INTERNATIONAL COMPETITIVE BIDDING
(Two-Envelope Bidding Process with e-Procurement) (Without Prequalification)

REQUEST FOR PROPOSAL
Works and Operation Service
(Design, Build and Operation)
of 440 MLD Water Treatment Plant and associated Transmission Network and Over Head Service Reservoirs in City of Amritsar, Punjab, India

VOLUME-2 : EMPLOYER’S REQUIREMENTS

RFP No: IN-PMIDC-170755-CW-RFP
Project: Punjab Municipal Services Improvement Project

Employer:

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Nodal Officer cum S.E.
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Project Preparation & Award

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# SECTION VII – EMPLOYER’S REQUIREMENTS

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1 EMPLOYER’S REQUIREMENTS

1.1 Introduction

Punjab state is situated in the northwest of India and it is bordered by Pakistan on the West, the Indian States of Jammu and Kashmir on the North, Himachal Pradesh on its Northeast and Haryana & Rajasthan to its South. The state is spread over an area of 50.362 square kilometers (Punjab occupies 1.54% of the country’s total geographical area). The capital of Punjab is Chandigarh. The state has a total population of 277.04 lacs (Census 2011), out of which, rural population is around 173.05 lacs, whereas the urban population is 103.99 lacs. Punjab has 22 districts each under the administrative control of a District Collector. The districts are sub-divided into 82 Tehsils, which are under the administrative control of a Tehsildar. Each Tehsil consists of blocks, which are total 143 in number. The blocks consist of revenue villages and the total number of revenue villages in the state is 12,581. There are 166 urban local bodies (ULBs) in Punjab.

Due to water quality issues and over-exploitation of groundwater for irrigation, the groundwater sources are found to be unsustainable over a period. It is therefore felt necessary to use surface water from available surface water sources after treating it and connecting to the existing drinking water supply system of the town, and thereby reducing the use of groundwater.

The MCA in association with the PMIDC, has decided to undertake the development of Bulk Water treatment and Supply along with allied facilities, with a proposed capacity of 440 MLD, at an identified land near Vallah head regulator at Amritsar on a DBOT basis, through a hybrid annuity model.

1.2 Existing Facilities

The salient features of Amritsar city are as under:-

i) City Area – 139 Sq km
ii) Population as per 2011 census: 11.37 lakhs
iii) Present estimated population: 14 lakhs
iv) Coverage of water supply: 80 %
v) Water supply lines: 1260 km
vi) Deep Tube wells: 400 Nos. (approx.)
vii) Existing Overhead Service Reservoirs: 56 Nos.
viii) Existing House connections (water supply): 253800 Nos.

Currently water supply in Amritsar is fully dependent on groundwater and abstraction is through tube wells being operated by MCA. As per report by Central Ground Water Board the water table has depleted at about 3.0 m in the period 2014-16 with the average depletion rate of about 0.5 - one meter per year. The rate of depletion is increasing in every coming year with the present habit of water extraction and limited aquifers.

At present Amritsar city is producing 290MLD water from 400 deep tube wells (each with 20 to 30 HP submersible pump), supplied through 1260 km of pipe network on an intermittent basis i.e. 12 hours a day (5 hours in the morning, 2 hours in noon and 5 hours in the evening). Water obtained from these bore wells is sometimes pumped to the OHSRs & then fed to piped water supply distribution network while mostly direct pumping from tube wells to the distribution network is being done. There are presently 56 OHSRs existing in the city. 42 are existing OHSR which are under MCA and out of which two OHSR (Ram Bagh and Islamabad
are abandoned). Four OHSRs and 11 OHSRs are being constructed recently under South East Project and AMRUT Project respectively. Amritsar city has a total of 1.475 lakhs domestic & commercial connections.

1.3 Project Proposal
Currently, water supply in Amritsar is fully dependent on groundwater abstraction through tube wells being operated by Municipal Corporation Amritsar. The groundwater table has gone to 40-meter-deep in recent decades. As per report by Central Ground Water Board the water table has gone 25 meter down in the last 25 years with the average depletion rate of one meter per year. The rate of depletion is increasing in every coming year with the present habit of water extraction and limited aquifers. The rate of water extraction from the ground is multiple times excessive than its natural replenishment due to which the situation will get worse as the city grows and develops. Under these circumstances the only option to ensure a sustainable and resilient water source for the city is to switch to surface water. In this project, the proposed source of surface water supply MBL Canal also called as UBDC Canal. MBL supplies water for irrigation purposes to Punjab. MBL passes in the east of city boundary line.

The Project also aims to improve the service level of water supply and O&M of the Water supply system.

1.4 Objective of The Project
The Project aims to shift source of water from ground water to surface water source. This will reduce the ground water extraction and achieve sustainability. It is proposed to design, build, operate and a ‘Smart’ bulk water supply system to deliver potable clean water to all parts of the Amritsar city.

1.5 Base and Ultimate year for the Project
Infrastructure shall be designed to meet water demand for the 30 years period from Base year. Base Year for infrastructure sizing for the project shall be the year 2025 and the intermediate Year shall be 2040 followed by ultimate horizon year of 2055.

1.6 Population Projection
Population projection is undertaken by a convergence method wherein, at first, the population of the entire city has been projected using different methods and analyzed.

Amritsar being a tourist hub, a tourist population of around 200,000 people per day has been considered and the demand for the tourists has been assumed in two categories, tourists visiting the city during the day and tourists who stay in the city overnight. The percentage of tourists staying overnight in the city has been assumed to be around 30% with a high service level. The future number of tourists are assumed to be 10% higher in the year 2040 and an additional 10% growth is considered for the year 2050.

Following are the details of projected population.

<table>
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<tr>
<td><strong>Year</strong></td>
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Rounded to 440 MLD

1.7 Water Treatment Plant and Location

Capacity of proposed Water Treatment Plant (WTP) proposed is for ultimate year of rated output capacity of 440 MLD. Available intake shall be canal intake at Vallah village on UBDC Canal having an intake of 440 MLD. WTP has been proposed on 40 acres of land located next proposed intake at Vallah village (drawing of the land available).

The Water Treatment Plant of 440 MLD capacity has been proposed to meet the water demand for whole city up to year 2055. Water resources Department has confirmed for availability of 200 cusecs of raw water from canal to meet this capacity.

1.8 Design and Build Services

The activities to be performed by the Contractor as detailed in this Section titled “Scope of Works” are indicative and not exhaustive. The Contractor should perform all activities as are required for design, build and operation services under the Contract for providing Bulk water supply services in Amritsar City. The term ‘Bulk Water supply’ shall include canal intake, raw water channel/piping, raw water storage and pumping, 440 MLD fully automated water treatment plant, treated water storage / clear water storage, pumping systems, transmission pipe lines to supply treated water from clear(treated)water storage tank to OHSRs, rehabilitation and construction of OHSRs, SACDA with required control room for full operation and control with automation of all systems right from raw water drawl to deliver to all OHSRs, including all valves and all allied works etc., water quality lab, etc., complete.

The Contractor shall carry out and be responsible for the design and construction of the entire Bulk Water Supply System and all allied appurtenant structures. The Contractor’s work and services as part of the “Design Build Services” shall cover all necessary or desirable services / activities for the design and construction of the Bulk Water Supply System and all allied works in accordance with and as contemplated by the Contract including:

a) the Design and construction services in respect of the Bulk Water Supply System and all allied works including all hydraulic, structural, electrical, instrumentation, mechanical and piping design, and all hydraulic including surge, civil, structural, electrical, mechanical, instrumentation and piping drawings including all architectural & construction drawings.

Works for Existing OHSRs include structural safety and stability check including appropriate Non-Destructive Tests (NDT), assessment of repairs required and rehabilitation for making it fully functional. : First a condition assessment will be made with NDT s which includes Rebound hammer test, Pull-out and Pull-off tests, Ultrasonic pulse velocity (UPV) test, Core sampling and testing, Cover survey and Carbonation test .Based on results report will be prepared on required repairs and on approval. Repairs will be carried out

b)  
c) Design and Construction of proposed OHSRs including all hydraulic, civil, structural, electrical, instrumentation, and piping etc., as required all complete.
d) the building and construction work and services in respect of the Water Supply System and all allied works as set out in this Design Build Services Schedule.

e) Social and Environmental assessment with necessary mitigation measures, as set out in this Design Build Services Schedule and the Schedule 4: Environmental codes of practice.

f) Operation and maintenance of Bulk Water System which include uninterrupted supply of water for a period of 10 years

1.9 Supplemeting the General Conditions

The provisions contained in this Design Build Services Schedule are to be read in conjunction with the FIDIC- Conditions of Contract: Gold at Part-3-Section VIII and Section IX: Particular Circular (Special Conditions of Contract), for the purpose of providing greater specificity of the Design Build Services that the Contractor shall perform.

1.10 Appointment of IVA

The Employer shall appoint an ‘Independent Verification Agent’, (IVA), which shall be responsible for the following during the Design Build Period and Operation and Maintenance Period of the Contract:

- Review and approval of Designs, drawings, BOQ, Estimates, and any other report submitted by the Contractor
- Review and recommend to approval of Design Build specifications and GFC drawings submitted by the Contractor.
- Assess the contractor’s progress of works against the milestones during construction work under the contract as required by Employer.
- Verify and check the quality of material; preferably at manufacturing plant and equipment being used.
- Review and verify the contractor’s Quality Assurances procedures and quality of the work by being present at the implementation locations.
- Guide the employer on major contract management issues
- Review and approval of performance indicators during O&M.

1.11 Design and Build Services

1.11.1 Brief Scope of works

The scope of work of the Contractor shall include but not be limited to the following activities.

- Carry out detailed assessment of the proposed Bulk Water Supply System using employers’ Project Feasibility Report (available in data room) as a starting point.
- Topographic survey of WTP land, transmission mains route alignment, OHSR sites and preparation of Maps and drawings on AutoCAD mapping site conditions. Underground utilities coming in the alignment of transmission mains should also be mapped using latest technologies. Data acquisition and processing for GIS base maps through GPS ground control survey for transmission main route for providing sufficient control points evenly distributed over the area.
- Carry out Geotechnical survey for Intake, WTP land including approach road,
transmission main, OHSR sites and other sites as required

Carry out conditional Assessment of existing OHSRs for checking the structural adequacy, adequacy of pipes, valves; and other rehabilitation measures required for making the OHSRs operational. Structural adequacy tests of OHSRs shall be done using set of non-destructive tests for evaluating the structural adequacy of existing OHSRs. DMM: First a condition assessment will be made with NDTs which includes Rebound hammer test, Pull-out and Pull-off tests, Ultrasonic pulse velocity (UPV) test, Core sampling and testing, Cover survey and Carbonation test. Based on results report will be prepared on required repairs and on approval. Repairs will be done.

- (Employer’s conditional assessment report of existing OHSRs is available for guidance in data room).
- Establish and confirm water quality (organic and inorganic content) of the raw water from proposed source.
- Prepare detailed designs of new works and processes required to fulfil the output requirements for Bulk Water Supply Systems.
- Contractor shall prepare Quality assurance Plan and EHS plan and submit for approval of Employer.
- Prepare detailed designs and drawing for the SCADA for monitoring, controlling and operation of entire Bulk Water Supply System which include controlling water flows to various OHSRs from SCADA room. Data acquisition through SCADA system to enable monitoring of pressure, flow and water quantity audit, energy audit and water quality at various points. Provide and install required mechanical and electrical equipment for full operation of the specified pumping and SCADA systems to enable equitable distribution of treated water to all OHSRs and conduct water audit, energy audit and water quality monitoring.

- The system shall be designed to ensure uniform distribution of water to all OHSRs (managing minimum 1/3 quantity in all reservoirs at all times) such that 24/7 supply shall be managed drawing water from various OHSRs to supply to consumers.
- The scope includes design and construction of canal intake works with appropriate sluice gate and flow measurement arrangement; raw water transmission main till raw water storage tank.
- The raw water storage tank and pump house shall be constructed within WTP premises. The raw water shall be pumped to inlet chamber of WTP by DI (K9) rising main of required diameter and length. Scope includes the construction of a new WTP of 440 MLD capacity including all civil, mechanical and Electrical, Instrumentation & SCADA items.
- Supply all materials for construction and installation of the plant with laying, jointing of all pipes and controls required for the water facilities.
- Supply and install all electrical cabling and control panels for safe and effective operation of the plant and equipment at WTP and OHSRs.
- Installation of substation of required capacity and DG facility to ensure uninterrupted power supply to WTP and pumping stations.
- Carry out Tests after Completion and upon commission the Works and New Facilities.
constructed.

- Prepare operations and maintenance manuals for all installations
- Recruit and train water supply personnel in the operation and maintenance of the Works and New Facilities.
- Provide tool and tackles and maintain minimum spare parts for all items of equipment including filter media and other accessories as required; and Provide lubricants and tools for routine maintenance.
- Transmission should be designed to meet demand fluctuations in supply areas under OHSRs (use of IA and other disruptive technologies are encouraged) and modify supply parameters. It is optional to use more than 1(one)peak factor in designing the transmission system such more water can be delivered during peak hours.
- Supply and install all types of pressure gauges, NRV and other valves and bulk meters at all intake, storage facilities, pumping machinery, transmission piping, Operate and maintain the complete Bulk water supply system or as required; for the period defined in the Contract delivering water required to meet the demand of the city.
- Prepare the SOP (Response Plan) for emergency events including any Pollution Event at any Raw Water intake or canal closure. The final Response Plan agreed between the Contractor and the Employer shall be the Agreed Response Plan.

The design, construction and completion / commissioning of the Bulk Water Supply System shall be executed in compliance with international best practices and all relevant Indian legislation.

1.11.2 Design and Build Specifications

The Contractor shall be responsible for the provision and obtaining all relevant permits necessary for construction, preparation of detailed designs and the construction of the elements as defined in the Design Build Specifications. The Bulk Water Supply System shall, as a minimum, include the infrastructure defined in Design Build Specifications. The design and construction of the Bulk Water Supply System shall facilitate future expansion of the system as the population in covered areas grows.

- For the use of his own staff and work force the Contractor shall provide erect construct, maintain and subsequently remove all temporary offices, sanitary arrangements, stores, workshops, compounds, parking areas and the like necessary for the completion of the Works and maintenance of the Permanent Works and the siting and layout of these shall be to the approval of the Engineer. The site office shall include necessary furniture, required office equipment. The location and layout and equipment of site offices shall be got approved from the Employer’s representative before providing the same. The office equipment, computers with software/hardware, furniture & fixture etc. shall be handed over to Employer by the contractor on completion of works.

Contractor shall provide site office for the Employer’s representative with adequate number of rooms. The office shall be well furnished with necessary equipment required for the functioning of Employer’s representative. The layout of site offices shall be got approved from the Employer’s representative

- The Contractor is responsible for provision of all relevant permits necessary for detailed
design and construction of the works as defined in Schedule.

- The Contractor shall liaise with the IVA or third-party monitoring team and any other agency to be engaged by Employer.

- The works objective is to provide a complete and fully functioning Bulk Water Supply System including but not necessarily limited to the items described in the Scope of Works in section 2A of this Design Build Schedule.

- The provisions contained in this Design Build Specification are intended to supplement the FIDIC-Conditions of the Contract-GOLD: ‘Design, Build & Operate Projects’ for the purpose of providing greater specificity of the Design Build Services that the Contractor shall perform.

- The design shall be undertaken following best international and national standards based upon 150 LPCD supply considerations as prescribed in the Contract. Total water demand for base year, 15-year and 30-year period has been fixed to which the systems need to be designed.

- The technical specifications for the component structures for the Water Supply System are provided in the Section Specifications of this Bid. If not otherwise specified in the Technical Specifications, the design shall be carried out with regard to the following standards and guidelines with the indicated ranking and priority:
  
  
  - Latest versions of Indian standards, codes and guidelines published by Bureau of Indian Standard & other Regulatory Bodies whenever existing.
  
  - CPWD Specifications

- If no Indian standards exist, ISO standards shall be used. Finally, if neither of the above standard systems exist, international standards can be used after approval of the Employer’s Representative in consultation with Employer. Examples of international standards are:
  
  - B.S.- British Standards
  - EN Euro codes-European Union Standards
  - D.I.N. -Deutsche Industries Norm
  - AWWA-American Water Works Association

- Materials and construction methods to be used shall be so as to ensure that the residual life of the Bulk Water Supply System shall be as per the applicable good engineering practices and standards.

- The Contractor shall sign and maintain insurances according to the FIDIC- Conditions of Contract, and make Performance Security according to the FIDIC- Conditions of Contract (in the following GCC) in the form of a Bank Guarantee or a Performance Bond.

- The Contractor shall prepare Debris Disposal Plan, Environmental Data Sheet (EDS),
assign categorization and Environmental Management Plan (EMP) endorsed by the Employer’s Representative and IVA in Design Build Documents, and follow Environmental Code of Practices as per Indian legislation and the World Bank/ IBRD Loans guidelines.

- The Employer shall provide required land, including acquisition, for the Project and right of access to Project areas according to GCC. Any deviations necessary from the standards/norms to maintain service delivery standards, the same should be discussed with the Employer or his representative for relaxation from such conditions.

1.11.3 **Design Services – Design and Engineering**

i) The Contractor shall read, familiarize itself with, and understand the relevant institutional arrangements and Applicable Laws to determine in detail which roles the Corporation, as the asset holding and operating entity. influent

ii) The Contractor shall review all available reports commissioned during project preparation including the Project Report, the Report on Outline Specifications for Utility Systems, Procedures and Equipment as well as other relevant documents such as the City Development Plan and the Comprehensive Master Plan for the City if any

iii) All the Studies undertaken by the Employer for Project such as Feasibility Reports, Project Reports, Water Quality, Structural Stability Test Reports etc., are available in Data Room. Data Room is at Office of Superintending Engineer (O&M), MCA. Contractor can access the information for any further Project related purpose. The information available is only indicative to assist contractor to make assessment for the Bidding purpose.

iv) All the design and construction work shall be as per provisions of the Contract, and as per relevant applicable national & international Code and latest good engineering practice.

v) The Contractor shall be responsible for any discrepancies, errors or omissions in the specifications, drawings and other technical documents that it has prepared, whether such specifications, drawings and other documents have been approved by the Employer’s Representative or not.

vi) The Contractor shall make their own investigations as deemed necessary to ensure that the design is adequate for meeting the specifications and shall have full responsibility for any design, data, drawing, specification or other document, developed by the Contractor. The Contractor shall be entitled to disclaim any modification thereof provided or designated by or on behalf of the Employer, by giving a written notice of such disclaimer to the Employer/Employer’s Representative.

