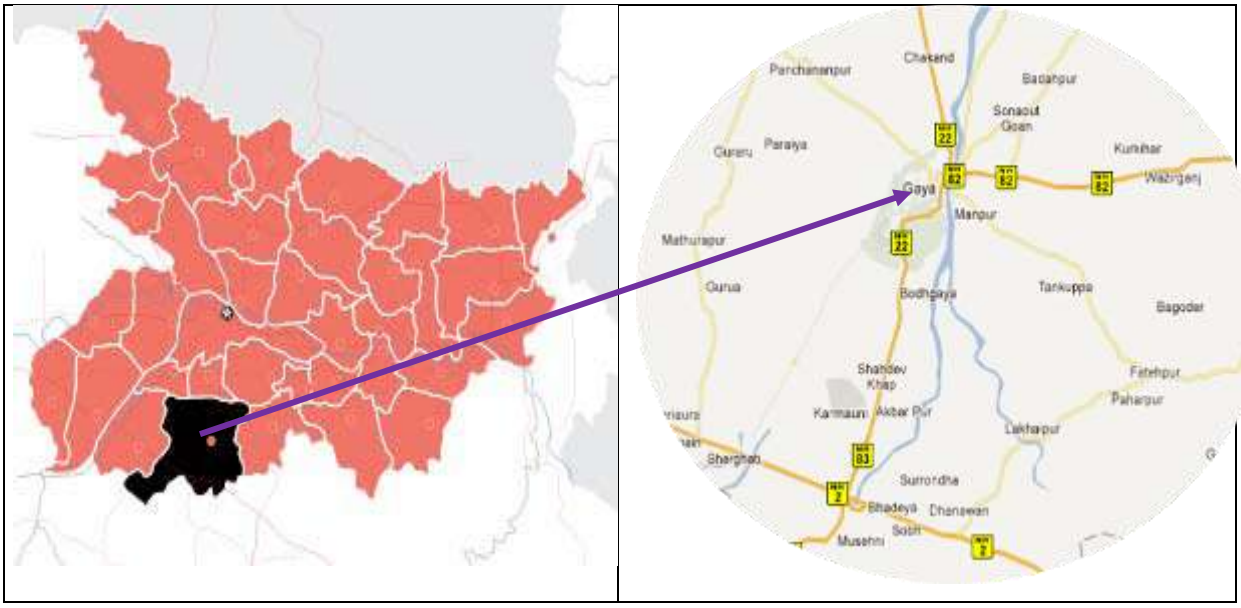


Figure 7: Location of Gaya in Bihar

Figure 8: Gaya City

2. Topography, Drainage, and Natural Hazards

79. **Topography.** The historical City of Gaya is developed along the banks of River Phalgu, a tributary of River Punpun, which in turn is a tributary of River Ganga. The elevation of the area on an average is 110 m above MSL (Mean Sea Level). Gaya is located in the transit region between the uplands of Chhotanagpur Plateau and Gangetic plains of South Biharextending from Patna. There are a ring of hills around the City in the north (known as Ramshila), west (Katari Hill), and south (Brahmyoni). Except these hilly areas, topography of the City is flat, and gently slopes and drains into the River Phalgu, flowing from south to north. City is mostly developed on western side of the river, while new development is seen on the eastern side.

80. **Drainage**. General topography of the Gaya city is flat with some small hillocks in and around the city. River Phalgu divides the city into two parts. The portion located on the west bank of the river is much larger comparing to the portion located on the eastern bank of the river. Natural gradient of the Gaya Municipal Corporation (GMC) area is such that the portion of the GMC area on the west bank, slopes from west to east and south to north whereas the portion on the east bank of the river slopes from east to west and from south to north. As a result, storm runoff from both sides of the river normally flows towards the River Phalgu which flows along south-north direction. Average annual rainfall of the region is about 1150mm.The existing storm water drainage system of the Gaya is based on gravity flow. Depending on the existing topographical features, the city is divided into four drainage zones namely Central, North-Western, Western and Eastern zones. The existing drains are mostly outfall to the River Phalgu or open lands at Katari and Kondinava and Kujapee drain. Partial flow of Kujapee drain is leading to Jamune River that flows parallel to the river Phalgu, through the western fringe of Gaya, about 6 km from municipal boundary. Remaining flow of Kujapee drain finds its way to

agricultural land. About 80 percent of the GMC area is covered under drainage network. Most of these drains were constructed during the period from 1932 to 1944.

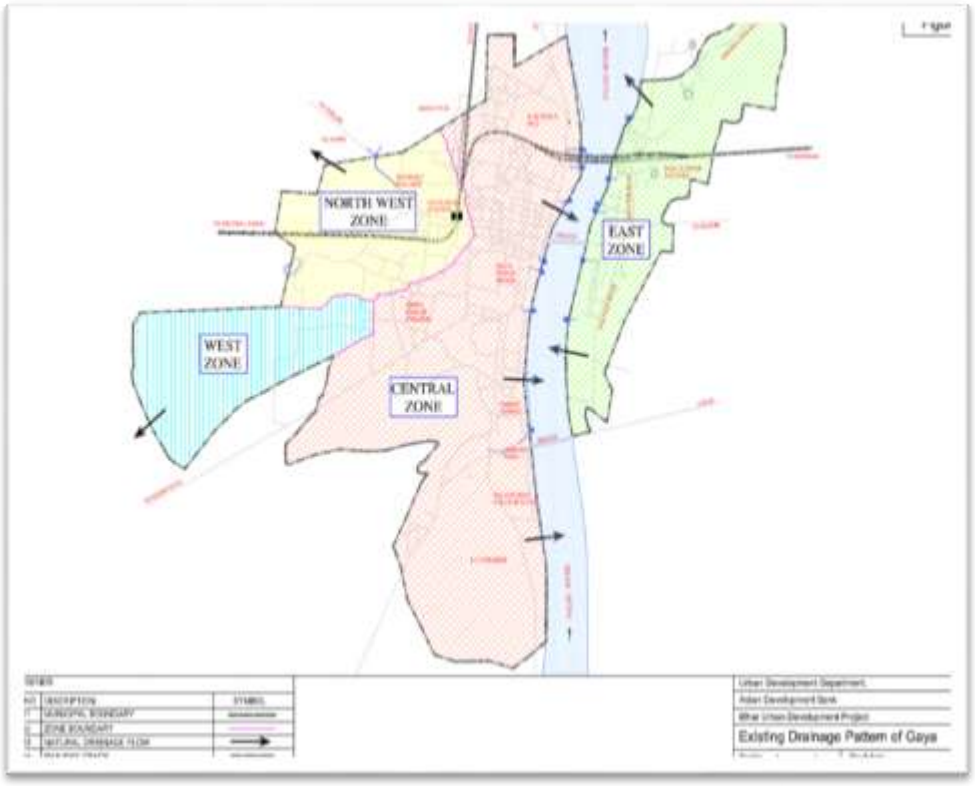


Figure 8: Existing Drainage map of Gaya

81. **Natural Hazards.**

(i) Earthquake. Earthquake hazard map of India (**Figure 9)** and Bihar shows that Gaya district falls in Seismic Zone III, which is a moderate risk zone and an earthquake up to a magnitude of 7.0 on Richter scale has the potential to hit the area. Thus Gaya Municipal Area is an earthquake hazard prone area and falls in moderate damage risk zone.

(ii) Wind hazard. The wind hazards map of Bihar shows that Gaya districts falls in moderate damage risk zone with cyclonic wind velocities around 39 m/s. Thus Gaya Municipal Area is a moderate wind hazard prone area.

(iii) Floods. The flood hazard map of Bihar shows that Gaya district is not susceptible to any major flooding. It is evident that Gaya city located in Gaya district is susceptible to natural hazards with moderate risk or probability of occurrence of a moderate intensity earthquake and wind. A map (**Figure 10**) showing flood zone in Bihar is shown below. It indicated that Gaya district does not come under flood zones.

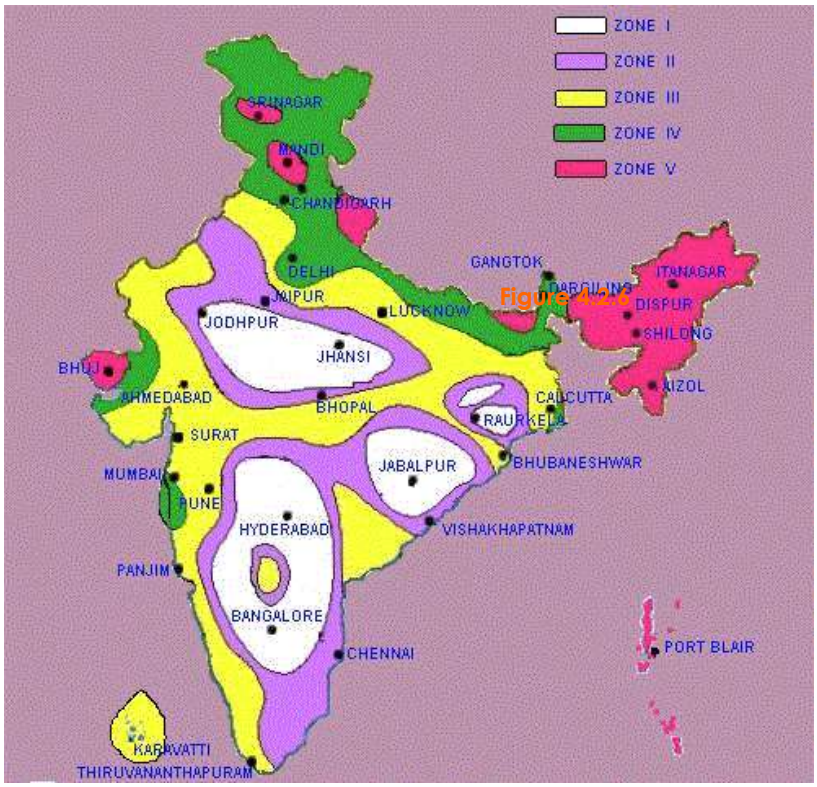


Figure 9: Earthquake zone map of India

Figure 10: Flood zone of Bihar

Source: State Environment Report, Bihar (2007)

3. Geology, Geomorphology and Soils

82. **Geology and Geomorphology**. The main geological formation of the region is of Quaternary age. The area is mostly covered by unconsolidated sediments which is known as Alluvial deposits followed by consolidated deposits of Satpura range. Few areas are also characterized by units of Archaean ages. The Satpura range mainly exposed in Gaya hills and Rajgir hills comprises low grade supracrustals – Schists, ferruginous phyllite, quartzites and phyllitic slate.

83. The Archeans are the oldest rock formation in the area. The most predominant rock type is gneisses and granites with basic intrusives and pegmatoides.

84. **Soils.** Gaya is covered with reverine Alluvium of both old and recent. It consists of a thick alluvial mantle of drift origin. This wide alluvial plain is part of Gangetic depressions with alluvial deposits of immense depth, and is broken by groups of low ranges of hills or isolated peaks arising abruptly from the plains. Soils in the region are deep and excessively drained that are formed in eolian sands over lacustrine deposits derived from mixed rocks. Five main types of soils present in the region: sandy loam, loamy soil, sandy loam, black soil and red soil.

4. Climate

85. The climate of Gaya is generally tropical and has three distinct seasons: winter season from November to middle of March, summer season from mid-March to mid-June and rainy season from mid-June to October. Winters are generally cold, summers are hot and dry, and the monsoon season is characterized by moist heat and oppressive nights. The cold weather commences early in November and temperatures (both day and night) decrease rapidly with the advance of the season. January is the coldest month. Temperature increases rapidly from middle of March till May. With the onset of monsoon in the month of June, the temperature starts decreasing. In the hot season Gaya is very unpleasant.

86. Rainfall in the region is mainly from southwestern monsoon during the period of June mid to early October. Rainfall also occurs due to northeast monsoon in January and February although its contribution is very limited. Monthly rainfall pattern is tabulated in **Table 10**. Annual rainfall during this period fluctuated between as low as 683 millimeter (mm) to 1260 mm. Monthly rainfall shows that about 90 percent of annual rainfall is received during the monsoon period of June to October.

Table 10: Monthly Rainfall Pattern (2008-2015) in mm

Month	2008	2009	2010	2011	2012	2013	2014	2015
January	95.4	8.4	0.2	6.0	19.9	0.0	38.6	19.7
February	13.4	0.0	3.4	3.0	4.4	10.7	20.1	0.8
March	0.6	0.4	0.0	0.1	10.8	0.9	7.8	8.2
April	13.3	2.4	0.0	32.9	21.2	32.1	0	15.9
May	40.3	73.7	25.8	18.2	25	91.8	84.4	13
June	404.9	68.4	97.8	393.3	109.6	47.8	56.4	161.7
July	283.5	194.8	202.7	133.2	236	80.3	247.9	232.6
August	209.6	152.5	202.9	419.8	392.6	168.3	313.5	171.6
September	48.9	269	50.3	244.7	134.2	127.1	132	78
October	0.0	17	91.0	8.5	66.9	158.5	8.8	0.8
November	0.0	11.8	6.4	0.0	34.3	0.0	0	0.0
December	0.0	2.3	2.8	0.0	0.0	0.0	2.7	0.0

Month	2008	2009	2010	2011	2012	2013	2014	2015
Total	1109.9	800.7	683.3	1259.7	1054.9	717.5	912.2	702.3

Source: India Meteorological Department.

87. Maximum and minimum temperatures during summers are: 43°C and 21°C and during winters: 20°C and 6°C. Normally lowest temperature is recorded in the month of January while the highest is in the month of May or June. During the summer the humidity is much lower (about 30-40 percent) due to the hot and dry westerly winds. With the onset of monsoon humidity increases and it is generally in the range of 80 to 84 percent in July and August. Predominantly winds blow from east and west. Westerly winds usually prevail from the beginning of January to the end of March. Then onwards till middle of June the east and west winds are nearly balanced. From middle of June to end of July winds are predominantly easterly. From end of July to the end of August westerly winds prevail. Then onwards till the end of October east winds prevail. In November and December east and west winds are nearly balanced.

88. Earlier there was no fixed monitoring air quality stations at Gaya, which was also not subject to monitoring by the Bihar State Pollution Control Board (BSPCB) as there are no major industries. Gaya is located in the transition zone between the fertile alluvial plains and hills of Chhotanagpur Plateau, and generally dry weather prevails. During summers it experiences very dry and hot weather. Traffic is the only significant air pollution source, so levels of oxides of sulphur and nitrogen are likely to be well within the National Ambient Air Quality Standards (NAAQS). Due to dry weather, poor road conditions and traffic particulate matter is likely to be high, particularly during summers. In the year 2014 ambient air quality monitoring has been conducted at Gaya. Monitoring station is located at Gaya Collectorate office corner. Month wise result is given in the **Table 11.** Result shows that at all the months concentration PM_{10} is above the standard. Except few months concentration of NO_2 was above the national standard.

Table 11: Recent ambient Air Quality of Gaya city

Status of Ambient Air Quality of Gaya – Collectorate office											
		Main Pollutants & BTX Parameters 2014 (µg/m^3)									
S. No	Year 2014	CO	SO_2	NO	NO_2	NOx	O_3	PM_{10}	Benzene	Toluene	Xylene
		Avg	*Avg*	*Avg*	*Avg*	*Avg*	*Avg*	*Avg*	*Avg*	*Avg*	*Avg*
1	March	1.56	6.9	25.4	93.8	119.2	17.7	239.5	3.05	11.4	7.8
2	April	2.99	6.6	34.2	113.4	147.6	34.9	270.5	2.76	11.3	4.82
3	May	2.61	6.1	16	51.5	67.5	46.8	198.2	1.98	7.7	3.08
4	June	3.00	5.7	12.1	58.3	70.4	42.2	165.9	1.94	7.3	2.82
5	July	1.77	5.2	15.8	40.5	56.4	18	83.9	1.78	8.1	3.55
6	Aug	1.38		16.9	33.4	50.2	16.9	73.5	1.57	6.1	2.81
7	Sept	2.45		16.5	25.5	42	10.2	75.9	1.51	6.3	3.23
8	Oct	3.84		24.9	25.5	50.4	12.4	196.8	1.89	7.5	4.38
9	Nov	4.63		53.2	49.8	103	15.1	324.2	2.7	9.8	6.8
Standard – Annual average		**2000**	**50**	**-**	**40.0**	**-**	**100**	**60.0**	**5.0**	**-**	**-**

Source: Bihar State Pollution Control Board (BSPCB) 2015, BTX: Benzene Toluene Xylene

5. Ambient noise levels

89. The Bihar State Pollution Control Board (BSPCB) measures the noise level across the Gaya city during 2004-05. Data shows that day time noise levels are high at all locations, exceeding the ambient noise standards. Concentrations of parameters are always higher than WHO standard.

90. Presently primary noise level data is generated on September 2015 from the BUDIP project. Result presented in the following **Table 12**, the noise levels at silence, residential and commercial zones exceeding the standards, attributed mainly to the vehicular traffic. Noise level values are above the WHO standard.

Table 12: Noise Levels in Gaya city

Location	Noise Level (day time) dB(A) Leq	Noise Zone	Standard (day time) dB(A) Leq
Panchayati Akhara	82.2	Residential	55
Panchayati Akhara-Tutwari Road	81.5	Residential	55
Near Ramshila	90.0	Commercial	65
Azad Park Near Temple	87.5	Commercial	65
Tikari road	85.4	Commercial	65
GhantaGhar	95.0	Commercial	65
Rammana road	94.0	Commercial	65
GB road	93.8	Commercial	65
SP road	87.7	commercial	65
DM office	90.5	commercial	65
Jai Prakash Narayan Hospital	87.6	silence	50
Prabhat hospital	70.9	silence	50
Zila shool gate	99.5	silence	50
Brabmayoni hill	84.5	silence	50
Near manglagauri	84.6	silence	50
Dandibagh	85.0	silence	50

(BUDIP generated data, September 2015)

91. On comparison of noise quality data with the limits specified for different types of the areas in the ambient noise quality standards {under schedule to the Noise Pollution (Regulation and Control) Rules, 2000 of Government of India} it is evident that the noise values at most of the sites are higher than the permissible standards. This may be attributed to the commercial activities and traffic movement coupled with frequent traffic jams and honking of horns in the subproject area.

6. Water Resources

92. **Surface Water**. Gaya city is situated along the banks of River Phalgu. This river is formed by the merger of two streams of Nilanjan and Mohana about 5 km south of Gaya city, and flows south to north through the heart of Gaya District. The width of river in Gaya is about 900 m. The famous Vishnupad Temple is located on the banks of the River and there are a number of ghats (bathing and worshipping) developed for the pilgrims. This river is a tributary of River Punpun, which joins River Ganga near Patna.

Figure 11: Gaya and Phalgu River, seen from Ramshila Hill

93. In the scope of hydro-geological investigations carried out by BUDIP in early 2014, the flow regime of the Phalgu River has been studied. At Gaya city the river has a catchment area of about 3058 km^2, mainly in the hills in Jharkhand, south of Bihar. See the map in **Figure 12**. Average annual runoff was estimated at 1030 million m^3.Runoff with a 90% dependability (reliability) was estimated at 417 million m^{3}per year.

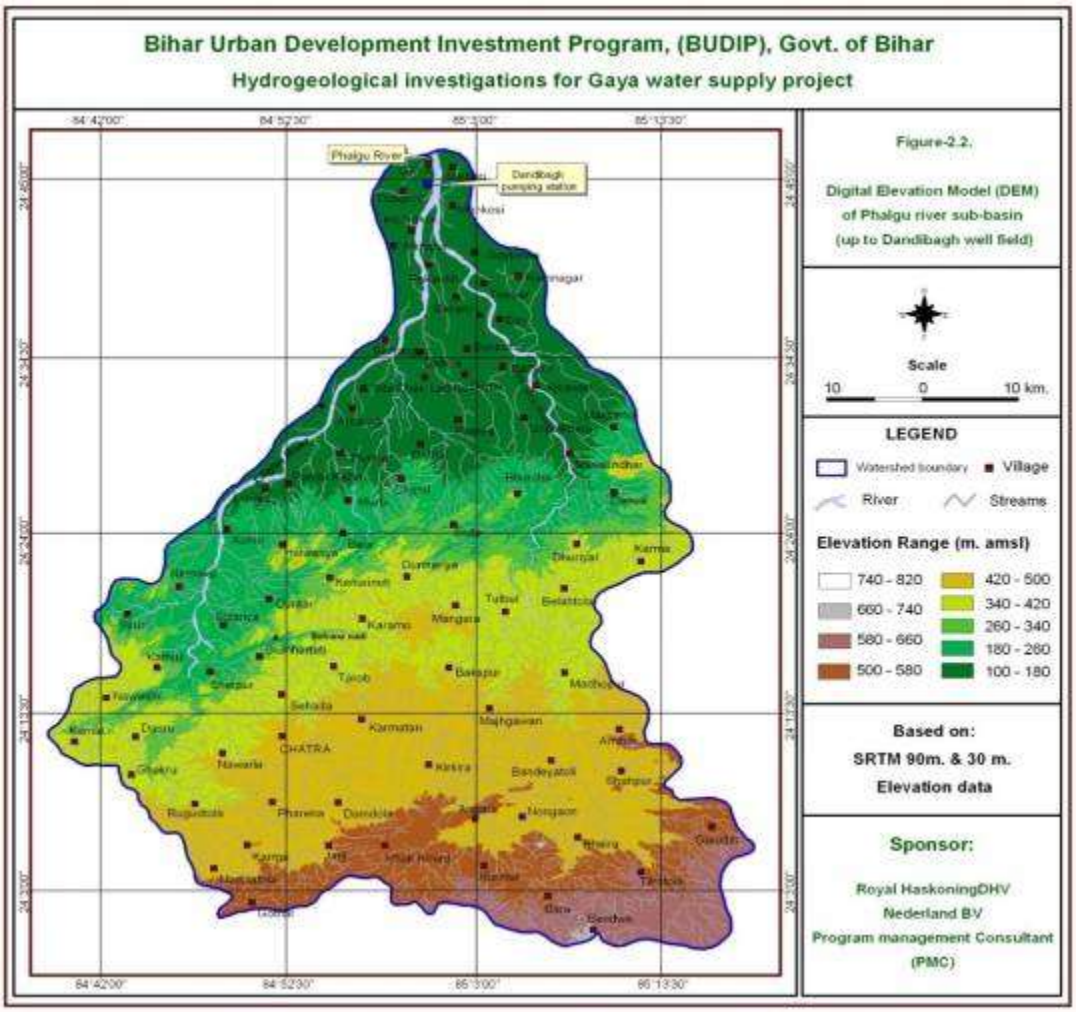


Figure 12: Hydrological investigation map

94. Phalgu is a seasonal river, and flows only during monsoon and partly in post monsoon (mid-June to November or December). During the rains, river carries very high flows but in the other seasons the flow is limited to a shallow, meandering channel of a few tens of meters wide. In February 2014, well into the dry season, a flow of 2.5m^3/s or 200 MLD was measured. The investigations in 2014 suggest that, in an average year, there is a period of no-flow in the river of 2.5 months. This may extend to 4 months in a dry year.

Photo: Phalgu River in February 2014

95. Due to a good monsoon season in 2006, the river over flowed its banks and flooded the nearby localities. However, this was not severe and no damage to human lives or property is reported.

96. It is observed that due to lack of sewerage system in the City, the waste water is discharged into the storm water drainage system, which ultimately joins and pollutes River Phalgu.

97. **Geohydrology and Groundwater.** Gaya is located in the transition region between the uplands of Chhotanagpur Plateau and Gangetic plains of South Bihar e**xtending from Patna. The exte**nsive and deep aquifer of the Bihar Plains starts from Nepal Border in the north, where depth is said to be about 2,000m and which gradually decreases southwards to around 650 m in Patna and becomes shallower further south to about 60 m in Gaya District. In Gaya City, the

aquifer thickness is still shallower. The plain around Gaya generally consists of 20 to 30m thick alluvial material underlain by hard rock.

98. The aquifer under the Phalgu River has much more potential. Existing production tube wells at Dandibagh, constructed on the edge of the river, have yields of 100 to over 200 m^3/h. Earlier reports already indicated the high potential of the Phalgu bed upstream of the town and it was decided that the necessary investigations be carried out by BUDIP. If the investigations were to provide positive results, than a design alternative, i.e. using the Ganges River as water source and transporting the water over 100km to Gaya, would not be required.

99. The aquifer, about the width of the river (900m) and some 20 to 30m deep, consists of recent, coarse alluvial deposits such as sand and gravel intermixed with clayey material. The aquifer has therefore a favorable permeability and water bearing capacity. It is regularly replenished by surface water flowing in the river directly above.

100. **Sustainable water source - water availability.** The hydro-geological investigations carried out by Hydro-Geo-survey Consultants Pvt. Ltd., Jodhpur, to examine the suitability of groundwater of Gaya in the bed of the Phalgu River, up stream of Gaya city, as water source for the city's water supply system. The field investigations took place in February 2014 and the final report was submitted in July 2014.

101. The study area extended over the catchment area of the Phalgu River upstream of Gaya city (see **Figure 12** above) to identify the most promising geological formations. The relatively poor water yielding capacity of the plains was confirmed. The study then focused in on the bed of the Phalgu River. Pumping tests on existing production tube wells were carried out to determine key aquifer characteristics. For example, permeability (K-value) of 150 to 230 m/day were found, indicative of very course aquifer material and potentially high yields per well. Also, geo-electric resistivity surveys were carried out over a 4km long river stretch upstream of Dandibagh to locate zones in the aquifer with the most conducive constitution. **Figure 13** shows a tri-dimensional composition of the results of the resistivity soundings.

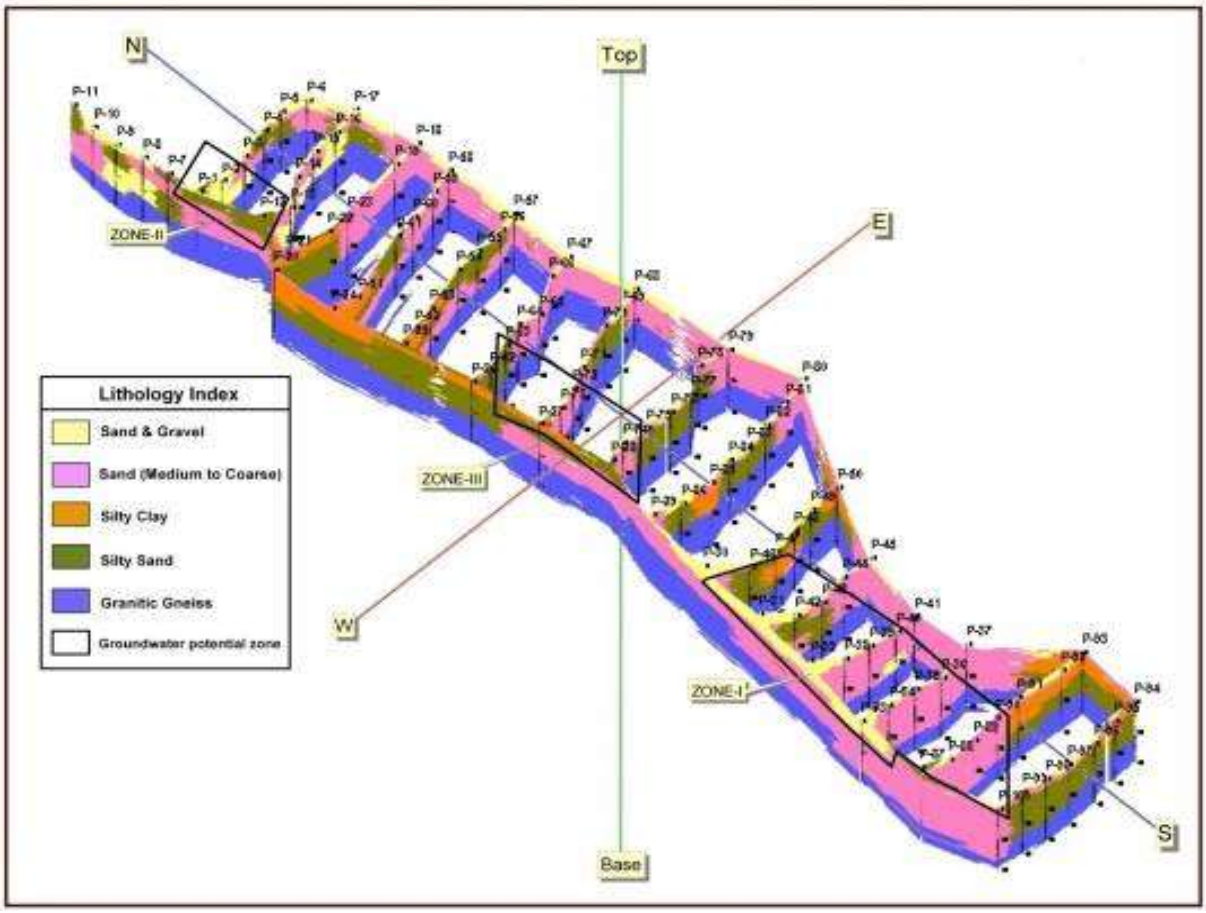


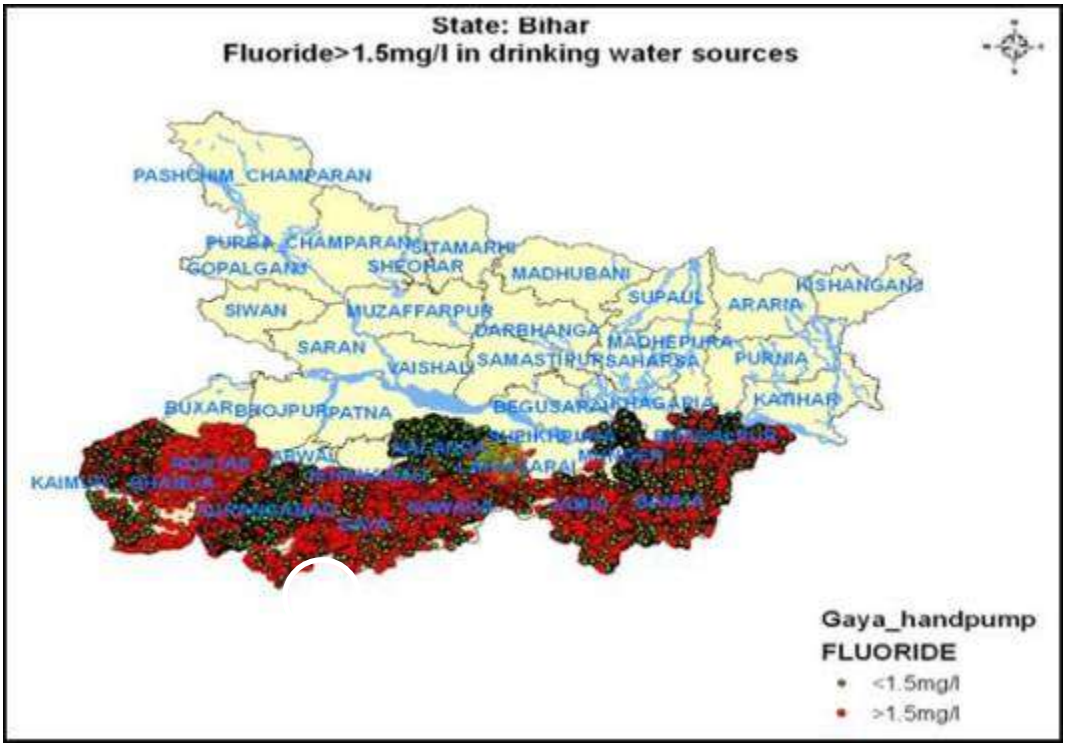
Figure 13: Fence diagram showing disposition of sub-surface fluvial deposits, Phalgu River bed at Gaya towns upstream of Dandibagh

102. The report has been reviewed by the Central Ground Water Board (CGWB) who complemented the team on the quality of the report. Minutes of a meeting with CGWB are attached as **Appendix 5.** The outcome of the investigations is positive. Water sustainability study summary discussed in Appendix section C of Chapter 2 and appended as **Appendix 2.**

103. **Groundwater Quality:** Although groundwater is used for domestic water supply, no regular water quality monitoring is conducted. However, some historic data from PHED is available. In addition the project has carried out several water quality analysis campaigns. The results are presented below. A distinction is made between the quality of groundwater in the Bihar plains surrounding Gaya city, the same aquifer underlying the city and the special aquifer of the Phalgu River bed.

104. **Groundwater quality, Bihar Plain.** As far as chemical contents in ground water are concerned, Gaya district is one of the nine fluorides affected districts. A report shows that fluoride level up to 6.8 ppm has been detected against the permissible limit of 1.5 ppm in the ground water of Nawada District, a neighbor district of Gaya. However Gaya district is not covered within 16 arsenic affected districts in Bihar. **Figure 14** shows the Fluoride map of Bihar and Gaya.

Source: India Water Portal



Source: PHED, Govt. of Bihar

Figure 14: Fluoride enriched area of Bihar

105. The presence of fluoride is indeed confirmed by analysis carried out for BUDIP (Hydro-

geological Investigations, 2014) but none of the samples is above the acceptable limit of 1.0 mg/l. The data are reproduced in **Appendix 5.**

106. **Groundwater quality, under Gaya City**. Examination of the water quality of (production tube wells) tapping the aquifer underlying the city is of relevance to assess the performance of the existing tube wells and whether it is recommendable to further rely on these wells.

107. For the preparation of the DPR for GWSP1, water samples of a selected number of production tube wells were analyzed. General conclusion was that the water of wells underlying the Gaya city was safe for drinking. Further data was collected from PHED who sampled a number of wells in June 2012. It showed some excess in turbidity and Fe above permissible levels in one occasion.

Table 13: Physic- chemical analyses data of Gaya supply water

S. N.	Location Details	Physico - Chemical and Bacteriological Parameters														
		pH	Turbidity (NTU)	EC	Total Dissolved Solids (mg/l)	Total Hardness (mg/l)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)	Alkalinity (mg/l)	Fe (mg/l)	NO_3 (mg/l)	SO_4 (mg/l)	F (mg/l)	As (mg/l)	Total Coliform (no/ 100 ml)
1	P/W Supply Scheme Dandibag	7.7	4.0	190	123	84	25.65	4.86	22.72	40.0	0.17	0.36	0.29	0.43	BDL	ND
2	P/W Supply Scheme AP Colony-1	7.9	7.0	170	110	84	27.25	3.88	19.88	20.0	0.25	0.76	0.09	0.53	BDL	ND
3	P/W Supply Scheme AP Colony-2	8.0	5.0	160	104	88	17.63	10.7	56.80	140	**0.79**	0.95	0.19	0.14	BDL	ND
Desirable limit*		**6.5-8.5**	**1**	**-**	**500**	**200**	**75**	**30**	**250**	**200**	**0.3**	**45**	**200**	**1**	**0.01**	**-**
Permissible limit* in absence of alternate source		**NR**	**5**	**-**	**2000**	**600**	**200**	**100**	**1000**	**600**	**NR**	**NR**	**400**	**1.5**	**0.05**	****

(Source: Physico - Chemical and Bacteriological Parameters (Report no. PHE/Patna DW-26359- 6361/R/Gay/12-13, dated 2/06/2012.)

Note: *****(1) Drinking Water Specification IS: 10500- 2012

(2) BDL = Below Detection Limit,

(3) Testing Methods are taken by APHA 20th Edition.

(4) NR = No Relaxation, ND= Not detected

**(a) Throughout any year, 95% of the samples should not contain coliform organisms in 100ml,

(b) No sample should contain more than 10 coliform organisms per 100ml,

(c) Coliform organisms should not be detected in 100ml of any two consecutive samples.

108. A third set of data is also available from PHED and dates from March 2014. Testing results are shown in **Table 14.** The production tube wells at Azad Park and Delha tap the aquifer under the city. Especially Delha scores badly with values above acceptable levels in 6 counts. Although use of the water for drinking is permissible, it indicates the type of contamination mostly due to local discharge of household wastewater and unlined drain near water source. Only after treatment at source and storage water can be supply for the public.

109. Positive bacteria count in the Panchayatiya Akhara tube well is noted. It makes it unfit for drinking. The well is not tapping the larger aquifer under the city but is located in the Phalgu River bed. In this program (BUDIP) Sewage Treatment Plant will be constructed for Gaya city. Raw effluent will be treated before discharge into Phalgu river and tube well water will be protected from contamination.

Table 14: Physico-chemical and Biological test report

S. No	Parameters	In Phalgu bed			In aquifer under city		Indian Standards IS: 10,500-2012 Acceptable/ Permissible level
		Dandibagh Pump-1	Panchayatiya Akhara	Manpur	Azad Park	Delha	
1	PH	7.84	7.03	7.64	8.07	7.40	6.5-8.5
2	Turbidity (NTU)	1	2	3	1	1	1/5
3	Conductivity ((µS/cm)	379	650	650	925	2350	-
4	TDS (mg/l)	249	**1000**	**1000**	**1400**	**1525**	500/2000
5	Total Hardness(mg/l)	140	168	200	**244**	**544**	200/600
6	Calcium(mg/l)	40.08	70.04	59.20	**84.8**	**188.8**	75/200
7	Magnesium (mg/l)	9.72	25.34	21.31	**30.52**	**67.96**	30/100
8	Chloride(mg/l)	36.87	140	124	184	**472**	250/1000
9	Alkalinity(mg/l)	**220**	**220**	**216**	**321**	**448**	200/600
10	Iron(mg/l)	0.09	0.10	0.10	0.10	0.10	0.3/0.3
11	Nitrate(mg/l)	37	25	25	25	25	45/45
12	Sulphate(mg/l)	8.75	10	10	25	75	200/400
13	Fluoride(mg/l)	0.25	0.59	0.36	0.40	0.66	1/1.5
14	Bacteria(+,-)	<5.1	Positive(not safe for drinking)	Negative	Negative	Negative	Not detectable in any 100 ml sample

Source-Public Health Engineering Department-PHD Testing Lab-Gaya, 20-03-2014
Bold value – above the acceptable –desirable limit

110. **Groundwater quality, aquifer in Phalgu River bed**. This aquifer is of most interest because it is proposed to be used as source for the water supply scheme under GWSP2. The aquifer is unconfined and sensitive to potential contamination. Recharge of the aquifer is from the surface water in the Phalgu River and any contaminants in the river will percolate down into the aquifer. The sample taken from Panchayatiya Akhara in March 2014 (see **Table 14**) showed bacterial pollution and this is likely to originate from wastewater discharging from the town into the river upstream of the well. The secondary data on water quality of wells at Dandibagh, just upstream of the city, show values within acceptable levels (see tables **13 and 14**). At Gaya construction of STP will be taken up shortly through ADB funding and accordingly untreated water will be not discharge into Phalgu river. That will protect ground water quality in future.

111. As part of the hydrogeological investigations of 2014, carried out by the project, water of 10 wells throughout the study area were sampled and analyzed. The results are presented in **Appendix 6**. The wells include both hand-pumped wells and production tube wells. The hand-pumped wells are located in the larger aquifer around and under the city, the production wells

tap their water from or near to the Phalgu bed. Panchayatiya Akhara was not sampled. All parameters tested were within acceptable limits.

112. The sensitivity of the aquifer to pollution was further examined in June 2015 by carrying out sampling and analysis on both production tube wells (at Dandibagh and Panchayatiya Akhara) and on potential upstream sources of pollution. The latter included groundwater under agricultural fields and wastewater. The locations of the sampling points are indicated in **Figure 15.** The purpose was to examine any correlation. The results and its interpretation are presented in **Appendix 7**.

Figure 15: Location of sampling points for water analysis, June 2015

113. **Agriculture.** Land upstream of Gaya is used for agriculture. To examine potential harm from, especially, the use of pesticides samples were taken from two hand-pumped wells in the agricultural area (points 3 and 4) and tested on a wide range of pesticides. The results were negative (no residues detected) and it is concluded that the potential impact is negligible. Also, no traces were detected in the two production tube wells downstream.

114. **Wastewater***.* The nearest potential source of pollution by wastewater for the Dandibagh well field is the town of Bodhgaya, a town of 30,000 people some 8 km upstream. At Bodhgaya samples were taken from two sources (points 5 and 6): a major urban drain and from the Phalgu River just downstream of the town, and tested on a wide range of parameters indicative for domestic wastewater. These samples were compared with the water quality at Dandibagh for which the same parameters were analyzed. **Figure 16** shows the trends in reduction of concentrations for some selected parameters.

115. The study concludes that water from the production tube well at Dandibagh is safe for drinking. Although waste discharges originating from Bodhgaya town do show appreciable contamination, the concentrations of the relevant parameters show a substantial decrease in

the well sample. This suggests a purifying effect of the bed of the Phalgu River, both by dilution and by absorption / reduction.