1. vii) The Contractor is provided with the ward/area wise demand for the Amritsar city; and the Calculations on ward with deficit and surplus storage. Accordingly, Contractor will decide the capacity of OHSRs required and will check the adequacy of the land which have been identified by the Employer for OHSRs. If the design of the contractor requires additional land other than that is available with MCA, it will be procured at the cost of contractor.
1.11.4 **Design responsibilities**

The Contractor’s design and design-related services shall include:

i) The preparation of a design that meets the criteria set forth in the Design Build Documents and that provides for a Bulk Water Supply System that meets or exceeds the Technical Specifications and Standards.

ii) The acquisition of all data and information necessary to prepare the design and that are required to demonstrate that the Bulk Water Supply System meets or exceeds the Technical Specifications and Standards.

iii) The preparation of schematic design documents to illustrate the scale and character of the Design Build Services and how the parts of the Design Build Services functionally relate to each other.

iv) Estimate of design water demand based on existing population is given in Appendix 1B: Design Criteria and population projection rate for the service area are also provided. Ward/ DMA wise Water Demand is also provided. The design responsibility is limited to design all the systems to deliver the water to 30-year demand provided to various OHSRs.

v) The preparation of a design report, based on the schematic design documents submitted in the Contractor's tender and accepted by the Employer, consisting of drawings and other documents appropriate to the Project to describe the size and character of the entire utility and the Water Supply System including architectural, mechanical, civil works, instrumentation and electrical systems, materials, operational processes, landscaping, and such other elements as may be appropriate;

vi) The preparation of Design Build Documents setting forth in detail the requirements for construction based on the design development documents accepted by the Employer.

vii) Obtaining all approvals, permits, including building permits, and licenses for the Design Build Services, except for those approvals, permits or licenses that the Employer is explicitly required to obtain itself under the Applicable Law in which case the Contractor shall prepare all documentation and provide assistance to the Employer in obtaining such approval, permits or licenses;

viii) The preparation of assurances required to regulatory authorities respecting conformance of the design with the applicable building regulations, environmental standards and occupational health and safety requirements, including construction safety issues.

ix) The coordination required to integrate all parts of the Design Build Services.

x) Such other Design Build Services that may be required from time to time that are agreed to by the Contractor and the Employer in writing; and

xi) The conducting of general reviews of the progress of the design process, to the extent necessary, in order to determine to the Contractor’s satisfaction that the design services are performed in compliance with the requirements of the Contract and Applicable Laws.
1.11.5 Design Build Documents

i) The Contractor shall prepare all of the Design Build Documents. The Design Build Documents shall include but not limited to plans, schematic design documents, design development documents, detailed designs, drawings, GFCs, Cost estimates, detailed list of requirements, as-built documents, operations manuals, specifications, and all modifications thereto required in order to properly and fully test, analyses, and build the Project as contemplated in the Technical Specifications and Standards and the remaining provisions of the Contract.

ii) The Contractor shall prepare any other document, as may be requested by the Employer’s Representative, that the Employer’s Representative considers necessary to monitor the progress of the Design Build Services and assess the Contractor’s compliance with the Contract.

iii) The Contractor shall also prepare any other documents necessary to instruct the Contractor’s Personnel.

iv) The Contractor shall provide each of the Employer’s Representative and the Employer with two sets of all of the Design Build Documents in reproducible form and four C.D.s of same and shall modify them to keep them up-to-date as requested by the Employer’s Representative acting in a professionally reasonable manner. The Design Build Documents, with the exception of the as-built documents, shall be subject to the review and approval of the Employer’s Representative prior to performing any of the services.

v) When the Contractor notifies the Employer of completion of the Bulk Water Supply System, the Contractor shall provide to the Employer’s Representative one copy of the ‘as-built’ Design Build Documents in duly signed hard copy shape and in reproducible form and four C.D.s of same showing the exact ‘as built’ locations with coordinates, sizes and details of the project and Design Build Services as executed. The Project and the Water Supply System shall not be considered to have reached Completion until such Design Build Documents have been provided and failing which two percent of cost of Design Build services shall be deducted. The Contractor shall update the ‘as-built’ Design Build Documents as necessary for the correction of defects or deficiencies to satisfaction of Employer’s Representative.

1.11.6 Design Considerations

In preparing the design for the Project and the Design Build Documents, the Contractor shall:

i) Protect public health and safety in relation to impact from the works;

ii) Maximize the protection of the environment and minimize any adverse environmental impacts caused by the works;

iii) Ensure the works have the capacity to fulfil the anticipated services within the time horizon as stipulated in the following design criteria;

iv) Ensure that the works are designed in order to maximize its duration as a fully functional Bulk Water Supply System that meets or exceeds the Technical Specifications and Standards; and supports supply of continuous water in Amritsar city (24/7).

1.11.7 Preparatory Work and Establishment of Design Data
The Contractor shall for his own account carry out field investigations and surveys as deemed necessary to obtain sufficient physical conditions as required for the design. Normally, the following field investigations and surveys may be required and shall therefore be considered by the Contractor:

(i) Water resources survey to review existing water points potential, including:

- The Contractor will review available data on the volumes of water historically abstracted from existing water sources and prepare a summary of volumes, by month, over the last ten (10) years identifying key variabilities.

- Canal (discharge data including references, field measurements, estimates), water quality, UBDC canal water levels (lowest, highest and normal operating levels), flood levels, current land ownership, current quantified water use and overflow, water permit, state and protection of the intake box; indicative information concerning water quality of the proposed water resource, the UBDC canal is provided in Appendix 1A: Water Quality—to this Specification.

- the Contractor should identify in the Design Report any critical water resource issues that may, periodically, affect the ability of the Contractor to meet the Performance Standards. It is to be noted that canal will be closed occasionally for maintenance.

- Any other source with required information as for other sources.

(ii) Assessment of Water Quality

The Service Area, at the Effective Date is supplied with water sourced from a surface water and ground water from tube wells in addition to hand pumps, wells and other sources.

The Contractor shall collect the required number of samples each of the raw water from canal water and treated water from all the Water Works existing at the Effective Date.

The Contractor shall analyze the samples collected for all the physical, chemical and bacteriological characteristics in a recognized/NABL accredited lab as approved by the MCA/PMIDC. The results of such tests shall be notified to the Corporation within two (2) days of receipt of the results.

The results of the canal water quality analysis shall be used by the Contractor for designing the WTP. For Turbidity, highest turbidity value in a year shall be taken as a basis for design of WTP.

(iii) Topographic Survey

Through detailed topographic/cadastral surveys for project sites, specifically the safe bearing capacity of the soils and ground water tables as required for detailed design, ensure that the water production, transmission and storage facilities can be designed to operate properly, and so that quantities of work and materials required can be accurately determined. Field survey of Intake works, raw water transmission, WTP, sumps, pump houses, Clearwater transmission OHSR sites and other sites as required shall include the approach roads to these sites.

Preparation of Maps and drawings: Total station survey drawings on AutoCAD shall be
prepared by the Contractor, as per site conditions and converted to GIS. The Data Acquisition and processing for GIS base maps includes the following:

- Carry out GPS ground control survey for providing sufficient control points evenly distributed over the area.
- Post processing of ground control data.
- Digitization for planimetric data captures.
- Topographic survey
- Digitization and compilation of final maps
- The Key map /Index Map for the complete project shall be made to a scale matching to A0 size paper. The detailed drawings shall be in 1:200 scale plotted to A3 size papers.
- Data entry of the ground validation surveys for updating maps for any correction/mistakes
- Updating of the field verified data onto the digital data
- Separate drawings shall be prepared for: (i) Source, WTP and Reservoir sites for a scale of 1:500, (ii) Key Map / Index map for Longitudinal section along pipeline route made to a scale matching to A0 size paper. (iii) The detailed drawings shall be in 1 : 200 scale plotted to A3 size papers .(iv) Cross sections along pipeline routes for a scale of 1 : 200 plotted to A3 size papers. (v) Key Map / Index map for Road network within each GP to a scale matching to A0 size paper. (vi) The detailed drawings shall be in 1 : 200 scale plotted to A3 size papers. All maps shall be on GIS base.

(v) Sub Surface Utility Mapping for along the alignment of pipelines and other assets using suitable technologies.

(v) Sub Soil Investigation work:

Geotechnical soil investigations is required to be undertaken at all locations and for the excavation and support of pipelines at suitable intervals along the pipeline alignment. For selection and design of foundation system of the various structures, sub soil investigation is required. Various parameters of the foundation soil and safe bearing capacity of soil have to be determined by conducting subsoil investigation work at pin point location only.

Tentative Scope of Work for Sub Soil Investigation work:

Sub soil investigation work is to be done for determining various parameters of foundation soil viz. particle size; Atterberg’s Limit; Plasticity Index; Density; Sp. Gravity; Voids Ratio; C-Ø value; consolidation; sub surface water level etc. making standard penetration test (SPT) at every 1.5 m. interval or wherever there is change of strata, and calculating the Safe Bearing Capacity of Soil for determining type and size of the various structures viz. different units of the treatment plant; clear water reservoir; elevated service reservoirs etc.

Sub Soil Investigation in minimum 10 nos. of exploratory bore holes up- to 15.0 m. depth from the G.L. in case of Treatment Plant. Sub Soil Investigation in minimum 3 nos. of exploratory bore holes per site up-to 18.0 m. depth from the G.L for OHSRs. Sub Soil Investigation in minimum 1 nos. of exploratory bore holes up-to 15.0 m. depth from the G.L. per Kilometer in case of transmission lines. The subsoil investigation report shall include all the field investigation; Bore Hole Log showing soil profile, ‘N’ values at different depth (Observed, corrected and average);
determined soil parameters in tabular form as listed in the scope of work; graphical representation of the soil parameters; and calculation of safe bearing capacity including recommendation for type of foundation etc. From the above sub soil investigation work various soil parameters at the location of various structures shall be determined and ultimate as well as safe bearing capacity of the foundation soil shall be calculated. Based on these data the type and size of foundation for various system components.

The bidder is also required to conduct surveys using latest equipment to plot the subsurface utilities and any other obstacles to construct or lay any water assets. That is for all pipelines and other investments. This is required well before commencing of work; and to plan for shifting the same or to change the alignments.

(vi) Non-destructive structural adequacy test for existing OHSRs

1.11.8 Design Criteria

The Contractor shall design the project according to the following design criteria and those detailed in Appendix 1B: Design Criteria. The list of criteria shall not be considered a complete list of design criteria for the water supply project. Any required criteria not mentioned here shall be according to current CPHEEO Manual, Indian or International Standards, common international practices or as agreed with the Employer or his representative, the Employer's Representative:

i) The total design horizon of the project shall be 30 years after completion of Design Build Period which is year 2055 (Base year is considered as 2025).

ii) The minimum demand are: 150litres/person/day

iii) The Short Term Horizon shall be 15 years from the Base Period which is taken as 2025 which is year 2040. and the Long Term Horizon shall be 30 years from the base Period which is year 2055. Water Demand for 30 year is estimated as 440 MLD and hence, no need to calculate the same. This should be used to design raw water, WTP and transmission systems. But OHSRs are designed to meet 15 year demand only.

Table 2 Estimated Future Population and Water Demand

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected Population</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population 2019</td>
<td>Lakhs</td>
<td>13.15</td>
</tr>
<tr>
<td>Population Base Year 2025</td>
<td>Lakhs</td>
<td>14.51</td>
</tr>
<tr>
<td>Population Intermediate Year 2040</td>
<td>Lakhs</td>
<td>18.15</td>
</tr>
<tr>
<td>Population Ultimate Year 2055</td>
<td>Lakhs</td>
<td>22.11</td>
</tr>
<tr>
<td>Raw Water Demand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base Year 2025</td>
<td>MLD</td>
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</tr>
<tr>
<td>Intermediate Year 2040</td>
<td>MLD</td>
<td>375</td>
</tr>
<tr>
<td>Ultimate Year 2055</td>
<td>MLD</td>
<td>454</td>
</tr>
<tr>
<td>Treated Water Demand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base Year 2025</td>
<td>MLD</td>
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</tr>
<tr>
<td>Intermediate Year 2040</td>
<td>MLD</td>
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</tr>
<tr>
<td>Ultimate Year 2055</td>
<td>MLD</td>
<td>431</td>
</tr>
</tbody>
</table>

iv) All pipe works (raw water and clear water transmission mains) will be designed on the basis of the Long-Term Horizon.

v) Mechanical and electrical works for pumping facilities will be designed for the Long-
Term Horizon; associated civil works for the pumping facilities will be generally
designed for the Long Term Horizon

vi) Treatment facilities will be designed for the Long-Term Horizon (440 MLD). An
outline design for the Long-Term Horizon will be undertaken to demonstrate that the
future works can be accommodated in the available land for the project.

vii) Storage (elevated service reservoirs) will be generally designed for the Short-Term
Horizon (year 2040).

viii) Water Works

a. The Contractor shall plan and design the necessary Capital Works to ensure a
sufficient supply of treated water from the Water Works to meet the Performance
Standards; mainly maintaining minimum 1/3 volume of water in reservoirs at all
times to allow 24/7 supply. The designed hydraulic capacity will ensure that
during the times of sufficient raw water availability the Contractor can produce
necessary volumes of treated water to meet the water demand in the Service
Area.

b. It is preferable that process design of Water Treatment Plant shall be done as per
the design criteria contained in the bid document/ Manual on Water Supply and
Treatment (for 22 hour operation), published by Ministry of Urban Development,
Government of India. However, technology is neutral, through it should be
proven technology and should not have patent related restrictions on its use. The
bidder should have successful designed, constructed and implemented WTP
using the same technology elsewhere (at least two locations of reasonable
scale)to demonstrate that technology is successful. WTP should be designed for
possible higher turbidity and likely Ammonia level. Contractor shall to design
process unit for removal of excess Ammonia beyond permissible limit of 0.5
mg/l. The quality of the treated water reaching the customer shall fulfil
requirements of guidelines for potable water in compliance with the Indian

ix) Transmission Mains

a. Raw water and treated water pipelines shall be designed for 22 hours of supply
applied to the Long-Term Horizon demand.

b. Transmission system piping shall be of such construction and quality that
disinfectant applied at the treatment facility is retained to the farthest points of
the distribution system. The chlorine level shall be in such range as below:

- 2 ppm Residual Chlorine in the treated water is required at entry to Clear water
tank / Treated Water Tank at Water Treatment Plant.

- When water reaches OHSRs, the Contractor will test the Residual Chlorine and
if it is less than one ppm then dosing shall be done at OHSR location by the
contractor at OHSR so as to make it minimum 1 ppm.

- Employer or Distribution network Contractor will test the Residual Chlorine at
end point of the distribution system so as to be minimum 0.1 ppm and
maximum 0.2 ppm. Accordingly dosing of Chlorine at OHSR shall be increased
or decreased by the contractor.
x) The Residual head at Maximum Water Level/Full Supply Level of OHSRs (existing and proposed) shall not be less than 3.0 meter and will be monitored at the Bulk Water Meter and pressure gauges. Design of feeder system to OHSRs shall be such that distribution of water to the OHSRs is ensured at all times to maintain water in OHSRs – not below 1/3 capacity of OHSRs. The transmissions system can use suitable peak factor to ensure this; and be backed by good IA system that has logical/analytical support from SCADA system.

xi) Service Storage

a. The Contractor’s proposals shall ensure adequate service storage capacity for the Service Area and shall use existing reservoirs to the extent possible with abandonment only in the event that a reservoir is structurally found to be unsafe.

b. Contractor should also consider demolition and reconstruction of OHSR, in case existing OHSR is found to be unsafe by structural stability test. New OHSR shall be constructed of appropriate capacity at the location of old OHSR.

c. A key factor to be taken into account is the highly restrictive availability of land for installation of new reservoirs and hence the proposals should focus on expanding the utilizable storage through improved hydraulics and assigned demand patterns.

d. Employer has identified 50 locations for construction of OHSRs. Contractor should consider these land parcels for constructing new OHSR of adequate capacity after due assessment of space availability and other constraints.

e. In case if the identified locations for new OHSRs are not sufficient, Contractor can identify few more locations for OHSR with assistance of Employer’s Representative.

f. The Contractor, at the time of detailed design, shall produce a list of any additional land that will be required (with options) to allow implementation of the project component such as OHSRs. The status of ownership of such land will be recorded as will any implications for its acquisition, including the application of the Project’s safeguards/Environment and Social Management Framework (ESMF) requirements and environment management framework.

g. The rehabilitation works for the existing service reservoirs need to be planned on priority.

xii) Bulk water meters of appropriate capacity and rating capable to share the information to SCADA at appropriate interval in a day shall as a minimum be provided at:

- Raw water Inlet to Water Treatment Plant and on treated water inlet to clear water storage at WTP – to assess losses in treatment and to record production of water
- At appropriate places in pumping stations to enable energy audit of pumps in terms of KW/KL.
- Outlet of Clear water tank / Treated Water Tank (North and south)
- At appropriate location along transmission main
- Entry and exit points of all OHSRs. This is for water audit /NRW and for
invoicing purposes.

xiii) Any places considered necessary for the Contractor's operation of the water project. The Contractor shall design the entire Water Supply System, preferably, as per applicable standards including CPHEEO Manual on Water Supply and Treatment. The Contractor shall, therefore, during the period of the Operation and Maintenance, conduct water audit and if necessary make leak detection survey of the transmission network and necessary repair/replacements to ensure that physical losses is not more than 5% in the network of clear water conveyance system.

1.11.9 Design of Works

i) The Contractor shall, as the first task, prepare a time schedule for the entire Design Build period clearly showing submission of Construction Documents to the Employer or Employer’s Representative with a copy to IVA for review to conform / approval of the Schedule of Works and submission dates of the various stages.

ii) The Contractor shall submit his Works design as a complete package for the review, and comments of the Employer or Employer’s Representative and the IVA. The Employer or Employer’s Representative and IVA shall agree to the design and drawings after such review. Any changes shall be discussed and agreed between the Contractor and the Employer or Employer’s Representative before the Contractor proceeds with the Works. As a minimum, the design documents and drawings shall cover the topics and items that follow.

a) The system installed during the period of investment shall provide potable water to OHSRs to serve the present population of the served areas and for progressively serving the population till the ultimate design year.

b) The Contractor shall calculate the physical sizes of the components to suit the design water demand.

c) Under the above field survey and the design period the Contractor shall design a new intake and raw water transmission to WTP, clear water transmission mail from WTP to OHSR and storage tank.

d) The Contractor shall design a new water treatment plant to secure treated water fulfilling standards given in Government of India’s Manual on Water Supply and Treatment-1999, CPHEEO, GoI. Use best international standards for any items not covered in the said manual. Contractor shall plan and Design WTP considering following

The design shall include a clear description of all proposed treatment units and include a process flow diagrams for the whole Plant showing capacities flow rates, Layout of component structures, details of treatment process adopted by confirming raw water quality parameters, hydraulic analysis of the Plant under low, normal and high operating flows;

The process design of treatment plant shall have provision for recirculation of filter backwash water, treatment of the sludge and disposal of sludge.

Design, Supply & delivery at site, installation, testing and commissioning of both the hardware and software (SCADA) including communication systems and field equipment for the data acquisition, automation and control of the water treatment plant.
Landscaping including construction of Roads, footpaths, storm water drainage, cross-drainage works, external lighting, mechanical, sanitary & chemical drains, grass/turfing and landscaping. It is important that all the systems should be designed in a way that they are not flooded/submerged and withstand earthquakes. As such, necessary design standards should be followed.

 Provision of all kinds of Site utilities (water supply, sewerage, storm water drainage, electricity, telephone etc.) including safety and fire-fighting arrangements comprising complete hydrant networking. Provision shall also be made for utility buildings, stores, cars and scooter/cycle stand etc. facilities for Employer’s representative at site office, staff and labour at site.

 A properly scaled physical model of the project (representing existing plant, proposed plant and modifications) shall also be submitted at a scale of (1:2000) such that the size is not less than 1.5m x 2.5m. Model shall be mounted on a table and fitted within a wooden box having glass on its top.

 The Contractor should prepare the Computer 3D models of the entire design and layout of the entire Water Treatment Plant using suitable software such as BIM (Building information Modeling) from Autodesk/Bentley Systems etc. The details to be shown should include the Buildings, piping systems, mechanical, electrical and instrumentation works in each of the process units. The models should be prepared to view/monitor the progress of work during construction as well as use during the operation and maintenance phase.

e) The Contractor shall determine the location and capacity of storage requirements and the capacity of elevated storage tank(s) (OHSRs) supported by the design calculations considering diurnal demand for water to determine the reservoir sizes to meet the demand. Pipe material for pipe connections of OHSR and distribution network shall be DI pipes; DI –K9 Pipe (minimum) and DI K12 specials and DI valves. No leakages are permitted. Ultrasonic Water level indicator and transmitter has to be provided. Stairs to go up have to be provided be in RCC dog legged/spiral.

f) Employer has identified locations and land for proposed OHSRs. Contractor shall assess feasibility of these locations and can identify new locations, if required in assistance with Employer’s Representative.

g) The transmission systems shall be designed as a network to ensure as far as possible that supplies to OHSRs are interrupted for a minimum time when maintenance work is done. The system design must ensure that the output performance criteria can be consistently met throughout the system.

h) Type of valves: All valves should be DI material as per the relevant IS codes and of proven manufacture (a) Butterfly valves will be used for Online Control (b) Sluice valves / Butterfly valves on transmission mains (c) Motor operated BF valves to Control Inlet to treated water tank and OHSRs; (d) Air Valves conforming to IS 14845; and (e) Dismantling joints will be provided for butterfly and sluice valves shall be proposed as per the CPHEEO manual and good engineering practice(f) Anti vacuum valves on MS clear water transmission system. All valves and appurtenances should be proposed as per CPHEEO manual and good engineering practice. All valves shall be tested for all factory tests including water tightness. Minimum Number of air valve, Sluice valve and scour valve to be provided in transmission system is given in Appendix 1C Minimum Number of Valves and Bulk
i) Hydraulic design shall be carried out to ensure that the most cost-effective balance is reached between initial cost and operational and energy costs and include as a minimum:

- Hydraulic design calculations including surge analysis for the whole of the scheme from Intake to the transmission pipelines and to the OHSRs, including friction losses for all pipelines, fittings, storage and pumping facilities.

- Process design of conventional water treatment plant shall be, preferably, done as per the design criteria laid down in the Manual on Water supply and Treatment, published by Ministry of Urban development, Government of India/ bid requirements. New proven technologies should follow international /general standards applicable.

- NPSH calculations for pumps, and maximum and minimum system curves referred to pump characteristic curves. The system curve envelopes shall be used to determine pump duty requirements for the design flow ranges.

- Surge Analysis designs and reports of all transmission mains and on proposed piping layouts and propose surge suppression installations where required.

- Structural Design Report of all the units and structure proposed as per IS 456 and IS 800.

- The overall operation of the designed network will be checked using a numerical modelling tool for Short Term and Long Term Horizons. The tool to be used will be proposed as part of the Inception Report of the Contractor and should be acceptable to the Employer / Employer’s Representative.

j) Mechanical, Instrumentation and electrical drawings, schedules and calculations as follows:

- General arrangement drawings and sectional views, fully dimensioned and showing all mechanical, electrical equipment together with relevant Schedules.

- Substation layout, sectional plans, earthing system drawing cable trench drawing

- Electrical single line diagrams and general arrangement drawings for all switchboards, motor control centers and control panels.

- Process flow diagrams for the Plant together with full supporting schedule.

- Instrumentation diagrams with P&I diagrams for each section of the Plant and entire bulk water system together with full supporting schedule.

- datasheets for all equipment

k) Architectural, Civil and Building Works drawings, schedules and calculations
1) SCADA drawings and diagrams for WTP, Transmission main and OHSRs.

SMART SYSTEM: The objective of smart system is to ensure that water supply is response to demand variations; timely distribution of treated water to all OHSRs (to ensure 24/7 water supply by making available water at all times in adequate quantity of water) and conduct water audit as per IWA framework, energy audit and online water quality monitoring”. The contractor will build a centralised control/operational facility to manage all these operations.

The Contractor shall design and implement PLC based SCADA for monitoring and control of inflows and outflows at all OHSRs and Sumps and monitoring the residual heads at OHSRs through use of bulk water meters and pressure gauge, motorized operation of BF valves installed with actuators or flow control valve for automatic operation. Contractor shall install all valves including control valves and level sensors on existing and proposed tanks to enable them for being operational by SCADA. All OHSRs shall have manual level indicators as well. Data shall be acquired and transmitted to control center including the various parameters to be monitored as per the Performance Standards specified in Appendix 3 - Schedule of Performance Standards. Additional data for water quality should be included. Data analytics should be used to understand demand fluctuations, quality changes. From this, adjust pumping parameters to distribute water to all OHSRs.

Brief description of the concept of SCADA to be provided is given below:

- The residual heads (pressures) at OHSRs are also to be regulated and need to be adjusted for progressive changes in demand. The inflow into each OHSR if existing has to be controlled to the required rate of flow and also to control the cumulative flow.

- When the OHSR overflows the level is to be sensed and the flow into OHSR is to be stopped. To achieve this control of inflow into the OHSRs with manual operations is not feasible and not desirable. It is necessary to provide flow, pressure and level measurement devices along with control device to control the inflow and outflow from OHSRs from SCADA control center. Apart from the above the flow measurement also helps in analyzing the water losses and water auditing in the system. The availability of dependable quality power is always an issue which affects the performance of the control devices and same should be considered in the design.

- Inlet and outlet of OHSR shall have chlorine and other water quality analysers to check the chlorine level and other important parameters.

- Main Components of Flow and pressure measurement and controls are: Ultrasonic Level Sensor & Transmitter, Pressure Sensor and Transmitter and pressure reducing valve if required, Electro-magnetic flow meter with signal generation, Valve Actuator Motor, Valve Actuator Drive (MOV), Programmable Logic Controller/Remote Terminal Unit, Battery power Backup system including for Motor actuator.

- The flow and pressure are monitored through the flow measured device and it will be transmitted to SCADA center through RTU. When the flow varies from the set point of flow then the MOV will operate by automatic command from the RTU to regulate and achieve the required design flow at inlet of the OHSR. The level in the OHSRs will be monitored and transmitted through RTU. When the maximum water level reaches in the OHSRs inlet valve will close by automatic command from RTU. When the water level falls below minimum water level which is to be maintained in each OHSRs,
MOV at inlet will open by automatic command from RTU. The battery back-up system is required with charger facility with minimum 24 hour battery back-up.

- The system will field equipment’s include at the Entry point of OHSRs existing as well as proposed including water quality sensors, online chlorine analyzers etc.,

- SCADA for WTP shall include rapid sand filters with automatic backwash system controlled via specified pressure/flow drop mechanism, online TDS monitoring system, energy analyzer and clarifier with flow measurement through electromagnetic flowmeters.

- Software, Instruments and field equipment proposed shall enable complete water audit and all the parameter required for monitoring and fulfilling the performance standard stipulated in

- Brief description of data and controls required is given below:

**Data acquisition:** Shall cover all information required for IVA to verify functional and performance guarantees.

i. **Intake:** Level of canal,

ii. **Raw water pumps:**
   - Individual pump’s (a) flow rate, (b) energy consumption, (c) cumulative pumping hours.
   - Record of power failures, record of DG set running and fuel consumption

iii. **WTP:**
   - Raw water Inflow quantity and quality- pH, TDS and Turbidity
   - Chemical consumption – Alum, poly-electrolyte and Chlorine Kgs /MLD, any other chemical used
   - Power consumption for whole WTP compared with output of clear water in MLD
   - Filters: For each filter, (a) average turbidity of influent and effluent, (b) Hours run in between washing, (c) maximum Loss of head and (d) average rate of flow.

iv. **Clear water sump:** water level – hourly and quality

v. **Clear water pumps:**
   - Individual pump’s (a) flow rate, (b) energy consumption, (c) cumulative pumping hours. Record of power failures and record of DG set running,
   - Total clear water pumped per day.
   - Quality of clear water pumped: pH, Turbidity and residual chlorine etc
   - Power consumed
   - Pump operation hours

vi. **Transmission Main**
   - Quantity of flow at major junctions
   - Pressure at major junctions

vii. **OHSR:**
   - Pressure at inlet to OHSR to be measured.
   - In flow Quality of clear water: pH, Turbidity TDS, and residual chlorine
   - Outflow quantity and residual chlorine analyzer
   - Total clear water received per day.
   - Water level
   - Any others equipment
Controls Required: This control systems should be SMART and work based on the IA or any other suitable analytics. This should allow the system to be operated in a SMART way responding to changing demands and raw water characteristics.

i. At Intake well:
   i) To stop and start the raw water pumps based on receipt of command from WTP
   ii) To have record of power failure and hours of operation of DG set

ii. WTP: Controls required for automatic operation of entire plant
   i) Automatic operation of all filters
   ii) Inlet and outlets of all units
   iii) Chemical House: control dosing of chemicals
   iv) To have record of consumption of chemicals

iii. Clear water sump: Sense Maximum water level of CWS and send a signal to Raw water pumps to stop raw water pumps and sense a preset level of CWS and send a signal to raw water pumps to restart pumps.

iv. Clear water pumps:
   i) To stop and start the clear water pumps based on receipt of command from OHSR
   ii) To have record of power failure and hours of operation of DG set
   iii) Each pump to have record of (i) flow rate, (ii) energy consumption, (iii) cumulative pumping hours.
   iv) To record cumulative quantity of water received and pumped in MLD.

v. OHSR
   i) Pressure at inlet to OHSR to be controlled to preset value.
   ii) At MWL/FS: water level is sensed and command sent to inlet valve to close.
   iii) At preset level of OHSR, water level is sensed and command sent to inlet valve to open.
   iv) To sense cumulative quantity of water received into OHSR in MLD and send command to inlet valve once required for the water is supplied. Note: This should be amenable to change the quantity to be supplied.
   vi. All the output reports and data analysis should be shared with employer representatives which include water auditing and WQ parameters. The preferred interval of data sharing should be weekly.

m) Building and Construction Services

i) The Contractor shall carry out all building and construction of all items required to meet the output requirements.

ii) The Contractor shall provide all of the demolition, excavation, building, coordination, repair, warranty, review, inspection, testing, quality assurance and control, monitoring, scheduling, clean-up and other construction work and services required for the modification of the Sites and the building of the Bulk Water Supply System as contemplated by Design Build Documents.

iii) The Contractor shall have total control of the building and construction services and shall effectively direct and supervise the building and construction services so as to ensure conformity with the Design Build Documents.

iv) Contractor shall undertake building work as per CPWD Manuals
v) The Contractor shall be solely responsible for construction means, methods, techniques, sequences, and procedures and for coordinating the various parts of the Design Build Services under the Contract.

1.11.10 Establishment of Contractor's Camp and Working Sites

The Contractor shall in connection with the mobilization of the works and sites assure the following facilities and conditions at his cost:

i) Establish design office with all required design facilities for the design staff.

ii) Provide potable water for construction site personnel and general cleaning in addition to any required for the construction, testing and completion of the Works.

iii) Install, operate, maintain and subsequently remove temporary electricity supplies in addition to supplies required for testing and completion the Works. The cost of electricity utilized by Proposer / Contractor during its tenure of construction & erection, up-to time of issue of commissioning certificate shall be directly paid by him to the Power Utility

iv) Erect, construct, maintain and subsequently remove all temporary accommodation necessary to for the efficient conduct and self-supervision of the Contract.

v) Before starting work, instruct all employees in the necessity for pollution prevention and following environmental, health & safety laws and practices. Any employee or Contractor’s representative polluting or fouling the Sites shall be immediately dismissed and removed from the Site. No medically unsuitable persons may be employed in or around water supply installations. Arrange for employees to be examined and tested in the manner approved by the Employer’s Medical Officer and the Employer’s Representative.

1.11.11 Site Work

During work on the sites the Contractor shall:

i) Ensure that methods of working cause minimum disturbance to land, owners and occupiers where Works are constructed on over under in or through privately owned land.

ii) Check and prepare survey data and benchmarks and their precise relationship to the National Datum before using the data to establish any further benchmarks. The Contractor shall be entirely responsible for all levels and setting out undertaken by him in the Works.

iii) Establish working and construction lines and grades according to approved detailed design drawings and supply all the materials needed to establish and preserve survey points and benchmarks.

iv) Set out the works precisely in vertical and horizontal planes and angles. Mark the location of corners with timber pegs. Locate offset pegs at one meter offsets so that all corner points can be relocated after excavation. Setting out shall be verified by the Employer’s Representative before excavation.

v) Comply Environmental Code of Practices and Environmental Management Plan, World Bank Safeguard policies; take all necessary safety measures for persons
working for construction of Water Supply System as per Factory Act/Safety Rules. It shall be certified by the Employer’s Representative and the certification will be appended with bill of Contractor.

vi) On completion of the works remove any temporary access required for the execution of the Works and reinstate the access route as a minimum to the same condition it was in before entry to the Site.

vii) Keep the works well drained and ensure that as far as is practicable all work is carried out in the dry. Excavated areas shall be kept well drained and free from standing water.

viii) On completion of the Works, leave all areas that have been occupied for whatever reason in a condition equal or better than at the time of entry. Remove and dispose of all surplus plant and materials.

1.11.12 Procurement and Transportation

i) The Contractor shall manufacture or procure and transport all the Plant and Equipment in an expeditious and orderly manner to the Site.

ii) The Contractor shall at its own risk and expense transport all the Plant and Equipment, the Contractor’s Equipment (Design Build) and the Contractor’s Equipment (Operations) to the Site by the mode of transport that the Contractor judges most suitable under all the circumstances.

iii) Unless otherwise provided in the Contract, the Contractor may select any safe mode of transport operated by any person to carry the Plant and Equipment, the Contractor’s Equipment (Design Build) and the Contractor’s Equipment (Operations).

iv) Upon dispatch of each shipment of the Plant and Equipment, the Contractor’s Equipment (Design Build) and the Contractor’s Equipment (Operations), the Contractor shall notify the Employer by telex, cable, facsimile or e-mail of the description of the Plant and Equipment and of the Contractor’s Equipment (Design Build), the point and means of dispatch, and the estimated time and point of arrival in the country where the Site is located, if applicable, and at the Site. The Contractor shall furnish the Employer with relevant shipping documents to be agreed upon between the parties.

v) The Contractor shall be responsible for obtaining, if necessary, approvals from the authorities for transportation of the Plant and Equipment, the Contractor’s Equipment (Design Build) and the Contractor’s Equipment (Operations) to the Site. The Employer shall use its reasonable endeavor’s in a timely and expeditious manner to assist the Contractor in obtaining such approvals, if requested by the Contractor. The Contractor shall indemnify and hold harmless the Employer from and against any claim for damage to roads, bridges or any other traffic facilities that may be caused by the transport of the Plant and Equipment, the Contractor’s Equipment (Design Build) and the Contractor’s Equipment (Operations) to the Site.

vi) The Contractor shall, at its own expense, handle all imported Plant and Equipment, Contractor’s Equipment (Design Build) and Contractor’s Equipment (Operations) at the point(s) of import and shall handle any formalities for customs clearance. If the Applicable Law requires any application to be made by or in the name of the Employer, the Employer shall take all necessary steps to comply with such Applicable Law. In the event of delays in customs clearance that are not the fault of the Contractor, the
Contractor shall be entitled to an extension in the Time for Completion.

1.11.13 Building Responsibilities

Temporary Supports, Structures and Utility Services
i) The Contractor shall have the sole responsibility for the design, erection, operation, maintenance, and removal of temporary supports, structures and utility services and the design and execution of construction methods required in their use.

ii) The Contractor shall engage and pay for registered professional engineering personnel skilled in the appropriate disciplines to perform those functions referred to in Point 1 where required by law or by the Design Build Documents and in all cases where such temporary supports, structures and utility services and their designs and method of construction are of such a nature that professional engineering skill is required to produce safe and satisfactory results.

1.11.14 Document Review

The Contractor shall be responsible for all approvals and permits of the Design Build Documents of the present specification. If the Contractor during the course of the construction does discover any error, inconsistency or omission in the Design Build Documents, the Contractor shall not proceed with the work affected until the Contractor has corrected any such errors or inconsistency or supplied any missing information and these corrections have been approved in writing by the Employer's Representative or the Employer.