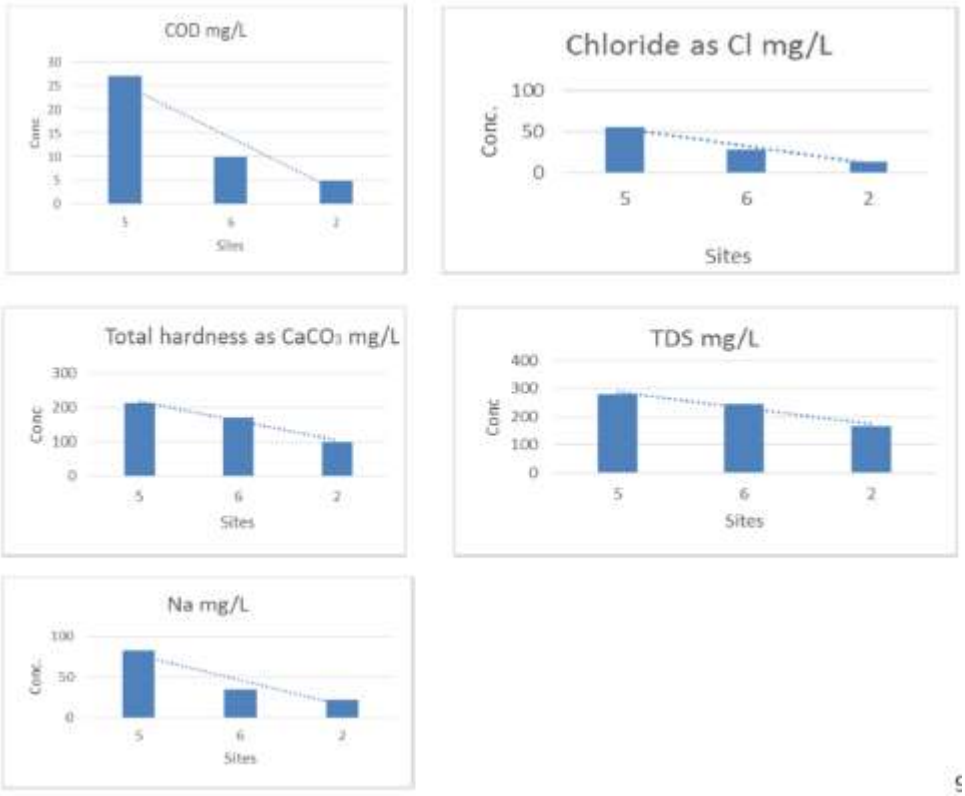


Figure 16: Correlation between pollution by waste water parameters, Bodhgaya town (points 5 & 6) and Dandibagh well (point 2).

116. The same exercise was done to correlate wastewater discharge from a large urban drain in Gaya (point 7) with the production tube well at Panchayatiya Akhara. **Figure 17** shows the results. Contamination of the well at Panchayati Akhara is more pronounced than at Dandibagh. This correlates with the relatively large discharges of wastes from the adjacent urban area. Although all relevant parameters at the well are still within acceptable limits, the threat from the town's waste is apparent. The study concludes that, to protect the aquifer in the bed of the Phalgu River from further pollution, it is required to collect and treat the city's wastes in the town area that drains directly into the Phalgu. Since the well is proposed to be rehabilitated under GWSP1, its water quality shall be monitored vigorously.

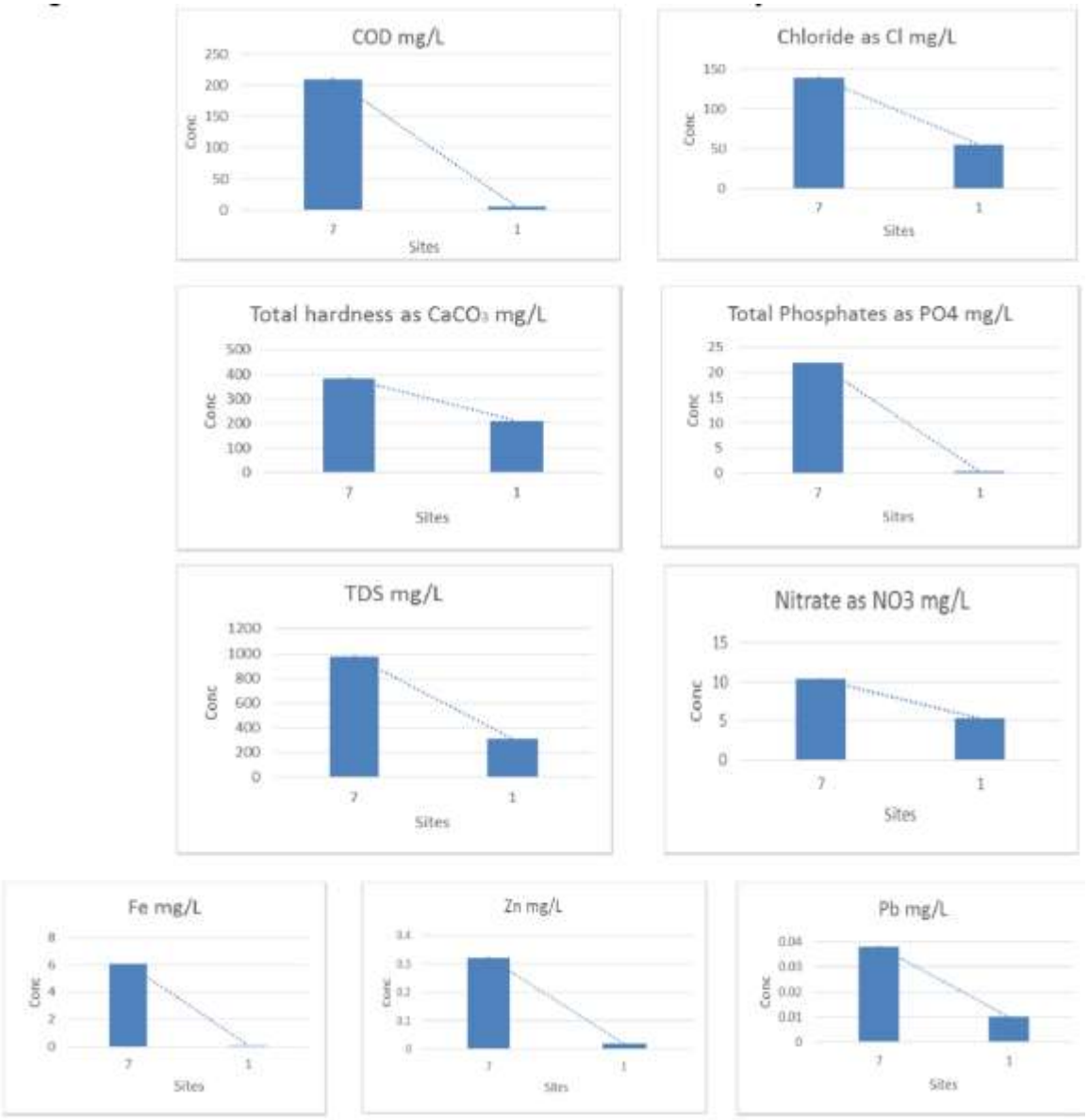


Figure 17: Correlation between pollution by wastewater parameters, Gaya city (point 7) and Panchayatiya Akhara well (point 1)

117. To further examine the resilience of the Phalgu aquifer against potential contamination, a desk study was carried out. At Bodhgaya a sewage treatment plant (STP) has recently been constructed which is located just upstream of the designated well fields proposed under GWSP2. Effluent from the STP will be discharged into the river where it will be diluted (depending on the flow in the river) and then percolate into the aquifer. In the desk study retention times inside the aquifer (the time required for the [diluted] effluent to reach the well screens) were estimated and the behavior of indicative parameters examined. There is a reduction in concentration because of dilution, adsorption or chemical processes depending on the type of parameter. **The study,** which is appended as **Appendix 8**, **concludes that the concentrations of all parameters examined will reduce sufficiently to keep the wells safe for drinking water.** A scenario where the STP is by-passed and sewage is discharged untreated has not been examined.

B. Ecological Resources

118. Forest cover map of Bihar is shown below. Total Forest coverage of the state is 7.27% out of the state geographical coverage. As per 2011 assessment Gaya district have forest (medium and open) coverage of 12.66%.

Source : India state of Forest Report 2011

Figure 18: Forest Map of Bihar

119. Gaya city was developed along the western banks of the River Phalgu, in the transition between fertile Gangetic alluvial plains extending from Patna, and Chhotanagapur Plateau. Lands surrounding the city, especially on the northern side, are cultivated extensively. With the growing population, the city is grown to the present size occupying the surrounding land that was under agricultural use. There is no natural habitat in the city, and the flora is limited to artificially planted trees and shrubs, and the fauna comprises domesticated animals (cows, goats, pigs and chickens), plus other species able to live close to man (urban birds, rodents and some insects).

120. There is no wildlife sanctuary, national park or sensitive environmental areas in or near the city. Nearest protected area is Gautam Budha Wildlife Sanctuary located at a distance of 50 km south of Gaya. The area of the Sanctuary is about 259 sq. km and is predominantly a hilly terrain and undulating tract, which is an extension of Chhotanagpur plateau. Among the wild Life found in sanctuary are Tigers, Leopards, Hyenas, Sloth Bear, Wolf, Wild Dog, Wild Boar, Sambhar, Spotted Deer, and Nilgai etc.

121. No wild animals are reported in and around the subproject corridor as the same are located mostly in the city area.

122. Rare or Endangered Species: No rare or endangered animal or plant species are reported in the subproject impact zone.

123. Proposed water storage reservoir at Singrasthan is within government land. No forest land will be required for construction of water storage reservoir. For construction of CWR at ITI Polytechnic 1 tree needs to be cut, while at Dandibagh proposed operator office land though 15 trees are located within entire land but selection of building location will be done through judicial engineering design to save all trees. Permission of tree felling will be obtained from concerned authority as per prevalent rules and regulations.

C. Economic Development

124. Gaya has a large number of household industries like production of *agarbattis*, production of *tilkut* and *lai,* power looms and hand looms. Gaya functions as a service centre for the surrounding towns and villages. Commercial activities are located along the important roads of the city. The main vegetable market in the city is the Kedarnath Market. In additional the city has a large number of informal shops. Because of Gaya being an important centre for religious tourism, the city has a large number of affordable accommodations.

125. **Land use Pattern**. The existing land-use distribution of Gaya Municipal Area based on the primary survey is tabulated in Table below.

Table 15: Existing Land Use of Gaya Municipal Area

Land Use Categories	Area in Ha		Area in Percentage
Residential		1170	23.4
Commercial		36	0.64
Industrial		59	1.17
Public Semi Public		27	2.53
Transportation		164	3.27
Parks/Open spaces (including Orchards)		108	2.15
Sub Total		1664	33.2
Area undeveloped/ natural features	Agricultural & Vacant Land	2699	53.79
	Water bodies (including river)	356	7.1
	Hills	298	5.93
Sub Total		3353	66.8
Total Area under Gaya Municipal Corporation		**5017**	**100**

Source: Gaya Master Plan vision 2027

126. The land use in the project corridor comprises of built up areas consist of residential complexes, government or private offices and buildings, educational institutes, religious places and commercial establishments such as shops, hotels, restaurants, etc. The transportation area constitutes of existing roads in the subproject area.

127. **Commercial Activities**. The subproject area is located within Gaya city and the predominant activities in the impact zone are of mixed type including, residential, commercial and institutional houses.

128. Commercial activity will be impacted due to the implementation of the subproject components for laying of rising mains. The new mains will be laid within the available right of

way (ROW) of existing road (in shoulders). It has been found through the transect walks along with a team of water supply design engineers that on an average available ROW including the dedicated pedestrian walkway in selected category of roads in Gaya city. The improvement work will be carried out within the ROW in road shoulders. The maximum required width for laying down of different categories of pipeline will be 1.2 m. However, at certain junctions there may be some temporary impacts, which may disrupt some business activities in terms of temporary impact on the access. The exact nature of temporary impacts will be known at the time of drawing up of the construction schedule of the contractor, which will be documented and mitigated at the time of construction[9] as per the entitlement matrix of the resettlement plan and resettlement framework on case by case basis. To determine the extent of temporary impacts due to the laying of rising main pipelines within the city, transect walks were undertaken along the proposed networks with focus on the nature of the existing ROW, density of commercial and residential structure, etc.

129. The partial blocking of road will follow particularly in narrow stretch during the time string of action of excavation followed by laying of pipeline, testing of water supply, backfilling of excavated trenches and road restoration. The access to these shops, residences and institutions will be affected for a maximum of 1-2 days.

130. Potential temporary impacts of access disruption for all these shops/commercial establishments can be mitigated through good construction practices, which will be the responsibility of construction contractors. Measures are identified in the IEE and include: (i) providing walkways and metal sheets to maintain access across trenches, (ii) increasing the workforce in front of shops or commercial establishments or sensitive receptors so as to reduce the period of impact, (iii) consulting business and institutions regarding operating hours and factoring this in work schedules, (iv) providing advance information on works to be undertaken including appropriate signages etc. The project contractor will ensure that there is provision of alternate access during the construction so that there is no closure of these shops or any loss of clientage. Moreover, as per the contract provisions, the contractor will be required to put back the road to its original condition after the pipe laying.

131. In case, the loss of access to the shops during construction is not effectively mitigated by provision of alternate access by project contractors same may cause temporary loss of income during the construction for which provision for livelihood allowances have been made in the resettlement plan. There could be temporary disruption of business during working days for which affected persons will be provided assistance for this transitional period on a case-to-case basis as per the provisions of the Entitlement Matrix in agreed resettlement framework. A lump sum budgetary provision has been kept in the Resettlement plan for same. The payment of assistance will be made for days of closure, and will be subject to the production of requisite documents in support of the claim. Cash assistance will be released after proper verification of documents[10].

132. A detailed Resettlement Plan has been prepared for rehabilitation and resettlement of parties affected by execution of proposed subproject.

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[9] The excavation of trenches for primary lines will last for a maximum of 1 to 2 days. The construction will be scheduled in such a way as to minimize disruption.

[10] Income certificate or income tax return certificate or any other document proving their income from affected commercial establishment

133. **Industrial Development**. There is no major industrial development in and around Gaya in general. Small scale industries like production of *agarbattis,* production of *tilkut* and *lai,* power looms and hand looms are common. There are few agro-based industries in the city. Tourism is a most important economic activity in the city.

134. **Agriculture**. State is predominantly an agriculture based economy with fertile lands. Gaya region is also rich in agricultural produce, crops like rice, wheat, maize, jowar and other pulses are cultivated here.

135. **Infrastructure Facilities**. Since, the subproject is spread over portions of Gaya City; the infrastructure facilities like schools, hospitals, colleges, electricity and communication in the subproject area are satisfactory.

136. During execution of the proposed subproject, there will be no impact on the main building of any department or facility, therefore no impact on any educational, administrative or medical service is anticipated.

137. **Water supply**. Piped water supply system in Gaya was introduced in 1924, with Phalgu River as a source. Later on in 1954-55, due to inadequate flow in the river during summers and to cope with the growing water demand, a groundwater based source at Dandibag on the bank of River Phalgu was developed. The water supply system was expanded to different parts of the City from time to time. The present water system is based on groundwater, and an estimated 27.6 MLD or less of water is supplied every day at the rate of 40 liters per capita per day (LPCD), much less than the stipulated norm of 135 LPCD. Water distribution system consists of 150 km with 50-600 mm Dia. pipeline Due to old system leakages are frequent, and the system losses are as high as 40% of the water supply. About 60% of population have access to water supply and remaining population depends on in house own tube wells and hand pumps provided by the GMC and PHED. Improvement of the water supply services in Gaya is subject of GWSP1 and GWSP2 and is elaborated in Chapter 2 of this report.

138. **Sewerage and Drainage System**. Gaya has no separate sewerage system to carry the wastewater. Existing drainage system was developed in 1930's and is a combined system to carry both wastewater and storm runoff. This drainage system covers 80% of the City area, and consists of open and as well as underground drains: of the 80 km length, 65 km drains are open drains and remaining 15 km are underground closed drains. There is no defined drainage system in southwestern and southern parts of the City. Due to lack of sewerage system, about 75% of the households depend on individual septic tanks or other on-site facilities and remaining 25% depend either on public toilets or resort to open defecation. Effluent from the septic tanks joins the drainage system. Owing to the topography, the drainage system is gravity based, and drains mostly into Phalgu River. Since there is no treatment facility, wastewater is directly discharged into the river without any treatment. Now it is planned to construct STP under ADB funding. After completion of project waste water of Gaya will be discharge after treatment at STP.

139. The drainage of Gaya is influenced by the hills surrounding it on three sides – Mangla Gauri, Shringa Sthan, Ramshila and Brahmayoni – and the River Phalgu on the remaining side. The road to the west of the Collectorate divides the drainage into two zones – western and eastern. Gaya's drainage network is 60 km long – covering 40% of the road network – with 46 km of the drains being pucca and 16km kutcha. The main drains in the western zone include Kujapi, Karimganj and Katari Hill Road *Nallah* and these discharge effluents at various places like the Gandhi Maidan, near the Railway Station etc. The main drains in the eastern

zone include Mansarva, Mashanghat and Nadraganj *Nallah* and these discharge effluents into the River Phalgu. The area to the north of Dhobi Road *Nallah* to Katari Hill Road Nala, Gandhi Maidan to Kujapi *Nallah* and newly developed colonies in Manpur, Ghughari, Monapur, and Kumar Colony have no drainage and are prone to water logging.

140. **Solid Waste**. Gaya generates about 250 tons of municipal solid waste per day. The GMC collects about 60 percent of the waste generated through its solid waste management system. At present there is no door-to-door collection system. The waste collected through community dustbins (about 100 in Nos.) is transported to the disposal sites using tractors and open dumper trucks. Street littering is prevalent, and solid waste is mostly deposited on the side of the roads and vacant lands. At present no specific MSW disposal site exists in the City. Part of the solid waste collected is dumped along the roadsides at Gagri Tand area, 7 km from the City. Remaining waste is dumped in vacant plots, along the roads, drains and low-lying lands in and around the City.

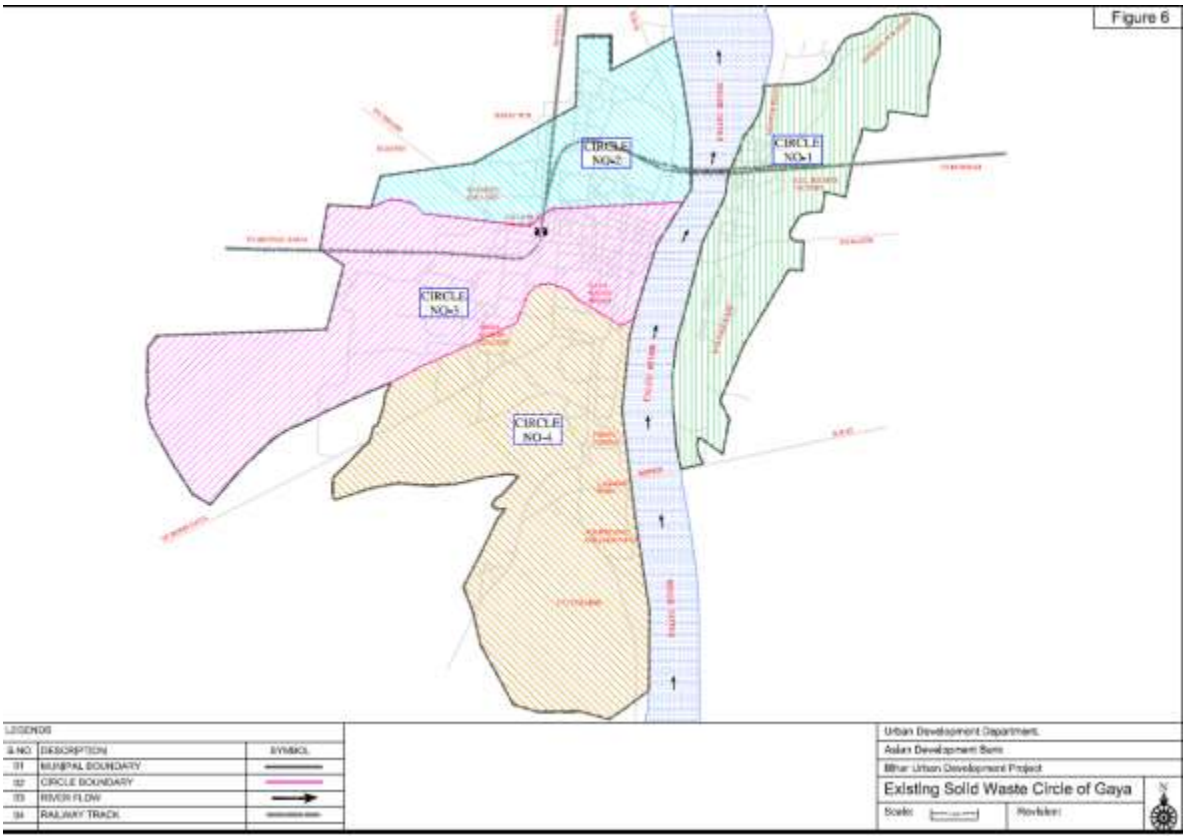

Figure 19: Present Solid waste circle at Gaya

141. Currently, garbage and solid wastes are dumped at various open spaces both along the river line as well as on other places under the GMC area. There was no significant dumping of Solid Waste in the upstream of Falgu River beyond Kendui. The Executive Officer, Bodh Gaya Nagar Panchayat informed that a Solid waste Management system has been put in place and the task had been out sourced to Ecosmart Waste Management Private Limited. The waste is collected from various collection points to be dumped at Naily, a site earmarked for the development of a controlled landfill. However, interaction with local community members at Azad Bigha, Naily revealed that tractors carrying the garbage do not come regularly, and dumping of solid wastes at Naily has been stopped.

142. **Transportation**. Gaya is well connected by road, rail and air. Two National Highways pass through the City: NH-83 running north-south connects Gaya to Patna in the north and Dobhi in the south; and NH-82 running east-west connects Gaya to Bihar Shariff and Mokama in the east and Dudnagar in the west. A bypass runs on the southern side of the City, connectingNH-82 and NH-83. There are three State Highways (SH) passing through Gaya. Gaya is well connected by railways. Main railway line connecting Kolkata in the east and Delhi and the west passes through the City. Gaya also has an airport. Gaya has a well developed internal road network. The total length of roads in Gaya is 105km, of which 67% are municipal roads and remaining are State and National Highways. Most of the roads in the City are narrow, congested and carries traffic exceeding its capacity. The average road width is 5.5m which is further reduced to 3.5m due to encroachments. There is no organized public transport system. There is heavy dependence on para-transit facilities: auto and cycle rickshaws and *tongas* (horse-drawn vehicles).

143. **Power Supply.** Thermal power is the main source of energy in Bihar, contribution of hydro power is negligible. State-owned Bihar State Electricity Board is responsible for power generation, transmission and distribution of electricity. Power is supplied from the central grid by overhead cables carried on metal and concrete poles, mainly located in public areas alongside roads. The power supply is erratic and there are frequent outages in warmer months, and large fluctuations in voltage.

D. Social and Cultural Resources

144. **Demography.** Based on 2011 census, Gaya City population was 463,454, up from 291,675 in 1991,registering a decadal growth of around 33%. Average population density is 10,963persons/sq. km. Sex ratio (females per 1000 males) was 886 which is lower than the State and the national average of 919 and 929 respectively. Overall literacy rate is reported at 85.74% with 90.49 % for males and 80.35 % for females (the corresponding State figures are 63.82%, 73.39% and 53.33 % respectively).Overall work participation rate (WPR) in the City is 24.5 %, reported at 39.8% for males and 7.3% for females. Occupational pattern shows that 82.6% of the persons are engaged in industrial and service sector (organized and unorganized, excluding the workers engaged in household industry and agriculture). Around 7.2 % workers are engaged in agricultural activities and the rest 10.2% in household industries.. Majority of the people are Hindus and the remainder are mainly Muslims. Other religious communities like Sikhs, Christians, Jains and Buddhists also found in the City but in few numbers. Main languages spoken in the City are Hindi, Magahi (dialect), Bhojpuri and Urdu. Among the total population 9.6% comprise scheduled castes (SC) population; around 0.2% of population belong to Scheduled Tribes (ST) category - but these are all part of the mainstream population. Demographic status as per 2011 census is shown in Table below.

Table 16: Demographic status of Gaya city

Gaya City	Total	Male	Female
Population	**463,454**	245,764	217,690
Literates	**346,747**	194,377	152,370
Children (0-6)	**59,015**	30,966	28,049
Average Literacy (%)	**85.74**	90.49	80.35
Sex ratio	**886**		
Child Sex ratio	**906**		

Source: Census 2011

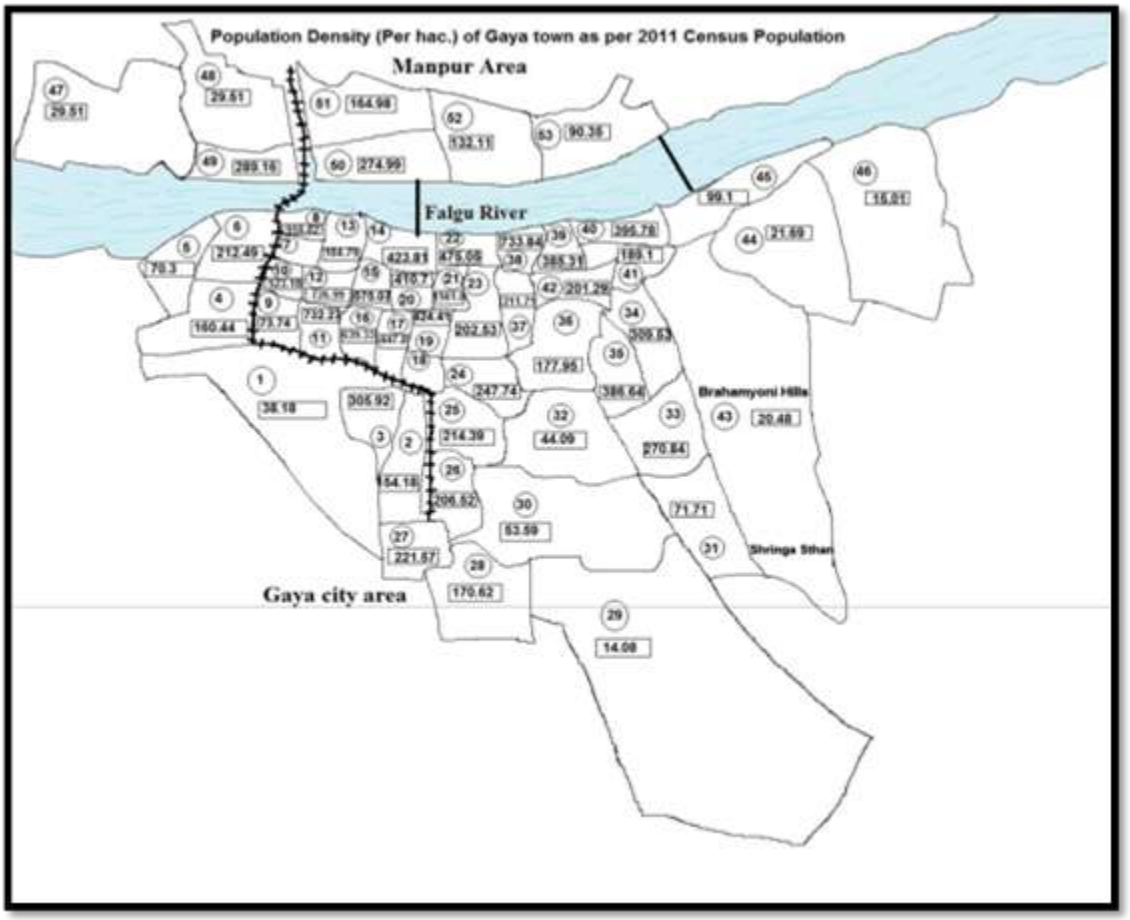

Figure 20: Ward wise population density at Gaya

145. **Educational and Health Facilities.** *Education:* There are at present about 117 primary schools, 52 middle schools, 15 inter schools and 3 district level schools in the city. The availability of basic educational institutions appears to be fairly adequate at the city level as the average population served is well within the norms for the same. The Magadh University established in 1962, is located at Bodhgaya, which is comfortably accessible from Gaya. Gaya has several colleges, the well known ones include Gaya College, Anugrah Memorial College,

Jagjivan College, Mirza Ghalib College, and Gautam Buddha Mahila College for women.Anugraha Narayan Magadh Medical College and Hospital (ANMMCH) located here is a renowned institution in the field. There are also few private engineering colleges in the city. Gaya also has an Industrial Training Institute for vocational education located on Bodhgaya Thus, in respect of educational facilities, the availability of basic facilities appears fairly adequate though, spatial distribution has not uniformly facilitated their accessibility.

146. **Health.** At present there are six major hospitals, which caters to the patients from the entire region. In addition to these, there are a number of allopathic, ayurvedic and homeopathic and other dispensaries and private nursing homes of various specializations in Gaya. Thus, in terms of quantitative requirement, the availability of medical facilities appears to be quite adequate as of now, while the accessibility is not uniform, in view of the location of these facilities only in selected areas.

147. **History, Culture, and Tourism.** Gaya*,* located in Mahadh Region, is a historic and a most important religious centre for Hindus. The world famous Buddhist centre of Bodh Gaya is located 13 km south of Gaya. The history of Gaya has a unique place in the evolution and development of Hindu civilization. According to the religion of Puranaas, it is incumbent on every Hindu to visit Gaya and make offerings for the souls of his ancestors. Gaya is believed to be the one of the oldest exiting cities in the World, and it presents a nucleus of several religions(Hinduism, Buddhism, Jainism etc) and its effects.

148. *History:* Magadh history goes back to Sisunaga Dynasty (600 BC); however, it was during the time of Bimbisara (545 BC), the Magadh Region and the Gaya came into prominence. During his reign Gautama Buddha came to Gaya, and spent time in contemplation on a rocky crest, now known as Brahmayoni Hill (it is now a declared monument of the State Government) before he passed on to Bodh Gaya. After Bimbisara, his son Ajatasatru became the King. Ajatasatru was succeeded by Udayi, and then the Nanda Dynasty took over the Magadga Region. Thereafter, Magadh Region came under the rule of the famous Maurya Dynasty. Mauryan King Ashoka (272 BC – 232 BC) embraced Buddhism; he visited Gaya and built the first temple at Bodh Gaya to commemorate Prince Gautama's attainment of supreme enlightenment. Gaya came under the reign of Muhamaddan rulers in the 12th century with Muhammad Bakhtiyar Khilji invading the region. The region came into British Rule after the battle of Buxar in 1764.

149. **Places of Importance and Tourism**. Gaya City is divided into two parts: the old City of Gaya popularly known as Andar Gaya, and the new City of Sahebganj. Andar Gaya is one of the most ancient inhabited areas. The main attractions of this old City are the sacred shrines, which attract Hindu pilgrims from all over the world. Vishnupada temple is main temple in and around Gaya. **Table 17** presents a list of monuments or sites declared as protected by the Government of Bihar. People mainly visit Gaya for offering Pind Dan (oblations) for salvation of soul of one’s ancestors. There are 360 Vedis (places where offerings are made) located within Pancha Kosi Gaya. Thousands of pilgrims visit Gaya throughout the Year. Pitrapaksha Mela (fair), organized for 15 days as per the Hindu calendar every year in Gaya is a very important Hindus. Few hundred thousands of people visit Gaya during this period. No project components are located within any ancient monuments and historical protected area.

Table 17: Ancient Monuments, Historical and Tourism Places in Gaya

S.N.	Name	Features
1	Vishnupad Temple	This is the main temple in Gaya dedicated to Lord Vishnu. This is located along the Phalgu River, marked by a footprint of Vishnu and Buddha incised into a block of basalt. The present day temple was rebuilt by Devi Ahilya Bai Holkar, the ruler of Indore, in the 18th century. There is a gold flag and couple of Kalash made of gold has been embedded at the top of the temple which use to always glitter
2	Brahmyoni Hill	It was at Brahmayoni hill that Buddha preached the Fire Sermon (Adittapariyaya Sutta) to one thousand former fire-worshipping ascetics, who all became enlightened while listening to this discourse. At that time, the hill was called Gayasisa.
3	Ramshila Hill	Ramshila Hill is situated 5 km from Vishnupad Temple. One of the most sacred hills, with considerable antiquity, the hill is dotted with numerous stone sculptors. It is closely associated with Lord Ram and takes its name after him.

Source: http://asi.nic.in/asi_protected_monu_bihar.asp

150. **Sensitive Environmental and Social Receptors.** The sensitive environmental receptors existing along the alignment of proposed sub-project include religious places, educational institutions, health care centres, community property resources, etc. The details of the existing sensitive environmental receptors near project sites are given in the **Appendix 8.**

151. The assessment is done for understanding possibility of impact on sensitive receptors. It is noted from the Table in the appendix that few religious places, health centers and schools are located within or near the ROW. All the sensitive environmental receptors existing along the subproject sites shall be properly supervised during the subproject execution stage to avoid and minimise any negative impact. As such, these sites may face the minor impacts of temporary disruption of access and increased air and noise pollution during execution of the proposed subproject.

V. ANTICIPATED IMPACTS AND MITIGATION MEASURES

152. This section of the IEE reviews possible subproject-related impacts, in order to identify issues requiring further attention and screen out issues of no relevance. ADB SPS (2009) require that impacts and risks will be analyzed during pre-construction, construction, and operational stages in the context of the subproject's area of influence. As defined previously, the primary impact areas are (i) the sustainability of the water source, sites for tube wells, water storage reservoir, transmission mains; (ii) main routes or intersections which will be traversed by construction vehicles; and (iii) quarries and borrow pits as sources of construction materials. The secondary impact areas are: (i) entire Gaya city outside of the delineated primary impact area; and (ii) entire Gaya district in terms of overall environmental improvement.

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

154. Categorization of the subproject has been undertaken using ADB's REA Checklist for Water Supply. REA checklist is attached as **Appendix 1.**

155. In the case of this subproject, it is viewed that (i) except for the issue of water source sustainability, most of the individual elements are relatively small and involve straightforward construction and operation, so impacts will be mainly localized and not very significant; (ii) most of the predicted impacts are associated with the construction process, and are produced because the process is invasive, involving excavation and earth movements; and (iii) being located in the built-up area of Gaya city, the subproject will not cause direct impact on biodiversity. The subproject will be in properties held by the local government and access to the subproject locations is through public rights-of-way and existing roads. Hence, land acquisition and encroachment on private property are not expected under the subproject.

A. Pre Construction Planning and Design Phase

156. Planning principles and design considerations have been reviewed and incorporated into the site planning process whenever possible. The concepts considered in design of the proposed water supply subproject are: (i) water source sustainability; (ii) no involuntary land acquisition; (iii) substantial reduction of water losses in sub-project area; (iv) augmentation in adequacy of drinking water supply at the user end; (v) enhancing the efficiency of existing tube wells; (vi) providing adequate infrastructure facilities for storage and distribution of water in deficient areas; (vii) most suitable construction methodology; and (viii) site constraints.

157. Transmission route alignment is planned after minimizing environmental impact. **Appendix 8** shows possible impact and mitigation for planning of transmission route.

158. **Water Source Sustainability**. The subproject proposes to use a sensitive source of water, the aquifer underlying the Phalgu River. Extensive investigations have been carried out by the project to derive planning and design parameters for sustainable development of the water source. This concerns both water availability (quantity) and water quality.

159. **Water quantity.** As discussed under Chapter 2 section C, that present ground water abstraction of 24,000 m^3/day for 75 days (when the river Phalgu is dry) is hardly 31.50 % of the total sub-surface water storage (5.70 mcm) within 2 m of aquifer in 14.25 km^2 of the ground water potential zone during summer months. Similarly, with the ground water abstraction of 124 MLD for 75 days of 9.30 mcm from the sub-surface water storage of 25 m thick aquifer of 53.43 mcm will be 17.40 % and it will lower the water level by 4.35 m, still keeping the aquifer thickness of 20.65 m which is considered as sufficient to sustain the yield of tube wells.

160. The impact of pumping 124 MLD during the summer months (75 days) can be further reduced if the well fields are increased instead of having only one well field of Dandibagh. Two more well fields can be developed, one near village Kendui and another near Kendua on the left bank and fourth near Manpur - Buniyadgunj on the right bank. By having four different well fields, there will be less pumping from a small area of a well field, thereby creating a small ground water depression and less lowering of water level around it.

161. Study concluded that despite lowering of water level by 4.35 m during summer months, the tube wells will sustain the yield and will restore original yield as soon as Phalgu river starts flowing after getting the first spell of rainfall in mid -June. Detail study report annexed as **Appendix 2.**

162. **Water Quality**. The investigations carried out by the project indicate that the aquifer is quite resilient against possible impacts from pollution by wastewater. The water quality of the aquifer upstream of Gaya city is well within allowable limits. However, water quality adjacent

and downstream of the city is under threat, witnessed by the poor quality of the water at the Panchayati Akhara wells. The designer has proposed new wells at three locations downstream of Panchayati Akhara, of which those at Dharamshala is less than a kilometer away.

163. It was decided that under the same program (BUDIP) construction of Sewage Treatment Plant (STP) will be taken up and city's wastewater will be treated before discharge into the Phalgu river. Consequently, it is expected that in future ground water resources will be protected from contamination.

164. **Design Period:** Different components of the proposed subproject are designed with design periods as under:

(i) The design period for distribution network is 30 years.
(ii) The design period for pumps and electrical equipment is 15 years.
(iii) The design period for civil works is 30 years.
(v) The design capacity for storage system is 30 Years (135 lpcd +15% for transmission losses).

165. **Basis of design.** Design population and coverage of the project is given below:

Table 18: Design basis of the Subproject

Design feature	Description
Base Year (2018) population	524,297
Mid-Design Year (2033) population	675,237
Design Year (2048) population	848,200
Coverage	53 municipal wards of GMC
Project area	50.17 km^2

Source: DPR Gaya Water supply

166. **Utilities**. Telephone lines and wires, water lines within the proposed subproject locations may require to be shifted in few cases. The mitigate the adverse impacts due to relocation of the utilities, DSC will (i) identify and include locations and operators of these utilities in the detailed design documents to prevent unnecessary disruption of services during construction phase; and (ii) require construction contractors to prepare a contingency plan to include actions to be done in case of unintentional interruption of services.

167. **Social and Cultural Resources.** Gaya is an area of large numbers of temples (some of them are historic) and other religious sites, so there is a risk that any work involving ground disturbance can uncover and damage archaeological and historical remains. For this subproject (construction of water storage reservoirs and laying of pipeline), excavation will occur in open area, so it could be that there is a medium risk of such impacts. Nevertheless, DSC or PMU or PMC will:

(i) Consult GMC to obtain an expert assessment of the archaeological potential of the site;
(ii) Consider alternatives if the site is found to be of high risk;
(iii) Include state and local archaeological, cultural and historical authorities, and interest groups in consultation forums as project stakeholders so that their expertise can be made available; and
(iv) Develop a protocol for use by the construction contractors in conducting any excavation work, to ensure that any chance finds are recognised and measures are taken to ensure they are protected and conserved.

168. **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 promote instability and result in destruction of property, vegetation and drinking water supply systems. Thickly populated 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 forest, water bodies or in areas which will inconvenience the community. **Appendix 4** shows site management plan for water storage reservoir sites.

169. **Site selection for equipment lay-down and storage area**. Improper selection will affect local environment and inconvenience to public. Possible mitigation measures are:

(i) Choice of location for equipment lay-down and storage areas must take into account distances to adjacent land uses, general onsite topography and water erosion potential of the soil. Impervious surfaces must be provided where necessary.
(ii) Storage areas shall be secure to minimize the risk of crime. They shall also be safe from access by children or animals etc.
(iii) Residents living adjacent to the construction site must be notified of the existence of the hazardous storage area.
(iv) Equipment lay-down and storage areas must be designated, demarcated and fenced if necessary.
(v) Fire prevention facilities must be present at all storage facilities.
(vi) Proper storage facilities for the storage of oils, paints, grease, fuels, chemicals and any hazardous materials to be used must be provided to prevent the migration of spillage into the ground and groundwater regime around the temporary storage areas.
(vii) These storage facilities (including any tanks) must be on an impermeable surface that is protected from the ingress of storm water from surrounding areas in order to ensure that accidental spillage does not pollute local soil or water resources.
(viii) Fuel tanks must meet relevant specifications and be elevated so that leaks may be easily detected.
(ix) Staff dealing with these materials or substances must be aware of their potential impacts and follow the appropriate safety measures.

170. **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. Mining Department approved sites would be selected first. 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. It will be the construction contractor’s responsibility to verify the suitability of all material sources and to obtain the approval of Urban Local Body. If additional quarries will be required after construction is started, then the construction contractor shall use the mentioned criteria to select new quarry sites, with written approval of PIU or PMU or PMC.