1.11.15 Plant and Equipment

i) The Contractor shall provide and pay for labour, Plant and Equipment, tools, construction machinery and equipment, materials and supplies, water, heat, light, power, transportation, and all other facilities and services necessary for the performance of the Design Build Services in accordance with the Design Build Documents.

ii) The Contractor shall ensure that all Plant and Equipment provided are new. Plant and Equipment which are not specified shall be of a quality consistent with those specified and their use shall be acceptable to the Employer’s Representative.

1.11.16 Documents at the Site

The Contractor shall keep one copy of the Design Build Documents as up-dated, submittals, reports and records of meetings at the Site, in good order and shall make them available to the Employer and the Employer’s Representative upon request and at any reasonable time.

1.11.17 Use of the Sites and Water Supply System

i) The Contractor shall confine construction machinery and equipment, storage of Plant and Equipment, Contractor’s Equipment (Design Build) and Contractor’s Equipment (Operations), and operations of Contractor’s Personnel to limits indicated by laws, ordinances, permits or the Design Build Documents and shall not unreasonably encumber the Site with Plant and Equipment, Contractor’s Equipment (Design Build) or Contractor’s Equipment (Operations). The Contractor shall not load or permit to be loaded any of the working areas or the Water Supply System with a weight or force that will endanger the safety of the areas or the Water Supply System.
ii) The Contractor shall not store Plant and Equipment, Contractor’s Equipment (Design Build) or Contractor’s Equipment (Operations) at the working areas which are not necessary for the construction of the Project.

1.11.18 Setting Out

i) The Contractor shall be responsible for the true and proper setting-out of the Sites and the Project in relation to benchmarks, reference marks and lines specified in the Design Build Documents.

ii) If, at any time during setting-out of the Project, it is found that the Site runs through forest area, natural habitats, protected area or through an area of physical and cultural importance, the Contractor shall forthwith notify the Employer’s Representative of such and immediately change the alignment of the Site to the reasonable satisfaction of the Employer’s Representative. The price adjustment to the Contract shall be done as per Part 3.

iii) If, at any time during the construction of the Project, any error shall appear in the position, level or alignment of the Sites and the Water Supply System, the Contractor shall forthwith notify the Employer’s Representative of such error and, at its own expense, immediately rectify such error to the reasonable satisfaction of the Employer’s Representative.

1.11.19 Quality Assurance

i) The Contractor shall institute a quality assurance system to ensure compliance with the requirements of the Design Build Documents. Compliance with the quality assurance system shall not relieve the Contractor of its duties, obligations or responsibilities.

ii) The Contractor shall submit for approval Quality Assurance Document with details of all quality assurance procedures, formats and documents relating to Contractor’s compliance with the quality assurance system to the Employer’s Representative before each stage of the Design Build Services are commenced. The QAP shall be approved by Employer’s Representative and IVA. The Approved QAP shall be implemented and binding on the contractor. When any document is issued to the Employer’s Representative, it shall be accompanied by the signed quality statements for such document, if any.

iii) The Design Build Operations Engineer may audit any aspect of the quality assurance system and the Contractor shall take any corrective action as the IVA may deem appropriate. On a day-to-day basis the Contractor shall afford reasonably availability of staff and documentation for the Engineer to assess the implementation of the quality system. The Contractor shall ensure that all relevant personnel and documentation are available for such audits.

iv) Quality assurance system should also include but not limited to the preparation and use of following as per the proforma approved by the Engineer:

- Daily progress report
- Bar bending schedule
- Concrete Pour Card
- Reinforcement Inspection check list
- Post concreting check ups
- Formwork check up
- Slump test register
- Inspection slip for plastering works
- Tests on materials (bricks etc.)

1.11.20 Contractor's Access Routes and Rights of Way during the Design Build Period

i) The Contractor shall satisfy itself as to the suitability and availability of the access routes it chooses to use during the Design Build Period for access to and from the project areas. The Contractor shall, as between the Parties, be responsible for the maintenance of access routes during the Design Build Period. The Employer will not be responsible for any claims which may arise from the use or otherwise of any access route. The Employer does not guarantee the suitability or availability of any particular access route, and will not entertain any claim for any non-suitability or non-availability for continuous use, during the Design Build Period, of any such route.

ii) The Contractor shall design Site Roads to provide access for proper operation and maintenance of the works and to support the heaviest wheel load expected on the site under all weather conditions. Arrange road surfaces so that where operating vehicles enter buildings there is a short ramp and road drainage leads away from buildings. Ensure road profiles cause no surface ponding and surface water is drained away in drains to avoid damage to the roads or to the site.

2. The Contractor shall bear all costs and charges for special or temporary rights-of-way required by it for access to working areas and the Contractor's camp. The Contractor shall also provide, at its own cost, any additional facilities outside the project areas required by it for the purposes of the Design Build Services. If the design of the contractor requires additional land other than that is available with MC, it will be procured at the cost of the contractor.

1.11.21 Site Regulations and Safety

i) The Contractor shall establish Site regulations setting out the rules to be observed in the execution of the Contract at the Sites and shall comply therewith. The Contractor shall prepare and submit to the Employer, a safety assurance plan with a copy to the Employer’s Representative, proposed Site regulations for the Employer’s approval, which approval shall not be unreasonably withheld. Such Site regulations shall include rules in respect of security, safety of the Site, Existing Facility and the Water Supply System, gate control, sanitation, medical care, emergency preparedness, emergency response, on-site safety training of employees and fire prevention.

ii) The Contractor shall comply with all applicable safety regulations in providing the Design Build Services and in occupying any part of the Sites, Existing Facility or Water Supply System. Unless otherwise stated in the Design Build Documents, the Contractor shall, during the Design Build Period,

a) provide secure fencing, lighting, guarding and watching of the Design Build Services;

b) provide temporary roadways, footways, guards and fences which may be necessary for the accommodation and protection of its employees, Site visitors, owners and occupiers of adjacent land, the public and others;
c) prepare a manual of safety policies and procedures applicable to each stage of the Design Build Services and to the Project as a whole and distribute such manual to all of its Sub-contractors, agents, representatives and employees working at the Project; and

d) carry out safety briefings of applicable site regulations to all employees, Sub-contractors, agents, representatives and visitors to the Project, Existing Facility and the Water Supply System prior to permitting first access of the applicable person to the project areas or the Water Supply System, and at regular intervals thereafter.

iii) During the Design Build Period, the Contractor shall develop and implement a comprehensive occupational health and safety program for the protection of the Contractor’s Personnel and all other persons who may attend at the project areas or the Water Supply System. The program shall include a description of how the Contractor will,

   a) carry out all occupational health and safety responsibilities in respect of the Project as required under the Applicable Law and the World Bank Health & Safety standards included in Section Environmental Code of Practices;

   b) develop and manage all required occupational health and safety reporting procedures; and

   c) manage all occupational health and safety claims.

1.11.22 Contractor’s Equipment (Design Build) and Site Clearance

i) All Contractor’s Equipment (Design Build) brought by the Contractor onto the Site shall be deemed to be intended to be used exclusively for the execution of the Contract. The Contractor shall not remove the same from the Site without the Employer’s Representative’s consent that such Contractor’s Equipment (Design Build) is no longer required for the execution of the Contract.

ii) The Contractor shall maintain the Sites, Existing Facility and Water Supply System in a tidy condition and free from the accumulation of waste products and debris. The Contractor shall remove waste products and debris resulting from the Sites to designated disposal sites as per the Debris Disposal Plan and shall leave the Facility clean and suitable for occupancy and performance of the Operation and Maintenance Services before attainment of Substantial Completion. The Contractor shall remove products, tools, construction machinery, and equipment, including the Contractor’s Equipment (Design Build), not required for the performance of the remaining Design Build Services.

iii) Prior to notifying the Employer, the Contractor shall remove products, tools, construction machinery and equipment, and waste products and debris, including the Contractor’s Equipment (Design Build).

iv) Upon the issue of any Completion Certificate, the Contractor shall clear away and remove, from the Site all Contractors’ Equipment (Design Build), surplus material, wreckage, rubbish and temporary work or structures. The Contractor shall ensure that the Sites, Existing Facility and the Water Supply System are in a clean and safe condition to the satisfaction of the Employer’s Representative.
v) If the Contractor fails to remove, no later than 30 days after the issue of the Completion Certificate, any remaining Contractor’s Equipment (Design Build), surplus material, wreckage, rubbish and temporary work or structures, the Employer may sell or otherwise dispose of such items. The Employer shall be entitled to retain, from the proceeds of such sale, a sum sufficient to meet the costs incurred in connection with the sale or disposal, and in restoring the Sites, Existing Facility and Water Supply System. Any balance of the proceeds shall be paid to the Contractor. If the proceeds of the sale are insufficient to meet the Employer’s costs, the outstanding balance shall be recoverable from the Contractor by the Employer.

vi) The Employer will, if requested, use reasonable efforts to assist the Contractor in obtaining any local, state or national government permission required by the Contractor for the export of the Contractor’s Equipment (Design Build) imported by the Contractor solely for use in the execution of the Contract that is no longer required for the execution of the Contract.

vii) Clearing and grubbing operations on sites shall be the minimum practicably necessary to construct the Works. The Contractor shall protect trees and other vegetation designated for preservation.

viii) Re-install any road furniture (e.g. traffic signs) removed to its original location in at least equal condition immediately after completion of pipe laying at a particular location.

ix) No blasting shall be carried out.

1.11.23 Protection of the Environment

The Contractor shall take all reasonable steps to protect the environment, both on and off the sites, and to limit damage and nuisance to people and property resulting from pollution, noise, dust and other results of its Services, including, adopting working practices that prevent or minimize the transfer of any pollutant off-site; maintaining the access roads in good repair; using appropriate dust suppressant methods; restricting trucking and loud machinery and equipment use to daylight hours; using mufflers, silencers and other appropriate methods to minimize the noise of the construction; using “silt fencing”, hay bales, silt traps or other methods to minimize soil erosion and prevent the contamination of surface water and the transportation of soil and sediment off-site onto adjacent properties; and maintaining clean sites, Existing Facility and Water Supply System that are free of garbage, except the disposal area, and debris. The Contractor shall, at all times during building and construction as well as during operation and maintenance ensure that the Environmental Management Plan is followed.

1.11.24 Security of the Site, Existing Facility and Water Supply System

Unless otherwise stated in the Design Build Documents:

i) the Contractor shall be responsible for keeping unauthorized persons off the Sites, Existing Facility and Water Supply System, the Contractor shall maintain detailed record of all persons that enter the Sites, Existing Facility and the Water Supply System; and the Contractor shall ensure that authorised persons shall be limited to the Contractor’s Personnel, the Employer’s Representative, employees of Sub-contractors and persons authorised by the Employer or Employer's representative.

1.11.25 Obtaining Permission and Co-operation with other Authorities
The department shall apply for the required road crossing such as road crossing permissions and the contractor shall pursue the case with the authority for an early sanction. For maintaining the continuity of the laying, the contractor shall keep close liaison with the authorities for any early execution of crossing work.

Employer shall provide assistance to contractor in coordination and obtaining relevant information or permissions from water resources, electricity and traffic authorities. Contractor has to coordinate with all such Government departments for timely execution of Work.

The Contractor shall consult and get approval from applicable authorities and utilities in connection with the following work:

i) Before starting any excavations, the Contractor shall satisfy himself and the Employer’s Representative as to the exact position of existing services by exploratory excavations and shall make his own arrangements with the service providers for any diversion or removal of services required.

ii) The Contractor shall be responsible for liaison with all relevant authorities and utilities and arrange his construction schedule to minimize inconvenience to all other parties and the public.

iii) Make least possible interference with existing amenities, whether natural or man-made. Keep Site clearance to minimum. Divert around the perimeter of the sites any minor watercourses crossing the sites that are needed for agriculture outside the site boundaries.

iv) Discharge or dispose of all water and waste products from the sites as per the Debris Disposal Plan, and to the satisfaction of the Employer’s Representative, and of any authority or person with an interest in land into which water and waste products may be discharged, without limitation to the Contractor’s general obligations.

v) Accept responsibility for safeguarding all pipes, cables and other things that would otherwise be liable to suffer damage without precautionary measures.

vi) Complete permanent fencing or other temporary safeguards around electrical equipment as far as practicable before connection of electricity supply.

vii) Ensure that all assemblies and sub-assemblies delivered to the site are of suitable size and weight for access to the place of installation and pack all items of plant and materials for transport to avoid damage from handling or weather. It is the sole responsibility of the Contractor to maintain protection of the equipment.

viii) Contractor shall prepare traffic diversion plan and submit the plan for approval of Employer’s representative. Plan after approval of Employer’s representative shall be submitted to Traffic authorities well in advance.

1.11.26 Physical Cultural Property

i) The Contractor shall take reasonable precautions to prevent its employees, agents, representatives, Sub-contractors, or other persons from removing or damaging any fossils, coins, articles of antiquity, and structures and other remains or things of geological or archaeological interest at the Site. The Contractor shall, immediately upon discovery of such article or thing, shall inform the Employer’s Representative, the Employer and Archaeological Survey of India. The Employer’s Representative may
issue instructions for dealing with the findings. All fossils, coins, articles of value or antiquity, and structures and other remains or things of geological or archaeological interest discovered on the Site shall be the property of Archaeological Survey of India.

ii) If the Contractor suffers delay or incurs any damages or costs in following any instructions of the Employer’s Representative pursuant to this document, and if such delay or damages or costs were Unforeseeable, the Contractor shall give notice to the Design Build Operations Engineer, with a copy to the Employer. After receipt of such notice, the Employer’s Representative shall determine if the Contractor is entitled to any extension of time or any compensation for such damages or costs and shall notify the Contractor accordingly.

1.11.27 Emergency Work

i) If, by reason of an emergency arising in connection with and during the execution of the Design Build Services, any protective or remedial work is necessary as a matter of urgency to prevent damage to the Sites, Existing Facility or Water Supply System, the Contractor shall immediately carry out such work.

ii) If the Contractor is unable or unwilling to do such work immediately, the Employer may do or cause such work to be done as the Employer may determine is necessary in order to prevent damage to the Sites, Existing Facility or the Water Supply System. In such event the Employer shall, as soon as practicable after the occurrence of any such emergency, notify the Contractor in writing of such emergency, the work done and the reasons therefore. If the work done or caused to be done by the Employer is work that the Contractor was liable to do at its own expense under the Contract, the reasonable costs incurred by the Employer in connection therewith shall be paid by the Contractor to the Employer. Otherwise, the cost of such remedial work shall be borne by the Employer.

1.11.28 Work at Night and on Holidays

i) Unless otherwise provided in the Contract, no work shall be carried out at night and on public holidays of the Country without prior written consent of the Employer, except where work is necessary or required to ensure safety of the Sites, Existing Facility or the Water Supply System or for the protection of life, or to prevent loss or damage to property, when the Contractor shall immediately advise the Employer’s Representative, provided that provisions of this document shall not apply to any work which is customarily carried out by rotary or double-shifts.

ii) Notwithstanding this document, if and when the Contractor considers it necessary to carry out work at night or on public holidays so as to meet the Time for Completion and requests the Employer’s consent thereto, the Employer shall not unreasonably withhold such consent.

1.11.29 Test and Inspection

i) The Contractor shall at its own expense carry out at the place of manufacture or on the Site all such tests and inspections of the Plant and Equipment and any part of the Project as are specified. The Contractor shall, in addition to those tests and inspections set out in the Contract, develop a plan for all testing and inspection of the Project that is required in order to complete the Project in accordance with the Contract.
ii) The Employer and the Employer’s Representative or their designated representatives shall be entitled to attend any test or inspection, provided that the Employer shall bear all costs and expenses incurred in connection with such attendance including, but not limited to, all travelling and board and lodging expenses.

iii) The Contractor shall obtain from any relevant third party or manufacturer any necessary permission or consent to enable the Employer and the Employer's Representative (or their designated representatives) to attend the test or inspection.

iv) If the Employer and the Employer’s Representative, or their designated representatives, fails to attend the test or inspection, or if it is agreed between the Parties that such persons shall not do so, then the Contractor may proceed with the test or inspection in the absence of such persons, and shall provide the Employer’s Representative with a certified report of the results thereof.

v) The Employer’s Representative may require the Contractor to carry out any test or inspection not required by the Contract, provided that the Contractor’s reasonable costs and expenses incurred in the carrying out of such test or inspection shall be added to the Contract Price. Further, if such test or inspection impedes the progress of work or the Contractor’s performance of its other obligations under the Contract, due allowance will be made in respect of the Time for Completion and the other obligations so affected.

vi) If any Plant and Equipment or any part of the Project fails to pass any test or inspection, the Contractor shall either rectify or replace such Plant and Equipment or part of the Water Supply System and shall repeat the test or inspection upon giving a notice under this document.

vii) If any dispute or difference of opinion arises between the Parties in connection with or arising out of the test or inspection of the Plant and Equipment or part of the Project that cannot be settled between the parties within a reasonable period of time, it may be referred to an Adjudicator for determination.

viii) The Contractor shall give the Employer and the Employer's Representative, at the Employer’s expense, access at any reasonable time to any part of the Project or any place where the Plant and Equipment are being manufactured or installed in the Water Supply System, in order to inspect the progress of the work and the manner of manufacture or installation, provided that the Employer's Representative shall give the Contractor a reasonable prior notice.

ix) The Contractor agrees that neither the execution of a test or inspection of Plant and Equipment or any part of the Site and the Water Supply System, nor the attendance by the Employer and the Employer’s Representative, nor the issue of any test certificate pursuant to this document, shall release the Contractor from any other responsibilities under the Contract.

x) No part of the Project or foundations shall be covered up on the Site without the Contractor carrying out any test or inspection required under the Contract. The Contractor shall give a reasonable notice to the Employer’s Representative whenever any such parts of the Project or foundations are ready or about to be ready for test or inspection; such test or inspection and notice thereof shall be subject to the requirements of the Contract.

xi) The Contractor shall uncover any part of the Project or foundations or shall make
openings in or through the same as the Employer’s Representative may from time to time require at the Site, and shall reinstate and make good such part or parts.

xii) If any parts of the Project or foundations have been covered up at the Site after compliance with the requirement of this document and are found to be executed in accordance with the Contract, the expenses of uncovering, making openings in or through, reinstating, and making good the same shall be borne by the Employer, and the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been delayed or impeded in the performance of any of its obligations under the Contract.

xiii) The Contractor shall provide a report for every test carried out to sign and certify that the test has been carried out and, the result. Tests witnessed by the Employer’s Representative shall be countersigned. The Contractor shall collect and collate all data into a bound certified report.

xiv) The Contractor shall provide all labour, materials, electricity, fuel, stores and apparatus and instruments necessary to carry out the tests efficiently. Measuring instruments indicators and other apparatus shall be as approved by the Employer’s Representative.

xv) The type and number of performance and operational tests to demonstrate compliance of the installations with the output requirements shall be agreed between the Employer’s Representative and the Contractor. At least 1 week before testing starts the Contractor shall submit the test schedule, detailed test procedures and method statements to the Employer’s Representative for approval.

The following tests shall be compulsory but not necessarily sufficient for the Project and the test plan agreed between the Employer’s Representative and the Contractor:

1.11.29.1 Pre-Completion Tests:

i) The Contractor will demonstrate the proper function and operation of all mechanical and electrical plant and confirm compliance of all mechanical and electrical equipment with the design and specifications, both individually and as part of a system.

ii) Water will be fed through each stream of each process stage in turn and each item of auxiliary equipment shall be operated in a similar manner. Changeover of duties of all plant shall be demonstrated. Each item of plant shall take a proportionate share of the operating duty for a total minimum of 72 hours of continuous satisfactory operation.

iii) The Contractor will systematically demonstrate completion of the plant and that it is ready for Completion.

iv) This process shall then be extended to the distribution system, where the specific procedures for flushing and sterilising pipelines complying with AWWA C 651, or other approved international standard, will apply.

1.11.29.2 Guarantee Tests:

i) The Contractor shall demonstrate the ability of the system to meet Functional Guarantees for the Treatment Plant and storage and distribution system. Complete the tests over 28 days of continuous operation immediately after completion of pre-completion. The tests shall assess performance of the facilities with relation or regard to the following criteria:
- Raw water composition.
- Treated water composition.
- Power consumption.
- Consumption of chemicals.

ii) Operate the plant in accordance with the Operating Manual and vary plant outputs over the full operating range. Send results and analysis with all other data collected to the Employer’s Representative each week for review at regular meetings with the Employer and the Contractor.

iii) Sample water quality at locations identified in the works and in the field to ensure that all requirements are met. Use these samples for analysis by an approved laboratory or by approved portable analyzers.

iv) Carry out system pressure tests on a systematic basis and always related to the time of day and to the water consumption rate to the service area.

v) The water quality test results shall fail if any of the following occurs:
   - More than one discrete sample exceeds the maximum value in any week;
   - More than three discrete samples exceed the maximum value during the 28 day test.

vi) Supply and install metering and data logging equipment to monitor the plant power consumption (KWh) throughout the Tests.

vii) The test shall fail, if the power consumption exceeds the guaranteed value stated by the Contractor in the Schedules.

viii) If a Performance Test fails, prepare and submit Plant modification proposals to the Employer’s Representative. When approved, carry out the modification work as quickly as possible, and as soon as complete, resume normal works operation and repeat the Guarantee Tests.

ix) Pressure testing of pipes (together with all specials and valves incorporated) shall be strictly in accordance with BS 6700 or any other approved international standard.

1.11.29.3 Completion of the Bulk Water Supply System

i) In compliance to GCC, and as soon as the Design Build Services have, in the opinion of the Contractor, been completed, excluding minor items not materially affecting the operation or safety of the Project, and the Project has satisfactorily passed all Tests on Completion, the Contractor shall so notify the Employer’s Representative and the Employer in writing (the “Notice of Completion”) and provide the ‘as-built’ Design Build Documents.

ii) The Employer’s Representative shall, no later than 30 days after receipt of the Contractor’s notice under this document, either issue a Completion Certificate stating that the Project has reached Completion as of the date of the Contractor’s notice under this document, or notify the Contractor in writing of any defects or deficiencies or both.

iii) If the Employer’s Representative is not satisfied that the Design Build Services are
complete, the Employer’s Representative shall notify the Contractor in writing of any defects or deficiencies no later than 7 days after receipt of the Notice of Completion.

iv) If the Employer’s Representative notifies the Contractor of any defects or deficiencies or both, the Contractor shall then correct such defects or deficiencies, and shall repeat the procedure described in this document.

v) If the Employer’s Representative is satisfied that the Design Build Services have reached Completion, the Employer’s Representative shall, no later than 7 days after receipt of the Contractor’s repeated Notice of Completion, issue a Completion Certificate stating that the Design Build Services have reached Completion as of the date of the Contractor’s repeated Notice of Completion.

vi) If the Employer’s Representative fails to issue the Completion Certificate and fails to inform the Contractor of any defects or deficiencies 14 days after receipt of the Notice of Completion or 7 days after receipt of the Contractor’s repeated Notice of Completion, then the Design Build Services shall be deemed to have reached Completion as of the date of the Notice of Completion or repeated Notice of Completion as the case maybe.

vii) As soon as possible after Completion, the Contractor shall complete all outstanding minor items so that the Project are fully in accordance with the requirements of the Contract, failing which the Employer will undertake such completion and deduct the costs thereof from any monies owing to the Contractor.

1.11.29.4 Completion and Operational Acceptance

Completion of the Water Supply System shall be commenced by the Contractor immediately after issue of the Completion Certificate by the Employer’s Representative, pursuant to this document, or immediately after issue of the deemed Completion, under this document.

1.11.29.5 Tests on Completion

i) The Tests on Completion, and repeats thereof, shall be conducted by the Contractor during Completion of the Project to ascertain whether the project or the relevant part can attain the Technical Specifications and Standards set out in the Contract. The Contractor’s and Employer’s Representative advisory personnel shall attend the Tests on Completion and shall advise and assist the Employer. The Employer shall promptly provide the Contractor with such information as the Contractor may reasonably require in relation to the conduct and results of the Tests on Completion, and any repeats thereof.

ii) If for reasons not attributable to the Contractor, the Tests on Completion of the Water Supply System cannot be successfully completed within 21 days after the period from the date of Completion specified in the Contract or any other period agreed upon by the Employer and the Contractor, the Contractor shall be deemed to have fulfilled its obligations with respect to the Tests on Completion.

1.11.29.6 Operational Acceptance

i) Operational Acceptance shall occur in respect of the Project when the Tests on Completion have been successfully completed.

ii) At any time after the successful completion of the Tests on Completion, the Contractor may give a notice to the Employer’s Representative requesting the issue of an
Operational Acceptance Certificate in respect of the Project.

iii) The Employer’s Representative shall, after consultation with the Employer, and no later than 7 days after receipt of the Contractor’s notice, issue an Operational Acceptance Certificate.

iv) If within 7 days after receipt of the Contractor’s notice, the Employer’s Representative fails to issue the Operational Acceptance Certificate or fails to inform the Contractor in writing of the justifiable reasons why the Employer’s Representative has not issued the Operational Acceptance Certificate, the project shall be deemed to have been accepted as of the date of the Contractor’s said notice.

1.11.30 Reporting during the Design Build Period

In addition to the other reports, the Contractor shall prepare First, Quarterly and Final Reports. All reports shall be prepared in the English languages in hard and electronic version for submission to the Employer.

1.11.30.1 First Report (Inception Report)

Not later than in four weeks upon commencement of the assignment, the Contractor will prepare and submit to the Employer a First Report. This report will include the information about the status of the Project preparation and implementation, any problems encountered during the project preparation, revised overall procurement plan and contracting strategy. The expected Project implementation schedule corrected in accordance with the realistic status will be attached to the report, as well as a confirmation on the Contractor’s work schedule for the next quarter.

The report shall also propose content of the schematic design documents with e.g. projected water demand and waterworks inventory, design reports, QAP, detailed technical specifications, supervision procedures and supervision reports.

1.11.30.2 Survey, Investigation and condition assessment

Not later than two months upon commencement of the assignment

1.11.30.3 Preliminary Design Report

Contractor shall submit Preliminary design of all the elements defined in Scope of Work. The Report shall be approved by Employer’s Representative and IVA. Not later than Three months upon commencement of the assignment

1.11.30.4 Final Design Reports and Estimates

Not later than Six months upon commencement of the assignment

1.11.30.5 Progress Report

Contractor shall submit Monthly progress report during the entire period of Design and Build Period. The report shall illustrate progress made by contractor in given period.

1.11.30.6 As-built records and drawings

The Contractor shall prepare, and keep up-to-date, a complete set of as-built records of the execution of works, showing the exact “as-built” locations, sizes and details of the work as executed. As-built records shall include all such drawings, schedules, documentation and
calculations as necessary for the complete understanding of the design, sizing and capacities of the structures and equipment.

The As-built records shall consist of the fully updated version of the approved construction documents incorporating any changes made during the construction/erection and commissioning of the works including additional information which will assist the Employer in operating and maintaining at a later date. The contractor shall submit, after due verification and approval of the Engineer, six copies of the final As-built records including 2 sets of soft copies 30 days after Completion of Work.

1.11.30.7 Quarterly Reports

Throughout the assignment the Contractor shall submit Quarterly Reports to the Employer by the fifteenth day of the following month. Each report will show events and progress for the Contractor’s activities of each of the main tasks. The format of quarterly reports shall be agreed with the Employer and shall include, but not be limited to, the following:

a) photographs and detailed descriptions of progress, including each stage of design, procurement, manufacture, delivery to the site, construction, laying, erection, testing and completion;

b) Chart and description of work and goods of each stage: Design, production, transportation, construction, installation, testing, completion, guarantee test and acceptance; the status of Design Build Documents, purchase orders, manufacture and construction.

c) for the manufacture of each main item, equipment, machinery, floor or component of the Water Supply System and New Facility, the name of manufacturer, manufacture location, percentage progress, and the actual or expected dates of commencement of manufacture, Contractor’s inspections, tests and delivery relating there to;

d) Comparisons of actual and planned progress including percentage completion achieved for each activity.

e) detailed records of the Contractor’s Personnel and Contractor’s Equipment (Design-Build) on the site and the actual usage of the Contractor’s Equipment (Design-Build) during the reporting period and the tasks performed by the Contractor’s Personnel.

f) Details of any aspects which may jeopardize the completion in accordance with the contracts, and the measures being (or to be) adopted to overcome such aspects.

g) Copies of the quality assurance documents, test results and certificates of materials, Plant and Equipment;

h) All monitoring results;

i) Safety statistics, including details of any hazardous incidents and activities relating to environmental aspects and public relations;

j) Projected contractual payments for next four quarters;

k) Where any activity is behind in the scheduled completion, comments and likely consequences and a description of the corrective action being taken.

l) Other information to be agreed with the Employer.
The quarterly progress reports should be short and whenever possible made in a table like for easy reference and comparison.

1.11.30.8 Final Report

The Contractor will prepare a draft of the Final Report one month prior to the end of the Design Build Contract and hand it over to the Employer. The Final Report will be in fact a review of the entire Contractor’s tasks fulfilment and include the necessary conclusions. It shall also include inventory register as per format approved by Employer’s representative and maintenance schedule any cost. Upon receipt of the Employer’s comments and suggestions the Contractor prepares the finalised version of the report.

1.11.31 Intellectual Property

i. The Contractor shall make available to and hereby licenses the Corporation to use free of charge all Intellectual Property owned by the Contractor(or to the extent they are legally able to do so for Intellectual Property licensed to the Contractor by third parties) which is required in connection with the performance of the Contractor's obligations under this Agreement. This license is for the purposes of providing the Services but no other purpose. Such license shall be irrevocable, be royalty free, shall not be transferable and shall not carry the right to grant sub-licenses.

ii. The Corporation shall, to the extent it is legally able to do so, grant the Contractor during the term of this Agreement a royalty free, non-exclusive, irrevocable personal and non-transferable license to use Intellectual Property which is owned by or licensed to the Corporation by third parties only to the extent necessary to enable the Contractor to perform its obligations under this Agreement. Such licenses shall not carry the right to grant sub-licenses.

iii. The Contractor shall indemnify the Employer/ MCA in full in respect of all loss, damage and expense of whatever kind and nature arising out of the use by the Employer /Municipal Corporation Amritsar,(MCA),of the Intellectual Property made available by the Contractor in accordance with its terms which infringes the rights of any third party.

iv. The MCA shall indemnify the Contractor in full in respect of all loss, damage and expense of whatever kind and nature arising out of the use by the Contractor of any Intellectual Property made available by the Corporation in accordance with its terms which infringes the rights of any third party.

v. All plans, drawings, specifications, designs, reports, and other documents and software submitted by the Contractor in accordance with this Agreement shall become and remain the property of the MCA, and the Contractor shall, no later than the date of termination or expiration of this Agreement, deliver all such documents and software to the Corporation, together with a detailed inventory thereof. Permission relating to the future use of these documents, if any, shall be specified by the Corporation and shall be binding on the Contractor surviving termination of this Agreement.

1.11.32 Replacement of Key Staff to be deployed by the Contractor during the Design Build Period.
If replacement of any Key Staff during design & build services period becomes necessary, the Contractor shall submit a proposal for Employer’s approval, advising therein the name of the replacement staff of equivalent or higher qualifications duly supported by his CV. The overlap period of the new key staff and the staff to be replaced shall be minimum of one month.

1.12 Operation and Maintenance

The contractor shall operate and maintain the Facilities constructed and rehabilitated under this contract for a period of 10 years and subject to direction of Employer or Employer’s Engineer from time to time.

The Contractor shall have the following general obligations as they may be applicable during the Operation and maintenance Period:

1) to perform the Services in accordance with this Contract, and carry out its obligations with all due diligence, efficiency, and economy, in accordance with generally accepted professional techniques and practices, and shall observe sound management practices, and employ appropriate advanced technology and safe methods. The Contractor shall always act, in respect of any matter relating to this Agreement or to the Services, as faithful service provider to the Corporation, and shall at all times support and safeguard the Corporation’s legitimate interests in any dealings with sub-contractors or third parties;

2) to carry out day-to-day management and operation of the water supply production, transmission and Storage within the Service Area;

3) to be responsible for maintaining all Permits to perform the Services throughout the Period of Contract;

4) to ensure that all materials and workmanship used in the course of the Agreement shall be in accordance with relevant standards of Bureau of Indian Standards and in the absence of which to the relevant standards of International Standards Organisation;

5) to maintain all records and data in up to date format on the various information systems;

6) to permit the Technical Auditor or Employer’s Representative or representative to conduct quarterly and annual audits to regularly review the performance of the Contractor under the Agreement from the Date of Commencement O&M period till the Expiry Date, and shall fully cooperate in the conduct of audit and review exercises and checks as may be required under this Contract and shall immediately provide all required information;

7) not to engage, and ensure that its Employees do not engage, either directly or indirectly, in any business or professional activities in India which would conflict with the provisions under this Contract;

8) To set-up website dedicated to the project which shall provide information regarding plan maintenance, approved quarterly performance reports etc. it should also have a link to online registration of complaints.

9) to update the Standard Operating Procedures periodically to reflect latest practices;

10) to follow the safeguards requirements for the Contract; and

11) The Contractor shall prepare an annual operation and maintenance plan for the Facilities (the “Operation and Maintenance Plan”) with sufficient detail of all critical and routine operating tasks at each unit of water supply chain with the objective of achieving and maintaining the
Required Service Levels. To this effect the Contractor shall be required to propose with sufficient justification any adjustment to the performance standards found necessary during the O&M period. The Contractor shall develop various policies, procedures and SOP as part of O&M Plan for effective and efficient service delivery which shall include but not be limited to, the following:

a) Emergency Response Plan (ERP)
b) Customer Management and Communications Plan
c) Energy optimization program
d) Environmental Management Plan, including health and safety
e) Connections policy for all types of connections including services to the urban poor and treatment of illegal connections
f) Network expansion policy
g) Stores and inventory management policy; and
h) Human resource management and training policy.

1.12.1 Integrated Management Information System

Contractor shall develop Asset Registry which shall be capable of recording all assets installed in the bulk water supply scheme including the asset rehabilitation and replacements executed from time to time. It shall have the capabilities for facility management, inventory management, operational job management and records and data management as well as all capabilities necessary for safe and efficient management, operation and maintenance of the Facilities and integration with GIS.

Within 180 days from the date of commencement of Operation and maintenance period, the Contractor, in accordance to the Technical Specifications, Particular Specifications and instruction of Employer’s representative, shall develop, establish, operate, update and manage during the remaining Contract Term a comprehensive integrated management information system (IMIS) in respect of all matters including but not limited to:

a. Data bases relating to complaints and questions, response times and resolution;
b. Financial management, including accounting systems;
c. Performance information systems; and
d. Asset registers from the perspective of maintaining a prudent GIS based or computerized maintenance management system (CMMS) linked to financial and inventory systems.

1.12.2 Operation and Maintenance Plan

The O&M Plan shall comprise the operating and maintenance strategy for improving the operating efficiency, methodology, organization structure, human resource plan, equipment deployment plan, environmental management measures, responsibilities for unit operations, monitoring and emergency response, related processes, systems, protocols, procedures including detailed costs for each activity of operations and maintenance etc.

O&M Plan will present in detail the monitoring protocol for water quality measurement around the system. This protocol will cover the whole process from designing the sampling regime, taking samples, testing samples, and reporting samples. The O&M Plan will also present the on-line water quality reporting system required to meet the performance standard mentioned in this contract.
1.12.3 Reporting

a) The Contractor shall maintain a periodical reporting system to provide access and retrieval of operating data, for the Water Treatment Plant and the specified components of the Bulk Water Supply System including all such information which is necessary to verify costs and expenses incurred and otherwise to confirm that the Contractor is in compliance with its obligations under the terms and conditions of this Contract;

b) The Contractor shall prepare daily and monthly reports about the work performance and submit to the Employer’s representative and will assist the PIU/corporation in preparing the necessary documents for their purposes and record as performance given from time to time. The report shall be as per the SCADA generated report.

c) The Contractor will prepare periodic reports in specified formats, as required by the Employer. The report shall follow the following areas and information, with specific details to be further developed and agreed with the Employer’s Representative. Report shall be submitted to the Employer within 7 days of start of the Month. Report shall present all information required to evaluate the performance of the contractor.