171. **Maintaining Core Labor Standard**. The Contractor and PMU are responsible for ensuring that international CLS[11] –as reflected in national labor laws and regulations are adhered to. PMU is ultimately responsible for monitoring compliance with national labor laws and regulations, provided that these national laws are consistent with CLS. ADB will carry out due diligence – during loan review missions - to ensure that executing and implementing agencies and contractors comply with applicable (national) core labor standards and labor laws. PMU or PIU 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; (b) equal pay for equal work of equal value regardless of gender, ethnicity or caste; and (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. These will be monitored as part of the project's safeguards reporting requirements.

B. Construction Phase

172. **Table 19** presents an indication of what activities and facilities are likely to be undertaken during construction of the subproject, including the associated inputs and outputs.

Table 19: Summary of Activities and Facilities, Resource Use, and Produced Outputs during Construction Phase

Activities and Facilities	Inputs/Resource Use	Outputs/Waste Production
• Construction camp and its associated facilities (including lay-down areas) • Storage camps and lay-down areas − Materials and equipment stockpiles − Handling and storage of hazardous materials including chemicals additives, gravel, cement, concrete and lubricants • Source of water • Vegetation clearance • Excavation	• Bitumen • Cement • Chemical additives used in concrete • Aggregate (sand and stone) • Gravel (fill material and selected material for sub-base and base layers) • Water − Drinking, cooking and sanitation at construction camps − Water for dust suppression − Water applied to base and sub-base layers during compaction	• Old asphalt (removed from road carriageway during laying of pipelines)[12] • Waste concrete and other construction rubble • Waste bitumen[13] • Used fuels, lubricants, solvents and other hazardous waste • General waste • Contaminated soil − Soil contaminated with bitumen − Soil contaminated with petrochemicals (i.e. oils and lubricants) and other chemicals

[11] Core Labor Standards (CLSs) are a set of four internationally recognized basic rights and principles at work: (i) freedom of association and the right to collective bargaining; (ii) elimination of all forms of forced or compulsory labor; (iii) effective abolition of child labor; and (iv) elimination of discrimination in respect of employment and occupation.

[12] The water supply improvement works affecting roads may involve the stripping and demolition of old asphalt layers. Ideally, old asphalt shall be reused during construction of the new road in order to avoid large quantities of waste being produced. However, depending on the availability and cost of virgin aggregate in the area through which the road is aligned, reusing the old asphalt may be more costly than using virgin aggregate.

[13] Bitumen has relatively low levels of polycyclic aromatic hydrocarbons (PAHs) and is largely inert. However, certain other potentially hazardous chemical may be added to the bitumen or to the aggregate during the construction process in order to render the compound more workable. The objective is to use the least hazardous chemicals available and to locate asphalt plants, aggregate stockpiles and mixing areas where they do not pose a significant environmental risk.

Activities and Facilities	Inputs/Resource Use	Outputs/Waste Production
• Drilling • Movement of construction staff, equipment and materials • Importation of selected materials for construction. • Temporary bypass • Noise and vibrations • Dust suppression • Waste production and temporary storage/disposal i.e. used fuels, waste concrete and bitumen, spoil materials and general waste • Use of bitumen/asphalt • Erosion prevention particularly at hill areas • Concrete batching plant (and associated storage and mixing areas, chemicals) • Rehabilitation of disturbed areas • Interaction between construction workforce and local communities • Management of the passing pedestrians and points of congestion • Implementation of the Resettlement Plan (as per R & R policy) prior to start of construction • Reminders to affected people of construction with timeframes	− Water for application to sub-base and base layers prior to compaction • Petrochemicals • Other chemicals/lubricants/paints • Construction vehicles, machinery and equipment • Temporary energy supply to construction camps • Labor − Recruitment of construction workforce − Skills training • Public movement control − need barriers (not just caution/danger tape) to protect people from trenches during construction	• Sewage and grey water (temporary construction camp sanitation) • Spoil material (excess soil removed during excavations for rehabilitation) • Noise and vibrations (construction vehicles and machinery operation) • Lighting at construction camps, equipment yards and lay-down areas • Smoke and fumes − Burning of vegetation cover − Fires used for cooking and space heating (construction camps) − Vehicle exhaust emissions • Dust − Vehicle & equipment movement

1. Screening of No Significant Impacts

173. The construction work is expected not to cause major negative impacts, mainly because:

(i) Most of the activities will be on the built-up areas of Gaya city thus could be constructed without causing impacts to biodiversity;

(ii) All the sites are located on an government-owned land which is not occupied or used for any other purpose;

(iii) Overall construction program will be relatively short and is expected to be completed in 18 months with activities to conducted by small teams and specified location so most impacts will be localized and short in duration; and

(iv) Most of the predicted impacts associated with the construction process are produced because the process is invasive, such as involving excavation for pipe laying and construction of reservoirs. However, the routine nature of the impacts means that most can be easily mitigated and the impacts are clearly a result of

the construction process rather than the design or location, as impacts will not occur if excavation or other ground disturbance is not involved.

174. As a result, there are several aspects of the environment which are not expected to be affected by the construction process and these can be screened out of the assessment at this stage as required by ADB procedure. These are shown in **Table 20**. These environmental factors are screened out presently but will be assessed again before starting of the construction activities.

Table 20: Fields in which construction is not expected to have significant impacts

Field	Rationale
Topography, Drainage, and Natural Hazards	Activities are not large enough to affect these features.
Geology, Geomorphology, Mineral Resources, and Soils	Activities are not large enough to affect these features. No mineral resources in the subproject location.
Climate	Activities are not large enough to affect this feature.
Air Quality	Short-term production of dust is the only effect on atmosphere
Geohydrology and Groundwater	Sustainable water source available at project sites
Protected Areas	No protected areas nearby the Gaya city and project locations
Flora and Fauna	No rare or endangered species .reported at project site
Land Use	No change in major land use.
Socio-economic	Subproject site is within govt. land. No socio economic impact
Commerce, Industry, and Agriculture	Activities are not large enough to affect these features
Population	Activities are not large enough to affect this feature.
Health and education facilities	Activities are not large enough to affect this feature.
Historical, Archaeological, Paleontological, or Architectural sites	No scheduled or unscheduled historical, archaeological, paleontological, or architectural sites

2. Construction method

175. **Construction methodology of production tube well**

(i) Drilling work of pilot hole is to be taken up and completed up to recommend depth at respective point

(ii) After the completion of pilot hole drilling, it is to be electrically logged, in order to identify the promising aquifers for screening it. Based on the physical observation of formation material (drill cuttings) and the Electro logging Test Results, corrected lithological log is to be prepared for recommending lowering of well pipe Assembly. Based on the study of Mechanical Analysis of Aquifer material for grain size distribution, the slot size & gravel size should be selected and recommended.

(iii) On confirmation of well pipe Assembly, Pilot hole is to be reamed (enlarged) to 500 mm diameter for lowering 250 mm pipe diameter or hole diameter of 600 mm for lowering 300 mm pipe diameter, as the case may be, up to the total recommended depth of tube well.

(iv) On lowering the pipe assembly into the enlarged hole, space between the (slotted &blank) pipe and enlarged hole should be packed with proper size gravel from the bottom of well up to the bottom of clay packing below ground level.

(v) From the top of the gravel packing, up to the ground level, perfect clay packing between Pipe and Hole is to be provided, for sanitary as well as water quality protection of well.

(vi) Well is to be developed through backwashing prior to compressor development test.

(vii) Production tube well is to be developed zone wise using Airline/Education pipe by using appropriate capacity of compressor for getting sand free discharge (or Well is to be developed at least for 40 to 50 hours whichever is less). Water samples should be collected for analyzing chemical and biological parameters.

(viii) Production tube well is to be developed (10 to 15 hours depending on the observation of sand free discharge it is indicative) through over pumping before conducting Pump Test. Thereafter Pump Test is to be conducted for yield test (5 to 6 hour continuous pumping) to recommend appropriate size & capacity of pump to be installed before putting the well. Water samples should be collected for analyzing chemical and biological parameters. Drawing 19 shows the typical drawing for production tube well and observation well.

(ix) Disinfection system for tube wells. It is proposed to provide one Electro Chlorinator at each Tube Well capable of producing the required quantity chlorine ranging from 1kg/hr to 1.5 kg/hr to maintain 10ppm at the delivery pipeline. The raw material required in these chlorinators will be common salt. Provision has been made in the electrical panel proposed at each TW for power supply required for the electro chlorinator.

176. Construction of GLSR and Clear Water Reservoirs will be done as per scope of work. All construction waste will be dispose after taking permission from the GMC. Simple civil construction method will be applicable for reservoirs.

177. Rising mains will be buried in trenches adjacent to roads un-used RoWs. In some areas occupied by drains or edges of shops and houses, trenches may be dug into the edge of the road to avoid damage to utilities and properties.

178. Trenches will be dug using a backhoe/manual, supplemented by manual digging where necessary. Excavated soil will be placed alongside, and the pipes (brought to site on trucks and stored on unused land nearby) will be placed in the trench by hand or using ropes for the Ductile Iron (DI) K9 pipes. Pipes will be joined by hand, after which filling will be done with the excavated soil manually up to the ground level and compacted by a vibrating compressor. Where trenches are dug into an existing roadway, the bitumen or concrete surface will be broken by hand-held pneumatic drills, after which the trench will be excavated by backhoe, and the appropriate surface will be reapplied on completion.

179. Pipes are normally placed by approx 1 m below the existing ground level or road level and a clearance of 200 mm is left between the pipe and each side of the trench to allow backfilling. Trenches will be around 1m deep and 700-1.2 m wide.

180. Simple civil construction guidelines will be followed for Operator Office at Dandibagh.

3. Anticipated Impacts and Mitigation Measures

181. Although construction of the subproject components involves quite simple techniques of civil work, the invasive nature of excavation and the subproject locations in the built-up areas of Gaya city where there are a variety of human activities, will result to impacts to the environment and sensitive receptors such as residents, businesses, and the community in general. These anticipated impacts are temporary and for short duration. 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) refilled and compacted after pipes are installed; (iii) if trenching done on roads, repaired to pre-construction conditions and (iv) any excavation done near sensitive area like school, religious places and house will be protected as per standard norms[14].

182. **Climatic Impact.** Potential impacts during construction are,

- The nature and intensity of rainfall events in an area, has implications for storm water management.
- Smoke from burning activities could be wider spread on windy days especially when dust could be blown off site.

Mitigation measure:

- ✓ Seasonal climatic variations will be considered during scheduling of construction activities in the area.
- ✓ Consideration of suitable season (non monsoon /lien period) for major construction activity
- ✓ Excavations and other clearing activities will only be done during agreed working times and permitted weather conditions.
- ✓ Storm water control (through drainage, diversion) during construction phase as per the method approved by the Engineer.

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

(i) The material sources permitted by government;
(ii) Verify suitability of all material sources and obtain approval of PIU & DSC; and
(iii) Submit to DSC on a monthly basis documentation of sources of materials.

184. **Air Quality.** Emissions from construction vehicles, equipment, and machinery used for excavation and construction will induce impacts on the air quality in the construction sites. Anticipated impacts include dusts and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides, and hydrocarbons) but temporary and during construction activities only. To mitigate the impacts, construction contractors will be required to:

(i) Consult with DSC or 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) Avoiding the need to stockpile on site;
(iv) Use tarpaulins to cover sand and other loose material when transported by trucks;
(v) Fit all heavy equipment and machinery with air pollution control devices which are operating correctly and rregular servicing of the vehicles & equipments off site in order to limit gaseous emissions; and
(vi) Excess earth and other windblown loads in transit will be kept covered

185. **Surface Water Quality.** Mobilization of settled silt materials, run-off from stockpiled

[14] Occupational Health and Safety of employees working only in factories and mines have been specifically covered in GOI laws. However, the Constitution of India has provisions to ensure that the health and well-being of all employees are protected and the State has the duty to ensure protection. For this subproject, the mitigation measures were based on the World Bank Environmental, Health, and Safety (EHS) Guidelines.

materials, and chemical contamination from fuels and lubricants during construction works can contaminate water body. 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 GMC or PIU on designated disposal areas;
(iii) Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies;
(iv) Proper discharge of waste water as generated during development of tube well
(v) Place storage areas for fuels and lubricants away from any drainage leading to water bodies;
(vi) Dispose any wastes generated by construction activities in designated sites; and
(vii) Conduct surface quality inspection according to the Environmental Management Plan (EMP).

186. **Noise Levels.** There are no health facilities, scheduled or unscheduled historical, archaeological, paleontological, or architectural sites within the construction impact zones. However, construction works will be on settlements, along and near schools, and areas with small-scale businesses. The sensitive receptors are the general population in these areas. Increase in noise level may be caused by excavation equipment, and the transportation of equipment, materials, and people. Impact is negative, short-term, and reversible by mitigation measures. The construction contractor will be required to:

(i) Plan activities in consultation with DSC or 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) Require horns 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;
(iv) Ensure that machinery is in a good state of maintenance.
(v) Monitor noise levels in potential problem areas, 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.

187. **Generation of Spoil and Disposal**. In case of disposal of the earth within the water body, turbidity will increase.

188. The following measures should be taken up,

(i) Not to dispose any construction materials in water body which may pollute the surface water and aquatic fauna
(ii) Disposal arrangement of muck as generated from tube well construction
(iii) Spoil Disposal Management Plan (SDMP) will be prepared and implemented to minimize the potential effects of sediment plumes on aquatic habitats. Sample spoil management plan is attached as **Appendix 9.**
(iv) Details of the proposed Water Quality Monitoring Program will be included in the environment management plan.

189. **Existing Infrastructure and Facilities.** Excavation works can damage existing infrastructure located alongside roads, in particular water supply pipes. It will be particularly

important to avoid damaging existing water pipes. It is therefore important that construction contractors will be required to:

(i) Utility shifting (if required) will be undertaken prior to commencing construction works.
(ii) Keep construction related disturbances to a minimum.
(iii) Consult with affected service providers regarding impacts on access to infrastructure and services and alternatives.
(iv) Consult with affected communities or businesses prior to foreseeable disruptions, for example notifying residents of a temporary interruption of water supply.
(v) Provide backup or alternative services during construction-related disruptions.
(vi) Provide access points to infrastructure and services.
(vii) Monitor complaints by the public.

190. **Landscape and Aesthetics.** The construction works will produce excess excavated, excess construction materials, and solid waste such as muck, removed concrete, wood, trees and plants, packaging materials, empty containers, spoils, oils, lubricants, and other similar items. 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;
(ii) Storage areas will be properly fenced off;
(iii) Avoid stockpiling of excess excavated soils;
(iv) Top soil needs to be utilised by farmers for nutrient value;
(v) Coordinate with DSC-PIU for beneficial uses of excess excavated soils or immediately dispose to designated areas;
(vi) Recover used oil and lubricants and reuse or remove from the sites;
(vii) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas for improvement of aesthetic environment;
(viii) Remove all wreckage, rubbish, or temporary structures which are no longer required; and
(ix) Request DSC or PIU to report in writing that the necessary environmental restoration work has been adequately performed before acceptance of work.

191. Preliminary estimates indicate, overburden earth quantity (including road dismantling)
(i) For rising mains DI K9 pipes: 4,909 m^3
(ii) Road Dismantling quantity: 2874 m^3

Total waste- excavated earth & dismantling waste: 7783 m^3. Excess earth after testing will be generally utilized for landfilling at water reservoir sites or will be disposed at low lying area after taking permission from GMC.

192. **Surface and Groundwater Quality.** Another physical impact that is often associated with excavation is the effect on drainage and the local water table if groundwater and surface water collect in the voids. To ensure that water will not pond in pits and voids near subproject location, the construction contractor will be required to conduct excavation works on non-monsoon season.

193. **Ecological resources –Terrestrial.** Felling of the trees (if any) will affect terrestrial ecological balance. Following mitigation measures will be applied,

- Minimize removal of vegetation and disallow cutting of trees if any at reservoir sites.

- Minimize removal of vegetation and disallow cutting of trees as far as possible through design modification particularly at Dandibagh
- If tree-removal will be required, obtain tree-cutting permit or NOC from concerned agency;
- Require to plant three (3) native trees for every one (1) that is removed; and
- Prohibit employees from poaching wildlife, bird hunting, and cutting of trees for firewood.
- Non removal of trees of religious importance.

194. **Traffic & Accessibility.** Hauling of construction materials and operation of equipment on-site can cause traffic problems. Road safety concerns due to slow moving construction vehicles are also an impact. Traffic flow within the vicinity will be affected. The temporary road closure will result in a decrease in overall network performance in terms of queuing delay, travel times or speeds. Also, pedestrian movements will be affected by the temporary road closure or traffic diversion.

195. Potential impact is negative but short term and reversible by mitigation measures. The construction contractor will be required to:

(i) Plan transportation routes so that heavy 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 Govt. Traffic Department for temporary road diversions and with for provision of traffic aids if transportation activities cannot be avoided during peak hours; and
(vii) Notify affected sensitive receptors by providing sign boards informing nature and duration of construction works and contact numbers for concerns or complaints.

196. Sample Traffic Management Plan is attached as **Appendix 10.**

197. **Social, Socio-Economic Including Income.** The subproject components will be located in Government land. Construction works will impede the access of residents to specific site in limited cases. The potential impacts are negative and moderate but short-term and temporary. The construction contractor will be required to:

(i) Contractor's activities and movement of staff to be restricted to designated construction areas.
(ii) Conduct of the construction staff when dealing with the public or other stakeholders shall be in a manner that is polite and courteous at all times.
(iii) Leave spaces for access between mounds of soil;
(iv) Provide walkways and metal sheets where required to maintain access across for people and vehicles;
(v) Increase workforce in front of critical areas such as institutions, place of worship, business establishment, hospitals, and schools;
(vi) Consult businesses and institutions regarding operating hours and factoring this in work schedules; and
(vii) Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns or complaints.

(viii) Contractor shall submit to Engineer the confirmation obtained from the business or shop owner that such access was provided during project execution on the specified format titled “Confirmation from Operator of Commercial establishment or shop for provision of temporary Access by Contactor”. This format is appended as **Appendix 11**.
(ix) Lighting on the construction site shall be pointed downwards and away from oncoming traffic and nearby houses.
(x) The site must be kept clean to minimize the visual impact of the site.
(xi) Notice of particularly noisy activities must be given to residents or businesses adjacent to the construction site. Examples of these include:
  a. noise generated by jackhammers, diesel generator sets, excavators, etc.
  b. drilling
  c. dewatering pumps
(xii) Noisy activities must be restricted to the times given in the Project Specification or General Conditions of Contract
(xiii) A complaints register (refer to the Grievance Redressal Mechanism) shall be housed at the site office.

198. **Socio-Economic – Employment.** Manpower will be required during the 18-months construction stage. 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 within the 2-km immediate area if manpower is available; and
(ii) Secure construction materials from local market.

199. **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. World bank Environmental, Health, and Safety (EHS) Guidelines - EHS Guidelines for water & sanitation will be followed (http://www.ifc.org/wps/wcm/connect/e22c050048855ae0875cd76a6515bb18/Final%2B-%2BWater%2Band%2BSanitation.pdf?MOD=AJPERE). The construction contractor will be required to:

(i) Designate a safeguard focal person and undertake safeguards orientation by PMC or DSC
(ii) Develop and implement site-specific Health and Safety (H and S) Plan which will include measures such as: (a) excluding public from the site; (b) ensuring all workers are provided with and use Personal Protective Equipment; (c) H & S Training[15] for all site personnel; (d) documented procedures to be followed for all site activities; and (e) documentation of work-related accidents (approval will be required from PMC before implementation;

[15] 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.

(iii) Strict compliance of H&S plan and requirements of wearing personal protective equipment (PPE) during work hours;
(iv) Provide specific guidance for suitable PPE for every on-site work assignment.
(v) Ensure that qualified first aid can be provided at all times. Equipped first-aid stations shall be easily accessible throughout the site;
(vi) Provide medical insurance coverage for workers;
(vii) Secure all installations from unauthorized intrusion and accident risks;
(viii) Provide supplies of potable drinking water;
(ix) Provide clean eating areas where workers are not exposed to hazardous or noxious substances;
(x) 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;
(xi) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitors do not enter hazard areas unescorted;
(xii) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas;
(xiii) Ensure moving equipment is outfitted with audible back-up alarms;
(xiv) 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
(xv) 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.

200. There should be official notification related to penalties for non-compliance of safety issues.

201. **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 at isolated area, hence health and safety risk to community is minimum. Potential impact is negative but short-term and reversible by mitigation measures. The construction contractor will be required to:

(i) Plan routes to avoid times of peak-pedestrian activities.
(ii) Liaise with DSC- PIU in identifying risk areas on route cards or maps.
(iii) Maintain regularly the vehicles and use of manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.
(iv) Provide road signs and flag persons to warn of dangerous conditions, in case of location near the road.
(v) Provide protective fencing around open trenches, and cover any open trench with metal planks during non-construction hours.

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

(i) Consult with DSC-PIU before locating project offices, sheds, and construction plants;
(ii) Minimize removal of vegetation and disallow cutting of trees;
(iii) Provide water and sanitation facilities for employees;
(iv) Prohibit employees from poaching wildlife and cutting of trees for firewood;
(v) Train employees in the storage and handling of materials which can potentially cause soil contamination;
(vi) Recover used oil and lubricants and reuse or remove from the site;
(vii) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas;
(viii) Remove all wreckage, rubbish, or temporary structures which are no longer required; and
(ix) Request DSC to report in writing that the camp has been vacated and restored to pre-project conditions before acceptance of work.

203. **Social and Cultural Resources.** For this subproject, excavation will occur at specific isolated location and along the roads, so it could be that there is a moderate risk of such impacts. Nevertheless, the construction contractor will be required to:

(i) Strictly follow the protocol for chance finds in any excavation work;
(ii) Request DSC- PIU or any authorized person with archaeological/historical field training to observe excavation; and
(iii) Stop work immediately to allow further investigation if any finds are suspected; State Department of Archaeology will be contacted if any heritage resources or objects, defined in the Act, be discovered and all activities will be ceased until further notice.

C. Operation and Maintenance Phase

1. Screening out areas of no significant impact

204. Because a water supply system should operate without the need for major repair and maintenance, there are several environmental sectors, which should be unaffected once the system begins to function. These are identified in **Table 21** below, with an explanation of the reasoning in each case. These factors are thus screened out of the impact assessment and will not be mentioned further.

Table 21: Fields in which Operation and Maintenance of the Water Supply Component is Not Expected to have Significant Impacts

Field	Rationale
Climate	No impact expected
Wildlife, forests, rare species, protected areas	There are no wildlife, forests, rare species, and protected areas.
Coastal resources	Gaya is not located in a coastal area.
Industries	The water supplied by the new system will not be for industrial use

2. Operation and Maintenance of the Improved Water Supply System

205. O&M of the water supply system will be the responsibility of GMC. A small number of people will be employed to operate and maintain the tube well, reservoir and pipelines. GMC will employ local contractors to conduct repairs, and contractors should be required to operate the same kinds of Health and Safety procedures as used in the construction phase to protect workers and the public.

206. 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 pumps and other equipment in working order. The stability and integrity of the system will be monitored periodically to detect any problems and allow remedial action if required. Any repairs will be small-scale involving manual, temporary, and short-term works involving regular checking and recording of performance for signs of deterioration, servicing and replacement of parts.

207. The main O&M activities of the refurbished infrastructure will be detection and repair of leaks and pipe bursts. These are, however, likely to be minimal as proper design and selection of good quality pipe material should mean that leaks are minimal. Leak repair work will be similar to the pipe laying work as earlier explained. Trenches will be dug to reveal the leaking area; pipe will be removed and replaced if necessary.

3. Anticipated Environmental Impacts and Mitigation Measures

208. **General.** If trenches are will be dug to locate and repair leaks or remove and replace lengths of pipe or illegal connections, the work will follow the same procedures during the construction stage. GMC 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.

209. **Water source sustainability – water quantity and quality**. Construction of new tube wells and abstraction of excess water will affect water reserve at Gaya. Possible impacts on,

(i) Over-exploitation of aquifer – depletion of water reserve
(ii) Sand quarrying: reduction of available aquifer thickness
(iii) Contamination of aquifer by wastewater.
(iv) Sand quarrying: contamination by accidental fuel and lubricant spills of equipment.

Mitigation measures

(i) Mitigated during design- pre construction phase
(ii) Continuous monitoring water level and quality through observation well
(iii) Prohibit sand mining in designated zones around wells.

210. **Health & safety issues.** Adverse impacts on the appearance of surrounding environment and exposure of workers to hazardous debris. Improvement of water supply system is expected to significantly enhance the quantity and quality of the supplied water. Reduction in leakages will ensure adequate supply of potable drinking water minimizing contamination risks with corresponding reduction in health risks to the citizens.

211. Mitigation measure include, Follow World bank EHS guidelines during operation phase

(i) Undertake regular monitoring and maintenance of water supply infrastructure.
(ii) Regular chemical & biological testing of tube well (groundwater) from supply sites. Parameters are as per Indian standard
(iii) Sewage water will be treated in STP before discharge into environment, which will protect environment

212. **Storage of Common salt as chemical used in water treatment at tube well site.** The impact associated with loss of chemical due to poor storage. Mitigation measures include:

(i) Storage should be in dry place
(ii) Storage should be minimum
(iii) Material safety data sheet to be maintained at chlorine and common salt storage area
(iv) Regular laboratory testing for dosing and residual chlorine
(v) Chlorination in water will be done as per CPHEEO manual and ensure residual chlorine within permissible limit.
(vi) Trained workers will be depute for selected dosage of chlorine to be added in the water supply

213. **Ecological Resources.** There are no significant ecological resources in or around the city as well as project location, so any repairs or maintenance work can be conducted without ecological impacts.

214. **Economic Development.** There are no major anticipated economic development impacts during O and M of the facilities. Nevertheless GMC needs to require its O and M contractor to:

(i) Inform all residents, businesses and sensitive receptors about the nature and duration of any work well in advance so that they can make preparations if necessary;
(ii) Consult city authorities regarding any such work so that it can be planned to avoid traffic disruption as far as possible, and road diversions can be organized if necessary.

215. The provision of an improved and expanded water supply system is not expected to have direct economic benefits for business or industry, as connections will only be provided to domestic users. However, businesses will almost certainly benefit from the expected improvement in the health and well-being of their workforce as this should result in fewer days lost through illness, and overall increased productivity.

216. **Social and Cultural Resources**. Although there is a medium risk of excavation in the city discovering material of historical or archaeological importance, there will be no need to take precautions to protect such material when areas are excavated to repair.

217. Repair works could cause some temporary disruption of activities at locations of social and cultural importance such as schools, hospitals, temples, tourist sites etc, so the same precautions as employed during the construction period should be adopted. GMC needs to require its O & M contractor to:

(i) Consult the city authorities to 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 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.

218. The citizens of the Gaya city 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 subproject will improve the over-all health condition of the town as diseases of poor sanitation (such as diarrhea and dysentery) will be reduced.

219. **Aesthetics, Landscape character and Sense of Place**. The subproject is considered compatible with the surrounding landscape and is not likely to impact negatively on the existing visual quality or landscape character of the area; rather it is expected to improve the general environment through adequate supply of potable water in the subproject area.

Mitigation measures:
(i) The new Tube well proposed to be constructed under this subproject will be similar in construction and design to existing Tube well in and around
(ii) Monitor housekeeping, littering and illegal dumping.

220. **Appendix 12** depicts Indian Standards for Drinking Water - Specification (Bureau of Indian Standard, BIS 10500: 2012). The standard indicates desirable and permissible limit of drinking water under Indian condition.

D. Cumulative Environmental Impacts

221. As per present scope of work construction of new tube wells, construction of new CWR & GLSR and laying of new rising mains will ensure adequate supply of potable water to the water deficient areas and low-pressure area. Also water loss will be checked through development of the project, which will save energy. The proposal for additional utilization of water reserve is related to water sustainability for future use. All sort of positive and negative impact has been studied to achieve the goals of a good urban water supply system. Cumulative impact is positive, which involves development of the city with better water supply system. At the same time there will also be reduce the health risks associated with contamination of water due to leakages in water supply pipelines. Metering of connections shall substantially reduce the non-revenue water losses in the selected areas, which is also treated as positive cumulative impact towards development of a city.

222. **Table 22** presents the cumulative impacts, which are impacts that result from the incremental impact of the subproject activity on a common resource when added to the impacts of other past, present, or reasonably foreseeable future activities. Cumulative impacts are identified, predicted in the same level of detail as the impacts discussed above.

E. Assessment of No-Go (No Build) Option

223. **Table 23** outlines potential impacts associated with the “No-Go” option. The No-Go option involves no additional commitment of resources. Choosing the No-Go option has the same effect as if the decision never occurred.

Table 22: Summary of Anticipated Potential Cumulative Environmental Impacts

Environmental Aspect	Summary of Implications and Mitigation	
	Potential Impacts	**Mitigation**
Significant enhancement in water production and storage facilities (only as additional after GWSP1)	• Construction of new tube well, storage facility and transmission of water shall ensure adequate supply of potable water to support projected requirement	• Refer to tables above
Sustainable water source impact	• Over exploitation of the Phalgu aquifer – resulting land subsidence and un-sustainability of water availability • Contamination of water source by untreated wastewater.	• Refer to tables above (Mitigated in design phase)
Land use	• It is expected that improvement in the water supply system of the water deficient areas will act as a catalyst for overall development of the area.	• Refer to tables above

Table 23: Summary of Anticipated Potential Environmental Impacts of the No Build Options

Environmental Aspect	Summary of Implications and Mitigation	
	Potential Impacts	**Mitigation**
Climate	• No obvious impacts	• n/a
Air Quality	• Will remain the same • No impacts on sensitive receptors during construction	• None
Geology	• No obvious impacts	• n/a
Drainage and hydrology	• No obvious impacts	• n/a
Land Use	• The water deficient areas shall continue facing the same impacts and their development shall be hindered.	• None
Traffic	• No obvious impact	• n/a
Health and Safety	• Subproject areas will continue facing health risks owing to degradation in water quality due to leakages in pipelines and storage reservoirs	• None
Noise and dust Pollution	• Noise and dust pollution will remain the same. • No impacts on sensitive receptors during construction.	• None
Aesthetics, Landscape Character and sense of place	• Likely to deteriorate as sanitation of the area depends largely on availability of water supply.	• None

VI. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

A. Project Stakeholders

224. The primary stakeholders are:

(i) Residents, shopkeepers and businesspeople who live and work alongside the roads in which improvements will be provided and near sites where facilities will be built;
(ii) Custodians and users of socially and culturally important buildings in affected areas;
(iii) State and local authorities responsible for the protection and conservation of archaeological relics, historical sites and artifacts; and

225. The secondary stakeholders are:

(i) UDHD as the executing agency and BUIDCo as implementation agency;
(ii) Other government institutions whose remit includes areas or issues affected by the subproject (state and local planning authorities such as PHED, GMC);
(iii) Forest Department, ASI, State Archeological Department;
(iv) NGOs and CBOs working in the affected communities;
(v) Other community representatives (prominent citizens, religious leaders, elders, women's groups);
(vi) The beneficiary community in general; and
(vii) ADB, Government of India, State Government of Bihar and Ministry of Finance.

B. Public participation during the preparation of the IEE

226. The public participation process included: (i) identifying interested and affected parties (stakeholders); (ii) informing and providing the stakeholders with sufficient background and technical information regarding the proposed development; (iii) creating opportunities and mechanisms whereby they can participate and raise their viewpoints (issues, comments and concerns) with regard to the proposed development; (iv) giving the stakeholders feedback on process findings and recommendations; and (v) ensuring compliance to process requirements with regard to environmental and related legislations.

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

(i) Local communities, individuals affected and owners and employees of affected commercial establishments who are directly or indirectly affected were given priority while conducting public consultation.
(ii) Walk-through and informal group consultations in the proposed subproject area.
(iii) The local communities had been informed through public consultation about the project and its benefits.
(iv) The environmental concerns and suggestions made by the participants were listed and discussed. The suggestions were incorporated in the EMP.

228. Different techniques of consultation with stakeholders were used during project preparation (interviews, official meeting, public meetings, etc). Questionnaire was designed and environmental information was collected. Apart from this, a series of public consultation meetings were conducted during the subproject preparation. Various forms of public consultations (consultation through adhoc discussions on site) have been used to discuss the

subproject and involve the community in planning the subproject design and mitigation measures.

229. **Table 24** shows the persons consulted during preparation of IEE, including the information and issues discussed.

Table 24: List of Official person consulted during preparation of IEE

S.N.	Name	Designation	Place	Date	Issue Discuss	Remarks
1.	Mr. S. N. Jaiswal	Dy. Analyst	Pollution Control Board, Patna, Bihar	02.01.2014	Secondary/ published Data of Air, Water, Noise for Gaya	Water and Air data provided
2.	Mr. A. K Srivastava	Water Lab Incharge	Pollution Control Board, Patna, Bihar	02.01.2014	Water Quality Data for Gaya	Dandibagh ground Water Data Received. Understanding of contamination of ground water.
3.	Mr. Arun Kumar	Air Lab In-charge	Pollution Control Board, Patna, Bihar	02.01.2014	Air quality Data for Gaya	Air Data received. Understanding air pollution status
4.	Mr. Dipak Kumar	Executive Engineer	Gaya Municipal Corporation	09.01.2014	About the pipeline which was laid down by Kriloskar and regarding advantage of proposed project	Information on present status of pipeline as laid down by Kirloskar
5.	Mr. Sailendra Kumar	Chemist	PHED, Gaya	13.11.2013	Groundwater quality	Collection of Ground Water Data
6.	Mr. K. P. Sharma	Retd. Executive Engineer	SPUR	09.01.2014	About the existing water supply system and water quality. Discussed specifically about Ward 53	Existing water supply information map data provided
7.	Mr. T.P. Sharma	Retd. Ex. En	SPUR	09.01.2014	About the existing water supply system and water quality. Discussed specifically about Ward 53	Existing water supply information map data provided

230. Further consultations have been carried out particularly for the GWSP2 subproject. These consultations are listed in **Table 25** below.

Table 25: Official Consultation at Gaya 07.07.2014 to 11.07.2014

S.N.	Name	Designation	Discussion
1	Uchit Prasad Singh,	Horticulture Inspector	Flora ,Fauna
2	D. Pal	Plant protection Supervisor	Bio fertilizer, Pesticide, Insecticide contamination of river
3	Rakesh Kumar	Plant protection Supervisor	Bio fertilizer, Pesticide, Insecticide contamination of river
4	Jitendra Prasad Singh	Cashier -Tube well Div	Tube well at Phalgu River Bed
5	Sohail Ahmed Ansari	Assistant Eng'g-Irrigation Dept.	Existing and proposed irrigation scheme near phalgu river bed, Water Harvesting Scheme
6	Laxmikant Choudhary	Minor Irrigation Dept –	Scheme of Minor Irrigation Dept.

S.N.	Name	Designation	Discussion
		Assistant Engineer	
7	City Manager	GMC	Solid Waste management, Sewerage, Drainage
8	Adil Husain	Sr. Engg Bodh gaya Nagar Panchayat	Water supply, Sewerage, Drainage, Solid Waste management, Sand Mining
9	Mr. Amit	IT Manager, Bodhgaya Nagar Panchayat	Discussion on availability of infrastructure facility at Bodhgaya
10	Sanjay Kumar Lal	Executive Officer, Bodh Gaya	Discussion on availability of infrastructure facility at Bodhgaya
11	Praveen Sharma	Jindal Water Infra, Marketing Officer	Water Supply, Bodhgaya
12	Suresh Prasad	Operator, Military Engg	Water supply Bodhgaya
13	Rajnikant Misra	Farmer, Bhojubigha	Soil, Agriculture, Water level of River Bed, Pesticide, Fertilizer
14	New Upkar Beez Bhandar, Bodh Gaya		Pesticide Used
15	Kamaleshwar Rajak	Assistant Director, Mining	Mining in Phalgu River
16	Biswajit Dan	Dy. Director, Mining	
17	Ajay Kumar Sinha	Clerk, Forest Department	Flora and Fauna
18	Sudama Mahto	Distt AG Officer	Pesticide, Fertilizer, Flora and fauna

231. Discussions were also held with the local people during site visits. Issues discussed are:

(i) Awareness and extent of knowledge about the subproject.
(ii) Information on the benefits of the subproject in terms of economic and environmental enhancement.
(iii) Information on perceived losses from the proposed subproject during execution stage in terms of temporary disturbance like loss of access to residences, commercial establishments or shops, institutions, etc., traffic problem and increase in air and noise pollution, etc. during construction.
(iv) Drinking water and other problems encountered, if any.
(v) Necessity of tree felling, etc. at project sites.
(vi) Labor availability in the project area or requirement of outside labor involvement.
(vii) Presence of any historical or cultural site in the vicinity.
(viii) Presence of any protected area or wetland in or adjoining the construction site.
(ix) Information on economic development in terms of creation of an important urban facility and generation of direct employment during the execution of the subproject.

232. Public consultations and group discussion meetings were conducted by PMC and PMU during 9 to 11 January 2014, 5 to 6 February 2015, 23 February 2015 and 6 March 2015 at Gaya. The objectives were to appraise the stakeholders about the program's objectives and safeguard issues. These consultations are discussed in GWSP1 subproject IEE. Three more local level consultations were carried out on 19 August 2015, 31 August 2015, and 01 September 2015. Minutes of these most recent local level consultations are attached as **Appendix 13.** The issues and comments have been considered and incorporated in the design of the subproject and mitigation measures for the potential environmental impacts raised during

the public consultations.

C. Future Consultation and Disclosure

233. BUIDCo extended and expanded the consultation and disclosure process significantly during implementation of BUDIP. It is in the process of appointing an experienced NGO to handle this key aspect of the program. The NGO will continuously (i) conduct a wide range of activities in relation to all subprojects in the city; and (ii) ensure that the needs and concerns of stakeholders are registered and are addressed in the proposed subproject design.

234. For this subproject, the NGO or Public Relationship and Community Development Specialist will develop, in close coordination with PMU and safeguard specialists of PMC, a public consultation and disclosure program which is likely to include the following:

(i) Consultation during detailed design:
   (a) Focus-group discussions with affected persons and other stakeholders (including women's groups, NGOs and CBOs) to hear their views and concerns, so that these can be addressed in subproject design where necessary; and
   (b) Structured consultation meetings with the institutional stakeholders (government bodies and NGOs) to discuss and approve key aspects of the project.

(ii) Consultation before start of construction activity:
   (a) Public meetings with affected communities (if any) to discuss and plan work program and allow issues to be raised and addressed once construction has started; and
   (b) 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;

(iii) Project disclosure
   (a) Communications strategy is of vital importance in terms of accommodating traffic during road closure, if any. Local communities will be continuously consulted regarding location of construction camps, access and hauling routes and other likely disturbances during construction. The road closure, if any, together with the proposed detours will be communicated via advertising, pamphlets, road signages, etc. Public information campaigns via newspaper or radio or TV, etc. wherever required, to explain the subproject details to a wider population. Public disclosure meetings at key project stages to inform the public of progress and future plans.

235. For the benefit of the community, the summary of IEE will be translated in the local language and made available at: (i) BUIDCo office; (ii) District Magistrate Office; and, (iii) PIU or GMC. It will be ensured that the hard copies of IEE are kept at such places, which are conveniently accessible to citizens. Electronic version of the IEE will be placed in the official website of BUIDCo and the official website of ADB after approval of the IEE by ADB. The PIU will issue Notification on the start date of implementation of the subproject. The notice will be issued by the PIU in local newspapers one month ahead of the implementation works.

236. Information, Education and Communication (IEC) materials for the sub project will be developed using mass-media techniques. Design of the systems and delivery of the messages will be responsibility of the NGO in consultation with the PMU or PMC. The process will include:

(i) Preparing education and awareness materials such as posters, billboards and streamers for community display;
(ii) Developing Leaflets and stickers for general awareness of all community members;
(iii) Television spots or messages of about 30 seconds duration;
(iv) Discuss with the PR team at PMU or PMC on the 'key messages' to be disseminated (indicated in table below);
(v) Videos;
(vi) Newspaper advertisements; and
(vii) Any other suitable modern techniques.

Key Messages to Specific Target Groups		
Sl.No.	Target Group	Key Message
1	All Citizens	○ Good citizens are those who pay bills on time, have legal connection, & avoid water wastage. ○ Only good citizens can demand good services.
2	Slum Dwellers	○ Safe storage of water; seek individual HH Legal connections.
3	Middle/Upper Class	○ Pay bills on time; give up illegal connections.
4	Business Centers, Councilors	○ Discourage illegal connections; exhort to pay bill on time; ○ Participate in planning process by ULB & PHED.
5	Municipal Officers/ Municipal Supervisors/ Workers	○ Support to water supply project, PHED to facilitate improved services; ○ Communicate link between improper services & water or vector borne diseases.
6	Water Supply Dept. Workers, PHED Staffs	○ Support to water supply project; ○ Good water services means better work environment; ○ To meet with the state level norms
7	Media	○ Good water services are good for families; it attracts more business & industry
8	School Teachers / Students	○ Clean water means healthier lives & better education.

VII. GRIEVANCE REDRESSAL MECHANISM

237. The GRM will provide an accessible platform for receiving and facilitating resolution of affected persons' grievances related to the Program. A common grievance redress mechanism (GRM) will be in place for social, environmental or any other Project/sub-project related grievances; each Resettlement Plan (RP), Indigenous People Plan (IPP), and Initial Environment Examination (IEE)/ Environmental Impact Assessment (EIA) will follow the grievance redress mechanism described below.

238. **Grievance Redress Process:** Grievances or suggestions of APs can be dropped in suggestion boxes or conveyed through phone or mail (Sample Format attached). The Community Liaison Officer (CLO) of the implementing NGO or Safeguard Officer of PIU (who deals with social issues and RP implementation) will be responsible for conducting periodic

community meetings with affected communities to understand their concerns and help them through the process of grievance redressal (including translation from local dialect/language, recording and registering grievances of non-literate APs and explaining the process of grievance redressal).

239. Grievances will first be registered at the Complaints Cell[16] of the implementing NGO/PIU, who will resolve smaller issues and in case of not resolved issues it will go to PMU. Safeguard officer and for larger issues, consult/seek the assistance of the BUIDCo. Grievances not redressed through this process within one month of registration will be brought to the notice of the Town Level Committee/City Level Committees (CLC) set up to monitor project implementation in each town/city. As a Grievance Redressal Committee, the town level committee will meet the pending issues (if there are pending, registered grievances), determine the merit of each grievance, and resolve grievances within a month of receiving the complaint—failing which the grievance will be addressed by the state-level Program Steering Committee (PSC)[17]. Further grievances will be referred by APs to the appropriate courts of law. The grievance redress process is shown in **Figure 21**. The GRCs will continue to function throughout the project duration.

240. The maximum time period of 30 days of redressing grievances at the project level will include the following specific actions and timeframes based on the date of receipt of the complaint or grievance: (i) acknowledge the letter of complaint or grievance within 5 days; (ii) issue a notice of meeting to the GRM panel within 10 days; (iii) hold GRM panel meeting and agree on a decision within 15 days; (iv) issue the decision within 20 days; (v) meet with the complainant to deliver the decision within 27 days; and (vi) allow complainant to respond within 3 days from receipt of the decision.

241. **Composition of GRC and PSC:** The Town level committee and Steering committee formed for ADB project will act in Grievance Redressal Mechanism for resolving the issues on town and state level. In Steering Committee, members are Development Commissioner; Principal Secretary, Finance; Principal Secretary, Planning and Development; and Principal Secretary, Urban Development and Housing and Managing Director ,BUIDCo.

242. **Areas of Jurisdiction:** The areas of jurisdiction of the GRC–headed by the District Magistrate will be (a) all locations/sites within the district where sub-project facilities are proposed, or (b) their areas of influence within the District.

243. The PSC shall have jurisdictional authority across the State (i.e., areas of influence of sub-project facilities beyond district boundaries, if any).

244. A maximum time period of 90 days is allocated for project level grievance redress,60 days for the GRC/CLC and 90 days for the PSC, in BUIDCo's resolution on project grievance redress process dated 27 May 2015.

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[16] Complaints Cells to be established at the ULB/PIU office or in a location easily accessible to affected communities (e.g. fishing community / riverbank communities)

[17] Grievances pertaining to broader concerns related to the program/sub-project, i.e., those not necessarily confined to the city/district shall be directly forwarded to the PSC if received at the city-level Complaints Cell. There will be a Grievance Registration/Complaints Cell at PMU office (state-level) as well, which will evaluate the area of jurisdiction of a particular grievance and either advise the NGO/PIU on resolution or forward it to GRC for resolution.

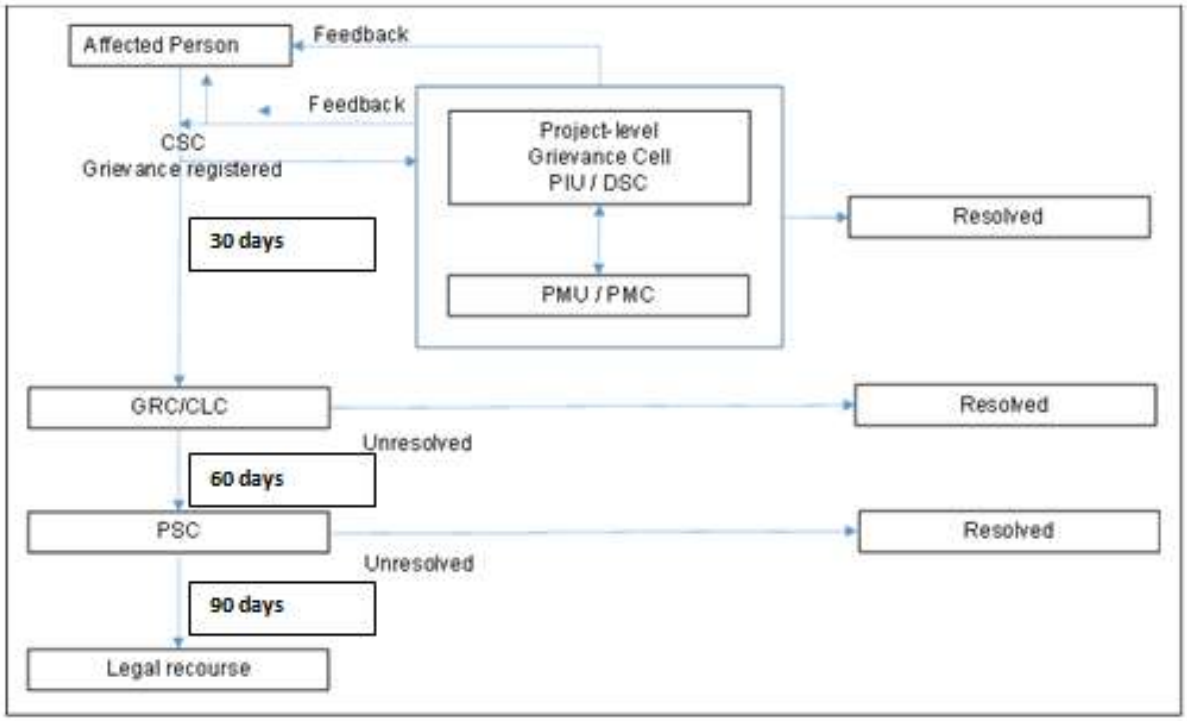


Figure 21: Grievance Redress Mechanism Process

CLC- City Level Committee, ESMC-Environment and Social Management Coordinator, GRC- Grievance Redress Committee, NGO-Non Government Organization, PSC-Program Steering Committee

245. **Consultation Arrangements:** This will include (a) group meetings and discussions with APs, to be announced in advance and conducted at the time of day agreed on with APs (based on their availability) and conducted by the Community Liaison Officer (CLO) of the implementing NGO and PIU-PMU at least quarterly in the first year and half-yearly in subsequent years of RP implementation to address general/common grievances; and (b) availability of CLO of Implementing NGO and Environment and Social Management Coordinator of PMU on a fixed day of every fortnight (as required, based on the number of grievances) for one-to-one consultations. The Implementing NGO will be responsible for ensuring that non-literate APs/ vulnerable APs are assisted to understand the grievance redress process, to register complaints and with follow-up actions at different stages in the process. Records will be kept by the PIU/PMU of all grievances received including contact details of complainant, date the complaint was received, nature of grievance, agreed corrective actions and the date these were effected, and final outcome.

246. **Information Dissemination Methods of the GRM:** The Implementing NGO and PIU shall be responsible for information dissemination to APs on grievance redressal procedure, who to contact and when, where/how to register grievance, various stages of grievance redress process, time likely to be taken for redressal of minor and major grievances etc. A Sample Grievance Registration Form has been attached in **Appendix 14.**

247. **Costs:** All costs involved in resolving the complaints (meetings, consultations, communication and reporting / information dissemination) will be borne by the PMU. Summary statement of community members shown below.

248. **Committee member – Summary**

Level of GRM		Members	Action
1st Tier	***First level (PIU level)***	**1.Project director-PIU, 2.Safeguard officer and 3.Hired NGO**(if issues are related to implementation of Resettlement Plan	Attending Grievances/suggestions of APs and local level smaller environmental/ social issues related to project.
	Second level (PMU level)	**1.Environment & Social Management Coordinator (ESMC), 2.Resettlement Officer and 3.Environmental Engineer**	1.Grievances related to Environmental & Social issues if remain unresolved at PIU level. 2.Members will conduct quarterly meeting at PIU toresolve the issues. 3. Grievances not redressed by ESMC within one month of registration, case will be placed at third level means BUIDCo.
	Third level (BUIDCo level)	1.**MD BUIDCo** (Programme director ADB Project) 2.**Nodal Officer ADB project** (Joint Programme director)	1.Grievances related to larger Environmental & Social issues and need special attention and policy level decision. 2. Grievances not redressed by BUIDCo within one month of registration, case will be placed in Town Committee/CLC/ GRC
2nd Tier		**Town Committee/City Level Committees (CLC)/ Grievance Redress committee (GRC) in each project town** – Town Committee is already formed under ADB project act as CLC/GRC and members are as follows for town committee:- 1.**District Magistrate**(Respective district)-Chairmain 2.**Municipal Commissioner/Executive Officer** (Respective ULBs)-Member Secretary 3**.Executive Engineer**(Respective ULBs) 4.**Line agencies representative**(Respective district) 5.**NGOs/Civil Society** of respective district.	1.Town committee formed for ADB Project will work as City Level Committee or GRC for addressing grievances related to project. 2.Whenever meeting of town committee shall be conducted, pending issues of GRC will be addressed. 3.Letter of Town Committee formed for ADB project is attached as Annexure-1.
3rd Tier		**Steering Committee (SC)** – Members include 1.**Development Commissione, Bihar**-Chairmain; 2.**Principal Secretary, Finance**-Member; 3.**Principal Secretary, Planning and Development**-Member; 4.**Principal Secretary, Urban**	1.Steering Committee is already formed for ADB project (Annexure-2). 2.Grievance will be addressed in the state-level Steering Committee (SC) in case of strong grievances and not resolved in Town Committee/CLC/ GRC.

Level of GRM		Members	Action
		Development and Housing-Member Secretary ,and 5.**MD,BUIDCo** (Programme Director, ADB Project)-Member	

VIII. ENVIRONMENTAL MANAGEMENT PLAN

249. The EMP will guide the environmentally sound construction of the subproject and ensure efficient lines of communication between the DSC (Engineer), contractors, and PIU or PMU or PMC. The EMP identifies three phases of development as: (i) site establishment and preliminary activities; (ii) construction phase; and (iii) post construction or operational phase.

250. The purpose of the EMP is to ensure that the activities are undertaken in a responsible non-detrimental manner with the objectives of: (i) providing a pro-active, 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 subproject; (iii) detailing specific actions deemed necessary to assist in mitigating the environmental impact of the subproject; and (iv) ensuring that safety recommendations are complied with.

251. A copy of the EMP must be kept onsite during the construction period at all times. 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. It shall be noted that the Supreme Court of India[18] mandates that those responsible for environmental damage must pay the repair costs to both the environment and human health and the preventive measures to reduce or prevent further pollution and/or environmental damage. (The polluter pays principle).

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

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

A. Institutional Arrangement

253. The Urban Development and Housing Department (UDHD) of Government of Bihar is the Executing Agency (EA) for the Project, which will receive strategic directions from a state-level Steering Committee. During the course of implementation of the program, ADB and BUIDCo agreed to change the PMU from UDHD to BUIDCo and to merge PMU and PIU since BUIDCo is currently the single window for all national and external assistance to Bihar's urban sector, and manages various urban sector projects. PMU has been headed by MD of

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

BUIDCo, who works closely with and reports to the Principal Secretary of UDHD. UDHD, on the other hand, will implement the institutional reform component under the investment program and coordinate with (i) national and state agencies to resolve any inter-departmental issues, and (ii) BUIDCo and city ULBs for implementation of physical investment activities.

254. The main agencies involved in managing and implementing the subproject are:

(i) UDHD is responsible for management, coordination, and execution of all activities funded under the loan;
(ii) BUIDCo, PMU is responsible for coordinating construction of subprojects across all towns, and for ensuring consistency of approach and performance;
(iii) PMC assists PMU in managing the program and assures technical quality of design and construction;
(iv) DSCs design the infrastructure, manage tendering of Contractors and supervise the construction process;
(v) PIUs appoint and manage the Contractor to design, build and operate elements of the infrastructure in a particular town;
(vi) A Program Steering Committee (PSC)[19] assists UDHD in providing policy guidance and coordination across all towns and subprojects; and
(viii) City/Town Level Committees[20] (C/TLCs) have also been established in each program town or city to monitor project implementation in the town and provide recommendations to the PIU where necessary.

255. **PMU's Role in Safeguards.** The PMU within BUIDCo have an Environmental and Social Management Coordinator (ESMC) who address environmental and social safeguards issues with assistance from Program Management Consultants (PMC). Environment Engineer of PMU will responsible of supervision and management of environment issues related to engineering aspects of the project. The PMC includes an Environmental Specialist and a Social Safeguards Specialist engaged. The ESMC will ensure that the EARF, resettlement framework, and IPPF are followed during subproject implementation as well as the environmental management plan and resettlement plan prepared for different Tranches. The ESMC through the PMC also lead preparation of safeguards documents for future Tranches with inputs from PIU/ DSC.

256. The Environmental and Social Management Coordinator (ESMC) in the PMU will:
(i) coordinate with PIUs' Safeguards Officers for the day-to-day monitoring of subproject implementation
(ii) ensure overall compliance with all government rules and regulations regarding site and environmental clearances, as well as any other environmental requirements (e.g., location clearance certificates, environmental clearance certificates, etc.), as relevant;

[19] PSC: The PSC will include the Minister for Urban Development (Chairperson), State Chief Secretary (Vice Chairperson), and Ministers, Directors and/or representatives of other relevant government ministries and departments, e.g., Finance, Planning, PHED, Roads, BRJP,etc., Mayors of respective municipal corporations and the project director (Member Secretary and Convener) as members.

20 CLC: The CLC, acting as a Grievance Redress Committee (GRC) will have District Magistrate (Chairman), Municipal Commissioner\Executive Officer (Member Secretary), Executive Engineer (Respective ULB), Line Agencies representative (Respective district) and NGO\civil society of respective district.

(iii) confirm existing IEEs are updated based on detailed designs and that new IEEs and EMPs are prepared in accordance with the EARF and subproject selection criteria related to safeguards;
(iv) confirm IEEs are included in bidding documents and civil works contracts;
(v) for DBO contract/s, coordinate with contractor/s in the updating of the draft IEE once detailed design is available;
(vi) provide oversight on environmental management aspects of subprojects and ensure EMPs are implemented by the contractors;
(vii) establish a system to monitor environmental safeguards of the project including monitoring the indicators set out in the monitoring plan of the EMP;
(viii) facilitate and confirm overall compliance with all Government rules and regulations regarding site and environmental clearances as well as any other environmental requirements (e.g., No Objection Certificates, Consent for Establishment, Forest Clearance, Consent for Operations, etc.), as relevant; All necessary environmental clearances should be obtained prior to contract awards to avoid delay in physical progress of relevant subprojects;
(ix) approve contractor's including subcontractor/s site environmental plans (SEPs);[21]
(x) supervise and provide guidance to the contractors to properly carry out the environmental monitoring and assessments as per approved IEEs, EMPs and SEPs;
(xi) review, monitor and evaluate the effectiveness with which the EMPs and SEPs are implemented, and recommend necessary corrective actions to be taken as necessary;
(xii) consolidate monthly environmental monitoring reports from contractors and submit semi-annual monitoring reports to ADB;
(xiii) ensure timely disclosure of final IEEs in locations and form and language accessible to the public and local communities; and
(xiv) address any grievances brought about through the Grievance Redress Mechanism (GRM) in a timely manner;
(xv) ensure adequate measures for climate change adaption and mitigation are incorporated in the detailed engineering design and implementation; and
(xvi) organize an induction course for the contractors covering, including among others, EMP implementation, health and safety, grievance redressal, and community protection.

257. **The Project Management Consultants (PMC)** has an Environmental Specialist (ES) and Resettlement/Social Development Specialist who are responsible for the preparation/ updating of IEE/EIA and RP/IPP reports respectively. The Environment Specialist and Resettlement/Social Development Specialist of PMC will review and finalize all reports in consultation with the ESMC of PMU. The Environmental Specialist (ES) and Resettlement/Social Development Specialist of PMC will submit periodic monitoring and implementation reports to PMU, who will take follow-up actions, if necessary.

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

258. The ESMC of PMU will endorse/submit periodic monitoring reports received from PMC to the Program Director, PMU who will then submit these to ADB. The monitoring report will focus on the progress of implementation of the IEE/EIA and EARF, RP/RF and IPP/IPF, issues encountered and measures adopted, follow-up actions required, if any, as well as the status of compliance with subproject selection criteria, and relevant loan covenants. The PMU will seek clearance from the state government of Bihar for submission and disclosure of the environmental and social monitoring report to ADB.

259. **PIU's Role in Safeguards**. The PIU is primarily tasked with the day-to-day implementation of safeguards plans. PIU field offices in program towns will have a Safeguard Officer who will be responsible for data collection for IEE/EIA and RP/IPP preparation and implementation. PIU field offices will obtain right of way clearances and prepare progress reports with respect to IEE/EIA and RP/IPP implementation. PIU will be responsible for obtaining statutory clearances and obtaining NOCs from government agencies/ other entities and entering into agreements with them for use of their land. It will also co-ordinate for obtaining right of way clearances with related State and National agencies. The Safeguards Officers will:

(i) oversee day-to-day implementation of SEPs by contractors, including contractors' compliance with all government rules and regulations;
(ii) take necessary action for obtaining right of ways;
(iii) approve contractors and subcontractors SEPs;
(iv) supervise implementation of SEPs including environmental monitoring by contractors;
(v) take corrective actions when necessary to ensure no environmental impacts;
(vi) conduct continuous public consultation and awareness;
(vii) address any grievances brought about through the GRM in a timely manner;
(viii) ensure contractors attend safeguards induction course prior to mobilization;
(ix) organize workshops/ seminars on EMP implementation, environmental monitoring requirements related to mitigation measures, and on taking immediate action to remedy unexpected adverse impacts or ineffective mitigation measures found during the course of implementation;
(x) consolidate monthly environmental monitoring reports; and
(xi) Ensure timely disclosure of final IEEs in locations and form accessible to the public.

260. **The Contractor**

This individual/agency:

(i). complies with all applicable legislation, is conversant with the requirements of the EMP, and briefs staff about the requirements of same;

(ii). ensures any sub-contractors/ suppliers, who are utilized within the context of the contract, comply with the environmental requirements of the EMP. The Contractor will be held responsible for non-compliance on their behalf;

(iii). supplies method statements for all activities requiring special attention as specified and/or requested by the Engineer or Environmental Specialist during the duration of the Contract;

(iv). provides environmental awareness training to staff;

(v). bears the costs of any damages/ compensation resulting from non-adherence to the EMP or written site instructions;

(vi). conducts all activities in a manner that minimizes disturbance to directly affected residents and the public in general, and foreseeable impacts on the environment.

(vii). ensures that the Engineer is informed in a timely manner of any foreseeable activities that will require input from the Environmental Specialist

(viii). appoints one full time Environment & Safety Officer for implementation of EMP, community liaison, reporting and grievance redressal on day to day basis.

(ix). receives complaints/grievances from the public, immediately implements the remedial measures and reports to the Engineer (DSC) and PIU within 48 hours.

261. Summary of responsibilities is as follows:

(i) **Responsible for carrying out mitigation measures**

a. During construction and operations stages, implementation of mitigation measures is the Contractor's responsibility.
b. To ensure implementation of mitigation measures during the construction period, contract clauses for environmental provisions will be part of the civil works contracts.
c. Contractors' conformity with contract procedures and specifications during construction will be carefully monitored by the Safeguard Officer of PIU.

(ii) **Responsible for carrying out monitoring measures**

a. During construction, PMC's Environmental Specialist, Biodiversity Expert and the Safeguard Officer of PIU will monitor the Contractor's environmental compliance.
b. During the operation stage, monitoring of the Contractor's environmental compliance will be the responsibility of the PMC and PIU/PMU

(iii) **Responsible for reporting**

a. UDHD (EA)/BUIDCo (PMU- IA) will submit to ADB semi annual reports on implementation of the EMP and will permit ADB to field annual environmental review missions which will review in detail the environmental aspects of the subproject. Any major accidents having serious environmental consequences will be reported immediately.

262. Report format for semi - annual environmental monitoring report is attached as **Appendix 15.**

263. Safeguard implementation arrangement for the program is shown below.

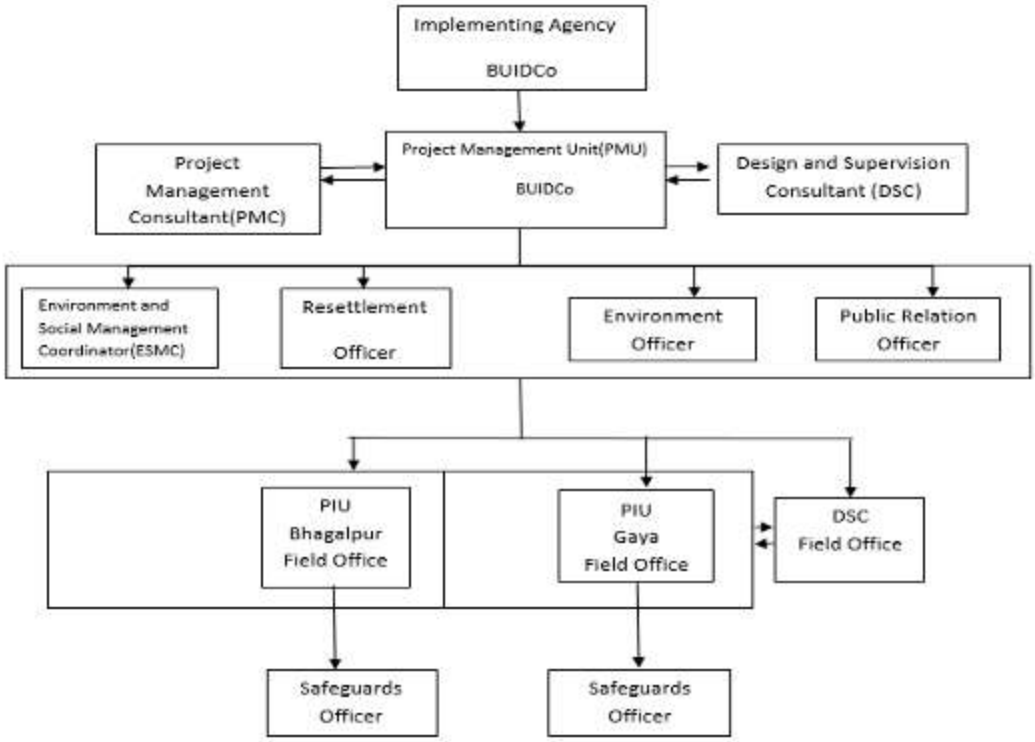


Figure 22: Safeguards Implementation Arrangement

B. Capacity Building

264. Training will be provided to PMU, PIUs and contractors. Typical modules will include: (i) sensitization; (ii) introduction to environment and environmental considerations in water supply projects; (iii) review of IEEs and integration into the project detailed design; and (iv) monitoring and reporting systems. Specific modules customized for the available skill set will be devised after assessing the capabilities of the target participants and the requirements of the program. The contractors will be required to conduct environmental awareness and orientation of workers prior to deployment to work sites.. The proposed training program, along with the frequency of sessions, is presented in **Table 26.**

Table 26: Training Program for Environmental Management

Description	Contents	Schedule	Participants
Pre-construction stage			
Orientation program .	- BUDIP Environmental safeguard requirements - Implementation arrangement -monitoring & reporting -Corrective actions	½ day orientation workshop - at the start of the program	BUIDCo, PMU, and PIU – all senior and mid-level officials and engineers involved in BUDIP

Description	Contents	Schedule	Participants
Training program on EMP implementation & monitoring	Module 1 – Orientation - ADB SPS; - Government of India Environmental Laws and Regulations. Module 2 – Environmental Assessment Process. - Environmental process, identification of impacts and mitigation measures, formulation of an EMP, implementation, and monitoring requirements; - Review & approval of environmental assessment reports Module 3: EMP Implementation, monitoring & reporting - Incorporation of safeguard clauses and EMP in bid and contract documents -Pollution prevention and abatement (IFC EHS Guidelines) -.Monitoring & evaluation - Formulation of corrective action plans (CAP) -Reporting Module 4: Consultation & disclosure - Grievance redress mechanism	2 day training program	PMU & PIUs staff
Construction stage			
Orientation program	- Contractual requirements -Legal & regulatory requirements -EHS requirements -Site Environment Plan (SEP) preparation, EMP implementation and reporting -roles and responsibilities	½ day orientation course to during mobilization	Contractors and PIU, PMC supervising staff
Training program/ workshop for contractors and supervisory staff.	- Environmental issues during construction; - Site specific SEP - EMP Implementation - Day to day monitoring - Periodic ambient monitoring - Reporting -Consultation & grievance redress	1 day workshop immediately after mobilization	Contractors and PIU, PMC supervising staff
Periodic refresher training workshop	Same as above	½ day workshop thrice a year	Contractors and PIU, PMC supervising staff
Stakeholder workshop Experience and best practices sharing.	- Experience of EMP implementation – issues and challenges; - Best practices followed.	½ day workshop Once in a year during implementation	PMU, PIU, and stakeholder agencies PWD, Municipal Corporation, Patna Police

Description	Contents	Schedule	Participants
			etc.,)

265. Environmental Management Plan is prepared for pre construction, construction and post construction stages.

266. **Table 27** outlines the site establishment and preliminary activities.

267. **Table 28** outlines management of construction activities and workforce.

268. **Table 29** outlines the post-construction activities.

Table 27: EMP: Site Establishment and Preliminary Activities - Design phase

Sr. No.	Activity	Management/Mitigation	Responsible for Mitigation /	Responsible for Monitoring and supervision	Frequency
1.	Legislation, permits and agreements	In all instances- covering Environment & Forest, BUIDCo, implementation agency, contractors and consultants must remain in compliance with relevant local and national legislation.	SO- PIU, E- DSC	ES- PMC, ESMC-PMU	Prior to moving onto site and Quarterly during construction
		Proof of compliance to Air Act & Noise Act must be forwarded by the contractor to PMU/PMC/PIU (in relation to hot mixing, batch mix plants, stone crushers, diesel generators, etc. if any)	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	Prior to moving onto site and Quarterly during construction
		NOC from forest Dep. for renovation work, clearance from State Museum & Archaeological Directorate if required	SO-PIU, DSC	ES- PMC, ESMC-PMU	Prior to moving onto site and Quarterly during construction for compliance
		A copy of the EMP must be kept on site during the construction period	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	At all times
2	Water Source Sustainability	Study on availability of quality water from Phalgu river bed For protection of sub surface water source construction of Sewage Treatment Plant (STP) should be taken up and city's waste water will be treated before discharge into the Phalgu river	E- DSC, PMU	ES- PMC, ESMC-PMU	During designing of the project
3	Access to site[22]	Access to site at water storage reservoir and tube well locations will be via existing roads. The Contractor will need to ascertain the existing condition of the roads and repair damage due to construction. Site management plant and alignment of approach road to site needs to be followed	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	Prior to moving onto site and monthly
		The Local Traffic Department must be informed at least a month in advance if the	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	Prior to moving onto site and quarterly

[22] Access to site and traffic management shall be done in accordance to the directions of Engineer

Sr. No.	Activity	Management/Mitigation	Responsible for Mitigation /	Responsible for Monitoring and supervision	Frequency
		traffic in the area will be affected (if any)			
		The location of all affected services must be identified and confirmed.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	Prior to moving onto site and quarterly
		All roads for construction access must be planned and approved by the Engineer and its Environmental Specialist ahead of construction activities. They shall not be created on an ad-hoc basis.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	Prior to moving onto site and during construction - quarterly
		No trees, shrubs or groundcover may be removed or vegetation stripped without the prior permission of the Engineer/Environmental Specialist	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	Before and during construction- semi annually
4	Setting up of construction camp[23]	Choice of site for the Contractor's camp requires the Engineer's/ ES permission and must take into account location of local residents, businesses and existing land uses, including flood zones and slip / unstable zones. A site plan must be submitted to the Engineer for approval.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During surveys and preliminary investigations and prior to moving onto the site
		The construction camp may not be situated on a floodplain or on slopes greater than 1:3 (Horizontal: Vertical ratio). Preferable slope 1:1 (plain land) or !:2 (marginal slope)	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During surveys and preliminary investigations and prior to moving onto the site- quarterly monitoring
		Private land needs to be avoided. If no option NOC from Pvt. party will be required	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site establishment and ongoing – monthly inspections
		In most cases, on-site accommodation will not be required. The construction camp can thus be comprised of: • site office • designated first aid area • separate eating areas	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During set-up and monthly

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

Sr. No.	Activity	Management/Mitigation	Responsible for Mitigation /	Responsible for Monitoring and supervision	Frequency
		• storage areas • batching plant (if required) • refueling areas (if required) • maintenance areas (if required) • crushers (if required)			
		The camp must be properly fenced and secured	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site establishment and ongoing –monthly inspections
		The Contractor shall make adequate provision for temporary toilets (gender specific) for the use of their employees during the Construction Phase. Such facilities, which shall comply with local authority regulations, shall be maintained in a clean and hygienic condition. Their use shall be strictly enforced.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site establishment and ongoing – weekly inspections
		Bins shall be provided at convenient intervals for disposal of waste within the construction camp.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site set-up and ongoing- weekly
5.	Establishing equipment lay-down and storage area[24]	Choice of location for equipment lay-down and storage areas must take into account distances to adjacent land uses, general onsite topography and water erosion potential of the soil. Impervious surfaces must be provided where necessary.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site set-up
		Storage areas shall be secured so as to minimize the risk of crime. They shall also be safe from access by children / animals etc.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site set-up and monthly
		Residents living adjacent to the construction site must be notified of the existence of the hazardous storage area.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site set-up and monthly
		Equipment lay-down and Storage areas must be designated, demarcated and	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site set-up and monthly

[24] Storage areas can be hazardous and unsightly and can cause environmental pollution if not designed and managed carefully.

Sr. No.	Activity	Management/Mitigation	Responsible for Mitigation /	Responsible for Monitoring and supervision	Frequency
		fenced if necessary.			
		Fire prevention facilities must be present at all storage facilities.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site set-up and monthly
		Proper storage facilities for the storage of oils, paints, grease, fuels, chemicals and any hazardous materials to be used must be provided to prevent the migration of spillage into the ground and groundwater regime around the temporary storage areas.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site set-up and monthly
		These storage facilities (including any tanks) must be on an impermeable surface that is protected from the ingress of storm water from surrounding areas in order to ensure that accidental spillage does not pollute local soil or water resources.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site set-up and monthly
		Fuel tanks must meet relevant specifications and be elevated so that leaks may be easily detected.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site set-up and monthly
		Staff dealing with these materials / substances must be aware of their potential impacts and follow the appropriate safety measures.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site set-up and monthly
6.	Materials management – sourcing[25]	Prioritize sites already permitted by the Mining Department	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	On receipt of natural materials
		Contractors shall prepare a source statement indicating the sources of all materials (including sands, natural gravels, crushed stone, asphalt, clay liners, etc), and submit these to the Engineer for approval prior to commencement of any work.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	On award of contract and continued quarterly
		If other sites are necessary, inform	SO-PIU, E- DSC,	ES- PMC, ESMC-	On receipt of natural materials

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

Sr. No.	Activity	Management/Mitigation	Responsible for Mitigation /	Responsible for Monitoring and supervision	Frequency
		construction contractor that it is their responsibility to verify the suitability of all material sources and to obtain the approval of DSC	Contractor	PMU	and continued quarterly
7.	Education of site staff on general and environmental conduct[26]	Ensure that all site personnel have a basic level of environmental awareness training.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During staff induction and ongoing monthly monitoring
		Staff operating equipment (such as excavators, loaders, etc.) shall be adequately trained and sensitized to any potential hazards associated with their task.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During staff induction, followed by ongoing weekly
		All employees must undergo safety training and wear the necessary protective equipments (e.g. helmets, gloves, gumboots, nose mask, and earplugs as per type of work) and clothing.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During staff induction, followed by monthly monitoring
		A general regard for the social and ecological well-being of the site and adjacent areas is expected of the site staff. Workers need to be made aware of the following general rules: • no alcohol/drugs on site; • prevent excessive noise; • construction staff are to make use of the facilities provided for them, as opposed to ad hoc alternatives (e.g. fires for cooking, the use of surrounding bushes as a toilet facility); • no fires permitted on site; • trespassing on private/commercial properties adjoining the site is forbidden; • other than pre-approved security staff,	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During staff induction, followed by ongoing monthly monitoring

[26] These points need to be made clear to all staff on site before the subproject begins.

Sr. No.	Activity	Management/Mitigation	Responsible for Mitigation /	Responsible for Monitoring and supervision	Frequency
		no workers shall be permitted to live on the construction site; and • no worker may be forced to do work that is potentially dangerous or that he/she is not trained to do.			
8.	Social impacts[27]	Open liaison channels shall be established between the contractors and interested and affected parties such that any queries, complaints or suggestions can be dealt with quickly and by the appropriate person(s).	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	Prior to moving onto site and ongoing monthly
		Road closure (if any) together with the proposed detour needs to be communicated via advertising, pamphlets, radio broadcasts, road signage, etc.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU,	Prior to moving onto site and ongoing monthly
		Advance road signage indicating the road detour and alternative routes (if required). Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/ complaints.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU,	Prior to moving onto site and ongoing monthly
		Storage facilities and other temporary structures on site shall be located such that they have as little visual impact on local residents as possible.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU,	During surveys and preliminary investigations and site set-up. Monthly monitoring
9.	Conservation of the natural environment[28]	No vegetation may be cleared without prior permission from the Engineer.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site setup and quarterly
		Trees that are not to be cleared shall be marked beforehand with danger tape. The PIU/ES-PMC /Engineer (DSC) must be given a chance to mark vegetation that is to be conserved before the Contractor	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU,	During site set-up and as per requirement

[27] It is important to take notice of the needs and wishes of those living or working adjacent to the site. Failure to do so can cause disruption to work.
[28] Alien plant encroachment is particularly damaging to natural habitats and is often associated with disturbance to the soil during construction activities. Care must be taken to conserve existing plant and animal life on and surrounding the site.

Sr. No.	Activity	Management/Mitigation	Responsible for Mitigation /	Responsible for Monitoring and supervision	Frequency
		begins clearing the site.			
10	Set-up of waste management procedure	The excavation and use of rubbish pits on site is forbidden.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	Monthly monitoring
		Burning of waste is forbidden.	E- DSC, Contractor	ES- PMC, ESMC-PMU	Monthly monitoring
11	Social and Cultural Resources	(i) Consult Archaeological Survey of India (ASI) or concerned dept. of Tripura 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.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU,	During site set-up and ongoing quarterly
12	Core Labor Standard (CLS)- safety and compliance	Monitoring compliance with national labor laws and regulations, provided that these national laws are consistent with CLS. DSC 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; (b) equal pay for equal work of equal value regardless of gender, ethnicity or caste; and (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.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU,	During site set-up and ongoing quarterly
13	Occupational health	Comply with IFC EHS Guidelines on Occupational Health and Safety- ref.	Contractor	SO-PIU, ES- PMC, ESMC- PMU,	During site set-up and ongoing monthly.

Sr. No.	Activity	Management/Mitigation	Responsible for Mitigation /	Responsible for Monitoring and supervision	Frequency
	&safety	(www.ifc.org/ifcext/enviro.nsf/Content/ Environmental Guidelines) Mitigation measures as mentioned during construction phase to be followed			
14	Security and safety	Lighting on site is to be set out to provide maximum security and to enable easier policing of the site, without creating a visual nuisance to local residents or businesses.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	During site set-up and continued monthly
		Material stockpiles or stacks, such as, pipes must be stable and well secured to avoid collapse and possible injury to site workers / local residents.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	Monthly
		Flammable materials shall be stored as far as possible from adjacent residents / businesses.	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	Monthly
		All interested and affected parties shall be notified in advance of any known potential risks associated with the construction site and the activities on it. Examples are: • stringing of power lines • earthworks / earthmoving machinery on steep slopes above houses / infrastructure • risk to residences along haulage roads / access routes	SO-PIU, E- DSC, Contractor	ES- PMC, ESMC-PMU	Week prior to activity and monthly to be continued

ASI = Archeological Survey of India, BSPCB= Bihar State Pollution Control Board,
DSC: Design and Supervision Consultant, E: Engineer, ES: Environment Specialist**,** ESMC: Environment & Social Management Coordinator, PIU: Project Implementation unit, PMC: Project Management Consultant**,** PMU: Project Management Consultant, SO: Safeguard Officer

Table 28: EMP: Management of Construction and Workforce Activities- Construction phase

	Issues	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
1	Climatic impact	✓ Seasonal climatic variations will be considered during scheduling of	E- DSC, Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Quarterly monitoring

	Issues	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
		construction activities in the area. ✓ Consideration of suitable season (non monsoon /lien period) for major construction activity ✓ Excavations and other clearing activities will only be done during agreed working times and permitted weather conditions. ✓ Storm water control (through drainage, diversion) during construction phase as per the method approved by the Engineer.			
2.	Maintenance of construction camp and work site	The Contractor must monitor and manage drainage of the campsite to avoid standing water and soil erosion.	E- DSC, Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Weekly inspection
		Run-off from the campsite must not discharge into neighbors' properties.	E- DSC, Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Weekly inspection
		Toilets are to be maintained in a clean state and shall be moved to ensure that they adequately service the work areas.	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Weekly inspection
		Drinking water facility needs to be maintained at camp and work site	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Weekly inspection
		The Contractor is to ensure that open areas or the surrounding bushes are not being used as toilet facility.	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Weekly inspection
		The Contractor shall ensure that all litter is collected from the work and camp areas daily.	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Weekly inspection
		Bins shall be emptied regularly and waste shall be disposed of at the pre-approved site.	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Weekly inspection
		Eating areas shall be regularly serviced and cleaned to ensure the highest possible standards of hygiene and cleanliness.	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Weekly inspection
		The Contractor shall ensure that his camp and working areas are kept clean at all times.	E- DSC, Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Weekly monitoring
3.	Staff conduct	The Contractor must monitor the performance of construction workers to ensure that the points relayed during their induction have been properly understood and are being followed.	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Monthly monitoring.
		The rules that are explained in the worker	Contractor	SO-PIU/ ES-PMC,	Monthly monitoring.