Monthly Report shall present following information but not limited to.

i.) Performance Standards achieved or maintained during the month; exceptional reports on emergencies; etc.

ii.) Water Consumption: This section will present
   - the total amount of water (in m³) extracted, treated, and supplied to OHSRs
   - Inflow and outflow of OHSR.

iii.) Unaccounted for Water: This section will present information on Unaccounted for Water computed
   - as the difference between water extracted and produced expressed as a percentage of net water extracted;
   - as the difference between water produced and supplied expressed as a percentage of net water produced;
   - as the volume of water lost per kilometer of water distribution network during the Operation and Maintenance period.

iv.) Efficiency of Operations: This section will present information on the efficiency of operations showing the number of unscheduled water supply failures lasting more than 30 minutes.

v.) Quality of Service: This section will present information on continuity of service expressed as the Average Hours of water supply per day for the period and parameters such as pesticide residues, heavy metals, chemical and bacteriological as prescribed in Appendix 3 - Schedule of Performance Standards.

vi.) Consumption Report
   The amount of chemicals consumed, Power consumption, Diesel consumption etc.

vii.) Investments: This section will present a summary of the capital works carried out and the investment involved for the period. The maintenance works under this Operation and Maintenance Schedule will be presented separately with break down by main type of investment.

d) Annual Report:
   The Contractor will prepare a draft of the Annual Report one month prior to the end of each year of the Operation & Maintenance Period and submit it over to the Employer.
The Annual Report will be a review of the entire Contractor’s tasks fulfilment in a year and include the necessary conclusions. Upon receipt of the Employer’s comments and suggestions the Contractor will prepare and submit the finalized Annual Report.

1.12.4 Record Keeping

The Contractor shall keep complete record of:

a) Monthly compilation of complaint redressal performance
b) Annual fitness certificate of the transport vehicles and loading equipment
c) Disagreements/ disputes, if any and proposed measures to be taken
d) Brief report of any accident/incident related to the Project, injury/ fatality, property damage, cause of accident and actions taken to avoid recurrence
e) Copies of any reports submitted for purposes of regulatory compliance and of notices received or reports or notices submitted to any competent authority or otherwise
f) Any other report that may be reasonably required by the Corporation for itself or to fulfil any regulatory compliance.
g) The frequency and formats for the reports to be submitted shall be finalised in consultation with the Technical Auditor and shall form part of the O&M plan.
h) Logbook showing Water abstraction from canal, flows, pressure & discharge in the production, transmission, storage, distribution system, levels in storage reservoirs, and interruption of power if any, to be recorded;
i) Logbook showing Chemical consumption, diesel, energy consumption and any other consumables
j) Record of Stock of chemicals, diesel, spares, tools etc.
k) History sheet of overhauling / maintenance / replacement of consumable / non consumable related to all the important mechanical equipment;
l) Manual indicating the location, type, and operation of all electromechanical equipment;
m) Operation and Maintenance management plan including, inter alia, maintenance management, work scheduling, inspections, preventive maintenance, monitoring and control, operations management.

n) Certified copies of As built Drawings and Reports (minimum three copies)

The Contractor shall maintain and keep all O&M records) for the Facilities at the location decided in consultation with the Corporation inter alia including:

- records for regulatory compliance; and
- records of health and safety management.
- the Contractor shall finalize the formats for the records in consultation with the Technical Auditor and document the same.
- The Contractor would keep the Records for a period as per the statutory requirements or for at least ten (10) years, whichever is higher.

1.12.5 Undertaking capacity building measures

Prior to three months of handing over of Water Supply System to Employer, the Contractor shall conduct a training and handholding assistance program for 15 days in aspects of Operation and Maintenance of the Bulk Water Supply System and two batches for maximum Thirty employees of Employer and the local bodies. He shall prepare Training Manual and material in form of handouts, Notes with illustrations for understanding to be shared with employees of Employer and the local bodies during Training.
1.12.6 Staff
The qualification and experience of the personnel required for the Operation and Maintenance Period are specified in the Section of the Bid Contractor’s Representative and Key Personnel. In case the Contractor intends to change any Key Staff, such change will be subject to approval from the Employer on justification provided by the Contractor. The proposed replacement shall have to be of equivalent or higher qualification and experience specified above for the respective Key Staff.

- No labour below the age to 18 years shall be employed on the work. Advance intimation to be given before deputing/removing any Key Staff from site during the Operation and Maintenance Period. Not more than one of the Operator’s Key Staff shall be absent from the Project site at any given time.

- The Employer shall be authorised to direct the Contractor to remove any or all staff employed on the Operation and Maintenance of the Water Supply System, if in the opinion of the Employer, the continued presence of such staff is detrimental to the safety or proper operation and maintenance of the Water Supply System. After receiving such communication from the Employer’s Representative or the authorised representative of the Employer, the Contractor shall remove the concerned staff member and provide an appropriate replacement.

1.12.7 Safety/Security
The Contractor shall take all safety precautions under various Acts/Rules under Central/State Government from time to time. The Contractor shall be responsible for safety of its staff and the consequences thereof. The Contractor shall deploy round the clock security personnel at entrance of plant’s premises and in the compound for the safety of the plant and premises for the safety of the plant, equipment and personnel during this period.

1.12.8 Responsibility for damages
a) The care of the whole of the permanent works for the Water Supply System and New Facility shall remain with the Contractor. The Contractor shall be responsible for all accidents or damages from whatever cause arising and chargeable for anything that may be stolen, removed destroyed or damaged to whomsoever belonging and also for making good all defects and damages to the said works or to any property adjoining or any cause whatever, whether such damage or defects were occasioned by the negligence of the Contractor or not or may be or might have been discovered during the progress to be known after the completion whereof or whether payment may wholly or partially have been made or the works approved as supposed to have been properly done and no certificate of approval of any works by any officers or members of the Employer shall affect or prejudice the right of the Employer against the Contractor or be considered or held as at all conclusive as to the sufficiency of any work materials.

b) Adequate safety precautions against fire, flooding, lightening, electrical shocks, accident due to moving/non-moving heavy/light equipment shall be strictly observed by the Contractor at own cost. Suitable safety measures like gumboots, gloves, safety belts, ladders, safety lamps, gas masks, Oxygen apparatus, insulated tools, alarms etc. shall be provided by the Contractor. Necessary medical first aid kit shall be made available all the time. In absence of observance of above safety precautions, the Contractor shall be responsible for any unforeseen loss of the equipment or persons dealing with it. Any incidence of human life or accident will be totally the Contractor’s
responsibility.

c) The Contractor shall ensure that the Contractor’s staff employed takes all necessary precautions while carrying out the work either in shift duties or any general shift as per Indian Electricity Rules/Factory Act/CPHEEO Manual / other applicable regulations and manuals, or manufacturer's special instruction for safety / gas handling. The staff should use protective gear such as appropriate while carrying out the work on the operation and maintenance of the Water Supply System and New Facility.

d) The Contractor will make arrangement for all necessary safety equipment for persons working at WTP as per Factory Act/Safety Rules. In the event of any accident on or off site, in which the Contractor’s personnel are involved, in which an injury occurs to any person whether directly concerned with the project or a third party, the Contractor shall inform the Employer within 24 hours of the occurrence of the event. The plant will be open to local/state/central agencies for verification of safety/emission/acts compliance.

e) The Contractor’s staff engaged shall wear common uniform with name plate indicating name and designation during duty hours. The Contractor’s staff shall cooperate during surprise checks by authorized representatives / nominees of the Employer or other Government Authorities.

1.12.9 Site Order Book

The Site order Book shall be kept by the Employer’s Representative at the Water Treatment Plant site. Orders entered in this Book by the Employer’s Representative/ authorized representative of the Employer’s Representative shall be held to have been formally communicated to the Contractor. The Employer’s Representative/ authorized representative of the Employer’s Representative shall sign each order as it is entered and will hand over the duplicate to the Contractor or his agent, who shall sign the original in acknowledgment of having received the order

1.12.10 Transition Plan

a) At least two years prior to the End Date, the Contractor shall develop a plan to hand-over the Water Supply System and all appurtenant structures and allied works to the Subsequent Contractor at the end of the term of the Contract (the “Transition Plan”).

b) The Transition Plan shall include,

- plans to transfer the Water Supply System to the Employer or Subsequent Contractor identified by the Employer;
- transition plans with respect to the Contractor’s Personnel including a plan for transition of the Contractor’s Personnel to the Employer or Subsequent Contractor identified by the Employer;
- a proposed process for the transfer of all Contract Records to the Employer;
- plans to transfer operations and maintenance functions to the to the Employer or Subsequent Contractor identified by the Employer; and
• a program to train staff of the Employer in all aspects of the operation and maintenance of the Facility.

1.12.10.2 Taking Over

a) The Bulk Water Supply System including the New Facility and all appurtenant structures and allied works will be taken over by Employer on satisfactory completion of the Operation & Maintenance of the Bulk Water Supply System provided that

• The New Facility / works /equipment are in good, smooth running condition.
• In case of major repairs /replacement of equipment, the Performance Security / Guarantee is extended by six months from the date of putting back into satisfactory operation of such unit/equipment, in case such putting back is at the end of completion of Operation & Maintenance Period.
• All records of operation & maintenance are handed over to Employer in proper condition.
• The Third Party Inspection of the Water Supply System including New Facility and all appurtenant structures and allied works viz: Civil units, Mechanical units/equipment, Electrical units/equipment, instruments, & all other Major & minor units/machines has to be carried out & the defects/ unsatisfactory working performances of the equipment/ machines are to be corrected by the Contractor at his own cost. The necessary Third Party inspection Charges shall be borne by the Employer.
• The Contractor should repaint the New Facility and all appurtenant structures and allied works including all civil structures, mechanical, electrical equipment/ units /structures as per the tender specifications
• In case taking over is delayed on account of Contractor's failure to meet the requirement specified in sub clause (a) above, the Operation & Maintenance Period will be extended further till it meets the requirement without any additional cost to Employer.
2 SCOPE OF THE WORKS

These Clauses herein exhaustively lists the Scope of Works and shall be binding in case of contradictions with any other Clauses in the Employer’s requirements in Part 2.

2.1 Name of Works

(i) 440 MLD Water Treatment Plant (output) and associated Transmission Network and Overhead Service Reservoirs in City of Amritsar, Punjab and

(ii) Supply of potable water supply meeting quality standards including Operation & Maintenance of the complete works, complaint redressal for bulk supply for a period of 120 months,

2.2 Scope of work

The Scope of Work is provided along with sites chosen for location of facilities and pipeline alignment. Scope includes components/ facilities required for Bulk Water supply system as described in the document.