	Issues	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
		conduct section, must be followed at all times		ESMC- PMU,	
4.	Dust and air pollution[29]	Consult with DSC/PIU on the designated areas for stockpiling of clay, soils, gravel, and other construction materials	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Monthly monitoring.
		Damp down exposed soil and any stockpiled on site by spraying with water when necessary during dry weather	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Monthly monitoring.
		Avoiding the need to stockpile on site	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Monthly monitoring.
		Use tarpaulins to cover sand and other loose material when transported by trucks	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Monthly monitoring.
		Fit all heavy equipment and machinery with air pollution control devices which are operating correctly and rregular servicing of the vehicles& equipments off site in order to limit gaseous emissions	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Monthly monitoring.
		Excess earth and other windblown loads in transit will be kept covered	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Monthly monitoring.
		No fires are allowed on site	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Ongoing monthly monitoring.
5	Noise Level	➢ Plan activities in consultation with DSC/PIU so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance; ➢ Require horns not be used unless it is necessary to warn other road users or animals of the vehicle's approach; ➢ Minimize noise from construction	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Monthly monitoring

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

	Issues	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
		equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and portable street barriers the sound impact to surrounding sensitive receptor; ➢ Ensure that machinery is in a good state of maintenance. ➢ Monitor noise levels in potential problem areas, and ➢ Maintain maximum sound levels not exceeding 80 decibels (dbA) when measured at a distance of 10 m or more from the vehicle/s.			
6	Storm water	Earth, stone and rubble is to be properly disposed of so as not to obstruct natural water pathways over the site i.e. these materials must not be placed in storm water channels, drainage lines	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Monthly monitoring
		During construction, un-channeled flow must be controlled to avoid soil erosion.	E- DSC, Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Monthly monitoring
7	Water quality[30]	Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets	Contractor	SO-PIU/ES-PMC, ESMC-PMU	Regular monitoring - monthly
		Prioritize re-use of excess spoils and materials in the construction works. If spoils will be disposed, consult with GMC/PIU on designated disposal areas	Contractor	SO-PIU/ES-PMC, ESMC-PMU	Regular monitoring - monthly
		Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies	Contractor	SO-PIU/ES-PMC, ESMC-PMU	Regular monitoring - monthly

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

	Issues	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
		Proper discharge of waste water as generated during development of tube well	Contractor	SO-PIU/ES-PMC, ESMC-PMU	Regular monitoring - monthly
		Place storage areas for fuels and lubricants away from any drainage leading to water bodies	Contractor	SO-PIU/ES-PMC, ESMC-PMU	Regular monitoring - monthly
		Dispose any wastes generated by construction activities in designated sites	Contractor	SO-PIU/ES-PMC, ESMC-PMU	Regular monitoring - monthly
		Conduct surface quality inspection according to the Environmental Management Plan (EMP)	Contractor	SO-PIU/ES-PMC, ESMC-PMU	Quarterly monitoring
8.	Conservation of natural environment – terrestrial flora	As the work front progresses the Contractor is to check that vegetation clearing has the prior permission of the DSC/PIU Engineer and Environmental Specialist of PMC.	E- DSC, Contractor	SO-PIU/ES-PMC, ESMC- PMU,	Monthly monitoring
		Minimize removal of vegetation at water storage reservoir sites of Polytechnic and Sigrasthan and operator office at Dandibagh through modification of design	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Monthly monitoring
		Require to plant three (3) native trees for every one (1) that is removed	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Monthly monitoring
		Prohibit employees from poaching wildlife, bird hunting, and cutting of trees for firewood	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Ongoing monitoring. Monthly monitoring
		Non removal of trees of religious importance	Contractor	SO-PIU/ ES-PMC, ESMC- PMU,	Quarterly monitoring.
9.	Materials management	Stockpiles shall not be situated such that they obstruct natural water pathways.	E- DSC, Contractor	PIU/ES-PMC, ESMC-PMU	Monthly monitoring. Location as directed by the engineer
		Stockpiles shall not exceed 2m in height unless otherwise permitted by the concerned Engineer.	E- DSC, Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring Location as directed by the engineer and ES- PMC
		All concrete mixing must take place on a designated, impermeable surface.	Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring.
		Verify suitability of all material sources and obtain approval of PIU & DSC	Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring
10	Existing Infrastructure and Facilities	• Utility shifting (if required) will be undertaken prior to commencing	Contractor	PIU/ES-PMC, ESMC-PMU,	Quarterly monitoring

	Issues	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
		construction works. • Keep construction related disturbances to a minimum. • Consult with affected service providers regarding impacts on access to infrastructure and services and alternatives. • Consult with affected communities or businesses prior to foreseeable disruptions, for example notifying residents of a temporary interruption of water supply. • Provide backup or alternative services during construction-related disruptions, • Provide access points to infrastructure and services. • Monitor complaints by the public			
11.	Landscape and Aesthetics including Waste management	Refuse must be placed in the designated skips or bins, which must be regularly emptied.	Contractor	PIU/ES-PMC, ESMC-PMU	Monthly monitoring.
		Prepare and implement Waste Management Plan	Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring.
		In addition to the waste facilities within the construction camp, provision must be made for waste receptacles to be placed at intervals along the work front.	Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring
		Littering on site is forbidden and the site shall be cleared of litter at the end of each working day.	Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring
		Disposal arrangement of muck as generated from tube well construction	Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring
		Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas for improvement of aesthetic environment. Recycling is to be encouraged by providing separate receptacles for different types of wastes (including	Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring

	Issues	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
		demolition waste) and making sure that staff is aware of their uses.			
		All waste must be removed from the site and transported to a disposal site or as directed by the Engineer.	E-DSC and Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring.
		Waste from toilets shall be disposed of regularly and in a responsible manner.	Contractor	PIU/ES-PMC, ESMC-PMU,	Weekly monitoring.
		Hazardous waste disposal must be carried out by the Contractor in a responsible manner	E- DSC and Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring.
		Storage areas will be properly fenced off	E- DSC and Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring.
		Top soil needs to be utilised by farmers for nutrient value	E- DSC and Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring.
		Coordinate with DSC-PIU for beneficial uses of excess excavated soils or immediately dispose to designated areas	E- DSC and Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring.
		Recover used oil and lubricants and reuse or remove from the sites	E- DSC and Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring.
		Request DSC/PIU to report in writing that the necessary environmental restoration work has been adequately performed before acceptance of work	E- DSC and Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring.
12	Occupational Health and Safety	World bank Environmental, Health, and Safety (EHS) Guidelines - EHS Guidelines for water & sanitation will be followed. Specifically, (i) Develop and implement site-specific Health and Safety (H and S) Plan which will include measures such as: (a) excluding public from the site; (b) ensuring all workers are provided with and use Personal Protective Equipment like helmet, gumboot, safety belt, gloves, nose musk and ear plugs; (c) 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;	E-DSC and Contractor	PIU/ES-PMC, ESMC-PMU,	Ongoing Weekly

	Issues	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
		(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 areas where workers are not exposed to hazardous or noxious substances; (vii) 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; (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 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			

	Issues	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
		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.			
13	Community Health & Safety	Plan routes to avoid times of peak-pedestrian activities.	E-DSC and Contractor	PIU/ES-PMC, ESMC-PMU,	Ongoing Weekly
		Liaise with DSC- PIU in identifying risk areas on route cards/maps	E-DSC and Contractor	PIU/ES-PMC, ESMC-PMU,	Ongoing Weekly
		Maintain regularly the vehicles and use of manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.	E-DSC and Contractor	PIU/ES-PMC, ESMC-PMU,	Ongoing Weekly
		Provide road signs and flag persons to warn of dangerous conditions, in case of location near the road.	E-DSC and Contractor	PIU/ES-PMC, ESMC-PMU,	Ongoing Weekly
		Provide protective fencing around open trenches, and cover any open trench with metal planks during non-construction hours	E-DSC and Contractor	PIU/ES-PMC, ESMC-PMU,	Ongoing Weekly
		Maintaining accident register and arrangement of emergency response plan for community	E-DSC and Contractor	PIU/ES-PMC, ESMC-PMU,	Ongoing Weekly
14	Traffic & accessibility impact	Plan transportation routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites; Schedule transport and hauling activities during non-peak hours; Locate entry and exit points in areas where there is low potential for traffic congestion; Keep the site free from all unnecessary obstructions; Drive vehicles in a considerate manner; Coordinate with Govt. Traffic Department for temporary road diversions and with for provision of traffic aids if transportation	Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring

	Issues	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
		activities cannot be avoided during peak hours; and Notify affected sensitive receptors by providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints			
15	Social impacts[31]	Contractor's activities and movement of staff to be restricted to designated construction areas.	PIU, Contractor	PIU/ ES-PMC, ESMC-PMU,	Monthly monitoring
		The conduct of the construction staff when dealing with the public or other stakeholders shall be in a manner that is polite and courteous at all times.	PIU, Contractor	PIU/ ES-PMC, ESMC-PMU,	Monthly monitoring
		Disruption of access for local residents, commercial establishments, institutions, etc. must be minimized and must have the Engineer's permissions.	PIU, Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring
		The work plan for the construction and laying of pipelines will be devised in such a way to ensure that the construction period is minimized. Affected persons will be assisted in moving to the other side of the road and returning after construction work is completed. Where they are not required to shift, their access road will be ensured by the contractor. The construction period will be minimized and is estimated to be less than 30 days per section of work. Compensation will be provided to impacted person (all deals under Resettlement Plant)	PIU, Contractor	PIU/ ES-PMC, ESMC-PMU,	Monthly monitoring
		Provide walkways and metal sheets where required to maintain access for people and vehicles.	Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring
		Increase workforce in front of critical areas	Contractor	PIU/ES-PMC, ESMC-	Monthly monitoring

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

	Issues	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
		such as educational institutions, places of worship, business establishment and health care establishments to shorten the duration of impacts.		PMU,	
		Consult businesses and institutions regarding operating hours and factoring this in work schedules.	PIU, Contractor	PIU/ES-PMC, ESMC-PMU	At least 1 week prior to the activity taking place. Monthly monitoring
		The Contractor is to inform neighbors in writing of disruptive activities at least a week beforehand.	PIU, Contractor	PIU/ES-PMC, ESMC-PMU	At least a week prior to the activity taking place. Monthly monitoring
		Lighting on the construction site shall be pointed downwards and away from oncoming traffic and nearby houses.	Contractor	PIU/ES-PMC, ESMC-PMU	Monthly
		The site must be kept clean to minimize the visual impact of the site.	Contractor	PIU/ES-PMC, ESMC-PMU	Weekly monitoring.
		Machinery and vehicles are to be kept in good working order for the duration of the project to minimize noise nuisance to neighbors.	Contractor	PIU/ES-PMC, ESMC-PMU	Monthly monitoring.
		Notice of particularly noisy activities must be given to residents / businesses adjacent to the construction site. Examples of these include: • noise generated by jackhammers, diesel generator sets, excavators, etc. • drilling • dewatering pumps	PIU, Contractor	PIU/ES-PMC, ESMC-PMU	Monthly monitoring
		A complaints register (refer to the Grievance Redressal Mechanism) shall be housed at the site office.	E- DSC, Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring.
16	Cultural environment	All the staff and laborers of the Contractor be informed about the possible items of historical or archaeological value	E- DSC, ES- PMC, contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring
		If something of this nature be uncovered, ASI or State Department of Archaeology shall be contacted and work shall be stopped immediately.	E- DSC, ES- PMC, Contractor	PIU/ES-PMC, ESMC-PMU,	Monthly monitoring

	Issues	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
17	Environment Safeguard/safety Officer	Contractor shall appoint one Environment Safeguard/ Safety Officer who shall be responsible for assisting contractor in implementation of EMP, community liaison, consultations with interested/affected parties, reporting and grievance redressal on day-to-day basis.	Contractor	PIU/ES-PMC, ESMC-PMU,	Person to be appointed before start of construction activities and remain available throughout the project duration.

Monitoring method- Through field check, document check, visual observation, generation of air, water & noise level data

ASI = Archeological Survey of India, BSPCB= Bihar State Pollution Control Board,
DSC: Design and Supervision Consultant, E: Engineer, ES: Environment Specialist**,** ESMC: Environment & Social Management Coordinator, PIU: Project Implementation unit, PMC: Project Management Consultant**,** PMU: Project Management Consultant, SO: Safeguard Officer

Table-29: EMP- Post Construction Activities and Operation

	Activities	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
1.	Construction camp	All structures comprising the construction camp are to be removed from site or handed over to the property owner/ community as per mutual agreement (if established on private/community land).	Contractor	SO - PIU, ES-PMC, ESMC-PMU	Subproject completion
		The area that previously housed the construction camp is to be checked for spills of substances such as oil, paint, etc. and these shall be cleaned up.	Contractor	SO - PIU, ES-PMC, ESMC-PMU	Subproject completion
		The Contractor must arrange the cancellation of all temporary services.	Contractor	SO - PIU, ES-PMC, ESMC-PMU	Subproject completion
2.	Vegetation	All areas that have been disturbed by construction activities (including the construction camp area) must be cleared of alien vegetation.	Contractor	SO - PIU, ES-PMC, ESMC-PMU	Subproject completion
		All vegetation that has been cleared during construction is to be removed from site or used as much as per the re-vegetation specification	Contractor	SO - PIU, ES-PMC, ESMC-PMU	Subproject completion
		The Contractor is to water and maintain all planted vegetation until the end of the defects liability period and is to submit a method statement regarding this to the Engineer.	Contractor	SO - PIU, ES-PMC, ESMC-PMU	Subproject completion
3.	Land rehabilitation	All surfaces hardened due to construction activities	Contractor	SO - PIU, ES-	Subproject

	Activities	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
		are to be ripped and imported materials thereon removed.		PMC, ESMC-PMU	completion
		All rubble is to be removed from the site to an approved disposal site. Burying of rubble on site is prohibited.	Contractor	SO - PIU, ES-PMC, ESMC-PMU	Subproject completion
		The site is to be cleared of all litter.	Contractor	SO - PIU, ES-PMC, ESMC-PMU	Subproject completion
		Surfaces are to be checked for waste products from activities such as concreting or asphalting and cleared in a manner approved by the Engineer.	Contractor	SO - PIU, ES-PMC, ESMC-PMU	Subproject completion
		The Contractor is to check that all watercourses are free from building rubble, spoil materials and waste materials.	Contractor	SO - PIU, ES-PMC, ESMC-PMU	Subproject completion
4.	Materials and infrastructure	Fences, barriers and demarcations associated with the construction phase are to be removed from the site unless stipulated otherwise by the Engineer.	Engineer- DSC, Contractor	SO - PIU, ES-PMC, ESMC-PMU	Subproject completion
		All residual stockpiles must be removed to spoil or spread on site as directed by the Engineer.	Engineer- DSC, Contractor	SO – PIU, ES-PMC, ESMC-PMU	Subproject completion
		All leftover building materials must be returned to the depot or removed from the site.	Contractor	SO – PIU, ES-PMC, ESMC-PMU	Subproject completion
		The Contractor must repair any damage that the construction work has caused to neighboring properties.	Contractor	SO-PIU, ES-PMC	As directed by the Engineer.
5.	General	A meeting is to be held on site between the Engineer, ES- PMC and the Contractor to approve all remediation activities and to ensure that the site has been restored to a condition approved by the Engineer.	Engineer- DSC, SO-PIU, ES- PMC, Contractor	PIU, ES-PMC, ESMC- PMU	On completion of the construction and maintenance phases
		Temporary roads must be closed and access across these blocked.	Engineer- DSC, SO-PIU, ES- PMC, Contractor	SO – PIU, ES-PMC, ESMC-PMU	On completion of construction
		Access or haulage roads that were built across watercourses must be rehabilitated by removing temporary bridges and any other materials placed in/or near to watercourses.	Engineer- DSC and Contractor	SO – PIU, ES-PMC, ESMC-PMU	On completion of construction
		All areas where temporary services were installed are	Engineer- DSC and	SO – PIU, ES-	On completion of

	Activities	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
		to be rehabilitated to the satisfaction of the Engineer	Contractor	PMC, ESMC-PMU	construction
		Mitigated during design- pre construction phase	Engineer- DSC and Contractor	SO – PIU, ES-PMC, ESMC-PMU	On completion of construction
		Continuous monitoring water level and quality through observation well	Engineer- DSC and Contractor	SO – PIU, ES-PMC, ESMC-PMU	On completion of construction
		Prohibit sand mining in designated zones around wells.	Engineer- DSC and Contractor	SO – PIU, ES-PMC, ESMC-PMU	On completion of construction
6	Aesthetics, Landscape character and Sense of Place	The new Tube well proposed to be constructed under this subproject will be similar in construction and design to existing Tube well in and around Monitor housekeeping, littering and illegal dumping.	Engineer- DSC and Contractor	SO – PIU, ES-PMC, ESMC-PMU	On completion of construction
7	Hazards waste management	Store of common salt, dry, and dark conditions for no more than one month	Engineer- DSC and Contractor	SO – PIU, ES-PMC, ESMC-PMU	During Operation
		Use equipment constructed of corrosion-resistant materials	Engineer- DSC and Contractor	SO – PIU, ES-PMC, ESMC-PMU	During Operation
		Minimize the amount of disinfection materials for using in chlorinator	Engineer- DSC and Contractor	SO – PIU, ES-PMC, ESMC-PMU	During Operation
		Maintaining material safety data sheet	Engineer- DSC and Contractor	SO – PIU, ES-PMC, ESMC-PMU	During Operation
		Develop and implement a prevention program that includes identification of potential hazards, written operating procedures, training, maintenance, and accident investigation procedures	Engineer- DSC and Contractor	SO – PIU, ES-PMC, ESMC-PMU	During Operation
8	Water quality assessment and maintained – Health & safety	• Undertake regular monitoring and maintenance of water supply infrastructure. • Quality of drinking water will be checked regularly at tube well locations and water storage sites • Sewage water will be treated in STP (which is under design stage) before discharge.	Contractor, SO-PIU	ES-PMC, ESMC-PMU	During Operation
9	Sustainable water source – Both quantity and quality aspects	• Monitoring of water abstraction from Phalgu aquifer o Monitoring of water level in the aquifer: install a number of observation wells: inside the aquifer, some 40m from the river edge. PMC to propose suitable locations. Construction to	Contractor, SO-PIU	ES-PMC, ESMC-PMU	During Operation

	Activities	Management/Mitigation	Responsible for Mitigation	Responsible for Monitoring/ Supervision	Frequency
		be included in GWSP2 contract. ○ Monitoring water abstraction by production tube wells. ○ Regular analysis of correlations between above 2 points ○ Monitoring to be carried out by GWSP2 contractor (as part of his Operation task) • Monitoring of water quality of the source / Phalgu aquifer:			

ASI = Archeological Survey of India, BSPCB= Bihar State Pollution Control Board,
DSC: Design and Supervision Consultant, E: Engineer, ES: Environment Specialist**,** ESMC: Environment & Social Management Coordinator, PIU: Project Implementation unit, PMC: Project Management Consultant**,** PMU: Project Management Consultant, SO: Safeguard Officer

B. Environmental Monitoring Program

269. **Table 30** outlines the environmental monitoring program to ensure implementation of the management and mitigation measures specified in the EMP. The table shall be read within the context of the body of the entire EMP.

Table 30: Environmental Monitoring Program

Aspect	Parameter	Standards	Location	Duration / frequency	Implementation	Monitoring &Supervision
1. Site establishment and preliminary activities						
Legislation, permits and agreements	Consent for Establishment and Consent to Operate (in relation to hot mixing, wet mixing, batching plant, stone crushers, and diesel generators, etc. if any)	Air Act Water Act Noise Act	-	Prior to moving onto site and during construction	Contractor, PIU	Engineer of DSC / ESMC- PMU/EE-PMU/ ES- PMC
	Land clearance, NOC from concern Dep. and tree cutting NOC	Forest Act	-	Prior to moving onto site and during construction	Contractor, PIU	Engineer of DSC / ESMC- PMU / ES-PMC
	Copy of EMP	EARF and ADB SPS	Subproject site, offices, website, library, etc.	At all times	Contractor, Engineer of DSC &SO- PIU	ESMC- PMU/ ES-PMC
Access to site	Existing conditions	EMP	All access and haul roads	Prior to moving onto site	Contractor, Engineer of DSC &SO- PIU and ES-PMC	ES- PMC / ESMC-PMU
	Road closures and traffic rerouting if required	EMP	All affected roads	One week in advance of the activity	Contractor, Engineer of DSC &SO- PIU	ESMC- PMU/ ES-PMC
	Notifications and road signages	EMP	All affected roads	One week in advance of the activity	Contractor, Engineer of DSC &SO- PIU	ESMC- PMU/ ES-PMC
Construction camp	Approval of location and facilities	EMP	As identified	Prior to moving onto site	Contractor, Engineer of DSC &SO- PIU	ESMC- PMU/ ES-PMC

Aspect	Parameter	Standards	Location	Duration / frequency	Implementation	Monitoring &Supervision
Equipment lay-down and storage area	Approval of location and facilities	EMP	As identified	Prior to moving onto site and during site set-up	Contractor, Engineer of DSC &SO- PIU	ESMC- PM/ ES-PMC
Materials management – sourcing	Approval of sources and suppliers	EMP	As identified	Prior to procurement of materials	Contractor, Engineer of DSC &SO- PIU	EE- PMU/ ES- PMC
Education of site staff	Awareness level training - Environment - Health and safety	EMP and records	-	During staff induction, followed by schedule as determined	Contractor, ES- PMC	ESMC- PMU/ ES-PMC
Social impacts	Public consultations, information disclosure, communication strategy	EARF, ADB SPS and EMP	Subproject site	Prior to moving onto site and ongoing	Contractor, Engineer of DSC &SO- PIU	ESMC- PMU/ ES-PMC
	GRM register	EMP	Subproject site	Prior to moving onto site and ongoing	Contractor, SO- PIU	ESMC- PMU/ ES-PMC
Noise quality	Baseline data for noise level in dB(A) L_{eq}	National noise standards	Once before start of construction works at all the project locations as identified by ES-PMC	Once prior to site set-up	Contractor with the help of National Accreditation Board for Testing and Calibration Laboratories	SO- PIU, / ES- PMC
Air quality	Baseline ambient data for particulate matters 10 and 2.5 (PM_{10}, $PM_{2.5}$), sulfur dioxide (SO_2), nitrogen dioxide (NO_2)	National ambient air quality standards	Once before start of construction works at all the project locations as identified by ES-PMC	Once prior to site set-up	Contractor with the help of National Accreditation Board for Testing and Calibration Laboratories	SO- PIU, / ES- PMC
Storm water	Storm water management measures	EMP	As identified by the engineer	During site set-up and throughout the duration of the subproject- monthly	SO-PIU,EE- PMU/ ES-PMC	ESMC-PMU / ES-PMC
Conservation of natural environment	Existing conditions	EMP	Subproject sites	Prior to site set-up-then monthly	Contractor & ES- PMC	ESMC- PMU/ ES-PMC
Waste management	Disposal sites	EMP	As determined	Prior to site set-up	Contractor, ES-	ESMC-PMU / ES-

Aspect	Parameter	Standards	Location	Duration / frequency	Implementation	Monitoring &Supervision
procedure				and ongoing throughout the subproject- monthly	PMC	PMC
Cultural environment	Chance finds	ASI Act and EMP	As determined	Prior to site set-up and ongoing throughout the subproject- monthly	Contractor with Engineer- DSC &SO-PIU	ESMC-PMU / ES-PMC
Security & safety arrangement	Arrangement at working sites	EMP	Subproject sites	Prior to site set-up and ongoing throughout the subproject	Contractor with Engineer- DSC &SO-PIU	ESMC-PMU / ES-PMC
Occupational Health & safety	Compliance with IFC EHS Guidelines of World Bank	EMP, Guidelines	Subproject sites	Prior to site set-up and ongoing throughout the subproject	Contractor with Engineer- DSC &SO-PIU	ESMC-PMU / ES-PMC
2. Construction phase						
Access to site	Qualitative characteristics	Pre-subproject condition and EMP	All access and haul roads	Refer to EMP (table on management of construction and workforce activities	Contractor	ESMC-PMU / SO-PIU/ ES- PMC
Construction camp	Qualitative characteristics	Pre-subproject condition and EMP	Camp site	Prior to site set-up and ongoing throughout the subproject- weekly monitoring	Contractor	ESMC-PMU / SO-PIU/ ES- PMC
Staff conduct	Site records (accidents, complaints)	EMP	Subproject sites	Ongoing- monthly monitoring	Contractor	ESMC-PMU / SO-PIU/ ES- PMC
Air quality	PM_{10}, $PM_{2.5}$, SO_2, NO_2	National ambient air quality standards	Covering at all the project locations as identified by Engineer.	Once in a month on construction site along with Quarterly at water reservoir sites, pipe laying areas, tube well	Contractor with the help of National Accreditation Board for Testing and Calibration Laboratories	ESMC-PMU / SO-PIU/ ES- PMC

Aspect	Parameter	Standards	Location	Duration / frequency	Implementation	Monitoring &Supervision
				locations, operator office during subproject execution		
Storm water	Soil erosion management measures	EMP	Subproject sites	Ongoing- monthly	Contractor	ESMC-PMU / SO-PIU/ ES- PMC
Water quality	Protection from contamination	EMP, Water quality standard	Subproject sites	Ongoing- monthly	Contractor	ESMC-PMU / SO-PIU/ ES- PMC
Conservation of natural resources	Vegetation conditions	EMP	Subproject sites	Ongoing- monthly	Contractor	ESMC-PMU / SO-PIU/ ES- PMC
Materials management	Qualitative characteristics	EMP	Subproject sites	Ongoing- monthly	Contractor	ESMC-PMU / SO-PIU/ ES- PMC
Landscape and Aesthetics including Waste management	Qualitative characteristics	EMP	Subproject sites	Ongoing- monthly	Contractor	ESMC-PMU / SO-PIU/ ES- PMC
	Disposal manifests	EMP	Subproject sites	Ongoing- monthly	Contractor	ESMC-PMU / SO-PIU/ ES- PMC
Social impacts	Public consultations, information disclosure, communication strategy	EARF, ADB SPS and EMP	Subproject sites	Ongoing- monthly	Contractor with the Engineer, DSC ,SO- PIU	ESMC-PMU / ES-PMC
	GRM register	EMP	Subproject sites	Ongoing- monthly	Contractor with the Engineer, DSC, SO- PIU	ESMC-PMU / ES-PMC
Occupational Health and Safety	World bank Environmental, Health, and Safety (EHS) Guidelines	EMP	Subproject sites	Ongoing- weekly	Contractor with the Engineer, DSC, SO- PIU	ESMC-PMU / ES-PMC
Cultural environment	Chance finds	ASI Act and EMP	Subproject sites	Ongoing- monthly	Contractor	ESMC-PMU / SO-PIU/ ES- PMC
Noise quality	Noise level in dB(A) L_{eq}	National noise standards	Covering at all the project locations as identified by Engineer.	Once in a month on construction site along with Quarterly at water reservoir sites, pipe laying areas, operator office during subproject execution	Contractor with the help of National Accreditation Board for Testing and Calibration Laboratories	ESMC-PMU / SO-PIU/ ES- PMC
Community Health & Safety	Safety arrangement during construction	EMP	Subproject sites	Ongoing- weekly	Contractor	ESMC-PMU / SO-PIU/ ES- PMC

Aspect	Parameter	Standards	Location	Duration / frequency	Implementation	Monitoring &Supervision
Traffic & accessibility impact	Arrangement and follow up rules related to traffic safety	EMP	Subproject sites	Ongoing- monthly	Contractor	ESMC-PMU / SO-PIU/ ES- PMC
3. Post-construction activities						
Construction camp	Pre-existing conditions	EMP	Construction camp	Subproject completion	Contractor	ESMC-PMU / ES-PMC
Vegetation (if felled)	Pre-existing conditions	EMP	Subproject sites	Subproject completion	Contractor	ESMC-PMU / ES-PMC
Land rehabilitation	Pre-existing conditions	EMP	Subproject sites	Subproject completion	Contractor	ESMC- PMU/ ES-PMC
Materials and infrastructure	Pre-existing conditions	EMP	Subproject sites	Subproject completion	Contractor	ESMC-PMU / ES-PMC
General	Records	EMP	Subproject sites	Subproject completion	Contractor with Engineer- DSC &SO-PIU and ES-PMC	ESMC- PMU/ ES-PMC
Social and Cultural Resources	Pubic complaint	EMP	Subproject sites	During operation	Contractor	ESMC-PMU / ES-PMC
4. Operation and maintenance (defect liability period)						
Water Quality	As per national standard	Central Pollution Control Board standards	At reservoirs and tube well locations	Once in 6 months	Contractor with the help of National Accreditation Board for Testing and Calibration Laboratories	ESMC- PMU/ ES-PMC
Noise quality	Noise level in dB(A) L_{eq}	As per national noise standards	Once at all tube well pumping areas	Once in 6 months	Contractor with the help of National Accreditation Board for Testing and Calibration Laboratories	ESMC- PMU/ ES-PMC
Hazardous chemical & waste management	Storage and use	Safety data sheet EMP	At tube well water treatment site	Monthly monitoring	Contractor	ESMC- PMU/ ES-PMC

DSC: Design and Supervision Consultant, E: Engineer, ES: Environment Specialist**,** ESMC: Environment & Social Management Coordinator, PIU: Project Implementation unit, PMC: Project Management Consultant**,** PMU: Project Management Consultant, SO: Safeguard Officer

Note: PIU & contractor: Daily & weekly mitigation, monitoring and ES- PMC, ESMC- PMU: Fortnightly, Monthly & Quarterly monitoring or as per requirement & overall supervision

C. Environmental Management and Monitoring Cost

270. The Contractor's cost for site establishment, preliminary activities, construction, and defect liability activities will be incorporated into the contractual agreements, which will be binding on him for implementation. The air quality and noise level monitoring at construction phase and water quality (tube well water) at defect liability phase will be conducted by the contractor.

271. The operation phase mitigation measures are again of good operating practices, which will be the responsibility of implementing agency (BUIDCo) with the help of program Consultant. The water quality monitoring during the operation and maintenance phase will be conducted by the hired recognized environmental laboratory.

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

273. **Table 31** presents the estimated cost to implement the EMP.

Table 31: Indicative Cost for EMP Implementation

Component	Description	Number	Cost per Unit (INR)	Cost (INR)	Source of Funds
Legislation, Permits and Agreements	Consent to Establish and Consent to Operate for plants and machinery of the contractor.	As required	Not Applicable	Not Applicable	These consents are to be obtained by contractor on his own cost.
Public consultations and information disclosure	Information disclosure and consultations during preconstruction and construction phase.	As required	Lump sum	50,000	Project Cost- PMU
Land acquisition at Singrasthan and NOC from concern dept. for tree cutting and temporary impact	Acquisition of land for construction of water reservoir and laying of transmission pipeline. Trees need to compensate against each tree cutting	As per project requirement	Lump sum for all activities	3,00,000	Project Cost- PMU
Providing access to commercial establishments and properties.	Providing access, in case of access disruptions, to affected properties.	As per requirement	Contractor's liability	Not applicable	Covered under engineering cost
Dust Suppression at subproject sites	Application of dust suppression measures during construction phase.	As required	Lump sum	1,00,000	Covered under engineering design and cost – by

Component	Description	Number	Cost per Unit (INR)	Cost (INR)	Source of Funds
					contractor
Traffic management	Safety Signboards, delineators, traffic regulation equipments, flagman, temporary diversions, etc	Wherever required throughout subproject corridor	Contractor's liability	Not applicable	Covered in engineering cost
Baseline Monitoring Site preparation and preliminary activities					
Air	Once before start of construction work at water reservoir locations, operator office location, tube well and pipe laying locations as identified by Engineer of DSC & Environmental Specialist of PMC	Approx. 25 samples	10,000 per sample	2,50,000	Covered under engineering design and cost- by contractor
Noise	Once before start of construction work at water reservoir locations, operator office location, tube well and pipe laying locations as identified by Engineer of DSC & Environmental Specialist of PMC	Approx. 25 samples	1500 per sample	37,500	Covered under engineering design and cost- by contractor
Construction Monitoring					
Air	Once in a month on construction site along with Quarterly during construction works at both the water reservoir locations, operator office, few tube wells and pipe laying locations as identified by Engineer of DSC & Environmental Specialist of PMC	Approx. 35 samples	10,000 per sample	3,50,000	Covered under engineering design and cost- by contractor
Noise	Once in a month on construction site along with Quarterly during	Approx. 30 samples	1500 per sample	45,000	Covered under engineering design and

Component	Description	Number	Cost per Unit (INR)	Cost (INR)	Source of Funds
	construction works at both the water reservoir locations, operator office, few tube wells and pipe laying locations as identified by Engineer of DSC & Environmental Specialist of PMC				cost- by contractor
Water	Once in a month on construction site along with Quarterly during construction nearby water source	Approx 20 samples	10,000 per sample	200,000	Covered under engineering design and cost- by contractor
Defect Liability Period					
Water Quality	At constructed water storage reservoirs, operator office and selected tube well locations, as per drinking water standard parameters	Approx. 30 numbers	12,000 per sample	3,60,000	Covered under O & M cost – by contractor
Noise quality	Once in six months during the defect liability period at selected tube well locations, operator office	Approx. 20 samples	1500 per sample	30,000	Covered under O & M cost – by contractor
Water level monitoring at observation well and production well	Continuous	Lump sum Yearly		8,00,000	Covered under O & M cost – by contractor
Any unanticipated impact due to subproject implementation	Mitigation of any unanticipated impact arising during construction phase and defect liability period.	Lump sum	-	3,00,000	Project cost
TOTAL (INR)				**28,22,500**	
			TOTAL (USD)	**43,423**	

D. Monitoring and Reporting

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

275. PMC will organize an induction course for the training of contractors preparing them on:

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

276. During the construction phase, results from internal monitoring by the contractor will be reflected in their monthly EMP implementation reports to the PMC. These monthly report will be retained in PMC / PIU office for reference.

277. Monthly report will be prepared by PMC summarizing compliance with monitoring requirements, details on any noncompliance, remedial actions taken and additional environmental mitigation measures if necessary.
278. Environmental monitoring activities involving measurements will require engagement of external agencies and will be organized by contractor. Based on monthly reports and measurements, PMC will draft a 6-monthly EMP implementation report.

279. The PMU will review, approve and submit to ADB the semi-annual EMP implementation progress report. Once concurrence from the ADB is received, the report will be uploaded in the Project website.

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

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

IX. RECOMMENDATIONS AND CONCLUSIONS

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

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

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

285. This IEE was prepared based on preliminary designs therefore, is required to be updated during the detailed design stage, to reflect any changes, or amendments to the subproject. This IEE primarily: (i) provides information on the project and its environmental requirements; (ii) provides the necessary baseline conditions of the physical, ecological, physical cultural and socio-economic environments and/or resources in and surrounding the project's area of influence; (iii) identifies and assesses potential impacts arising from the implementation of the project on these environments and/or resources; (iv) recommends measures to avoid, mitigate, and compensate for the adverse impacts; (v) presents information on stakeholder consultations and participation during project preparation (vi) recommends a mechanism to address grievances on the environmental performance of the project; and (vii) provides an EMP which includes an environmental monitoring program, and the responsible entities for mitigation and monitoring. In particular, the EMP will (i) ensure that the activities are undertaken in a responsible non-detrimental manner; (ii) provide a pro-active, feasible and practical working tool to enable the measurement and monitoring of environmental performance on site; (iii) guide and control the implementation of findings and recommendations of the environmental assessment conducted for the subproject; (iv) detail specific actions deemed necessary to assist in mitigating the environmental impact of the subproject; and (v) ensure that safety recommendations are complied with. The IEE will guide the environmentally-sound detail design, construction and operation and maintenance of the subproject. It will ensure efficient lines of communication between the PMU, PIU in Gaya, consultant teams, and contractors. The IEE will be made binding on all GWSP2 contractors and a copy is required to be kept on site always.

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

287. 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.

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

Appendix 1: Rapid Environmental Assessment (REA) Checklist

Instructions:

(i)The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (RSES) for endorsement by the Director, RSES and for approval by the Chief Compliance Officer.

(ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.

(iii) 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/ Bihar Urban Development Project**

Sector division: **Water Supply- Gaya phase 2, GWSP2**

Screening questions	Yes	No	Remarks
a. Project siting Is the project area			
▪ Densely populated?	√		Gaya is densely populated
▪ Heavy with development activities?		√	No such heavy development activity is noted at Gaya
▪ Adjacent to or within any environmentally sensitive areas?	√		Gaya is a historic and a most important religious centre for Hindus. History of Gaya has a unique place in the evolution and development of Hindu civilization. According to the religion of Puranaas, it is incumbent on every Hindu to visit Gaya and make offerings for the souls of his ancestors. There are a number of temples in the town; a large number of pilgrims visit the town. Vishnupad Temple, Brahmyoni Hill and Ramshila Hill are the environmentally sensitive areas (State Archeological notified area) located nearby the project area
• Cultural heritage site		√	World famous Buddhist centre of Bodh Gaya is located 13 km of Gaya. In 2002, Mahabodhi Temple, located in Bodh Gaya, became a UNESCO World Heritage Site.
• Protected area		√	No Forest area is involved for construction of new reservoir. No archeological protected area nearby the project location
• Wetland		√	Not applicable
• Mangrove		√	Not applicable

Screening questions	Yes	No	Remarks
• Estuarine		√	Not applicable
• Buffer zone of protected area		√	None of the subproject component sites are within buffer zone of protected area.
• Special area for protecting biodiversity		√	None of the subproject component sites are in 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?		√	No such impact is anticipated. The water source for tube wells is underground water in deep water aquifers. Exploitation of surface water sources is not in the scope of the subproject.
▪ Impairment of historical/cultural monuments/areas and loss/damage to these sites?		√	There will be no impact on the cultural monuments as the proposed project will include construction of new tube well, laying of transmission pipeline
▪ Hazard of land subsidence caused by excessive ground water pumping?		√	Sufficient ground water is available at Gaya. No such impact is anticipated
▪ Social conflicts arising from displacement of communities?		√	No such impact is anticipated. R & R plan prepared separately
▪ Conflicts in abstraction of raw water for water supply with other beneficial water uses for surface and ground waters?		√	No such conflicts are anticipated. Abstraction of surface water for distribution is not proposed under this subproject. The ground water is not being tapped for any other purpose except drinking in the project area.
▪ Unsatisfactory raw water supply (e.g. excessive pathogens or mineral constituents)?		√	Ground water obtained from the tube wells is normally free from pathogens and will be supplied after disinfection. Regular water quality monitoring is carried out by the line department (PHED) to minimize threat to public health. Further, the tube wells will be deep and sufficiently away from any possible source of ground water contamination.
▪ Delivery of unsafe water to distribution system?		√	Ground water will be treated before delivery Moreover regular monitoring of water distribution will be done so the delivery of unsafe water will be unexpected
▪ Inadequate protection of intake works or wells, leading to pollution of water supply?		√	No such situation is anticipated. As per proposed project water will be withdraw from ground water source
▪ Over pumping of ground water, leading to salinization and ground subsidence?		√	No such impact is anticipated. The ground water abstraction has been planned after ensuring adequate availability in the ground water aquifer for withdrawal. Hydro-geological assessment study under progress

Screening questions	Yes	No	Remarks
▪ Excessive algal growth in storage reservoir?		√	Not expected from proposed project
▪ Increase in production of sewage beyond capabilities of community facilities?		√	No such impact is anticipated. Sewage volumes shall undoubtedly increase but this increase will not be beyond the existing community facilities. Moreover, the additional volume of water finding its way into the sewage shall dilute the actual concentration of contaminants.
▪ Inadequate disposal of sludge from water treatment plants?		√	Not Applicable as per scope of work
▪ Inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities?		√	Not Applicable as per scope of work
▪ Impairments associated with transmission lines and access roads?	√		Temporary impairments with transmission lines and access roads are anticipated during laying of new pipes in the subproject area.
▪ Health hazards arising from inadequate design of facilities for receiving, storing, and handling of chlorine and other hazardous chemicals.		√	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
▪ Health and safety hazards to workers from the management of chlorine used for disinfection and other contaminants?		√	Proper arrangement will be made for storage of common salt, which will be used in chlorinator
▪ Dislocation or involuntary resettlement of people		√	Not required as per present scope of work
▪ Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		√	No such impact is anticipated.
▪ Noise and dust from construction activities?	√		The noise and the dust emissions will be insignificant as per the nature of the work. Adequate mitigation measures will be taken to further minimize it.
▪ Increased road traffic due to interference of construction activities?	√		Construction will be managed as to allow traffic to maintain through access. There is no expected considerable increased in road traffic due to construction activities. Consultation with traffic police authority will be undertaken during laying of pipeline.
▪ Continuing soil erosion/silt runoff from construction operations?		√	No soil erosion is anticipated. Trenches will be filled back and restored to original conditions after completion of day‘s work.

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?		√	O&M manual will be prepared and followed. Training will be given to the staffs regarding operation and maintenance. User agency will establish lab system of regular collection and analysis of water samples for preventing any such impact.
▪ Delivery of water to distribution system, which is corrosive due to inadequate attention to feeding of corrective chemicals?		√	Not applicable as per chemical use
▪ Accidental leakage of chlorine gas?		√	Not applicable as per nature of work
▪ Excessive abstraction of water affecting downstream water users?		√	No such impact is anticipated as water source for the sub-project is ground water.
▪ Competing uses of water?		√	Ground water is not used for any other purpose except for drinking water supply in the project area.
▪ Increased sewage flow due to increased water supply	√		An increase in sewage flow is anticipated due to increase in water supply. However, the additional volume of water finding its way into sewage shall be beneficial, as it shall dilute the actual concentration of contaminants. As per plan, STP will be constructed for treatment of raw sewage of Gaya. It is anticipated that project will be funded from this program
▪ Increased volume of sullage (wastewater from cooking and washing) and sludge from wastewater treatment plant	√		A slight increase in the volume of sullage is expected due to increased water supply. However, the actual concentration of contaminants shall get diluted with this increase in water supply.
▪ Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	Construction of tube well and laying of pipeline is not a big construction. Hardly 20-30 laborers will be work during construction, therefore temporary burden to social infrastructure is insignificant In case of setting up of labor camp permission will be obtained from GMC. 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

Screening questions	Yes	No	Remarks
▪ Community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		√	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 zone III

A Checklist for Preliminary Climate Risk Screening

Country/Project Title: India/ Bihar Urban Development Investment Program
Sector: Urban Development
Subsector: Water Supply
Division/Department: Urban Development and Housing Department

Screening Questions		Score	Remarks[32]
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	Materials as selected for the project will be not affected from extreme climatic condition.
	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

[32] 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.