2.2.1 Design and Build

The scope of work includes design of the proposed Bulk Water Supply System. It is emphasized that the indicative payment schedule will be subject to change depending on the final design prepared by the Contractor and approved by the Employer’s representative and IVA. However, the lumpsum Price shall remain the same as accepted and awarded. The indicative payment schedule shall include required verification of digital survey, construction & maintenance including operation of the following units, but not limited to Scope of work mentioned below. The Scope of Work shall include but not limited to following:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Works Activity</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Survey Investigation and detailed design of Bulk Water Supply System</td>
</tr>
<tr>
<td>i</td>
<td>a. GPS ground control survey for conducting topographic and Preparation of GIS Mapping and AutoCAD based maps,</td>
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<tr>
<td></td>
<td>b. sub-soil investigations for design and estimation</td>
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<td></td>
<td>c. Testing of raw water quality of raw water</td>
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<td></td>
<td>d. Subsurface Utility Mapping for along the alignment of pipelines and other assets using suitable technologies.</td>
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<td>e. structural stability of existing OHSRs,</td>
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<td></td>
<td>f. Condition assessment of existing assets</td>
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<td></td>
<td>g. any other investigation required to undertake the design of the system</td>
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<tr>
<td>ii</td>
<td>Preparation of Condition assessment Report, design report for all works specified for the Bulk Water Supply System.</td>
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<tr>
<td>iii</td>
<td>Preparation of detailed design, drawings and detailed estimate including technical specification of works according to approved design report.</td>
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<tr>
<td>Item No.</td>
<td>Works Activity</td>
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<tr>
<td>2</td>
<td>Raw water intake system:</td>
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<td></td>
<td>Drawl of raw water from UBDC Branch Canal by making necessary intake arrangement comprising of:--</td>
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<tr>
<td>i</td>
<td>RCC Sump / Offtake chamber cum Operator’s Room near Canal bank of Intake Point of the required size (plinth height–600mm., finished height–3.6m)</td>
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<td></td>
<td>Raw water gravity main of required size to sump with Electromagnetic flow meter, sluice gate/ sluice valves energy meters required sensors and equipment for remote operation through SCADA etc as required all complete with latest amendments &amp; current at the time of execution etc and liaising with all government department following the norms as prescribed by the Irrigation Department, Punjab/ Competent Authority, all complete.</td>
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<td></td>
<td>All these structures should be built in a way that there will be no submergence during flooding.</td>
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<tr>
<td>ii</td>
<td>Approach Road conforming to MORT&amp;H specifications with latest revisions and till Intake Point / WTP site with Bituminous concrete pavement from the nearby public road/ Amritsar Bypass Road (minimum formation width at Top 7 mtr., minimum paved width-5.5 mtr.</td>
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<tr>
<td>iii</td>
<td>Land Development &amp; Reinforced Brick Concrete Security Wall of 1.8 mtr. height from finished Road level along with minimum 1m height MS post with concertina wire for Raw water Intake and offtake chamber with MS gate, and wall finished with weather coat cement paint &amp; gate finished with non-glossy synthetic enamel paint over a coat of red lead primer complete.</td>
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<tr>
<td>3</td>
<td>Raw water conveyance main</td>
</tr>
<tr>
<td>i</td>
<td>Supplying, laying, jointing, testing and completion of Raw water gravity MS Pipe of required size from off-take chamber to Under Ground Sump (UGS) cum pumping station in conformity with relevant BIS Code of Practices with latest amendments including all necessary earthwork, valves, sluice gates, flow meter &amp; specials, valve chamber, supporting structures, anchor / thrust block, expansion joints, etc. following the norms etc. as prescribed by the Irrigation Department, Punjab/CPHEEO standards, relevant IS Codes and employer etc, all complete.</td>
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<tr>
<td>4</td>
<td>Raw water storage tank, Pumping Station and Pumping machinery and other accessories</td>
</tr>
<tr>
<td>i</td>
<td>a) RCC underground Raw Water Storage tank and pump room of capacity of <strong>110 ML</strong> Minimum 6 hours detention time with pump room, with Water proofing, ladder/lugs, Manhole covers as required all complete including testing and commissioning as per specifications and direction of Employer’s Representative.</td>
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<td></td>
<td>b) Pump room shall be with space for maintenance bay, panel room etc including aluminum doors and windows. Staircase, MS railing with GI pipe, electrical fixtures, EoT of appropriate capacity and internal and external painting etc as per approved drawings .Built to meet requirements for earthquake, flooding etc.</td>
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<td>Item No.</td>
<td>Works Activity</td>
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<tr>
<td>ii</td>
<td>Providing and installation Raw Water Pumping machinery including all necessary electrical and other installation works: appropriate capacity (working with 50% standby &amp; 50% of working pumps shall have VFD). Pumps shall be horizontal split casing type electrically operated centrifugal pump set (as per relevant at required locations BIS specification) with matching drive motor (as per relevant BIS specification), all of reputed make and conforming to BIS specification &amp; other regulatory norms, including providing all necessary suction &amp; delivery piping arrangements with control valves &amp; specials viz. foot valve, sluice valve, non-return valve, energy meters required sensors and equipment for remote operation through SCADA etc. electrical switch gear, including water hammer control devices, furnishing manufacturer's test certificate &amp; characteristic performance curve of the pump set, all complete.</td>
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<tr>
<td>iii</td>
<td>Raw Water Pumping Main: Supplying, laying, jointing, testing and commissioning of MS pipeline of appropriate size and length (as per all relevant BIS specification) raw water pumping main of length as required including all necessary earthwork, valves, gates &amp; specials, valve chamber, Pressure gauge, water quality sensors, supporting structures, anchor/ thrust block etc all complete.</td>
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<tr>
<td>5</td>
<td>Water treatment plant</td>
</tr>
<tr>
<td>i</td>
<td>Design and Construction of Complete Water Treatment Plant of output capacity of 440 MLD for 22 hours of operation, with suitable design to achieve the water quality as IS 10500. For conventional WTP, it should in conformity with the CPHEEO Manual and all relevant BIS Code of practices with latest amendment, current at the time of design &amp; execution, having provision for Raw water Storage cum pre-settling tank, including all necessary Mechanical and Electrical Installation Works suitable for automated operation of the plant. Provision for Back Washing, sludge treatment system, recycling of back wash water, all internal connection &amp; by-pass piping system including provision for one Administrative Building and for Storage of chemicals, all internal and external electrification work for compound lighting etc., Main incoming electrical control panels for connecting &amp; hooking up of the electrical switch gears of various drive motors of the Treatment Plant units, clear water pumps etc. SCADA shall be designed for full automation of WTP. Establishing of Laboratory with all necessary equipment/instruments, furnishings for analysis and on-line sampling systems. Supply and installation of security system including CCTV cameras so as to ensure the surveillance of entire WTP area. Construction of an Administration building, space for Employer, conference room, meeting room should be planned. The building shall be constructed with all furnishing and amenities as per the works requirement. Appropriate water supply and sanitary systems system shall be installed. For advanced technologies, this should follow relevant code of practices, specifications etc. This should be proven technology and have successfully designed, built and operated by the bidders. The WTP should be designed to withstand earthquake, flooding or any disasters. Any such items of work which are not specified in the bid document but are essential to complete the project are deemed to be included for successful commissioning of the project.</td>
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<tr>
<td>ii</td>
<td>Land Development &amp; Security Wall (Reinforced Brick Concrete) of 1.8 mtr. height from finished Road Level along with 1mtr MS Post with concertina wire for...</td>
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<td>Item No.</td>
<td>Works Activity</td>
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<td></td>
<td>Treatment Plant with MS gate, and wall finished with weather coat cement paint &amp; gate finished with non-glossy synthetic enamel paint over a coat of red lead primer.</td>
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<td>iii</td>
<td>Twin type accommodation with RCC framed structure at Water Treatment Plant Location for 8 nos of staff members having total plinth area of 338 sqm (42.25 sqm per dwelling unit) having 600 mm. high plinth &amp; 3300 mm, finished roof height comprising of 1 living room 1 bed room with attached toilet, 1 kitchen &amp; 1 entry veranda having aluminum casement window / ventilator, 1st. class local hard Wood door frame, 1st. class local hard Wood paneled shutter (Toilet door shall be of solid molded PVC frame &amp; 25 mm. thick PVC shutter), internal wall finished with plastic paint &amp; exterior surfaces finished with weather coat cement paint with RCC roof slab including all necessary internal water supply &amp; sanitary installation work , internal electrification (with concealed copper wiring of required C/S. area) with all necessary electrical fittings &amp; fixtures viz., light / fan / power socket etc., necessary plinth protection work, white ant treatment.</td>
</tr>
<tr>
<td>iv</td>
<td>3.50 mtr. wide internal road made of asphaltic concrete inside the treatment plant area, land scrapping &amp; arboriculture, compound illumination with sufficient nos. of LED street light luminaries mounted on 3.0 m. high GI pole &amp; wiring with 6.0 sq.mm. PVC insulated copper conductor in loop within the treatment plant site including all necessary labour&amp; materials all complete.</td>
</tr>
<tr>
<td>6</td>
<td>Clear water pumping system</td>
</tr>
<tr>
<td>i</td>
<td>Construction of two numbers 9.15 Million ltrs. Capacity (Minimum 1 hours storage) RCC Under Ground Treated Water Sump in 2 (two) compartment and with a suction pit for pumps having provision for all inlet, outlet &amp; overflow arrangement; calibrated water level indicator; air vent pipe, Manholes with Covers; CI Lugs inside the sump etc all complete. Contractor shall also get the structural design and drawings vetted by the IIT / BITS Pilani or any other Institution approved by Employer.</td>
</tr>
<tr>
<td>ii</td>
<td>RCC Single Storied Clear Water Pump Room for ultimate year for North and South with RCC framed structure at treatment plant near to clear water sump of suitable size, all complete as per Scope of Work Item No 6 (ii), specifications and direction of Employer’s representative.</td>
</tr>
<tr>
<td>iii</td>
<td>Providing clear water pumping machinery (conforming to all relevant BIS or ISO specification) with 50% of working pumps with variable frequency drive where required for all the respective clear water pumping including all necessary electrical and other installation works, providing all necessary suction/ delivery piping arrangement with control valves, pressure gauges, electromagnetic flow meters, water quality sensors, level sensor and transmitter, surge protection devices &amp; specials, arrangement for priming pumps with 50% standby provision, priming water tank with staging &amp; required GI Pipes &amp; specials etc. (common priming arrangement for all the pumps for different route). furnishing the Manufacturer's test certificate &amp; characteristic performance curve of the pumps, all complete. (working + 50% standby) for North and South. Pump shall be horizontal split casing type electrically operated centrifugal pump set of required capacity with 50% of the working pumps for each zone with VFDs. All pumps, electrical drive motor, RPM meters, energy meters &amp; other appurtenances shall be of reputed make &amp; conforming to BIS Specification and other regulatory norms, current at the time of design and execution. the operation of clear water pumping system shall be operated only thorough SCADA.</td>
</tr>
<tr>
<td>Item No.</td>
<td>Works Activity</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>(Note: Bidder has to furnish manufacturer's test certificate and characteristic performance curve of the pumps)</td>
</tr>
<tr>
<td></td>
<td>Independent Manifold type Common Header for the Clear water main of MS Pipe of suitable diameter &amp; wall thickness from delivery point of pump till WTP premises from respective clear water main sump including necessary supporting structures, RCC Pump Foundation with anti- vibratory devices, surge control devices, control devices, field instruments, bulk water meters, pressure gauges and including all necessary electrical control units, all complete (2 different common header (one for North and one for South))</td>
</tr>
<tr>
<td>7</td>
<td>Construction of Proposed OHSRs</td>
</tr>
<tr>
<td></td>
<td>Design, drawing and Construction, testing, disinfection and commissioning of –; RCC Overhead service reservoir with minimum staging height of 25 meter or as per design and with suitable foundation system, including all necessary inlet/outlet/overflow/ draining etc. DI flange with puddle collar, duck foot bend piping arrangement, RCC inspection canopy at base of cylindrical wall of the reservoir, RCC stairs with GI pipe railing for ascending to the inspection canopy and then to the Roof dome &amp; aluminum ladder inside the reservoir descending to the reservoir floor from the roof, and water/sanitation arrangement and approach/Internal road, Air Vent pipes, CI/MS Manhole with frame &amp; cover with locking arrangement at roof dome, 1 no. each electrically operated control valves amenable to SCADA operation at inlet and outlet to the reservoir, calibrated water level indicator, lightening arrestor with minimum 2 nos. copper plate Earth station, Electromagnetic flow meter, ultrasonic level sensor and level transmitters, pressure gauge, water quality sensors, power connection Aviation Warning Lamp with auto switch ON/OFF devices, security wall &amp; gate, signboard, landscaping, arboriculture, painting of OHSR, compound Wall compound, site illumination with auto switch ON/OFF devices, all cables, GSM connectivity and integration with centralized SCADA System with etc. all complete as per approved design, drawing and Engineer-In-charge.</td>
</tr>
<tr>
<td>i</td>
<td>36 Nos OHSR s with Capacity of each OHSR as 1.00 ML</td>
</tr>
<tr>
<td>ii</td>
<td>19 Nos OHSR s with Capacity of each OHSR as 1.50 ML</td>
</tr>
<tr>
<td>iii</td>
<td>22 Nos OHSR s with Capacity of each OHSR as 2.00 ML</td>
</tr>
<tr>
<td>8</td>
<td>Clear Water Transmission System</td>
</tr>
<tr>
<td>Item No.</td>
<td>Works Activity</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
</tr>
<tr>
<td>i</td>
<td>Supplying, laying, jointing, testing, commissioning of DI K9 Pipes as per IS8329 and specials like bends, tees, tapers etc. of not less than K12 Class as per IS:9523 along with cement mortar lining as per specification with rubber gaskets for flexible joints and external coating as per specifications including cost of gaskets, flanges etc., cleaning the socket and spigot ends with approved methods before insertion of rubber gaskets, jacking and fixing to perfect conditions and level in trenches as per IS:12288 including cost of all material, transportation to site, loading, unloading, proper storage, hoisting, lowering, marginal cutting, assembling, providing temporary support, tools and plants, labour or any other item require for the completeness of work. The work shall include hydraulic testing as per specifications to specified pressure in stretches of length using pumps which should be able to provide specified test pressure, bedding for pipe supporting structures, anchor / thrust block, refilling of earth and other necessary equipment, water supplied by contractor including all lift and lead, labour, operation charges etc complete. Pressure gauges, flow control valves, pressure regulating valves, anti-vacuum valves and other any other valve, Electromagnetic flow meters&amp; specials with required brick valve chamber of adequate size shall be deemed included in the cost. All valves should be best quality and DI DF. Cutting, excavation of trench and road restoration of road hard crust / side berm including obtaining permission for laying of pipeline along / across any Govt. / Semi Govt./ Private property. The cost includes any trenchless pipe laying required. All work shall be undertaken as per Technical specification and direction of Engineer in charge, Tentative diameter, length of pipe is mentioned as under</td>
</tr>
<tr>
<td></td>
<td><strong>North Zone</strong></td>
</tr>
<tr>
<td>a</td>
<td>100mm dia, 3772, Rmt</td>
</tr>
<tr>
<td>b</td>
<td>150mm dia, 7258, Rmt</td>
</tr>
<tr>
<td>c</td>
<td>200mm dia, 11405, Rmt</td>
</tr>
<tr>
<td>d</td>
<td>250mm dia, 4326, Rmt</td>
</tr>
<tr>
<td>e</td>
<td>300mm dia, 4322, Rmt</td>
</tr>
<tr>
<td>f</td>
<td>350mm dia, 6745, Rmt</td>
</tr>
<tr>
<td>g</td>
<td>400mm dia, 3141, Rmt</td>
</tr>
<tr>
<td>h</td>
<td>450mm dia, 3529, Rmt</td>
</tr>
<tr>
<td>i</td>
<td>500mm dia, 1622, Rmt</td>
</tr>
<tr>
<td>j</td>
<td>600mm dia, 2203, Rmt</td>
</tr>
<tr>
<td>k</td>
<td>700mm dia, 1270, Rmt</td>
</tr>
<tr>
<td>l</td>
<td>750mm dia, 1135, Rmt</td>
</tr>
<tr>
<td>m</td>
<td>800mm dia, 167, Rmt</td>
</tr>
<tr>
<td>n</td>
<td>900mm dia, 1871, Rmt</td>
</tr>
<tr>
<td></td>
<td><strong>South Zone</strong></td>
</tr>
<tr>
<td>a</td>
<td>100mm dia, 2826 RMT</td>
</tr>
<tr>
<td>b</td>
<td>150mm dia, 4807 RMT</td>
</tr>
<tr>
<td>Item No.</td>
<td>Works Activity</td>
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<tr>
<td>---------</td>
<td>----------------</td>
</tr>
<tr>
<td>c</td>
<td>200mm dia, 4833 Rmt</td>
</tr>
<tr>
<td>d</td>
<td>250mm dia 6466 Rmt</td>
</tr>
<tr>
<td>e</td>
<td>300mm dia, 6347 Rmt</td>
</tr>
<tr>
<td>f</td>
<td>350mm dia, 3615, Rmt</td>
</tr>
<tr>
<td>g</td>
<td>400mm dia, 2591 Rmt</td>
</tr>
<tr>
<td>h</td>
<td>450mm dia, 3682 Rmt</td>
</tr>
<tr>
<td>i</td>
<td>500mm dia, 3892 Rmt</td>
</tr>
<tr>
<td>j</td>
<td>600mm dia, 3434 Rmt</td>
</tr>
<tr>
<td>k</td>
<td>700mm dia, 2897 Rmt</td>
</tr>
<tr>
<td>l</td>
<td>750mm dia, 3473 Rmt</td>
</tr>
<tr>
<td>m</td>
<td>800mm dia, 957 Rmt</td>
</tr>
<tr>
<td>n</td>
<td>900mm dia, 584 Rmt</td>
</tr>
<tr>
<td></td>
<td>Supplying, laying, jointing, testing and commissioning of requisite dia. ERW (Electric Resistance Welded) / SAW (Submerged Arc Welded) MS pipes (Fe-410 grade) conforming to IS 3589-2001 Transmission Main including inside CM 1:1.5 lining of minimum 12 mm thick and outside minimum 25 mm thick coating in CM 1:3 over 50x50 mm weld mesh of 13 gauge. MS pipelines shall be designed to withstand internal pressure, external load and collapsible pressure. Anti-vacuum valves shall be provided where required. The work shall include hydraulic testing as per specifications to specified pressure in stretches of length using pumps which should be able to provide specified test pressure, bedding for pipe supporting structures, anchor / thrust block, refilling of earth and other necessary equipment, water supplied by contractor including all lift and lead, labour, operation charges etc complete. Pressure gauges, flow control valves, pressure regulating valves, and other any other valve, Electromagnetic flow meters, sensors &amp; specials with required brick valve chamber of adequate size shall be deemed included in the cost. All valves should be best quality and DI DF, Factory and field testing shall be done rigorously. Cutting, excavation of trench and road restoration of road hard crust / side berm including obtaining permission for laying of pipeline along / across any Govt. / Semi Govt./ Private property. All work shall be undertaken as per Technical specification and direction of Engineer in charge, Tentative diameter, length of pipe is mentioned as under.</td>
</tr>
<tr>
<td></td>
<td><strong>North Zone</strong></td>
</tr>
<tr>
<td>a</td>
<td>1016mm OD, 1155 Rmt</td>
</tr>
<tr>
<td>b</td>
<td>1118mm OD, 1245 Rmt</td>
</tr>
<tr>
<td>c</td>
<td>1320mm OD, 1755 Rmt</td>
</tr>
<tr>
<td>d</td>
<td>1422mm OD, 517 Rmt</td>
</tr>
<tr>
<td>e</td>
<td>1524mm OD, 48 Rmt</td>
</tr>
<tr>
<td>f</td>
<td>1678mm OD, 1452 Rmt</td>
</tr>
<tr>
<td>Item No.</td>
<td>Works Activity</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
</tr>
<tr>
<td>g</td>
<td>1728mm OD, 2172 Rmt</td>
</tr>
<tr>
<td></td>
<td><strong>South Zone</strong></td>
</tr>
<tr>
<td>a</td>
<td>1118mm OD, 1410 Rmt</td>
</tr>
<tr>
<td>b</td>
<td>1524mm OD, 5 Rmt</td>
</tr>
<tr>
<td>c</td>
<td>1678mm OD, 1454 Rmt</td>
</tr>
<tr>
<td>d</td>
<td>1728mm OD, 1334 Rmt</td>
</tr>
<tr>
<td>e</td>
<td>1782mm OD, 3224 Rmt</td>
</tr>
<tr>
<td></td>
<td><strong>10 Dismantling of Existing OHSRs</strong></td>
</tr>
<tr>
<td></td>
<td>Dismantling of Existing RCC OHSR Include dismantling of all component of overhead tank including pipes, valves, domes, landing, staircase, columns/wall or another item, disposal with all lead and lift of all wastes to disposal site, salvaging of the serviceable material and clearing the site as per Engineer-In-charge</td>
</tr>
<tr>
<td>a</td>
<td>02 Nos 1.00 lakh Gallon</td>
</tr>
<tr>
<td>b</td>
<td>16 Nos 2.00 lakh Gallon</td>
</tr>
<tr>
<td>c</td>
<td>02 Nos 3.00 lakh Gallon</td>
</tr>
<tr>
<td></td>
<td><strong>11 Rehabilitation of OHSRs</strong></td>
</tr>
<tr>
<td></td>
<td>Conducting condition assessment using NDT tests, Repair and Rehabilitation of OHSR structure include jacketing of column, brace beam, ring beam, staircase and other structural elements etc. Water proofing with nipple grouting, scarping of vegetation, MS railing, Rehabilitation/construction of compound wall, guard room including lighting and water/sanitation arrangement and approach/Internal road, Air Vent pipes, CI/MS Manhole with frame &amp; cover with locking arrangement at roof dome, 1 no. each electrically operated control valves amenable to SCADA operation at inlet and outlet to the reservoir, calibrated water level indicator, lightening arrester with minimum 2 nos. copper plate Earth station, ultrasonic level sensor and level transmitters, pressure gauge, water quality sensors, power connection Aviation Warning Lamp with auto switch ON/OFF devices, Solar Power system with battery backup for minimum 48 hours for all the electrical installation therein, security wall &amp; gate, signboard, landscaping, arboriculture, painting of OHSR, compound Wall compound illumination with auto switch ON/OFF devices, all cables, GSM connectivity and integration with centralized SCADA System, plinth protection, disinfection of tank, Painting of OHSR etc all complete as per approved design, drawing and Engineer-In-charge.</td>
</tr>
<tr>
<td>a</td>
<td>01 Nos 0.50 lakh Gallon</td>
</tr>
<tr>
<td>b</td>
<td>03 Nos 1.00 lakh Gallon</td>
</tr>
<tr>
<td>c</td>
<td>17 Nos 2.00 lakh Gallon</td>
</tr>
<tr>
<td>Item No.</td>
<td>Works Activity</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
</tr>
<tr>
<td>12</td>
<td>SCADA includes PLC for (works other than WTP)</td>
</tr>
</tbody>
</table>

Design, procurement, Installation, synchronizing, testing and commissioning of SCADA system (including 120 months maintenance services), of reputed make and conforming to relevant BIS Code of Practices with latest amendment current at the time of execution for flow control and monitoring between raw water intake arrangement, treatment plant, clear water sump, clear water pump set and proposed and existing elevated reservoirs having main controlling unit for flow and pressure measurement and controls at the water works office at treatment plant location as per CPWD specification with all interiors and furniture. SCADA system shall be web enabled with application software so that other users can view, print and monitor. SCADA shall enable PLC automation of operations for equitable distribution among all OHSR s and acquiring data for water audit, energy audit and water quality monitoring. Items including following but not limited to.

- Programmable logic controller/remote terminal unit with redundancy of 1+1
- Display screen of suitable size
- RTUs
- Field instruments
- Cables
- UPS
- Data loggers
- SCADA software
- Data storage devices
- Desktop computers
- Printers

### 2.2.2 Operation and Maintenance Services Schedule

#### 2.2.2.1 Introduction

The Contractor shall ensure the Operation and Maintenance of the Water Supply System and other allied works in compliance to the appropriate guidelines contained in the applicable laws and regulations of the Government of India, New Delhi and the prescription laid down hereunder.

#### 2.2.2.2 Operation and Maintenance Specifications

The Contractor shall be responsible for the operation and maintenance of the Water Supply System as described in the Appendix 3 - Schedule of Performance Standards, to the proposed contract agreement attached at Section of Part-3. The Contractor shall manage, operate and maintain all new assets constructed under the Contract, in the water supply area delimited by, for the duration of, and under the terms defined in the Contract. The new assets shall include
plant and ancillary equipment that support the operation of the Bulk Water Supply System, including without limitation.

2.2.2.3 Scope of work

The Contractor shall operate the Water Supply System for a period of 120 months as specified below:

2.2.2.3.1 General Scope

a) The Contractor shall operate and maintain the Bulk Water Supply System under the Contract complete including the road works, landscaping, civil/structural, mechanical components, instrumentation system, and electrical system, all utility and ancillary buildings for the period of ten (10) years from the date of successful completion of “Tests after Completion of the Works” or issuance of Operation Acceptance Certificate.

b) The Contractor shall comply with all safety rules and regulations as followed by the Employer.

c) The Contractor shall make his own arrangements at his own cost for Works operation, personnel, lubricants, diesel, spares, tools and tackles, routine maintenance, screenings collection, desilted material collection, transportation and disposal, coordination with respective pollution control board, agency supplying power to the Bulk Water Supply System, and any other activity required for the operation and maintenance of the constructed Works in full compliance with all applicable rules, regulations, laws, codes, effluent quality requirements and any other limitations.

d) Electricity bills up-to the guaranteed power consumption quoted by the bidder for Water Treatment Plant and pumping the water to OHSRs shall be paid by the concerned Employer / Municipal Corporation. However, if any type of surcharge is levied on the electricity bill for reason like less power factor, over loading, Sparking or short circuiting of equipment, due to loose connection etc. shall be chargeable to the contractor.

e) Carrying out regular flow measurements and recording of treated water at Discharge Point to Existing and proposed OHSRs, regular calibration, cleaning, maintenance and replacement when required of measuring devices.

f) Water quality monitoring, including sampling, testing, analysis, recording and reporting, of raw water as well as treated water shall be done as per the Drinking Water Quality Monitoring Protocol.