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

Appendix 2: Geohydrological Study

CHAPTER – X: Geo-hydrological Study

10.0 EXPLOITABLE SUB-SURFACE WATER POTENTIAL OF PHALGU RIVER & IMPACT OF 124 MLD ABSTRACTION ON ITS POTENTIAL

10.1 Delineation of ground water potential zone

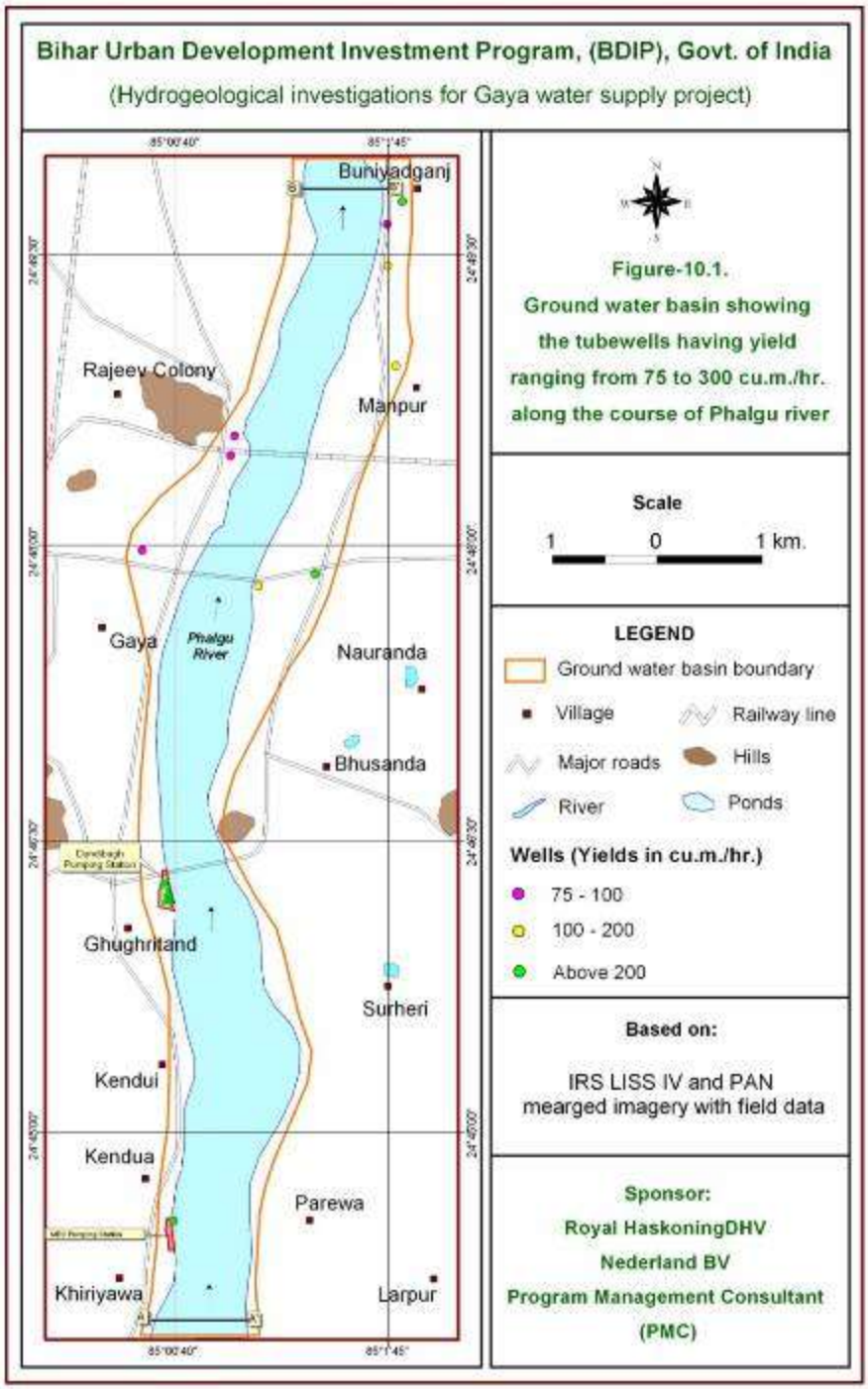
A ground water potential zone has been delineated based on hydro-geomorphological map, findings of resistivity surveys and covering the area where high yielding tube wells have been constructed/operated by GMC/PHED (yield ranging from 75 m^3/hour to 300 m^3/hour). This zone covers an area of 14.25 km^2 **(Figure-10.1)** on the left bank of Phalgu river, part of Manpur area on the right bank and part of Gaya city adjoining the river. Actually, this is the zone having adequate thickness of granular aquifer, deposited by Phalgu river along its present course and palaeo-channels which is most suitable for future ground water exploitation as has been proved by the existence of high yielding tube wells.

It was suggested by the CGWB during the meeting held on 16.05.2014 that ground water potential zone may cover area more than 14.25 km^2 if the lateral area on the left and right banks of Phalgu river are also studied by geoelectrical resistivity surveys. The existing well fields are a part of Phalgu ground water potential zone having the same aquifer thickness as in the river itself and it is likely that it may have similar aquifer thickness in lateral area. The exploitable ground water potential will be accordingly more if additional lateral area on either sides of river gets increased within the Phalgu ground water potential area.

It was also suggested by BUDIP during the meeting that an area of 4 -6 km downstream and 20 km upstream of Gaya town may also be studied along Phalgu river and it may provide additional ground water resources to plan for the 30 years water requirement.

10.2 Present status of ground water abstraction on sub-surface water of Phalgu river.

It has been observed that the present total ground water abstraction of 24,000 m^3/day considering 6-8 tube wells of Dandibagh well field (18,000 m^3/day), 4 tube wells of Manpur area (4,000 m^3/day), three tube wells of Gaya city (2,000 m^3/day) near the river and 3 tube wells of MES (1000 m^3/day) is recharged directly by the surface flow and during summer , it is tapping from the sub-surface water storage when the Phalgu river goes completely dry or with surface flow less than a cumec. The maximum lowering of water level in Phalgu river bed is less than 2 meters near the Dandibagh well field, which is being heavily pumped. This lowering is due to recharge provided by the sub-surface water of Phalgu river when a hydraulic gradient is developed towards the well field due to pumping of 18,000 m^3/day.



Average lowering of water in Phalgu river, from Khiriyawa to Buniyadgunj is less than a meter. However , taking the maximum lowering of two meters of water levels in river bed, the sub-surface water availability amounts to 5.7 mcm or about 76,000 m^3/day taking the specific yield of 20 % (as the upper river bed is loose coarse sand and gravel) within the area of 14.25 km^2 of ground water potential zone.

14.25 x 2 x 0.20 = 5.70 mcm

Area of ground water potential zone x aquifer thickness x Specific yield = Ground water availability

It is therefore seen that at present the availability of sub-surface water within the river bed in 2 meters of the saturated river bed is much more than the ground water abstraction of 24,000 m^3/day or 1.80 mcm (considering 75 day of dry river bed) indicating that the lowering of water level in the ground water basin

will be less than a meter. The present ground water abstraction is only the 31.50 % of the sub-surface water availability in an area of 14.25 km^2.

Even if the ground water abstraction increases from the existing tube wells for next 5 years or so, there will be no lowering of water level in the river bed of more than 2 meters as there is still surplus of 3.9 mcm in the river bed. The yield of existing tube wells will not be affected as there is still 23 meters of aquifer thickness available to sustain the present yields

10.3 Sub-surface flow of water in Phalgu river during summer months.

10.3.1 Sub-surface inflow

Once the Phalgu river is dry, there is sub-surface water flowing in the river towards the downstream side due north. An attempt has been made to estimate the inflow at the Section AA', near Khiriyawa (MES pumping station), (**Figure-10.1)** considering the hydraulic conductivity (150 m/day), section area of flow (average width of the river and average aquifer thickness) and hydraulic gradient of 1.5 m/km. The quantity of sub-surface flow amounts to 3994 m^3/day or say 4000 m^3/day or 0.3 mcm during the 75 days.

150 x 710 x 25 x 1.5 /1000 = 3994m^3/day

Hydraulic conductivity x width x aquifer thickness x hydraulic gradient = Sub-surface inflow

10.3.2 Sub-surface out flow of water in Phalgu river during summer months.

The sub-surface out flow has been estimated at Section BB' near village Buniyadgunj when the maximum 1,24,000 m^3/day of ground water abstraction will be done by the year 2044 from the ground water basin formed along Phalgu river. With the expected average lowering of water level of 4.35 meters, the outflow will be reduced with aquifer thickness and will be 2950 m^3/day.

150 x 635 x 20.65 x 1.5 /1000 = 2950 m^3/day

Hydraulic conductivity x width x aquifer thickness x hydraulic gradient = Sub-surface outflow

It is not known at this stage that what will be the impact of reduced inflow of river during summer months on the downstream stack holders of Section BB' as the number of irrigation tube wells are not known. However, as the irrigation wells are not operated during the summer months, (after the harvesting of Rabi crops), no major impact is anticipated.

10.4 Impact of ground water abstraction of 124 MLD on sub-surface water of Phalgu river

The sub-surface water storage in the ground water potential zone covering an area of 14.25 km^2 will be 53. 43 mcm taking average specific yield of 15 % for the average aquifer thickness of 25 meters

14.25 x 25 x 0.15 = 53.43 mcm

Area of ground water potential zone x aquifer thickness x Specific yield = Ground water availability

It is proposed that by the year 2044, there will be ground water abstraction of 124 MLD from tube wells located on left and right banks of the river. The ground water abstraction during the 75 days @ 1,24,000 m^3/day will be 9.30 mcm which happens to be 17.40 % of the total sub-surface water storage. Therefore, the water level will be lowered by 4.35 meters, leaving a substantial saturated aquifer thickness of 20.65 meters. It is presumed that entire ground water abstraction will be from sub-surface water storage of Phalgu river and the anticipated lowering of water level in the river bed will be 4.35 meters from an area of 14.25 km^2 of the ground water potential zone. This quantity of water will be derived from the static ground water reserves of the ground water potential zone covering the river bed which have been calculated as 53.43 mcm. In addition, there will inflow of sub-surface water from the upstream side, near Khiriyawa which has been estimated as 4000 m^3/day or 0.30 mcm during 75 days. The sub-surface inflow will provide additional quantity of water for compensating the dewatering of the basin and raising the water level in the summer months. The total water storage including the sub-surface inflow of 0.30 mcm will be 53.73 mcm. The ground water abstraction of 9.30 mcm will be 17.30 % which will create lowering of water level by 4.325 meters, leaving the aquifer thickness of 20.675 meters.

10.5 Discharge of tube well at reduced aquifer thickness during summer

It has been observed that tube wells constructed in Dandibagh well field are yielding around 300 m^3/hour at very low drawdown, less than 3 meters. The average thickness of aquifer is around 25 meters.

Hydrogeologically, it is stated that discharge of a tube well is directly proportional to its transmissivity which is hydraulic conductivity x aquifer thickness. Dandibagh, tube wells are yielding around 300 m^3/hour from an aquifer having transmissivity of 3750 m^2/day (K=150 m/day and aquifer thickness of 25 meters).The same tube well with aquifer thickness of 20 meters during summer with and maximum destuartion of 5 meters due to ground water abstraction of 124 MLD, the discharge of the tube well will be 240 m^3/hour at the same drawdown. Generally, tube wells tapping granular aquifer are pumped at normal drawdown of 6 to 8 meters. If the same tube well is pumped at 300 m^3/hour with aquifer thickness of 20

meters, it will yield 300 m^3/hour at drawdown of 6 to 8 meters. Normally, in case of confined aquifer, the discharge is directly proportional to drawdown and a tube well tapping confined aquifer will yield double the discharge at the double value of drawdown but in case of phreatic aquifer, it is not so and by doubling the discharge, the drawdown value becomes more than double due to reduced transmissivity. Therefore, the tube wells will maintain the same yield even in the summer but with increased drawdown by the same capacity of turbine pumps

10.6 Estimation of the period when the river has less surface flow to sustain well fields

While estimating the lowering of water in Phalgu river of 4.325 m for ground water abstraction of 124 MLD , it has been presumed that river will become dry or will have less flow of 2 cumecs for 75 days. (April to Mid –June). This is for period when monsoon fails for prolonged years. A case study has been done for Phalgu river on 18th February, 2014 using Manning equation. During the year 2013, the catchment area of Phalgu river received rainfall of only 574 mm against the normal annual rainfall of 1089 mm (Average of 100 years of IMD data). Therefore, it was much below the average annual rainfall and consequently very much reduced flow. It was observed on 18th February, 2014 that there is average water column of 15 cm in the river in the average width of 30 meters (**Photoplate-2.2).** This much flow is equivalent to 2.5 m^3/s or 0.21 mcm. as per the Manning's equation.

It means that by the 1st week of March, 2014, it will be reduced to 0.124 mcm and the tube wells would start tapping water from the sub-surface water of the river. It is therefore safe to assume that if the rainfall would have been 1089 mm of normal annual rainfall , the river might have had the surface flow of 2 cumecs (0.124 mcm) up to end of April,2014. Under such situation, the dry period of Phalgu river would have been only 45 or 50 days.

The maximum average peak flow of Phalgu river during the flood period has been observed as 3376 cumecs, when the rainfall during any day of the month of July was around 235 mm/day, the maximum rainfall as shown in Iso-pluvial map of IMD during last 25 years. The minimum flow during such years of less than 2 cumecs will be in either the 1st week or 2nd week of May for normal rainfall of 1089 mm and 50.47 mm in October. Under such situation, the dry period will be only of 30 days. Accordingly, there will be less drawl of sub-surface water storage of Phalgu river.

10.7 Stream gauging data recorded by Central Water Commission on Phalgu river at Gaya

Central Water Commission (CWC) has set up a stream gauging site on the left bank of Phalgu river, just downstream of road bridge **(Photoplat-10.1)**. This bank gets water when Phalgu river has full flow in its river width and during flood periods. Most of the time when there is no flow of water on the left bank , as seen in **Photoplate-10.2** but there is flow in the river , somewhere in its central part when the flow is more than 2 cumecs.

Efforts were made by HCPL to use the stream gauge data of CWC at Gaya if it could give reliable estimate of the period when the river is completely dry and well fields are tapping sub-surface water storage. However, it is observed that gauge heights show no flow while the central part of the river is having flow more than 124 MLD, the water requirement of Gaya town in the year 2044.

Under such situation, there is no other alternative except to take up hydrological modeling of Phalgu river basin.

Photoplate-10.1. Stream gauging station being monitored by CWC

Photoplate-10.2. Flow in Phalgu river in February while the left bank of

CWC station shows no flow much earlier

10.8 Conclusions

Based on the hydrogeological assessment studies of the ground water potential zone, it is observed that present ground water abstraction of 24,000 m^3/day for 75 days(when the river is dry) is hardly 31.50 % of the total sub-surface water storage (5.70 mcm) within 2 meters of aquifer in 14.25 km^2 of the ground water potential zone during summer months.

Similarly, with the ground water abstraction of 124 MLD for 75 days of 9.30 mcm from the sub-surface water storage of 25 m thick aquifer of 53.43 mcm will be 17.40 % and it will lower will lower the water level by 4.35 meters, still keeping the aquifer thickness of 20.65 meters which is considered as sufficient to sustain the yield of tube wells.

Therefore, it is concluded that despite lowering of water level by 4.35 meters during summer months, the tube wells will sustain the yield and will restore original yield as soon as Phalgu river starts flowing after getting the first spell of rainfall in mid -June.

The impact of pumping 124 MLD during the summer months (75 days) can be further reduced if the well fields are increased instead of having only one well field of Dandibagh. Two more well fields can be developed, one near village Kendui and another near Kendua on the left bank (Figure above) and fourth near Manpur - Buniyadgunj on the right bank (if investigated by resistivity surveys). By having four different well fields, there will be less pumping from a small area of a well field, thereby creating a small ground water depression and less lowering of water level around it.

Appendix 3: Photo Illustration and Google Maps of Project Locations

Proposed Tube Wells

Sr. No.	Tube well / batteries locations	Tube well IDs	Coordinates	Site photographs	Google map
1	Gauri Shankar Mandir	40, 41, 42, 43	24°49'7.37"N/85° 1'50.25"E		
2	Budhva Mahadev Mandir	44	24°49'48.03"N/85° 1'44.82"E		

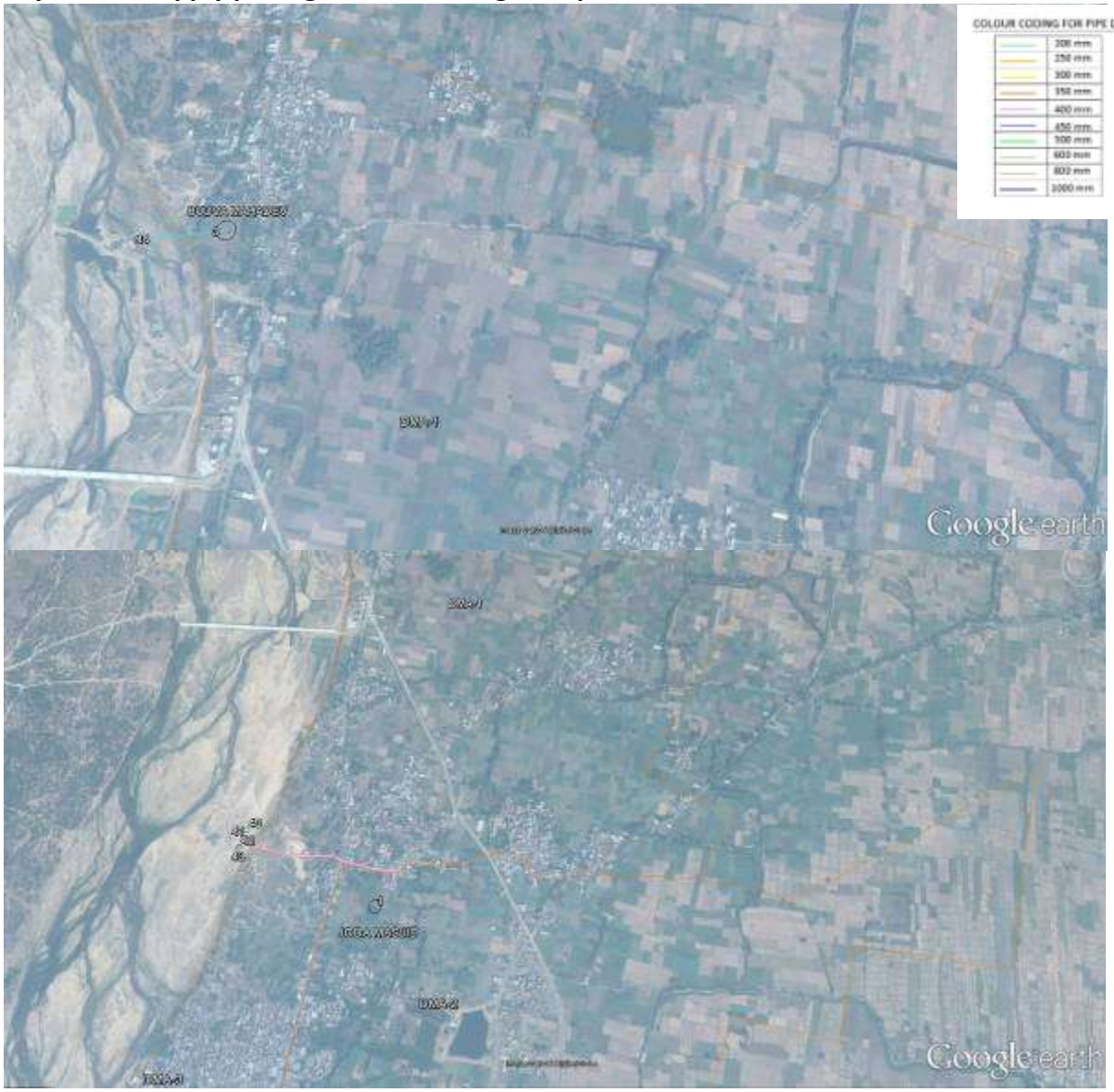
3	BhusandaMela	45, 46	24°47'4.03"N/85° 0'55.54"E		
4	Dharamshala	60, 61, 62, 63	24°.81'**4.86N/** 85°.0'**19.37**"E		
5	Polytechnic College	47, 48, 49	24°.76'**3.033N/** 85°.0'**10.61**"E		

6	Kendui	50, 51, 52	24°.75'**7.391N/**85°.0'**11.99**"E		
7	Kendua	53, 54, 55, 56, 57, 58, 59	24°.74'**6.205N/**85°.0'**11.336**"E		

Proposed Reservoirs under GWSP2

Reservoir Location	Coordinates	Site photographs	Google map
CWR at Govt. ITI	24°.76'0.2945N/ 85°.0'10.668"E		
GLSR at Singrasthan	24°46'36.66"N 84°59'35.38"E		

Gaya water supply package GWSP2; Google Maps




Google earth


Google earth


COLOUR CODING FOR PIPE DIA.
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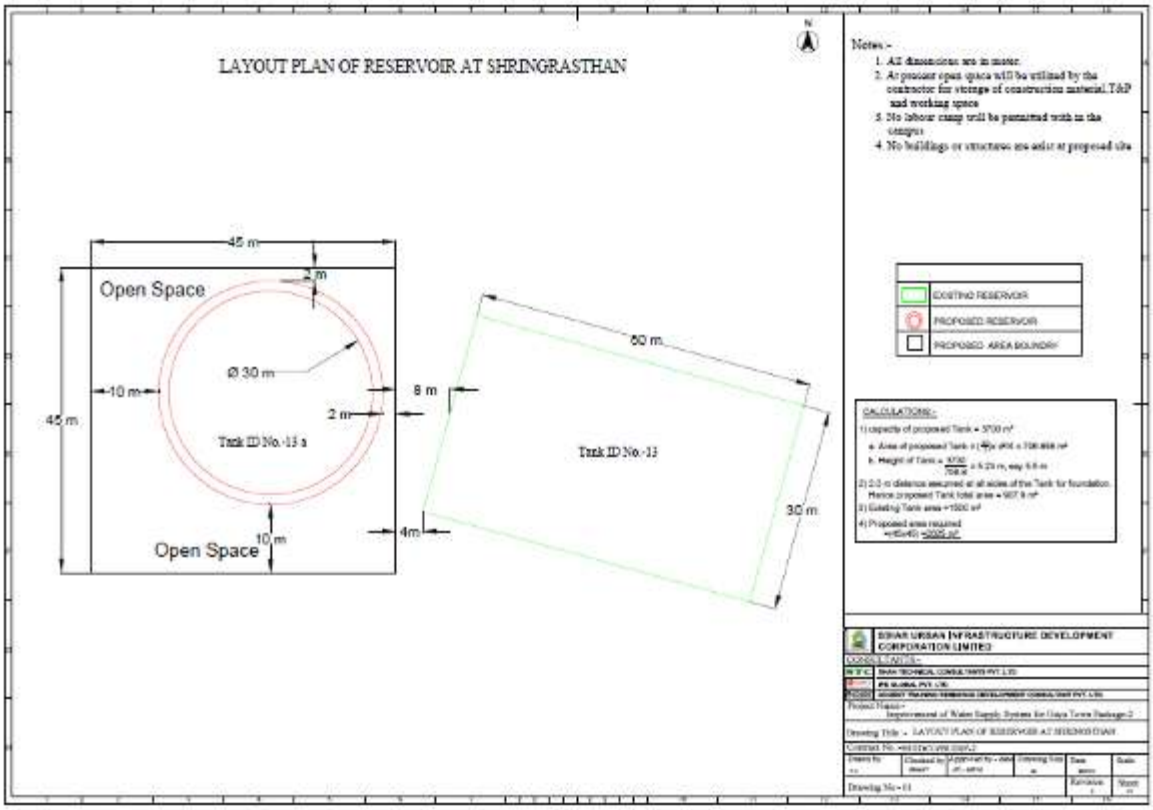
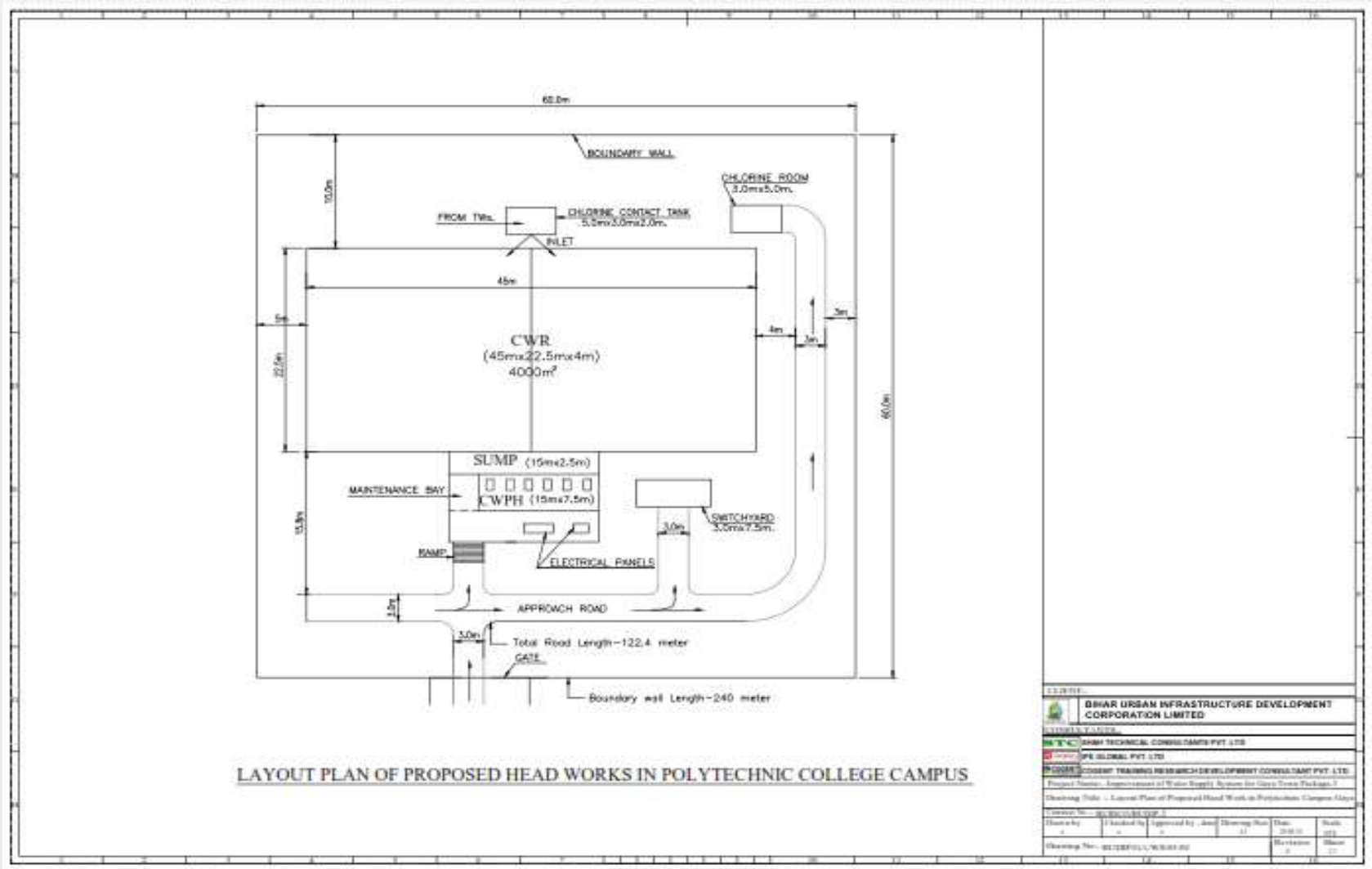
Appendix 4: Layout and site management plan drawing

Layout and site management plan drawing – ITI Polytechnic College and Singrasthan



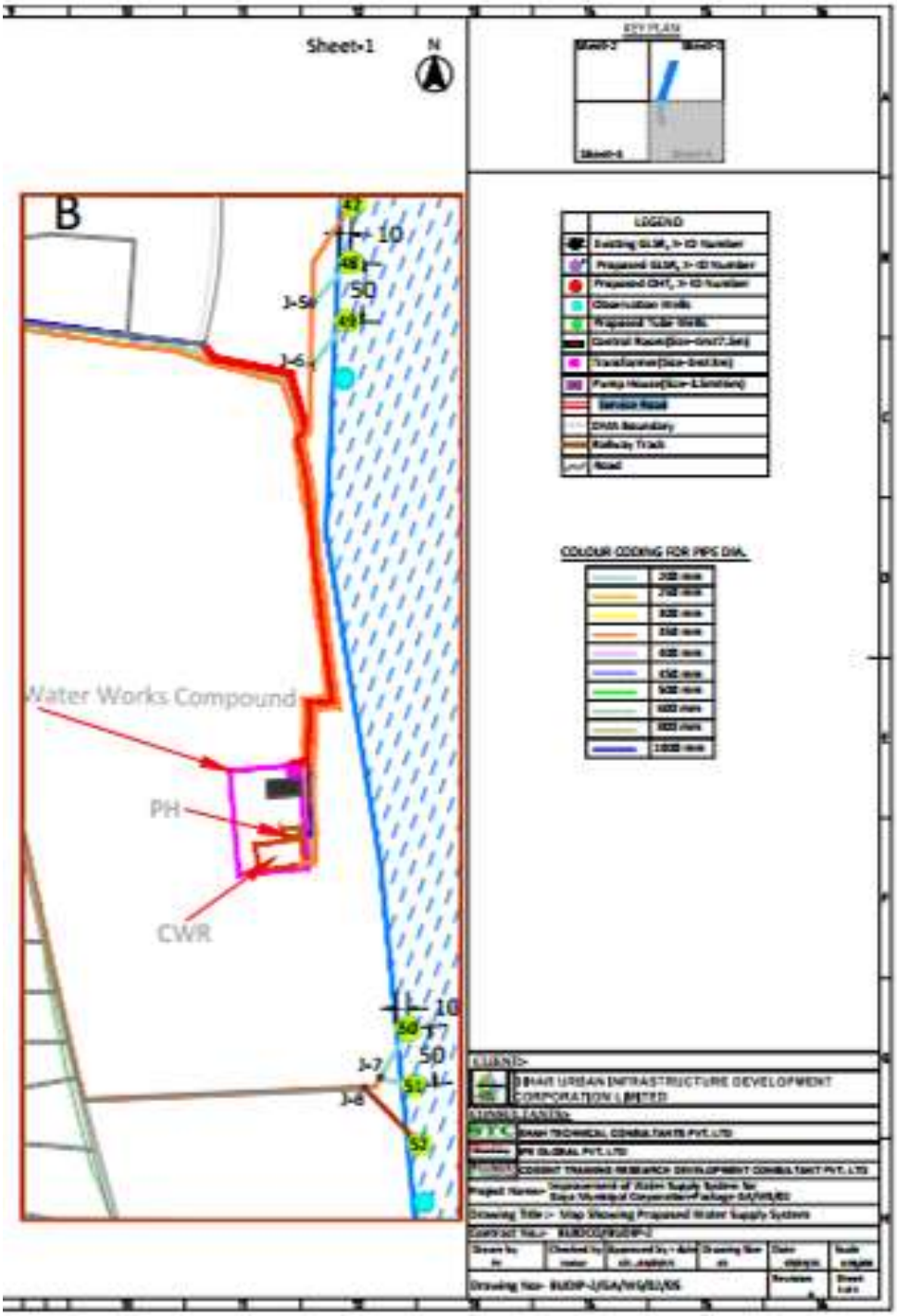
Layout plan at Singrasthan

Existing approach road at Singrasthan



LAYOUT PLAN OF PROPOSED HEAD WORKS IN POLYTECHNIC COLLEGE CAMPUS

Layout plan ITI Polytechnic College



Approach Road ITI Polytechnic College

Meeting on Water Source for Gaya Water Supply

16 May 2014

11am, BUIDCo Conference Room

Participants

• BUIDCo	Mr. A.K. Sharma, CGM	Mr. D.S. Mishra, GM Works
• CGWB	Mr. G.K. Roy	Mr. S.N. Dwivedi, Scientist
• PMU	Mr. V.K. Sharma, PM	
• PMC	Mr. J.H.C. Butter, TL	J.K. Singh, Dr. A. Mitra, J. Tyagi, A.K. Patni, N. Appa.
• HGSC	Dr. R. Khilnani	
• DSC	Mr. S. Ramakrishnan, Add.TL	

Minutes

1. **Presentation of the methodology and findings of the hydro-geological investigations for Gaya Water Supply Project,** by Dr. R. Khilnani, Hydro-Geo Survey Consultants (HGSC), Jodhpur.

2. **Discussions on the findings**
   2.1. CGWB complemented BUDIPO and HGSC on the comprehensiveness of the investigations and the richness of information provided in the 2nd Interim Report.
   2.2. CGWB had a number of specific queries:
   - To assess the exploitable water quantities, could a TIL methodology be used?
   - A specific yield of the Phalgu River bed of 15% seems at the high side, also considering that clayey pockets are encountered.
   - In the assessment of the exploitability of the aquifer, the area considered may be extended laterally from the river bed.
   - A lowering of the water table during the summer period (no flow in the Phalgu River) of 4 to 6m would be acceptable. Key condition is that hand pumped tube wells in the area would not be affected.
   - The duration of no-flow in the Phalgu river is a key parameter and further investigations with the aid of a runoff model would be advisable. Without further research a duration of 120 days seems acceptable.

   2.3. DSC had a number of observations:
   - A duration of no-flow of 2.5 months seems too optimistic;
   - The water demand of 124MLD mentioned in the report is not correct. This was clarified by PMC. The principles of the findings are not affected.
   - 50% dependability. This has already been adjusted since the 1st Interim Report in the 2nd Interim Report.
   - Advice to carry out additional resistivity soundings in the Manpur Area.

   2.4. BUIDCo advised that well siting, spacing and design be carried out based on the results of this 2nd Interim Report and that further investigations be carried out in parallel.
   2.5. Further discussions included the following topics:
   - Resistivity soundings may be carried out lateral (east and west) from the Phalgu.
   - There shall be a restriction on sand/gravel mining in the concerned stretch.
   - There is a need for continuous monitoring during operations.

- On a comprehensive groundwater model: this is complicated to make and requires extensive factual data. It may be considered after monitoring data has been gathered over a longer period of time.

3. **Conclusions**

3.1. The development of a well field to meet the medium-term (15-year) needs of Gaya Town is recommended.

3.2. A monitoring system shall be part of the design, consisting of some 6 observations wells in the well field area plus some 3 wells further away. A telemetric system shall be considered.

3.3. Further investigations to be taken up by BUDIP to plan for the 30-year requirements:

- to obtain more detailed information and assurance/ higher dependability about exploitation of the areas south of the town
- to examine the potential downstream of the town (4 – 6 km), and
- to examine the potentials further upstream (20km).
- And under GHSC's current contract, the execution of additional resistivity soundings in Manpur Area.

Signatures

(Mr. A.K. Sharma)
Chief General Manager, BUIDCo

(Mr. G.K. Roy)
CGWB

(Mr. J.H.C. Butter)
TL – PMC

(Mr. D.S. Mishra)
General Manger (Works), BUIDCo

(Mr. S.N. Dwivedi)
Scientist, CGWB

(Dr. R. Khilnani)
HGSC

(Mr. V.K. Sharma)
Program Manager, PMU

(Mr. S. Ramakrishnan)
Add. TL - DSC

Appendix 5: Hydro-geological Study – Water Quality

Hydro-geological Study- Water Quality

To find out the suitability of ground water which is being supplied to Gaya for drinking use, 10 water samples were collected from tube wells of Dandibagh pumping well field and other wells of study area. The water samples were analyzed in the Chemical Laboratory of the HCPL at Jodhpur, which is working since 1985 and is an ISO accredited Lab. by LMS (Linear Management and Certification Solutions Private Limited) of DAC. The water samples for bacteriological tests like coliform and E.Coli were brought by air from Gaya to Jodhpur within 2 days from the date of collection in perfectly sealed and sterilized bottles and for other radicals, there were analyzed within 3 days in sealed and sterilized bottles without affecting its chemical composition. The chemical analysis results were compared with the Indian Drinking Water Standards (IS-10,500-2012)

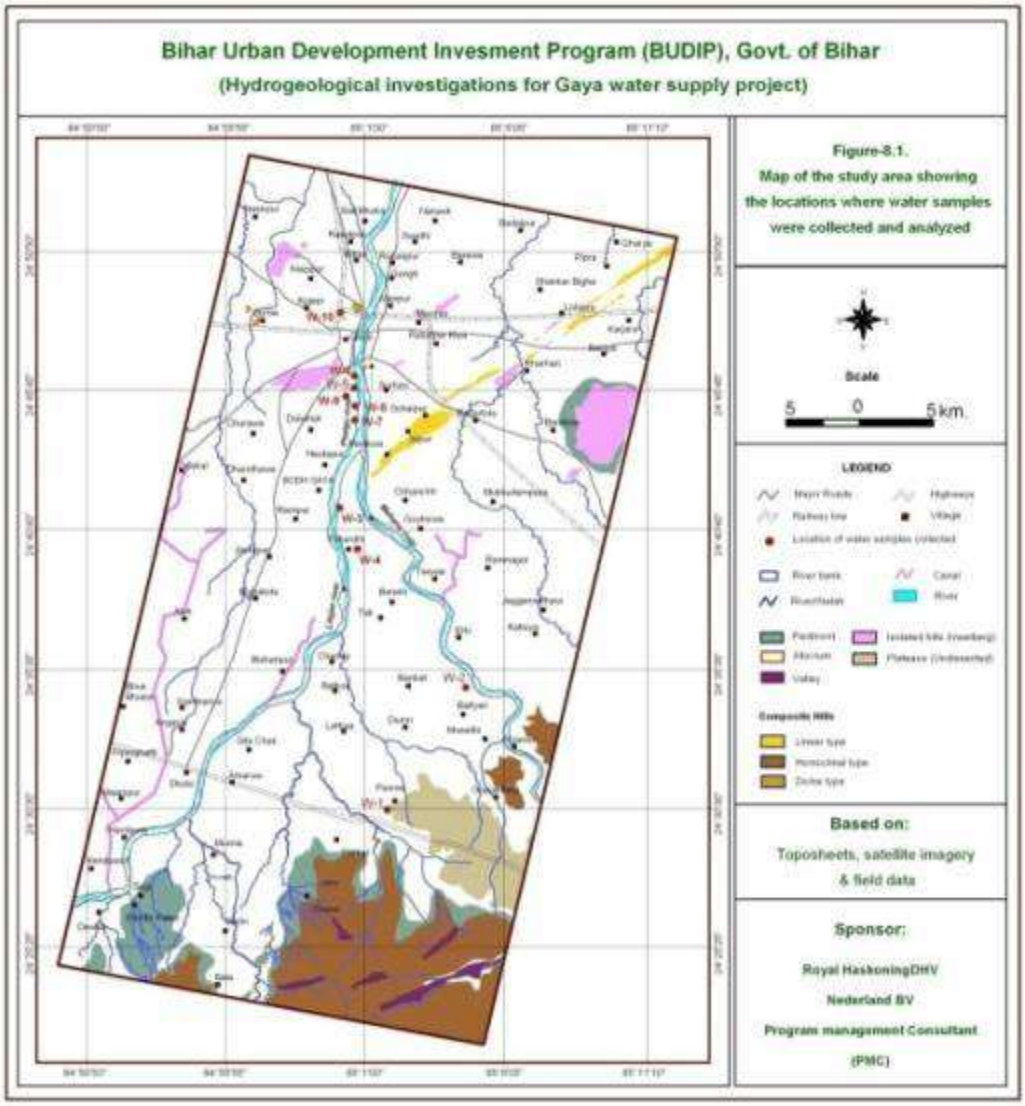


Figure: Location of water sampling areas

Table- 6.1: Details of location, type of source, coordinates and villages from where the water samples were collected and analyzed

S. No.	Water Sample Code	Source	Location/village	Co-ordinates	
				Longitude	Latitude
1.	WS-1	Hand pump	Partapi	85° 1' 47.4"	24° 30' 26.1"
2.	WS-2	Hand pump	Mohanpur	85° 4' 39.0"	24° 34' 53.8"
3.	WS-3	Hand pump	Bakror	85° 0' 03.7"	24° 41' 26.3"
4.	WS-4	Hand pump	Nima	85° 0' 42.4"	24° 39' 56.1"
5.	WS-5	Hand pump	ITI Ghughitand	85° 0' 35.0"	24° 45' 49.0"
6.	WS-6	Tube well	Dandibagh pump house	85° 0' 35.8"	24° 46' 15.2"
7.	WS-7	Hand pump	Khiriyawan	85° 0' 36.5"	24° 44' 37.7"
8.	WS-8	Tube well	Kundua	85° 0' 37.8"	24° 45' 08.6"
9.	WS-9	Tube well	Kundui	85° 0' 17.4"	24° 45' 30.5"
10.	WS-10	Tube well	Janta Colony, Gaya	85° 0' 05.2"	24° 48' 33.9"

Table 6.2: Chemical analysis of water sample collected form study area and acceptable limits as per IS-10,500-2012 (May 2014)

Parameter Tested	Results					Indian Standards IS: 10,500-2012	
	WS-1	WS-2	WS-3	WS-4	WS-5	Acceptable limit	Permissible limit
Color (Hazen units)	Colorless	Colorless	Colorless	Colorless	Colorless	**5**	**15**
Odor	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	**Agreeable**	**Agreeable**
Turbidity (NTU)	**Nil**	**1**	**Nil**	**Nil**	**2**	**1**	**5**
Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	**Agreeable**	**Agreeable**
pH	7.79	7.74	7.71	7.74	7.72	**6.5-8.5**	**No Relaxation**
Electrical Conductivity at 25^0C in μmhos/cm	595	510	272	518	315	**N.P.**	**N.P.**
TDS (Total Dissolved Solids)	340	285	155	292	175	**500**	**2000**
Calcium	39	33	18	34	19	**75**	**200**
Magnesium	23	20	10	21	12	**30**	**100**
Sodium	46	39	22	38	25	**N.P.**	**N.P.**
Potassium	3	2	1	2	1	**N.P.**	**N.P.**
Chloride	85	78	42	79	46	**250**	**1000**
Carbonate	138	119	61	120	72	**N.P.**	**N.P.**
Bi-Carbonate	-	-	-	-	-	**N.P.**	**N.P.**
Sulphate	46	32	17	34	21	**200**	**400**
Nitrate	17	13	8	15	9	**45**	**No relaxation**
Fluoride	0.37	0.34	0.29	0.34	0.29	**1.0**	**1.5**

Parameter Tested	Results					Indian Standards IS: 10,500-2012	
	WS-1	WS-2	WS-3	WS-4	WS-5	Acceptable limit	Permissible limit
Total Hardness as $CaCO_3$	192	165	86	171	97	**200**	**600**
Arsenic	BDL	BDL	BDL	BDL	BDL	**0.01**	**0.05**
E. Coli MPN/ 100 ml	Absent	Absent	Absent	Absent	Absent	**Absent**	**Absent**
Total Coliform MPN/100	0	0	0	0	0		

Contd..

Parameter Tested	Results					Indian Standards IS: 10500-2012	
	WS-6	WS-7	WS-8	WS-9	WS-10	Acceptable limit	Permissible limit
Color (Hazen units)	Colorless	Colorless	Colorless	Colorless	Colorless	**5**	**15**
Odor	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	**Agreeable**	**Agreeable**
Turbidity(NTU)	2	Nil	Nil	Nil	3	**5**	**10**
Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	**Agreeable**	**Agreeable**
pH	7.72	7.71	7.69	7.78	7.70	**6.5-8.5**	**No Relaxation**
Electrical Conductivity at 25^0C in μmhos/cm	310	290	312	326	366	**N.P.**	**N.P.**
TDS (Total Dissolve Solids)	173	165	170	184	214	**500**	**2000**
Calcium	18	17	18	20	22	**75**	**200**
Magnesium	12	10	11	13	14	**30**	**100**
Sodium	26	26	27	25	30	**N.P.**	**N.P.**
Potassium	1	1	1	3	2	**N.P.**	**N.P.**
Chloride	45	44	45	48	51	**250**	**1000**
Carbonate	71	66	71	70	84	**N.P.**	**N.P.**
Bi-Carbonate	-	-	-	-	-	**N.P.**	**N.P.**
Sulphate	21	18	21	23	27	**200**	**400**
Nitrate	8	7	8	9	14	**45**	**100**
Fluoride	0.26	0.27	0.22	0.24	0.28	**1.0**	**1.5**
Total Hardness as $CaCO_3$	94	84	90	103	112	**200**	**600**
Arsenic	BDL	BDL	BDL	BDL	BDL	**0.01**	**0.05**
E. Coli MPN/ 100 ml	Absent	Absent	Absent	Absent	Absent	**Absent**	**Absent**
Total Coliform MPN/100	0	0	0	0	0		

BDL- Below detection limit

N.P – Not prescribed

Appendix 6: Water Quality Analysis (Environment Implication related to waste water discharge impact on ground water resources at Gaya)

NOTE
Gaya Water Supply Project Phase 2 – Water Source
Environment Implication related to waste water discharge impact on ground water resources at Gaya – Water Quality Analysis

PMC, 28 July 2015

1. Purpose of Investigation

Gaya city is situated along the banks of River Phalgu. This river is formed by the merger of two streams of Nilanjan and Mohana about 5 km south of Gaya city, and flows south to north through the heart of Gaya District. The width of the river in Gaya is about 900 m. The famous Vishnupad Temple is located on the banks of the river and there are a number of *ghats* (bathing and worshipping) developed for the pilgrims. This river is a tributary of River Punpun, which joins River Ganga near Patna.

Under Gaya Water Supply Project – Package 2 (GWSP2) a new water source will be developed, by drawing water from the aquifer in the bed of the Phalgu River through batteries of new production tube wells (PTW). Because the aquifer is unconfined it is susceptible to contamination from nearby sources such as the city's wastewater and agricultural activities. This possible threat has been examined by analyzing the water quality of two existing PTWs in the same aquifer and analyzing possible sources of contamination, i.e. i) urban wastewater draining into the Phalgu River, upstream of the two PTWs and ii) groundwater underlying agricultural fields in the vicinity.

Water supplied from the existing Panchayat Akhara well field is located at the downstream side of Gaya city. It is noted that there is problem of color, odor of water from this well field. This may be due to pollution of groundwater from disposal of untreated waste into the river. There is no sewerage system in Gaya. Many people in the city use septic tanks and it is reported that these do not function properly, with leachate seeping into the groundwater through percolation and with overflows from septic tanks flowing into the town's drains. The same drains are recipient of untreated human wastes and of garbage. The other well field is located at Dandibag at the upstream side of the city.

2. Method of Analyses

Sampling locations

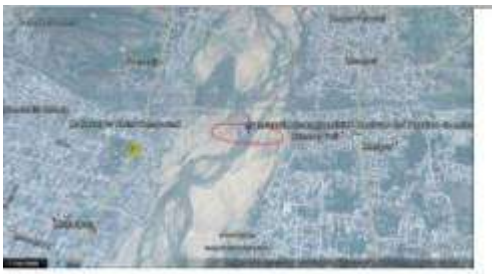
Sampling locations and number of samples are:

- ✓ Two samples of drinking water were collected from PTWs at Dandibagh and Panchyati Akhara and analyzed for both pesticide residue and physic-chemical analysis.
- ✓ Two ground water samples were collected from tube wells located at Amwan village and Khiriya village near new tube well source and analyzed for pesticide residue for understanding impact on groundwater from agricultural activities.
- ✓ Three samples of wastewater were collected, two from Bodhgaya (Mochari *nallaha* and Dhairiya Bigha) and one from Gaya central for physic chemical analysis of wastewater.
  - ✓ The Mochari *nallaha* in Bodhgaya drains a southern section of the town. The sample at Dhairiya Bigha is taken from the Phalgu River, immediately downstream of the town.
  - ✓ The sample in Gaya city is taken from a relatively large drain, which receives water from the congested city centre. It discharges into the Phalgu River some 1.5km upstream of the PTW at Panchyati Akhara.

Location map is shown in **Figure 1.**Details of location including co-ordinate shown in **Table 6-1**.

Figure 1: Location of sampling stations

Table Appendix 6-1 Detail water sampling locations

S.N.	Name of Site	Sample	Coordinate	Location map
1	Panchayati Akhara Tube well	Physicochemical and Pesticide residue Analysis	24.4748, 85.0047	
2	DandiBagh Tubewell (srimvikasno2PumpH62)	Physico chemical and Pesticide residue Analysis	24.4612,85.0038	

S.N.	Name of Site	Sample	Coordinate	Location map
3	Khiriyawa (Jaynath)	Pesticide Residue in Tube well/Hand pump	24.4427,85.0031	
4	Amwan Village (Lal JiPrasad)	Pesticide Residue in Tube well/Hand pump	24.4334,85.0010	
5	GWSP-2 Mochari *Nallaha*	Physico-chemical Analysis of Wastewater	24.4142, 84.5940	
6	GWSP-2 Dhairiya Bigha	Physico-chemical Analysis of Wastewater	24.4236,84.5952	
7	Gaya Mid City	Physico-chemical Analysis of Wastewater	24.4713, 85.0035	

Parameters

The water quality has been tested to assess possible contamination resulting from wastewater discharge and agricultural activities.

During sampling DO, temperature, and color were determined at sampling locations using digital meters. Water samples analyzed in laboratory for physico-chemical parameter as Maniacal Nitrogen as N , BOD at 27^0C for 3 days, COD, Chloride as Cl, color, Conductivity at 20^0C,DO, Fluoride, Total Hardness as $CaCO_3$,Total phosphates as PO_4, Sulphate as SO_4,TSS,TDS,Temperature,Nitrite as NO_2,Residual Free Chlorine, Arsenic as As, Total Chromium as Cr, Cu Pb, Manganese as Mn, Cd, Zn, Na, K, Ca Mg, Fe, Oil and Grease. Pesticide residue analysis of the selected parameter which are generally used in agriculture are Methyl Parathion, Chlorpyriphos, Malathion, Phorate, Gamma HCH ,Alpha HCH, Beta HCH, Delta HCH Endosulphan (alpha, beta and Sulphate).

Sample collection times

Water samples were collected during the dry period pre-monsoon season (on 17thJune 2015). Dry period/ pre monsoon season is the worst season and that time concentration of parameters in wastewater and well water is comparatively higher than normal condition.

3. Results and Discussion

Table Appendix 6-2 shows concentration of pesticide residues and status of physic-chemical parameters in drinking water as collected from the present well field areas.

Result indicates presence of Fluoride in both the samples, but concentration level is within the limit. Total hardness level at Panchyati Akhara is 210.1 mg/l, the value above the limit and which indicates presence of high level of Ca and Mg in water. Total dissolved solid level is also high in tube well water at Pancayati Akhra. This is due to high salt content of water. Concentrations of all other parameters are within the limit. Concentrations of heavy metals are always below the detection limit except concentration of Pb, which is detected in Panchyati Akhra tube well water. Disposal of waste and discharge of untreated effluent in the Phalgu River at Panchyati Akhra area may be the reason of contamination of tube well water. Pesticides are not detected in water samples.

Table Appendix 6-2: Testing results for Production Tube Wells: and physico- chemical properties and pesticide residues

S.N.	Parameters	Location		Standard: IS 10500:2012	
		1. Panchayati Akhara	2. Dandibagh		
	Physicochemical			**Acceptable**	**Permissible**
1	BOD(27^0C for3days)mg/L	BDL	BDL	-	-
2	COD mg/L	<5.0	<5.0	-	-
3	Calcium as Ca mg/L	56.7	26.7	75	200
4	Chloride as Cl mg/L	55.8	14.0	250	1000
5	Residual free Chlorine mg/L	BDL	BDL	0.2	1
6	Color in Hazen unit	10	10	5	15
7	Fluoride as F mg/L	0.3	0.3	1.0	1.5
8	Totalhardness as $CaCO_3$ mg/L	210.1	99.0	200	600
9	Mg mg/L	16.7	7.9	30	100
10	Nitrate as NO_3 mg/L	5.29	2.20	45	No relaxation
11	pH at 25^0C	7.58	7.84	6.5-8.5	No relaxation
12	Sulphates as SO_4 mg/L	9.6	6.3	200	400

S.N.	Parameters	Location		Standard: IS 10500:2012	
		1. Panchayati Akhara	2. Dandibagh		
13	TDS mg/L	311.2	165.6	500	2000
14	Arsenic as As mg/L	BDL	BDL	0.01	0.05
15	Total Chromium as Cr mg/L	BDL	BDL	0.05	No relaxation
16	Cu mg/L	BDL	BDL	0.05	1.5
17	Pb mg/L	0.010	BDL	0.01	No relaxation
18	Mn mg/L	BDL	BDL	0.1	0.3
19	Cd mg/L	BDL	BDL	0.003	-
20	Maniacal Nitrogen as N mg/L	BDL	BDL	-	-
21	DO mg/L	3.4	4.5	-	-
22	Conductivity as25^{0}C µS/cm	497	266	-	-
23	Oil and Grease mg/L	BDL	BDL	-	-
24	Fe mg/L	0.06	0.07	0.3	Non relaxation
25	Zn mg/L	0.02	0.02	5	15
26	Na mg/L	47.49	21.28	-	-
27	K mg/L	2.78	BDL	-	-
28	TotalPhosphatesasPO_4 mg/L	0.37	BDL	-	-
29	TSS mg/L	BDL	BDL	-	-
30	Temperature^{0}C	30.6	30.5	-	-
31	NitriteasNO_2 mg/L	BDL	BDL	-	-
	Pesticides			-	-
1	Methyl parathion µg/L	<0.01	<0.01	-	0.3
2	Malathion µg/L	<0.01	<0.01	-	190
3	Chlorpyriphos µg/L	<0.01	<0.01	-	30
4	DDT(o,pandp,p isomersof DDT DDEandDDD) µg/L	<0.01	<0.01	-	1
5	Gamma HCH µg/L	<0.01	<0.01	-	2
6	Alpha HCH µg/L	<0.01	<0.01	-	0.01
7	BetaHCH µg/L	<0.01	<0.01	-	0.04
8	Delta HCH µg/L	<0.01	<0.01	-	0.04
9	Endosulfan Sulphate(Alpha Beta and sulphate)µg/L	<0.01	<0.01	-	0.4

Table Appendix 6-3 shows the results of the analysis on residues of pesticides in tube wells underlying agricultural fields. In both the tube wells water pesticides are not detected. That indicates the aquifer is not contaminated with pesticides used for agricultural purpose.

Table Appendix 6-3: Results for groundwater underlying agricultural fields: pesticide residues in tube wells

S.N.	Parameters	Location	Standard: IS 10500:2012

		3. Khiriyawa village	4. Amwan village		
	Pesticide residue			**Acceptable**	**Permissible**
1	Methyl parathion µg /L	<0.01	<0.01	-	0.3
2	Malathion µg/L	<0.01	<0.01	-	190
3	Chlorpyriphosµg /L	<0.01	<0.01	-	30
4	DDT(o,pandp,pisomers of DDT DDE and DDD) µg/L	<0.01	<0.01	-	1
5	GammaHCH µg/L	<0.01	<0.01	-	2
6	Alpha HCHµg/L	<0.01	<0.01	-	0.01
7	BetaHCHµg/L	<0.01	<0.01	-	0.04
8	Delta HCHµg/L	<0.01	<0.01	-	0.04
9	Endosulfan Sulphate(Alpha Beta and sulphate µg/L	<0.01	<0.01	-	0.4

Table Appendix 6-4 shows physic-chemical property of wastewater. Results indicate that concentration of BOD (63.3 mg/l) is above the limit in Gaya *nallaha* (central part) water. Concentration of COD is also high in *nallaha* water. In all the *nallaha* water fluoride level is high. TSS level is also high in Gaya *nallaha* (central part) and Daharia Bigha *nallaha* water. Presence of Pb, Mn and Fe are also high in that *nallaha* water. Concentration of Pb and Fe is also above the limit in Gaya *nallaha* (central part).

Comparing the concentrations of pollutants in the drain at Gaya city (sample 7) with those taken at Bodhgaya (samples 5 and 6) confirms the expected higher pollution originating from the former.

Comparing the results for Bodhgaya indicates the effect of dilution of drain water (sample 5) after it flows into the Phalgu River (sample 6).

Table Appendix 6-4: Test Results for Wastewater: Physico chemical properties

S.N.	**Parameters**	**Location**			**Standard CPCB discharge into inland surface water**	
		5. Mochari *nallaha*	**6. Daharia Bigha**	**7. Gaya *nallaha* at Central part**		
	Physico-chemical					
1	Maniacal Nitrogen as N mg/L	28.3	<0.1	48.1	**-**	**50**
2	BOD (27^0Cfor3 days) mg/L	8.4	3.1	63.3	-	30
3	COD mg/L	27	10.0	210.0	-	250
4	Chlorides Cl mg/L	55.8	27.9	139.5	-	-
5	Color Hazen unit	50	50	45	-	-
6	Conductivity as 20^0C µS/cm	440	438	1590.0	-	-
7	DO mg/L	1.5	3.4	<0.1	-	-

S.N.	Parameters	Location			Standard CPCB discharge into inland surface water	
		5. Mochari *nallaha*	6. Daharia Bigha	7. Gaya *nallaha* at Central part		
8	Fluoride as F mg/L	0.3	0.5	0.4	-	2.0
9	Total hardness as $CaCO_3$ mg/L	212.1	171.7	383.8	-	-
10	pH	7.67	7.73	7.75	5	9.0
11	Total Phosphates as PO_4 mg/L	8.24	BDL	21.90	-	-
12	Sulphates as SO_4 mg/L	8.3	11.1	15.8	-	-
13	TSS mg/L	90.2	204	109.6	-	100
14	TDS mg/L	279.5	246.2	975.0	-	-
15	Temperature ^0C	30.8	31.1	31.2	-	-
16	Nitrite as NO_2 mg/L	3.21	0.01	0.02	-	-
17	Residual Free chlorine mg/L	0.10	0.10	0.10	-	-
18	As mg/L	BDL	BDL	BDL	-	0.2
19	Total Chromium as Cr mg/L	BDL	0.23	0.04	-	2.0
20	Cu mg/L	BDL	0.030	0.060	-	3.0
21	Pb mg/L	0.008	**0.25**	0.038	-	0.01
22	Mn mg/L	0.27	**2.55**	0.40	-	2.0
23	Cd mg/L	BDL	BDL	BDL	-	2.0
24	Zn mg/L	0.01	0.07	0.32	-	5
25	Na mg/L	82.79	35.10	112.38	-	-
26	K mg/L	20.49	7.20	46.93	-	-
27	Ca mg/L	84.43	61.17	133.40	-	-
28	Mg mg/L	24.48	26.07	32.23	-	-
29	Fe mg/L	0.27	**4.27**	6.05	-	3
30	Oil and Grease mg/L	BDL	BDL	2.6	-	10
31	Nitrate as NO_3 mg/L	6.08	11.57	10.39	-	-

Recommendations and Conclusion

From the results of present study we conclude that:

Contamination from agricultural activities

- *The aquifer underlying agricultural fields is not contaminated with pesticide and no traces are detected in the proposed water source, i.e. the bed of the Phalgu River.*

Contamination from domestic wastes - Dandibagh

- *Water from the Production Tube Well at Dandibagh (sample 2) is safe for drinking. Although waste discharges originating from Bodhgaya town (samples 5 and 6) do show appreciable contamination, the concentrations of the relevant parameters show a substantial decrease in the PTW sample. This suggests a purifying effect of the bed of the Phalgu River, both by dilution and by absorption / reduction.*

Contamination from domestic wastes – Panchyati Akhara

- *Contamination of the PTW at Panchyati Akhara (sample 1) is more pronounced than at Dandibagh. This correlates with the relatively large discharges of wastes from the adjacent urban area (sample 7). Although all relevant parameters at the PTW are still within acceptable limits, the threat from the town's waste is apparent.*
- *To protect the aquifer in the bed of the Phalgu River from further pollution, it is required to collect and treat the city's wastes in the town area that drains directly into the Phalgu.*

Appendix 7: Gaya Water Supply Phase 2 – Water Source - Potential Impact from Effluent Disposal on the Water Source

NOTE
Gaya Water Supply Phase 2 – Water Source
Potential Impact from Effluent Disposal on the Water Source

PMC, 20 November 2014

1. Introduction

To supply water to the city of Gaya, the aquifer of the river bed underlying the Phalgu River will be further developed. Additional wells will be constructed in the river bed upstream of the town.
During the environmental screening of the proposed well development works, the possibility of impact from disposal of wastewater originating at Bodhgaya, a town of about 30,000 populations some 8 km upstream of Gaya has been identified.
In this Note this potential impact is examined with the purpose to assess its significance.

2. Technical Parameters

2.1 The Water Source

Quantities

Average annual runoff in the Phalgu River at Gaya is estimated at 1030 million cubic meters (mcm) [Ref. 1]. The Phalgu River is a non-perennial river and does not carry surface flow during a period of 2 to 4 months each year. For the purpose of the analysis in this memo three typical moments are considered.

1. Normal river runoff. Assuming that the river carries water during 9 months a year, average daily flow would be about 3800 MLD.
2. Minimal runoff just before the river falls dry. We consider a flow of twice the total abstraction to Gaya water supply, i.e. 2 x 70 = 140 MLD (see next section for the 70 MLD).
3. The river is dry and the surface flow is zero.

Quality

Reference 1 includes results from water quality analyses of water from the Phalgu aquifer. It concludes that the water is very good quality, has no objectionable constituents (hardness, arsenic, fluoride) and no traces of pollution (such as nitrates, bacteriological).

2.2 Water Abstraction

Quantities

Of the 80 MLD medium-term requirements for Gaya town, some 70 MLD is to be abstracted from the Phalgu aquifer. Of this, 43.5 MLD are existing wells and 26.5 MLD has to be supplied from new wells [Ref. 2]. See the map in Annex 1.

Quality

Water supplied to Gaya shall meet the Indian Water Quality Standards.

2.3 Wastewater

Quantities

Bodhgaya is the largest town upstream of Gaya. It has about 30,000 inhabitants, about 1/10 of those in Gaya. Other settlements are small and dispersed and contribute relatively little to wastewater generation. Also, there is no industrial or important commercial establishment in the river's catchment area upstream of the proposed well field.
Until date, there was no planned collection and treatment of wastewater in Bodhgaya. Wastewater was either being disposed in the ground through soak pits or found its way to the Phalgu through the storm drainage ditches. It is difficult to estimate quantities. A population of 30,000 represents a total wastewater generation of about 1.5 MLD (@ 50l/cd). It is impossible to

say how much of this would reach the river. The same is valid for composition of the wastewater.

Currently a sewerage project is being implemented in Bodhgaya. A sewer network will be constructed and wastewater will be conveyed to a Sewage Treatment Plant (STP), situated near the village of Suryapur on the river's west bank. The STP site is just upstream of the production well owned by the military (MES) and about 2km upstream of the first horizontal collector well to be constructed under the project. See the map in the Appendix. The STP will be laid out in two stages, with the first stage of 10MLD capacity sufficient to meet the medium term needs [Ref. 4].

Quality

MBBR treatment process is considered for Bodhgaya. The aim is to meet Indian Standards for disposal of treated effluent in inland surface waters.

In the following, it is assumed that these standards are indeed being met.

1. The Physical Process

For the analysis of potential impact from the STP on water abstracted for Gaya town, consider the following chain of events:

- The STP on the bank of the Phalgu River disposes treated effluent at a rate of 10 MLD into the river.
- The effluent is more or less mixed with the river water and flows off downstream. This will cause a dilution of the effluent.
- In case the river is dry, the treated effluent will form a short stream downstream of its disposal point, gradually infiltrating into the aquifer and disappearing from the surface.
- The production tube wells for Gaya town abstract the water from the aquifer near to the underlying bedrock.
- When the river is in flow, the abstracted water is replenished by the river water.
- When the river is dry, the abstraction is not being replenished and the water table in the aquifer will gradually drop.
- In either way, the (diluted) effluent finds its way into the well. While it travels through the aquifer, the quality of this water will change.

Let us look at three scenarios.

3.1 Scenario 1 - Phalgu River in full flow

With an average daily flow of 3800 MLD, the effluent flow of 10 MLD will be diluted by a factor of almost 400. This situation prevails for about 7 months every year.

The diluted water will percolate into the aquifer, travel to the well and be pumped out to the town. During its journey through the aquifer, the water will be purified. We will elaborate on that in Scenario 2 (the next section), because the effects are more prominent.

3.2 Scenario 2 - Phalgu River in low flow

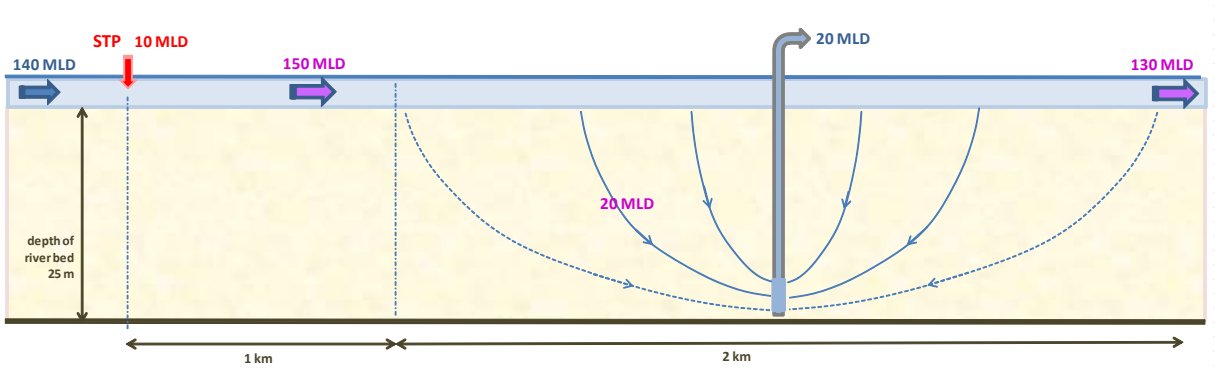
Dilution in the river

This situation may occur for about 2 months per year. Consider a river flow of close to the total rate of water abstraction, i.e. a flow of 140 MLD. Dilution of the effluent will be by a factor 15. This means that the concentration of most of the critical parameters in the effluent drop below the permissible levels for drinking water. For example, if the effluent has a sulfate content of 1000 mg/l as per allowable standard, it will drop to 67 mg/l, which is well below the desirable level for drinking water of 200 mg/l.

Other parameters, of which especially pathological contamination is of concern, may not drop sufficiently.

Because of dilution in the river, many critical quality parameters will drop below permissible levels. When the river is in full flow this effect is more pronounced.

Figure Appendix 7-1: Phalgu River bed, water abstraction and recharge – river with surface flow



Flow through aquifer

Figure Appendix 7-1 illustrates the flow through the aquifer from the river to the well screens. The retention time in the aquifer is the determining parameter. Theoretically, the sphere of influence of the well is about 1 km at both sides, giving a retention time of 375 days or 12 months[33]. However, this is in case of an unconfined aquifer in which the water table (and hydraulic head) drops towards the well as in Scenario 3 below. In Scenario 2, it is different as the hydraulic head is horizontal (and at river surface level). The effect is that groundwater flow nearer to the well is relatively higher and its contribution to the flow into the well larger. By analyzing the theoretical duration of flow from the river along groundwater flow lines (the curved lines in Figure) and into the well for different horizontal distances from the well, an average retention time of 66 days seems to be representative. In other words, the zone of influence would be about 175 m on both sides of the well.
A retention time of 2 months seems a safe assumption.

Risk of shortcuts
There is possible that the effluent does not mix immediately but forms a plume in the river. When this plum flows near to the well, there is a risk that disproportionally much effluent is drawn into the well. This may occur especially when traditional, single wells are used. By necessity, they will be constructed in the river near to the western bank. The river channel receiving the effluent runs along the same bank.

Purification in the aquifer
When contaminants are introduced into an aquifer, they will either move with the water, as nitrates do, or be retained on the solid matrix as generally happens to cations and organic matter. If pollutants that are retained do not break down, they will accumulate within the aquifer. This removal of pollutants in the water is generally considered as a positive impact [Ref. 5]. Pollutants that travel with the water can also break down such as microorganisms, of which especially the pathogens are of interest.

[33] Retention time: Volume (2000 x 1000 x 25 X 15%) / Flow (20 MLD) = 375 days.

The situation we have at hand with an STP of which the effluent infiltrates into the aquifer and is then "reused" as part of the water abstracted for drinking water supply, is very similar to an artificial aquifer recharge scheme (ARS). Over the past decade quite some research has been carried out on existing ARS's and information is available that gives some insight in purification processes and their effectiveness. Some of this is represented hereunder.

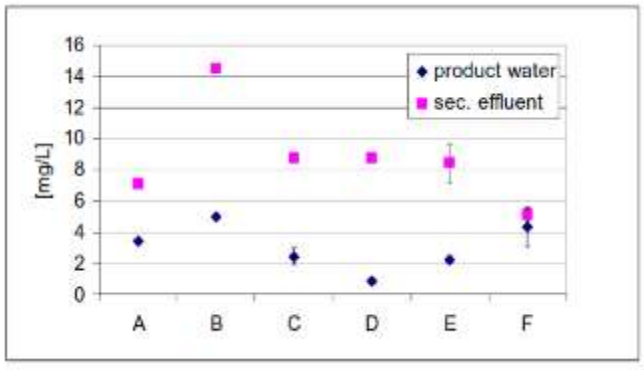
Table - Decay times for a 90% loss (T90) of pathogens and indicator microorganisms in groundwater at the ASTR[34] site[Ref. 5].

Pathogen/Indicator	T_{90} (days)	
	Reedbed	ASTR
E. coli	4.3	0.1
Enterococcus faecalis	6.2	2.5
Salmonella typhimurium	4.7	0.7
Campylobacter jejuni	ND[1]	0.2
Coxsackievirus	ND	109
Adenovirus	32.6	59
Rotavirus	ND	185
Cryptosporidium parvum oocysts	87	86

[1] ND = Not done.

Table shows average decay rates of pathogens and microorganisms as monitored at three aquifer recharge sites in Europe (the reedbed is not relevant). For example, the concentration of *Enterococcus faecalis* reduced to 10% of its original level within a period of 2.5 days. Or, after 10 days, the concentration would reduce by a factor 10,000.
The T90 decay time for Rotavirus was measured as 185 days of 6 months, similar to the estimated retention time at Phalgu.
Figure Appendix 7-2.shows results of investigations into the removal of organic compounds in aquifer recharge schemes. The indicator is a compound value for various organic parameters (DOC or bulk organic carbon). Results are from six different sites (A through F) where conditions do vary.

Figure Appendix 7-2. DOC of effluent and final groundwater at six different demonstration sites for groundwater recharge [Ref. 5]



A) Treated domestic wastewater injected by a sink hole into a fractured and karstic aquifer with relatively low residence time (< 30 days) (Nardò, Italy).

B) Treated domestic and industrial wastewater discharged into a river and infiltrated by bank filtration into the groundwater (water is recycled for lawn irrigation) (Sabadell, Spain).

C) Treated domestic wastewater treated by a low pressure membrane filtration (ultrafiltration, UF) prior to infiltration into a dug well with short term soil aquifer treatment (SAT retention time < 2 months) (Pilot unit, Shafdan) and

D) at the same location and source water quality infiltration for long term SAT with 6 - 12 months of retention time (Shafdan full scale plant).

E) At location (E) treated wastewater is processed in an integrated membrane system (UF followed by reverse osmosis) prior to pond infiltration and mid term SAT (Wulpen/Toreele Plant)

F) Domestic wastewater, coagulated (polyaluminum chloride) and ozonated before percolation for short term SAT treatment (Gaobeidian plant).

[34] ASTR = Aquifer Storage, Transfer and Recovery

certain standard parameters can easily increase. This remineralization is intentional, in particular when the water is used for drinking water production.

When comparing the influence of the residence time (Figure 3.12) the removal performance seemed lower for retention times below 60 days.

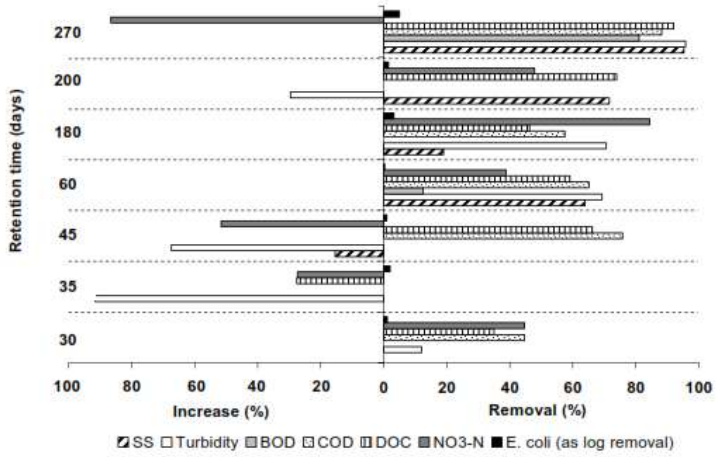
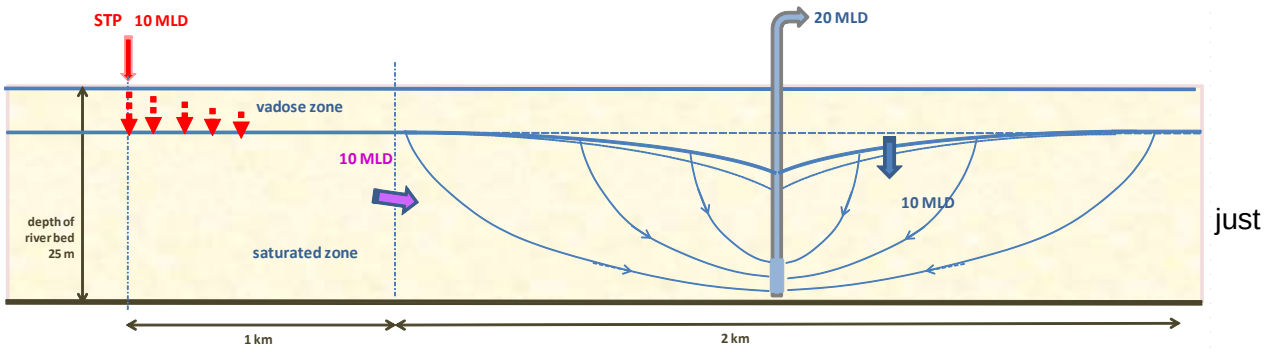


Figure 3.12 Average percentage removals or increase associated to the retention times of the sites studied.

3.3 Scenario 3 - Phalgu River without flow

Figure **Appendix 7-3** illustrates the situation when there is no flow in the river. This may happen during 3 months per year. The effluent percolates into the river bed, trickles through the unsaturated or vadose zone and recharges the aquifer. The well abstracts 20 MLD. 10 MLD of this replenished by the effluent, the other 10 MLD is obtained by a drop of the water level in the aquifer.

Figure Appendix 7-3: Phalgu River bed, water abstraction and recharge – no water in the river



just

- 10 MLD because of water level drop and flowing in from the downstream side.

Flow through the vadose zone

There is a purifying effect when the effluent percolates through the unsaturated zone. Literature suggests that this effect is stronger in the vadose zone than in a saturated aquifer.

The depth of the vadoze zone is “zero” initially and will gradually increase to about 5 meters over the 3-month period when the river is dry and the water table gradually drops.

In the analysis the flow through the vadose zone is not considered separately, but assumed to be subject to the same process as in the saturated zone.

Flow through the saturated zone

The key parameter is, again, the retention time. This is relevant for the treated effluent, flowing towards the well through the 1000m long aquifer upstream of the well. The retention time is about 375 days or 12 months.

Dilution

At the well the “effluent” containing groundwater is mixed with “pure” water from the aquifer, both at a rate of 10 MLD. There is a dilution by a factor 2.

4. Interpretation / Conclusions

4.1 Findings

Below Tables show how the effluent quality indicators change during movement through sub surface zone of Phalgu River. Particularly reduction of concentrations is being noted during Phalgu River in full flow (duration of 7 months), in low flow (duration of 2 months) and without flow (duration of 3 months) condition.

Scenario 1 - Phalgu River in full flow duration 7 months

indicators	effluent quality	reduction by mixing factor 400	reduction in aquifer[35] T = 2 months	possible quality at well	Indian Standard– Drinking water
Fecal coliform	-500/100mL desirable and 2500/100 mL Maximum permissible	maximum 2500/400 = 6/100ml	Survival time of Fecal coliform is 50 days only.	Safe	Shall not be detectable in any 100 ml sample
Nitrate	-	-	Reduction by denitrification	Safe	45 mg/l
Sulphate	1000 mg/l	2.5	Adsorption, reduction to sulphide	Safe	200-400 mg/l
Fluoride	2.0 mg/l	0.005 mg/l	Reduction	safe	1-1.5 mg/l
Oil & Grease	10 mg/l	0.025 mg/l	Adsorption	Safe	
Sulphide	2.0 mg/l	0.005 mg/l	Absorption	Safe	0.05 mg/l
Arsenic	0.2 mg/l	0.0005 mg/l	Adsorption	Safe	0.01-0.05 mg/l
Cd	2.0 mg/l	0.005 mg/l	Adsorption	Safe	0.003 mg/l
Cu	3.0 mg/l	0.0075 mg/l	Adsorption	Safe	.05-1.5 mg/l
Ni	3.0 mg/l	0.0075 mg/l	Adsorption	Safe	0.02 mg/l
Zn	5.0 mg/l	0.0125 mg/l	Adsorption	Safe	5-15 mg/l
Ammoniacal Nitrogen	50 mg/l	0.125 mg/l	Conversion to nitrate by	Safe	0.5 mg/l

[35] For a justification of the assessed reduction, please refer to the notes presented after the three tables.

			microbes		

Scenario 2 - Phalgu River in low flow duration 2 months

indicators	effluent quality	reduction by mixing factor 15	reduction in aquifer[3] T = 2 months	possible quality at well	Indian Standard– Drinking water
Fecal coliform	-500/100mL desirable and 2500/100 mL Maximum permissible	2500/15 =166/100ml	Number reduced –(Ref. to note below)	Safe	Shall not be detectable in any 100 ml sample
Nitrate	-	-	Reduction by denitrification	Safe	45 mg/l
Sulphate	1000 mg/l	67 mg/l	Adsorption, reduction to sulphide	Safe	200-400 mg/l
Flouride	2.0 mg/l	0.133 mg/l	Reduction	Safe	1-1.5 mg/l
Oil & Grease	10 mg/l	0.666 mg/l	Adsorption	Safe	
Sulphide	2.0 mg/l	0.133 mg/l	Absorption	Safe	0.05 mg/l
Arsenic	0.2 mg/l	0.013 mg/l	Adsorption	Safe	0.01-0.05 mg/l
Cd	2.0 mg/l	0.133 mg/l	Adsorption	Safe	0.003 mg/l
Cu	3.0 mg/l	0.2 mg/l	Adsorption	Safe	.05-1.5 mg/l
Ni	3.0 mg/l	0.2 mg/l	Adsorption	Safe	0.02 mg/l
Zn	5.0 mg/l	0.333 mg/l	Adsorption	Safe	5-15 mg/l
Ammoniacal Nitrogen	50 mg/l	0.125 mg/l	Conversion to nitrate by microbes	Safe	0.5 mg/l

Scenario 3 - Phalgu River without flow duration 3 months

indicators	effluent quality	reduction in aquifer[3] T = 12 months	reduction by mixing factor 2	possible quality at well	Indian Standard– Drinking water
Fecal coliform	-500/100mL desirable and 2500/100 mL Maximum permissible	0	0/2= 0	Safe	Shall not be detectable in any 100 ml sample
Nitrate	-	Nil (by denitrification)	-	Safe	45 mg/l
Sulphate	1000 mg/l	Nil (Adsorption, reduction to sulphide)	Nil	Safe	200-400 mg/l
Flouride	2.0 mg/l	Nil (Reduction)	Nil	Safe	1-1.5 mg/l

Oil & Grease	10 mg/l	Nil (Adsorption)	Nil	Safe	
Sulphide	2.0 mg/l	Nil (Absorption)	Nil	Safe	0.05 mg/l
Arsenic	0.2 mg/l	Nil (Adsorption)	Nil	Safe	0.01-0.05 mg/l
Cd	2.0 mg/l	Nil (Adsorption)	Nil	Safe	0.003 mg/l
Cu	3.0 mg/l	Nil (Adsorption)	Nil	Safe	.05-1.5 mg/l
Ni	3.0 mg/l	Nil (Adsorption)	Nil	Safe	0.02 mg/l
Zn	5.0 mg/l	Nil (Adsorption)	Nil	Safe	5-15 mg/l
Ammoniacal Nitrogen	50 mg/l	Nil (Conversion to nitrate by microbes)	Nil	Safe	0.5 mg/l

Notes

Fecal Coliform- In freshwater and wastewater (20-30 degree) survival time is <60 days but usually <30 days and in soil <120 days but usually <50 days [Ref. 7].

E-Coli- In a recharge well survival time of E-Coli 63 days[Ref. 7].

Nitrate- Nitrate is found in the soil of high agricultural input area and high animal wastes disposal/utilization area. Nitrate is available in STP effluent. Evidence for de-nitrification as an important process affecting the differences in isotopic composition of groundwater and surface water is seen in the comparison of the nitrogen and oxygen isotopes of nitrate. Denitrification converts NO_3 to N_2 gas [Ref. 8].

Sulphate and sulphite- Sulphate is an oxidized form of sulphur. Sulphate moves through soil along with water but it reduced to Sulphite and Sulphide at sub surface zone through microbial reduction, which cannot move to ground water, practically absorbed in soil. Sulphite is not harmful in general. Only after consumption of 0.7 mg/ kg body weight will produce some health impact.

Copper is retained in soils through exchange and specific adsorption mechanisms.

Zinc is readily absorbed by clay minerals, carbonates, or hydrous oxides.

Cadmium may be absorbed by clay minerals, carbonates or hydrous oxides of iron and manganese or may be precipitated as cadmium carbonate, hydroxide, and phosphate. Evidence suggests that adsorption mechanisms may be the primary source of Cd removal from soils [Ref. 10, 11].

Nickel does not form insoluble precipitates in unpolluted soil sand retention for Ni is, therefore, exclusively through adsorption mechanisms. Nickel will adsorb to clays, iron and manganese oxides, and organic matter and is thus removed from the soil solution. The formation of complexes of Ni with both inorganic and organic ligands will increase Ni mobility in soils

Arsenic is often present in anionic form, it does not form complexes with simple anions such as Cl^- and SO_4^{2-}. Arsenic speciation also includes organo-metallic forms such as methyl arsinic acid $(CH_3)AsO_2H_2$ and dimethyl arsinic acid $(CH_3)_2AsO_2H$. Many Arsenic compounds adsorb strongly to soils and are therefore transported only over short distances in groundwater and surface water. Naidu and Bhattacharya (2006) have suggested that ferric hydroxide plays an important role in controlling the concentration of As in soil and in aqueous media

4.2 Conclusions

Above Tables concluded that:

- Fecal coliform concentration will be reduced to safe levels in case of all the probable conditions
- Oil and grease, sulphide, cadmium, copper, nickel, zinc,, arsenic adsorbed in soil/ silt surface and hence probability of movement through sub surface zone reduced substantially. Therefore chances of contamination of ground water from those chemicals (including heavy metals) is insignificant
- Similarly reduction of nitrate and sulphate by denitrifying and sulphur reducing bacteria before adsorption will reduce movement of those anions through soil and chances of contamination through those chemicals also became .insignificant
- Reduction of fluoride,, adsorption of sulphide and conversion of ammoniacal nitrogen to nitrate further decrease of chances of contamination of ground water from effluent
- Dilution of all parameters under variable conditions reduced concentration levels substantially to safe limits.
- ***Since movement of the metals and chemicals through sub surface zone is restricted due to above mentioned situation , chances of contamination of ground water from discharge of STP effluent is insignificant. Hence ground water is safe for drinking***

It is recommended for long term monitoring of well water (for both chemical & biological parameters) through observation wells nearby the river or through piezometer. Frequent checking of STP effluent after treatment is necessary.

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Annex 1

Water abstraction from the Phalgu River bed: proposed abstraction zones

Appendix 8: Environment Impact of Transmission Mains under GWSP2 - (Bodh Gaya-Gaya)

Environment Impact of Transmission Mains under GWSP2 - (Bodh Gaya-Gaya)

Stretch ID.	Environment			Coordinate		Remarks
	Sensitive receptor	Impact H/M/L	Mitigation Measure if any	Latitude	Longitude	
6-7	Primary School Kendua	L	During construction, it will be needed to ensure compliance with road safety norms	24.7454296	84.9674742	
7-8	MES water supply TW	L	Measures to ensure prevention of damage to the existing pipeline need to be taken up	24.7434454	85.0152489	
	Brahmasthan temple	NIL	NIL	24.7613755	85.0023389	
	Drain Culvert	L	Pipe laying alignment may be changed for damage of culvert			For new water source pesticide contamination study in water sample will be required
8-9	NIL	NIL	NIL			
9-10	Mahesh Singh Bed college	L	Safety issue will be given priority during construction	24.7924781	85.0093019	
10-11	NIL	NIL	NIL			

Environment Impact of Transmission Mains under GWSP-II (Manpur)

Stretch ID.	Environment			Coordinate		Remarks
	Sensitive receptor	Impact H/M/L	Mitigation Measure if any			
M1-M2	Mining Activity	M	Prevention of sand mining near the tube wells	24.7802554	85.0048982	
	Solid waste	NIL	NIL	24.7802554	85.0048982	
M1-M6	NIL	NIL	NIL			

M6-M7	NIL	NIL	NIL			
M2-M4	Solid waste	NIL	NIL			
M4-M5	Sita Kund	NIL	NIL	24.7980189	85.0041802	

Appendix 9: Sample Outline of Spoil Management Plan

Sample Outline of Spoil Management Plan (SMP)

1.0 Purpose and application:

SMP is to describe how the project will manage the spoil generated and reuse related to design and construction works. This is an integral part of EMP. The objective of SMP is to reuse of spoil from works in accordance with the spoil management hierarchy outlined in this document. Spoil should be mange as per new SWM Rules 2016.

2.0 Objectives of SMP:

The objectives of SMP are:

- To minimize spoil generation where possible
- Maximize beneficial reuse of spoil from construction works in accordance with spoil management hierarchy
- Mange onsite spoil handling to minimize environmental impacts on resident and other receivers
- Minimize any further site contamination of land, water, soil
- Manage the transportation of spoil with consideration of traffic impacts and transport related emissions

3.0 Structure of SMP:

Section 1: Introduction of SMP
Section 2: Legal and other requirements
Section 3: Roles and responsibilities
Section 4: Identification and assessment of spoil aspects and impacts
Section 5: Spoil volumes, characteristics and minimization
Section 6: Spoil reuses opportunities, identification and assessment
Section 7: On site spoil management approach
Section 8: Spoil transportation methodology
Section 9: Monitoring, Reporting, Review, and Improvements

4.0 Aspects and Potential Impacts

The key aspects of potential impacts in relation to SMP are listed in table below

Aspects	Potential Impacts
Air Quality	Potential for high winds generating airborne dust from the stock piles
Sedimentation	Potential for sediment laden site runoff from spoil stockpiles and potential for spillage of spoil from truck on roads
Surface and Groundwater	Contamination of water (surface and ground water)
Noise	Associated with spoil handling and haulage and storage
Traffic	Impacts associated with spoil haulage
Land Use	Potential for spoil to be transported to a receivable site that doesn't have permission for storage/disposal
Design specifications	Limitations on opportunities to minimize spoil generation
Sustainability	Limited sites for storage, reuse opportunities

5.0 Spoil volumes, characteristics and minimization

5.1 Spoil volume calculations: Estimate the volumes of spoils produced from each of the construction sites.

5.2 Characterization of spoil: Based on the type of spoil; characterization is done (sand stone, mud mix materials, reusable materials)

5.3 Adopt Spoil Reduce, Reuse Opportunities

An overview of the assessment methodology to be used is mentioned below.

- Consideration of likely spoil characteristics

- Identification of possible reuse sites
- Screening of possible reuse opportunities

5.4 Identification of possible safe disposal sites for spoil: Those spoils (which cannot be reused) shall be properly disposed in designated areas, such disposal areas should be identified in project locations. Such disposal areas should be safe from environmental aspects and there should not be any legal and resettlement related issues. Such areas need to be identified and prior cliental approval should be obtained to use it as spoil disposal area. The local administration must be consulted and if required permission should be obtained from them.

5.5 Storage and stock piling

5.6 Transportation and haulage route

6.0 Based on the above, the contractor will prepare a SMP as an integral part of EMP and submit it to the DSC for their review and approval.

Appendix 10: Traffic Management Plan Template

A. Principles

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
(v) Avoid hazards in 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.

C. Analyze the impact due to street closure, if required

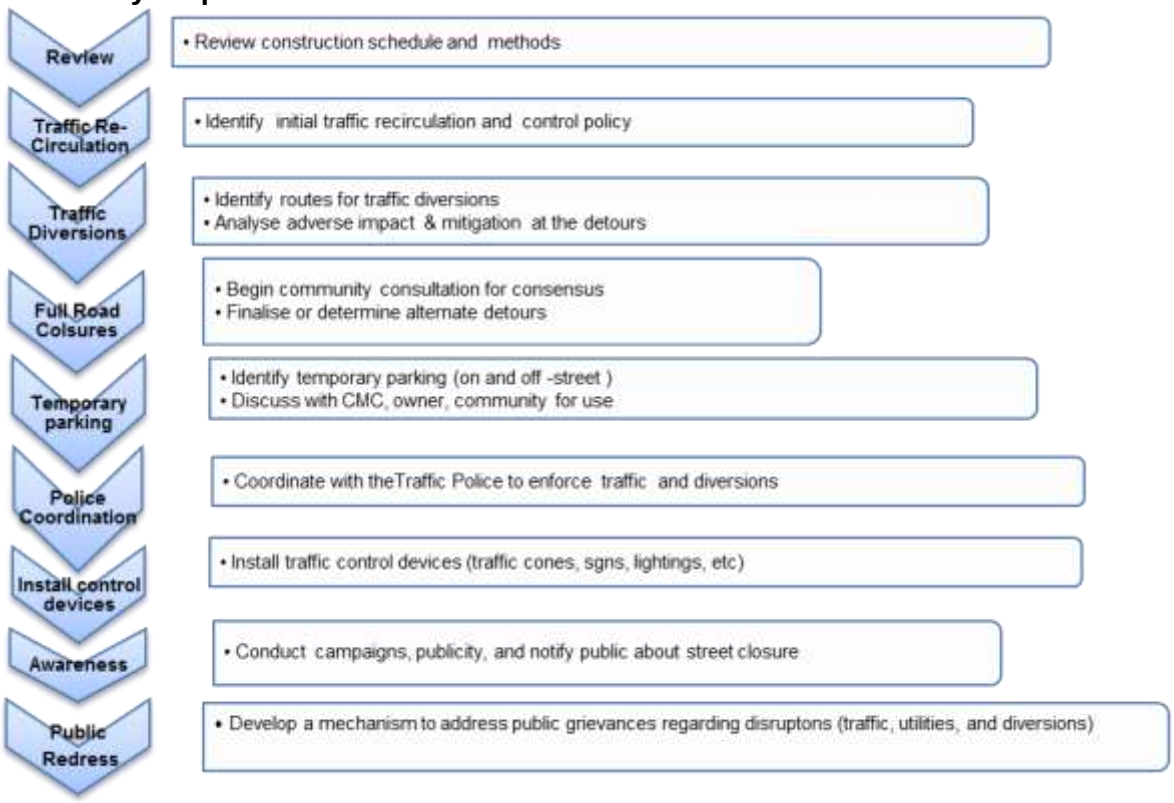
3. Apart from the capacity analysis, a final decision to close a particular street and divert the traffic should involve the following steps:

(i) approval from the PIU, local administration 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.

4. 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: 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 because 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 PMC/DSC 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 centers. In addition, the project will publish a brochure for public information. These brochures will be widely circulated around the area and will also be available at the PIU, and the contractor's site office. The text of the brochure should be concise to be effective, with many 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. Vehicle Maintenance and Safety

10. A vehicle maintenance and safety program shall be implemented by the construction contractor. The contractor should ensure that all the vehicles are in proper running condition, and comply with roadworthiness and certification standards of the state government of Bihar and Government of India. All vehicles to be used shall be in perfect condition meeting pollution standards of state government of Bihar and Government of India. The vehicle operator requires a pre state of shift checklist. Additional safety precautions will include the following requirements:

- Driver will follow the special code of conduct and road safety rules of Government of India
- Drivers to ensure that all loads are covered and secured drivers to ensure operation equipment can't leak materials hauled
- Vehicles will be cleaned and maintained in designed places.

F. 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 in the new city areas are wide but in old city roads very narrow and carry considerable traffic. However, regardless of where the construction takes place, all the work zones should be cordoned off, and traffic shifted away at least with traffic cones, barricades, and temporary signs (temporary "STOP" and "GO").

12. The work zone should take into consideration the space required for a buffer zone between the workers and the traffic (lateral and longitudinal) and the transition space required

for delineation, as applicable. For the works, a 30 cm clearance between the traffic and the temporary STOP and GO signs should be provided. In addition, at least 60 cm is necessary to install the temporary traffic signs and cones.

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

14 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.

15. The PIU/DSC and contractor will coordinate with the local administration and traffic police regarding the traffic signs, detour, and any other matters related to traffic. The contractor will prepare the traffic management plan in detail and submit it along with the EMP for the final approval.

Appendix 11: Format (Confirmation from Operator of Commercial establishment/shop for provision of temporary Access by Contactor

Confirmation from Operator of Commercial establishment/shop for provision of temporary Access by Contactor

Name of Subproject :_____
Name of Contractor :_____
Name of the Affected Person :_____
Nature of Establishment :_____
Location of Establishment :_____
Nature of Access Disruption :_____
Nature of Alternate Access
Provided by Contractor :_____
Duration & Date of Disruption : _____days from _____to_____

I hereby confirm that access disruption caused to my property as per the duration and the dates mentioned above was effectively mitigated by provision of alternate access by contractor. Provision of alternate access ensured no closure or loss of clientage to my commercial establishment.

Signature of Affected person **Signature of Contractor's representative**

Appendix 12: Standards for Drinking Water – Specification (Bureau of Indian Standard, BIS 10500: 2012)

Sl.No	Substance or Characteristic	Requirement (Desirable Limit)	Permissible Limit in the absence of Alternate source
Essential characteristics			
1.	Color, (Hazen units, Max)	5	25
2.	Odor	Unobjectionable	Unobjectionable
3.	Taste	Agreeable	Agreeable
4.	Turbidity (NTU, Max)	5	10
5.	pH Value	6.5 to 8.5	No Relaxation
6.	Total Hardness (as $CaCo_3$) mg/lit.,Max	300	600
7.	Iron (as Fe) mg/lit,Max	0.3	1.0
8.	Chlorides (as Cl) mg/lit,Max.	250	1000
9.	Residual, free chlorine, mg/lit, Min	0.2	--
Desirable Characteristics			
10.	Dissolved solids mg/lit, Max	500	2000
11.	Calcium (as Ca) mg/lit, Max	75	200
12.	Magnesium (as Mg)mg/lit, Max.	30	100
13.	Copper (as Cu) mg/lit, Max	0.05	1.5
14.	Manganese (as Mn)mg/lit ,Max	0.10	0.3
15.	Sulfate (as SO_4) mg/lit, Max	200	400
16.	Nitrate (as NO_3) mg/lit, Max	45	100
17.	Fluoride (as F) mg/lit, Max	1.0	1.5
18.	Phenolic Compounds (as C_6H_5OH) mg/lit, Max.	0.001	0.002
19.	Mercury (as Hg)mg/lit, Max	0.001	No relaxation
20.	Cadmiun (as Cd)mg/lit, Max	0.01	No relaxation
21.	Selenium (as Se)mg/lit,Max	0.01	No relaxation
22.	Arsenic (as As) mg/lit, Max	0.05	No relaxation
23.	Cyanide (as CN) mg/lit, Max	0.05	No relaxation
24.	Lead (as Pb) mg/lit, Max	0.05	No relaxation
25.	Zinc (as Zn) mg/lit, Max	5	15
26.	Anionic detergents (as MBAS) mg/lit, Max	0.2	1.0
27.	Chromium (as Cr^{6+}) mg/lit, Max	0.05	No relaxation
28.	Polynuclear aromatic hydro carbons (as PAH) g/lit, Max	--	--
29.	Mineral Oil mg/lit, Max	0.01	0.03
30.	Pesticides mg/l, Max	Absent	0.001
31	Radioactive Materials		
	i. Alpha emitters Bq/l, Max	--	0.1
	ii. Beta emitters pci/l,Max	--	1.0
32	Alkalinity mg/lit. Max	200	600
33	Aluminium (as Al) mg/l,Max	0.03	0.2
34	Boron mg/lit, Max	1	5

Appendix 13: Records of Public Consultations in Gaya

RECORDS OF PUBLIC CONSULTATION-GAYA

Subproject: Improvement of Water supply system in Gaya City- GWSP2

Date & Time: 19.08.2015, 31.08.2015 & 01.09.2015 From 11-00 PM to 3-00 PM

Various issues related to the proposed subproject were discussed at various locations of the subproject area. Discussions were held with the parties directly and indirectly affected by the subproject execution as well as the public of the subproject area. The problems faced by them along with their suggestions/concerns were recorded and the same have been given due consideration during formulation of the project design, IEE and EMP.

The participants, in general were in favor of the upcoming subproject at Gaya. However, they were concerned about the permanent and temporary impacts, which are expected to arise during construction stage. People are ready to extend all types of support during execution of the project. The details of the public consultation are detailed below:

Issues discussed- Dharamshala (Warish nagar)

- **Water quality**- As per discussion by public living near proposed tube well site on bank of river. One hand pump is situated on the bank and as per record of view of public the water quality is good and no diseases were found since long time by use of the Hand pump water.
- **Water Depth-**As per public record water is available at 30-40 feet depth in the river
- **Water Testing**-General Public requested for testing of water quality.
- **Employment of general public**-People are interested to do work on project area during construction

Issues discussed-Govt Middle school Kendui

- **Awareness about the project-**Discussed general awareness about the project
- **Safety of School children**-Issue of safety of school children during laying of pipeline were discussed
- **Availability of water for school children and Tariff**- School teachers are interested for availability of drinking water for school children through this project.

Issues discussed - Industrial Training Institute (ITI) Campus , Bodhgaya Road, Gaya

- **Awareness about the project-** Discussed general awareness about the project
- **Safety of School students**- Issue of safety of ITI students were discussed
- **Availability of water for school children and Tariff**- ITI Principal interested for availability of drinking water for ITI students, and staffs through CWR.

Issues discussed-Budva Mahadev

- **Awareness about the project-**Discussed general awareness about the project

- **Tree cutting**-1-2 tree are under project area..Tree cutting permission will be taken from forest department, Gaya. People are agreed for tree cutting.
- **Water quality**- Present drinking water problem and current water quality is not good .Local people needs supply water.
- **Employment of general public**-People are interested to do work on Tube well site during construction

Issues discussed-Bhusunda

- **Awareness about the project-**Discussed about general awareness about the project
- **Employment of general public**-People are interested to do work on Tube well site during construction
- **Safety-**during construction safety issue of general public will be required in the approach road area.(as given in GWSP-1)

Consultation - ITI

Consultation- Govt School Kendui

Consultation- Govt School Kendui

Dharamashala near TW

Dharamashala near TW

Dharamashala near TW

Budva Mahadev

Bhusunda near TW

Madanpore More ward 44

Summary of General and specific discussion

1. Issues: Problems faced due to absence of the proposed facility under the subproject
   - ✓ Feedback:
     - The quality and quantity of the water supplied at present is not adequate. Supply from new Kirloskar tube well is expected at few locations
     - New settlements mostly in the peripheries of the town lack proper water production and water storage infrastructure.

   - ✓ Remarks
     - The participants in general were of the view that the proposed new tube wells is the definite need and welcomed the subproject and ensured their full support.

2. Issues: Awareness and extent of knowledge about the subproject
   - ✓ Feedback
     Local people are not much aware on components of the project.

   - ✓ Remarks
     Public consultation in different forms like one to one consultation, circulations of questionnaire, group discussions, etc. need to be a continuous process and IA will ensure this process throughout the project execution.

3. Issues: Information on the perceived benefits of the subproject in terms of economic and environmental enhancement
   - ✓ Feedback:
     General benefits perceived by the people are summarized as follows:
     - Improvement in the water supply scenario will solve the issues and problems related to the unsatisfactory quantity and quality of the water supplied.
     - It is hoped that adequate provisions will be made for satisfactory and standardized filtration and purification of the water, which will be supplied in future.
     - The improvement in the water supply will provide safety to the people as they will be not at the risk of water borne diseases.
     - Areas of new settlements will get high benefit from the proposed subproject.
     - Proposed infrastructure will ensure overall health and hygiene of the people in the subproject area.
   - ✓ Remarks
     - People impacted directly or indirectly due to subproject implementation should be adequately compensated.
     - During implementation, maximum efforts should be made to minimize hindrances of public access by providing alternative access to roads, streets and homes.
     - The work should be carried out at a fast pace so that the duration of access disruption is minimized.
     - People suggested an efficient operation and maintenance system after the completion of the project

4. Issues: Information on perceived losses from the proposed subproject during execution stage in terms of disruptions in traffic, temporary access disruptions during execution and air and noise pollution, etc.
   - ✓ Feedback:
     - People opined that potential temporary impacts of access disruption for residences, shops/commercial establishments, and institutions, etc. should be mitigated through good construction practices and an effective environment and contractors construction plan which should ensure providing walkways and metal sheets to maintain access across trenches, increasing the workforce in front of shops/commercial establishments, consulting business and institutions regarding operating hours and factoring this in work schedules, providing advance information on works to be undertaken including appropriate signages etc.
   - ✓ Remarks

- Effective mitigation measure should be in place so that problems related to traffic disruptions; air and noise pollution are minimized.

5. Issues: Presence of any historical/cultural site in the vicinity
   Presence of any protected area in or adjoining the construction site.

   ✓ Feedback:
   - There is no historical/cultural site in the corridor of the subproject.
   - There is no protected area in the corridor of the subproject.

   ✓ Remarks
   - There are some sensitive receptors, which include few educational institutions, health centers, religious places etc. in the project area for which proper mitigation measures relevant to the location and nature of the receptor will be kept in place during project execution and same will be part of EMP.

Suggestion from general public & stakeholders – Consideration in impact assessment

- Public consultation in different forms like one to one consultation, circulations of questionnaire, group discussions, etc. need to be a continuous process and IA will ensure this process throughout the project execution.
- People impacted directly or indirectly due to subproject implementation should be adequately compensated.
- During implementation, maximum efforts should be made to minimize hindrances of public access by providing alternative access to roads, streets and homes.
- The work should be carried out at a fast pace so that the duration of access disruption is minimized.
- Efficient O & M system needs to be establish
- Effective mitigation measure should be in place to mitigate problems related to traffic disruptions
- air and noise pollution should be minimized
- For sensitive receptors like educational institutions, health centers, religious places etc. in the project area for which proper mitigation measures relevant to the location and nature of the receptor will be kept in place during project execution and same will be part of EMP.

List of the Participants in Public Consultation

Subproject Name: Improvement of Water Supply System in Gaya City

Location of Meeting/Consultation: Basish Nagar - Dharamshala

Date & Time: 1/3/2015

Sl. No	Name & Address	Occupation	Signature
1.	[illegible]	[illegible]	[illegible]
2.	[illegible]	मजदूरी	MOIN
3.	[illegible]	मजदूरी	
4.	मीना देवी	घर कार्य	मीना देवी
5.	रेनु देवी	घर कार्य	रेनु देवी
6.	कांति देवी	घर कार्य	
7.	[illegible]	मजदूरी	[illegible]
8.	[illegible]	मजदूरी	
9.	[illegible]	मजदूरी	[illegible]
10.	[illegible]	[illegible]	[illegible]
11.	[illegible]	[illegible]	[illegible]
12.	[illegible]	घर कार्य	[illegible]

List of the Participants in Public Consultation

Subproject Name: Improvement of Water Supply System in Gaya City

Location of Meeting/Consultation:

Date & Time: 1/9/2015

Sl. No	Name & Address	Occupation	Signature
1.	आरती देवी	गृहणी	आरती देवी
2.	अनिल शाह	राजमिस्त्री	अनिल साव
3.	मुन्ना प्रसाद	मजदूरी	मुन्ना प्रसाद
4.	मदन प्रसाद	मजदूरी	मदन प्रसाद
5.	उषा देवी	गृहणी	उषा देवी
6.	रामसेर	मजदूरी	

List of the Participants in Public Consultation

Subproject Name: Improvement of Water Supply System in Gaya City

Location of Meeting/Consultation: Govt. Middle School - Kendui

Date & Time: 1/9/2015

Sl. No	Name & Address	Occupation	Signature
1.	संजय कुमार शर्मा प्र० अध्यापक रा० म० वि० केंदुई	Teaching	संजय कुमार शर्मा
2.	मुरारी मिश्र स० शि०	"	मुरारी मिश्र 1/9/2015
3.	RINA KUMARI NAGAR TEACHER	"	Rina Kumari
4.	KUMARI PREMLALA NAGAR TEACHER	"	kumari Premlata
5.			

List of the Participants in Public Consultation

Subproject Name: Gaya Water Supply

Location of Meeting/Consultation: Bhusanda

Date & Time: 6/2/2015 5 PM to 6:30 PM

Sl. No	Name & Address	Occupation	Signature
1.	सत्यनारायण चौधरी	-	सत्यनारायण चौधरी
2.	मीरा देवी	-	मीरा देवी
3.		-	
4.	रविन्द्र पाण्डेया	-	रविन्द्र पाण्डेया
5.	रेणु देवी	-	रेणु देवी
6.	उषा कुमारी	-	उषा कुमारी
7.	कमलेश	-	कमलेश चौधरी
8.	बिरेन्द्र	-	Birendra Manjhi
9.	सरस्ती देवी	-	सरस्वती देवी
10.	गीता देवी	-	गीता देवी
11.	सोनी कुमारी	-	सोनी कुमारी
12.	सौरभ कुमार	-	सौरभ कुमार दास

List of the Participants in Public Consultation

Subproject Name: Gaya Water Supply

Location of Meeting/Consultation: Bhusunda Mela

Date & Time: 23/2/2015

Sl. No	Name & Address	Occupation	Signature
1.	कमलेश चौधरी ~~मजदूरी~~	मजदूरी	
2.	कुन्ती देवी	गृहणी	
3.	रामपुजन चौधरी	मजदूरी	Ramphujan
4.	अखीलेश चौधरी	मजदूरी	अखिलेश चौधरी
5.	कुछा चौधरी	मजदूरी	
6.	अनील चौधरी	मजदूरी	अनील चौधरी
7.	जय प्रकाश चौधरी	व्यवसाय	Jayprakash Choudhary
8.	सुनीता देवी	व्यवसाय	सुनीता देवी
9.	मंजु देवी	दाई	
10.	बेबी कुमारी	गृहणी	बेबी कुमारी
11.	श्यामा फुल देवी	मजदूरी	
12.	Gita devi	House wife	gita devi
13.	मुनी देवी	गृहणी	मुनीदेवी
14.	मालती देवी	गृहणी	मालती देवी

List of the Participants in Public Consultation

Subproject Name: Gaya Water Supply
Location of Meeting/Consultation: Budva Mahadev
Date & Time: 24/2/2015

Sl. No	Name & Address	Occupation	Signature
1.	अब्दुल कादिर / عبد القادر	سلائی	عبد القادر
2.	MD. SUHAIL ALAM	मजदूरी	Md. Suhail Alam
3.	VIRENDRA VERMA	~~Job~~	virendra verma
4.	मोहम्मद [illegible] / محمد [illegible]	मिस्त्री	[illegible]
5.	[illegible]	[illegible]	
6.	शाकिला	[illegible]	
7.	[illegible]	सिलाई	[illegible]
8.	मो० [illegible] आलम	बिस्कुट फेरी	[illegible]
9.	Md Shamim	सिलाई	Md. Shamim
10.	मो जाहिद	[illegible]	[illegible]
11.	अब्दुल हमीद	राजमिस्त्री	عبدالحمید
12.			

LIST OF PARTICIPANTS IN PUBLIC CONSULTATION

SUBPROJECT NAME:

LOCATION OF MEETING/CONSULTATION: Ward No - 44

DATE & TIME: 8 : 30 AM 10/1/2014

S.NO	Name & Address	Occupation	Signature
1	Prem Kumar Murli Hill	Study	Prem KR
2	दिलीप पासवान, मुरली हील	व्यवसाय, vender	दिलीप
3	बेनी माधो मालाकार मंगला गौरी मन्दीर	-	बेनी माधो
4	राजेश कुमार मंगला गौरी मन्दिर	व्यवसाय व दुकानदार	Rajesh Kumar
5	बबलू कुमार	व्यवसाय - दुकानदार	माँ मंगला गौरी
6	Anshu Kumar	दुकानदार	Anshu
7	Mangla gauri Temple (Gaya)	Student	Anshu Kumar
8	ARUN KUMAR YADAV	दुकान (सामाजिक कार्यकर्ता) 9853989066	ARUN KUMAR YADAV
9	मनोज गायन		मनोज गायन
10	नरेश यादव	खेती	नरेश
11	प्रदीप कुमार (माडनपुर)	सेवा दुकान	प्रदीप कुमार
12	Pintoo	Kirana Shop	Pintoo
13	Ramakant pathak	Business	[illegible]
14	Vikash anand	Student	Vikash anand
15	Anil Kumar	S. Health	Anil Kumar
	वार्ड 40		
16	दामोदर लाल गोस्वामी	पण्डा जी	दामोदर लाल गोस्वामी
17	सुभाष कुमार गुप्ता	व्यवसाय	सुभाष कुमार गुप्ता
18	विनय कुमार गुप्ता	व्यवसाय 9934215738	B.Kupta
19	Ashim kr Chakrabarty	Business	Chakrabarty
20	कैलाश प्रसाद गुप्ता	व्य. दुकान	कैलाश प्रसाद गुप्ता
21	सुरेश प्रसाद	दुकान	सुरेश प्रसाद
22	संजय लाल गुप्ता	पण्डा जी	संजय लाल गुप्ता
23	गोपाल पुजारी	-	गोपाल पुजारी
24	अरुण प्रसाद	दुकान -	अरुण प्रसाद
25	मनोज कुमार यादव	-	मनोज कुमार यादव
26	शशि भूषण सिंह	-	शशि भूषण सिंह

Appendix 14: Sample Grievance Registration Form

Sample Grievance Registration Form

(To be available in Hindi and English or local language, if any)

The **Bihar Urban Development Investment Program (BUDIP)**welcomes complaints, suggestions, queries and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback.

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

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

FOR OFFICIAL USE ONLY

Registered by: (Name of official registering grievance)	
If – then mode: ■ **Note/Letter** ■ **E-mail** ■ **Verbal/Telephonic**	
Reviewed by: (Names/Positions of Official(s) reviewing grievance)	
Action Taken:	
Whether Action Taken Disclosed:	■ **Yes** ■ **No**
Means of Disclosure:	

GRIVENCES RECORD AND ACTION TAKEN

Sr. No.	Date	Name and Contact No. of Complainer	Type of Complain	Place	Status of Redress	Remarks

परिशिष्ट 8: नमूनाशिकायतपंजीकरणफार्म

(हिंदी औरअंग्रेजीयास्थानीयभाषामेंउपलब्धहो, यदिकोईहो,)

बिहारशहरीविकासनिवेशकार्यक्रम (BUDIP) शिकायतें, सुझाव, प्रश्नोंऔरपरियोजनाकेकार्यान्वयनकेबारेमेंटिप्पणियोंकास्वागतकरताहैं1हमलोगोंकोशिकायतकेसाथउनकेनामऔरसंपर्कजान कारीप्रदानकरनेकेलिएप्रोत्साहितकरतेहैंताकिहमस्पष्टीकरणऔरप्रतिक्रियाकेलिएआपकेसाथसंपर्ककरसकें 1 आपकोअपनेव्यक्तिगतविवरणशामिलकरनेचाहिएलेकिनउसजानकारीकोगोपनीयरखाजायगा1 आपकानामऊपर (गोपनीय)

* लेखन / टाइपिंगद्वाराहमेंसूचितकरेंधन्यवाद

तारीख			पंजीकरणकास्थान		
संपर्ककरनेसंबंधीजानकारी / व्यक्तिगतविवरण					
नाम		लिंग	पुरुष महिला	आयु	
घरकापता					
गांव / शहर					
जनपद					
फोननं.					
ईमेल					
शिकायत / सुझाव / टिप्पणी / प्रश्ननीचेअपनीशिकायतकाविवरण (जो, क्या, कहांऔरकैसे) प्रदानकरें: सलगनक / नोट / पत्रकेरूपमें,शामिलहैं,कृपयायहाँटिककरें					
हमआपतकप्रतिक्रियाकेलिएकैसेपहुँचसंकतेहैंयाअपनीटिप्पणी / शिकायतपरनवीनीकरण?					

केवलकार्यालयउपयोगकेलिए

द्वारापंजीकृत:(सरकारीपंजीकरणशिकायतकानाम)	
यदि -फिरविधि: ⌗ नोट / पत्र ⌗ ईमेल ⌗ मौखिक / टेलीफोन	
सेसमीक्षित:(नाम / अधिकारीकीपोजिशनसमीक्षाशिकायत)	
कीगईकार्रवाई:	
कीगईकार्रवाईकाखुलासा:	⌗ हां ⌗ नहीं
प्रकटीकरणकामतलब:	

शिकायतरिकॉर्डऔरकीगईकार्रवाई

क्रमसंख्या	तारीख	नामऔर complainer कासंपर्कनंबर	शिकायतकेप्रकार	जगह	निवारणकीस्थिति	टिप्पणियाँ

Appendix 15: Semi-Annual Environmental Monitoring Report Template

I. Introduction

- Overall project description and objectives
- Environmental category as per ADB Safeguard Policy Statement, 2009
- Environmental category of each subproject as per national laws and regulations
- Project Safeguards Team

Name	Designation/Office	Email Address	Contact Number	Roles
1. PMU				
2. PIUs				
3. Consultants				

- Overall project and sub-project progress and status
- Description of subprojects (package-wise) and status of implementation (preliminary, detailed design, on-going construction, completed, and/or O&M stage)

Package Number	Components/List of Works	Contract Status (specify if under bidding or contract awarded)	Status of Implementation (Preliminary Design/Detailed Design/On-going Construction/Completed/O&M)[36]	If On-going Construction	
				%Physical Progress	Expected Completion Date

II. Compliance status with National/State/Local statutory environmental requirements[37]

Package No.	Subproject Name	Statutory Environmental Requirements[38]	Status of Compliance[39]	Validity if obtained	Action Required	Specific Conditions that will require environmental monitoring as per Environment Clearance, Consent/Permit to Establish[40]

[36] If on-going construction, include %physical progress and expected date of completion

[37] All statutory clearance/s, no-objection certificates, permit/s, etc. should be obtained prior to award of contract/s. Attach as appendix all clearance obtained during the reporting period. If already reported, specify in the "remarks" column.

[38] Specify (environmental clearance? Permit/consent to establish? Forest clearance? Etc.)

[39] Specify if obtained, submitted and awaiting approval, application not yet submitted

[40] *Example: Environmental Clearance requires ambient air quality monitoring, Forest Clearance/Tree-cutting Permit requires 2 trees for every tree, etc.*

III. Compliance status with environmental loan covenants

No. (List schedule and paragraph number of Loan Agreement)	Covenant	Status of Compliance	Action Required

IV. Compliance status with the environmental management plan (refer to EMP Tables in APPROVED IEE/S)

- Confirm if IEE/s require contractors to submit site-specific EMP/construction EMPs. If not, describe the methodology of monitoring each package under implementation.

Package-wise IEE Documentation Status

Package Number	Final IEE based on Detailed Design				Site-specific EMP (or Construction EMP) approved by Project Director? (Yes/No)	Remarks
	Not yet due (detailed design not yet completed)	Submitted to ADB (Provide Date of Submission)	Disclosed on project website (Provide Link)	Final IEE provided to Contractor/s (Yes/No)		

- For each package, provide name/s and contact details of contractor/s' nodal person/s for environmental safeguards.

Package-wise Contractor/s' Nodal Persons for Environmental Safeguards

Package Name	Contractor	Nodal Person	Email Address	Contact Number

- With reference to approved EMP/site-specific EMP/construction EMP, complete the table below

Summary of Environmental Monitoring Activities (for the Reporting Period)[41]

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						

[41] Attach Laboratory Results and Sampling Map/Locations

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

IV. Approach and methodology for environmental monitoring of the project

- Briefly describe the approach and methodology used for environmental monitoring of each sub-project.

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

- Discuss the general condition of surroundings at the project site, with consideration of the following, whichever are applicable:
    - Confirm if any dust was noted to escape the site boundaries and identify dust suppression techniques followed for site/s.
    - Identify if muddy water is escaping site boundaries or if muddy tracks are seen on adjacent roads.
    - Identify type of erosion and sediment control measures installed on site/s, condition of erosion and sediment control measures including if these are intact following heavy rain;
    - Identify designated areas for concrete works, chemical storage, construction materials, and refueling. Attach photographs of each area in the Appendix.
    - Confirm spill kits on site and site procedure for handling emergencies.
    - Identify any chemical stored on site and provide information on storage condition. Attach photograph.
    - Describe management of stockpiles (construction materials, excavated soils, spoils, etc.). Provide photographs.
    - Describe management of solid and liquid wastes on-site (quantity generated, transport, storage and disposal). Provide photographs.
    - Provide information on barricades, signages, and on-site boards. Provide photographs in the Appendix.
    - Indicate if there are any activities being under taken out of working hours and how that is being managed.
- Briefly discuss the basis for environmental parameters monitoring.
- Indicate type of environmental parameters to be monitored and identify the location.
- Indicate the method of monitoring and equipment 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 No.	Date of Testing	Site Location	Parameters (Government Standards)			
			PM10 µg/m3	PM2.5 µg/m3	SO2 µg/m3	NO2 µg/m3

Site No.	Date of Testing	Site Location	Parameters (Monitoring Results)			
			PM10 µg/m3	PM2.5 µg/m3	SO2 µg/m3	NO2 µg/m3

Water Quality Results

Site No.	Date of Sampling	Site Location	Parameters (Government Standards)					
			pH	Conductivity µS/cm	BOD mg/L	TSS mg/L	TN mg/L	TP mg/L

Site No.	Date of Sampling	Site Location	Parameters (Monitoring Results)					
			pH	Conductivity µS/cm	BOD mg/L	TSS mg/L	TN mg/L	TP mg/L

Noise Quality Results

Site No.	Date of Testing	Site Location	LA_{eq} (dBA) (Government Standard)	
			Day Time	Night Time

Site No.	Date of Testing	Site Location	LA_{eq} (dBA) (Monitoring Results)	
			Day Time	Night Time

VI. Grievance Redress Mechanism

- Provide information on establishment of grievance redress mechanism and capacity of grievance redress committee to address project-related issues/complaints. Include as appendix Notification of the GRM (town-wise if applicable).

VII. Complaints Received during the Reporting Period

- Provide information on number, nature, and resolution of complaints received during reporting period. Attach records as per GRM in the approved IEE. Identify safeguards team member/s involved in the GRM process. Attach minutes of meetings (ensure English translation is provided).

VIII. SUMMARY OF KEY ISSUES AND REMEDIAL ACTIONS

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

IX. APPENDIXES

- Photos
- Summary of consultations
- Copies of environmental clearances and permits
- Sample of environmental site inspection report
- all supporting documents including **signed** monthly environmental site inspection reports prepared by consultants and/or contractors
- Others

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

Resolution

Project Activity Stage	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 CONSTRUCTUION 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						
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 and display sign boards						
7	Provision for flags and warning lights						
8	Providing plastic crash barrier						
9	Provision of adequate staging form work and access (ladders with handrails) for works at a height of more than 3 m.						
10	Provision of adequate shoring/bracing/barricading/lighting for all deep excavations						
11	Demarcations (fencing, guarding and watching) at construction sites						
12	Provision for sufficient lighting especially for night time work						
13	Arrangements for controlled access and entry to construction zones						
14	Safety arrangements for road users/pedestrians						
15	Arrangements for detouring traffic to alternate facilities						
16	Regular inspection of work zone traffic control devices by authorized contractor personnel						
17	No excess earth, excavated materials, construction materials at site						
18	Storage of construction materials at proper location						
19	Construction workers safety – Provision of personnel protective equipment						
20	A. Helmets						
	B. Safety shoes						
	C. Dust masks						
	D. Hand gloves						
	E. Safety belts						
	F. Reflective jackets						
	G. Earplugs for labor						

Sl. No.	Safety Issues	Yes	No	Non compliance	Corrective Action	Penalty	Remarks
21	Workers employed for bituminous works, stone crushers, concrete batching plants etc. provided with protective goggles, gloves, gumboots etc.						
22	Workers engaged in welding work shall be provided with welder protective shields						
23	All vehicles are provided with reverse horns						
24	All scaffolds, ladders and other safety devices shall be maintained in safe and sound condition						
25	Regular health check-up for labor/contractor's personnel						
26	Ensuring sanitary conditions and all waste disposal procedures and methods in the camps						
27	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 banners and flag persons for traffic control						
28	Provision of insurance coverage for the contractor's personnel						

Contractor

Safeguard Monitor