- The Contractor will provide monthly reports to Employer that the quality of water is good for consumption with respect to biological, virologic, radiological, chemical, organoleptic and physical parameters.

- Water samples shall be taken from different points in the transmission system (source, balancing reservoirs, etc.) up-to the all OHSRs and tested in the laboratories. Proper log of all the tests conducted shall be maintained.

- Water samples shall be collected in the presence of officer from the Employer and atleast one sample for every test shall be tested at the laboratories of DWSS. or at NABL accredited Laboratory approved by Employer's Representative Frequency of testing shall be as per the guidelines established in Uniform Drinking Water Quality Monitoring Protocol (latest version).
g) Take all necessary measures to minimize the power consumption in carrying out its operations.

h) Operate electrical equipment during power failures by making appropriate alternative arrangements.

i) The Contractor shall submit a weekly report to the Employer detailing the Operation and Maintenance indicating the labour hours expended, Electrical Power Consumed and other Consumables consumed and also problems faced and rectified.

j) The Contractor shall submit detailed schedule/manual of all O& M activities with references of equipment manufacturers maintenance schedules/manuals to the for review and approval.

k) The Contractor shall submit Guidelines and Instructions manual for the maintenance staff of all levels for all the tools, plants and equipment and WTP under the Water Supply System to maintain the service levels within the standards prescribed in the Contract;

l) The Contractor shall carry out all O&M activities as per the approved Operation and Maintenance Manuals.

m) The Contractor’s responsibility shall also include the safety and security of the Works (Bulk Water Supply System) during the course of Operation and Maintenance.

n) Acquire and maintain sufficient stock of consumables required to operate the Water Supply System in accordance with good practices and applicable standards and procure necessary electrical and mechanical equipment required for operations and maintenance of Water Supply System to ensure continuous operations.

o) Establish a Project office to manage the Project. The Project office can be located at the water treatment plant campus or at any other appropriate location where land is made available by the Employer.

p) All Project sites shall be well secured and kept in a clean and hygienic condition with sufficient measures for safety and security of manpower, built structures, equipment and other system components.

q) During Operation and Maintenance period, the Contractor shall appoint suitable number of technical staff, operators, drivers, cleaners, fitters, electricians, helpers, gardeners, office peons, security guards, laborer’s as required for the operation and maintenance of complete proposed Water Supply System including the WTP for three shifts and adequate other staff / supporting personnel during general shift for security of man-power, built structures, equipment and other system components. The Contractor shall make the arrangement of reliever for weekly off/holiday etc. Absence on any grounds like weekly off or holiday shall not be considered. The presence of staff in each shift should be marked in muster to be maintained at office of shift in charge at Water Treatment Plant that shall be considered as final. The Contractor’s staff must mark their presence in this muster. The Contractor may maintain a separate register for own purpose.

r) The Contractor shall have to issue identity cards with photographs to all the staff employed for Operation and Maintenance. The list of the same shall be submitted to the Employer mentioning qualification & experience.

s) The Employer will not be responsible for any accident /injury to the staff of the Contractor. Further the Employer will not provide any insurance or medical facility to the staff of Contractor. The responsibility lies with the Contractor.
t) All Central / State Government / Semi-Government / Appropriate Regulator / Local Body’s Rules and Regulations pertaining to this contract shall be followed and observed by the Contractor without any extra cost to the Employer. No watch and ward, safety insurance, security, storage, housing accommodation etc. will be provided by Employer. This will be responsibility of Contractor.

u) No accommodation / guesthouse / transportation facility will be provided by the Employer to the Contractor.

v) Unsatisfactory and inefficient running of the Water Supply System and unnecessary and excessive usage of spare, consumable, etc. supported by the reasons which are under control of Contractor will be highly objected. In such cases Employer’s Representative’s decision will be final and binding on the Contractor.

w) The Contractor will be required to maintain the required power factor for the operation of the components of the Water Supply System including the WTP as prescribed by the applicable guidelines and authority in Punjab. In case any penalty is levied on the Employer for not maintaining the power factor, this will be recovered from the Contractor.

x) Variability of throughput: If the quantity of treated water can be increased in the existing system without impacting the annual fixed costs to the Contractor, the Contractor shall comply with such requirements. For a sustained requirement of higher throughput from the Facility, the Contractor may be required to frame and submit a proposal that shall be implemented if mutually acceptable.

2.2.2.4 Output and Operational Guarantees

The Contractor is fully responsible for meeting the Performance Standards prescribed in this Operation and Maintenance Schedule.

Contractor shall ensure that power consumption shall not any time during operational period exceed the Guaranteed Power consumption specified by him in the Contract.

2.2.2.5 Operation and maintenance manual

a. The Contractor shall prepare a detailed program (referred to as Operation and Maintenance (O&M) Manual) covering the operation and maintenance of the Water Supply System as a whole. Reference may be made for guidance in preparation of the Manual on O&M of Water Supply System, published by CPHEEO.

b. The Contractor shall provide 6 (six) copies of draft O&M Manual to the Employer, at the time of the completion of the Project. Post approval by the Employer, 10 (ten) copies of Operation and Maintenance Manual shall be supplied by the Contractor.

c. The O&M Manual shall include the daily, weekly, monthly, quarterly, half yearly and annual checks and remedies if necessary to be performed for effective operation of the WTP and other components. The O&M Manual should elaborate in detail, all operating and maintenance procedures and policies which are required, advisable and/ or necessary for the Facility to achieve full compliance with the operational guarantees and to achieve maintenance and repair standard for the New Facility which will ensure compliance with the maintenance specifications. For purposes of convenience, the O&M Manual may include separate manuals covering the procedures and policies for specific components of the Water Supply System such as the WTP. Therefore the specific components of the Water Supply System which need
to be covered in the O&M Manual and its sub-manuals will be finalized by the Employer and the Contractor.

d. Without limiting the generality of the foregoing, the O&M Manual shall include descriptions, procedures and shall comply with the requirements, set forth in the provisions of the Bid Documents.

e. The draft of the O&M Manual shall be subject to the review and approval of Employer, which shall have the right to make any changes and revisions to the O&M Manual as it may deem appropriate. The Contractor shall revise such draft O&M Manual prior to the commencement of the O&M period.

f. At the end of the Design Build Period and post Completion, the Contractor shall revise the draft O&M Manual (including appropriate sub-manuals) to reflect any updates, changes or revisions it deems appropriate, inter-alia based on its experience and as necessary to reflect any modifications or adjustments to the plant. Without limiting the above, the Contractor shall annually fully review, revise, update and modify the draft O&M Manual as may be necessary or appropriate. Any revision to the draft O&M Manual shall be subject to the review and approval of Employer.

g. Employer shall have the right to require revisions to the draft O&M Manual as it may deem appropriate. The Contractor shall prepare and submit to Employer, for its review and approval, 30 days prior to the proposed date of commencement of Operation and Maintenance Period a revised draft O&M Manual which reflects all changes, revisions and modifications. The Contractor shall prepare the O&M Manual, as approved by the Employer, prior to the start of O&M.

h. During the term of this Contract, the Contractor shall promptly notify Employer of any revisions, additions or modifications which in the Contractor’s professional opinion, should be made to the O&M Manual, whether as a result of additional experience in operating and maintaining the Water Supply System, changes in volume, changes or modifications to any equipment part, component or structure incorporated in the New Facility.

i. Such notification shall set forth the reasons and justification for the proposed revision. Any proposed revision shall be subject to the approval of the Employer. In addition, during the term of this Agreement, Employer shall have the right to require relevant changes, revisions, or additions to the O&M Manual as it, shall deem appropriate to ensure full compliance with the O&M Standards.

j. The Contractor shall submit 10 copies of the final O & M manual along with a soft copy in Microsoft Word and PDF format.

2.2.3 Technical Audit

The Employer has the right to conduct a technical audit of the Bulk Water Supply System and New Facility either by the Employer’s personnel or by a third party appointed by the Employer, and to perform any analysis or inspection deemed necessary by the Employer. The Contractor shall, at own cost, provide all assistance to the Employer to complete these inspections. Such audits may cover all or any of the obligations of the Contractor, including without limitation,

a. Verification of the system capacity and save for normal wear and tear during the Operation and Maintenance Period.

b. Verification of the Performance Standards and useful life of the individual
assets of the Water Supply System, save for normal wear and tear during the Operation and Maintenance Period.

c. Verification of the capacity of the Water Supply System / New Facility to meet Performance Standards during the residual life of the New Facility and save for normal deterioration expected during such residual life.

d. Sampling, testing and verification of the Performance Standards for treated water.

e. Based on the assessment of the Technical Audit, the Contractor shall, at no extra cost to the Employer, repair and re-condition all the mechanical equipment in the concluding year of the Operation and Maintenance Period to a condition so that they are in running condition with regular preventive and recommended maintenance as per manufacturer's recommendations or as per applicable regulations and guidelines.

### 2.2.4 Facility Visits

a) At any time or at the end of each twelve-month period, or at the initiative of the Employer, a visit shall be organized so that both parties can check the condition of the installations at the New Facility.

b) A report shall be drawn up to record the opinions of the both the Parties. The Employer reserves the right to call the equipment manufacturers or specialized technicians for these visits. All expenses are to be borne by the Contractor for the purpose.

### 2.2.5 Maintenance schedules

a) The Contractor shall prepare and follow a Maintenance plan, detailing the maintenance activities scheduled for each component of the New Facility on a periodic schedule approved by Employer's Representative and / or the Employer.

b) Every part of the works and all the materials to be used therein shall be subjected to such tests from time to time during the execution of the work as the Employer may direct and the whole of such tests shall in all cases be made at the Contractor's sole expense.

c) The work shall be carried on and completed under the exclusive control direction and supervision and to the satisfaction of the Employer. The Employer shall likewise have full power to reject or condemn any work or material that he may deem unsuitable. In case of any work or material being rejected by the Employer's Representative, the Contractor shall immediately remove and replace the same to the satisfaction of the Employer or the Employer shall have full powers to get the same removed and replaced and deduct the expenditure incurred in the process from any amount due or that may become due to the Contractor.

d) The Contractor shall use only the original and genuine spares of the original equipment as per recommendations given in the maintenance booklet of the manufacturers/as per directions of the Employer. Adequate stock of such spares is to be maintained by the Contractor. Test certificate of manufacturer is required for bearings along with supplies. Test certificate of all major equipment will be submitted from the manufacturer.

e) The Contractor shall also be responsible to maintain cleanliness in around the plant including machineries, disposal of floating matter, grit and other unwanted material.

f) If any material brought to the site of works, be in the judgment of the Employer's
Representative, found inferior or improper & not as per described standards, the said materials or workmanship shall, where required by the Employer shall be removed or amended by the Contractor forthwith or within such period for every breach by the Contractor in this clause.

g) All leakages should be attended promptly to avoid any nuisance etc. Choking should be removed at once. All the valves/gates which are not used regularly should be operated at least once a week and make sure that they are properly lubricated/greased.

h) All safety valves should be checked daily and ensure that they are working properly. In case of any fault the same should be attended immediately without any wait. The maintenance of the plant shall be as per maintenance manuals of the manufacturer for all equipment. Contractor shall keep all the safety devices in working order.

i) All the steel structures and machines installed in open areas should be painted after every monsoon period after cleaning the surface as per the instructions of the Employer’s Representative. The New Facility including all civil structures, mechanical equipment, HT panel and Transformers etc. shall be repainted after every 2 years as per original painting specifications.

j) The Contractor should make sure that no unwanted material should float/grow in and around different units. In case it is found the same shall be removed/cleaned immediately. The Contractor shall also be responsible for cleaning/sweeping the plant buildings inside and outside, roads, foot path etc.

k) During preventive/ breakdown maintenance, the Contractor has to visit the unit/units as and when needed. The pumping units or other machineries required if any shall have to be arranged by the Contractor at own costs for completing the work. In case of battery-operated auto system panels and also system alarm etc., batteries are required to be maintained and replaced as and when needed by the Contractor.

l) Consumables such as POL (petrol/Diesel Oil & Lubricants), disinfectants etc. has to be arranged by the Contractor as and when needed as per manufactures recommendations for periodical maintenance of entire Water Supply System. The Employer shall not provide such items.

m) In case of major repair due to normal wear and tear/break down, the Contractor should bring the same to the notice of the Employer immediately and necessary measures for its repair should be taken simultaneously. Breakdown, all repairs of any kind are to be attended by the Contractor. Any unit/equipment being irreparable in the opinion of the Employer will be replaced by the Contractor at no cost to Employer.

n) The Contractor shall provide the telephone no., contact addresses, etc. of the Authorized Representative and Key Staff to the Employer as well as shift duty shift to contact during emergency.

o) The Contractor will be responsible to carry day to day as well as periodic maintenance, necessary to ensure smooth and efficient performance/running of all equipment instruments installed at the New Facility. He shall be responsible for maintenance/replacement of street light poles and light etc. also. The Water Supply System including the New Facility and appurtenant structures shall remain the property of Employer.

p) Routine & preventive maintenance of electrical/Mechanical/ hydraulic/machines & equipment is to be carried out as per the operation & maintenance manual. Minimum oil & grease requirement for one-year Operation & maintenance of the Plant to be procured by the Contractor well in advance
2.2.6 Routine, Preventive, Minor & Major Maintenance of All Civil, Electrical, And Instrumentation.

a) The Contractor should prepare schedule of daily maintenance & preventive maintenance of all the equipment & machineries operated & run by him in the premises of the plant. The schedule should be as per the guidelines mentioned in the tender & as per the O& M manual. The scope covers Routine, Preventive, Minor & Major maintenance of all major minor equipment and machines in the Plant like pumps, valves, Channel gates, mechanical scrapers & bridge, mixers, filters, Sludge pumps, all dosing systems including alum, PAC and Chlorine Dosing equipment etc.

b) The scope also covers Routine, Preventive, Minor & Major maintenance of all the instrumentation system installed like PLC, Actuators, Flow meters level indicators, sensors etc. The Contractor should also carry out Routine, Preventive, Minor & Major maintenance of all major minor electrical equipment like Electrical Panels, Switch Gears, Power Cables, Control cables, Changeover switches DG set etc. so as to ensure uninterrupted round the clock operation of the Plant.

c) The Contractor should maintain all civil structures including Administrative building, Store room, Storm Drains, boundary wall etc. so as to complete the natural/Designed life of the civil structures.

d) The Contractor should carry out the safety audit of the plant & necessary certificate from the competent authorities. This item includes all types of Routine, Preventive, Minor & Major maintenance of all Civil, Electrical, Mechanical, hydraulic machines & equipment of the plant covering supply erection test & trial run of the part/machine to be repaired/ replaced with material & labor expenses, necessary hardware’s, sundry materials, lubricant oils, power oils, grease other materials plus machining charges etc.

e) The Contractor should procure all the spares required for all types of maintenances in advance. The part/equipment/machine to be repaired/replaced should be as per the Employer approved list & as per the O& M manual or as per the existing manufacturer’s brand.

f) The Contractor, after first notifying the appropriate agency / pollution control board shall be responsible for fulfilling all requirements associated with any release of any substance into the environment (from the facility or the site) as required by Applicable law or by any Applicable Law including but not limited to the notification or reporting of releases.

g) The Contractor shall process and obtain the clearance of all such agencies as required for the purpose, including all clearances during Operation and Maintenance Period. The Contractor shall be responsible to comply with all requirements of Laws including hazardous substances, emission standards for air, discharge standards for effluent oil, sub-soil pollution. The Contractor shall not release any hazardous/toxic materials inside the premises.
Appendix IA: Water Quality–UBDC Canal

Canal Water Quality Test Results

<table>
<thead>
<tr>
<th>Test Parameter</th>
<th>Units</th>
<th>Canal Quality</th>
<th>Water</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbidity – likely max</td>
<td>NTU</td>
<td>244</td>
<td></td>
<td>For Design purpose</td>
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<tr>
<td>Turbidity – normal</td>
<td>NTU</td>
<td>58</td>
<td></td>
<td>Observed in Month Sept 2019</td>
</tr>
<tr>
<td>pH value</td>
<td></td>
<td>7.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td></td>
<td>BDL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odour</td>
<td></td>
<td>Agreeable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDS</td>
<td>mg/l</td>
<td>112</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total alkalinity (as CaCO3)</td>
<td>mg/l</td>
<td>57</td>
<td></td>
<td></td>
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<tr>
<td>Ammonia</td>
<td>Mg/l</td>
<td>0.9</td>
<td></td>
<td>Observed in Month Sept 2019</td>
</tr>
<tr>
<td>Total hardness (as CaCO3)</td>
<td>mg/l</td>
<td>86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Coliform</td>
<td>MPN/100 ml</td>
<td>39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total E coli</td>
<td>MPN/100 ml</td>
<td>21</td>
<td></td>
<td></td>
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# Appendix 1B: Design Criteria

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Description</th>
<th>Unit</th>
<th>Criteria</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>1</td>
<td>Water Criteria Supply Design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Present population</td>
<td>year 2019 =</td>
<td>1315000</td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>Prospective population</td>
<td>Initial Stage in 2025 = 1451000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intermediate stage in 2045 = 1815000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ultimate Stage in 2055= 2211000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Design period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Intake</td>
<td>years 30(Year2055)</td>
<td>440 MLD+ losses</td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>Water treatment plant</td>
<td>years 30(Year2055)</td>
<td>440 MLD output</td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>Rising mains</td>
<td>years 30 (Year2055)</td>
<td>440 mld</td>
<td></td>
</tr>
<tr>
<td>2.4</td>
<td>Gravity mains</td>
<td>years 30(Year2055)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>Storage</td>
<td>years 15(Year2045)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.6</td>
<td>Pumping Stations</td>
<td>Year 30(Year 2055)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Service level</td>
<td>lpcd</td>
<td>150 lpcd on 2055 population</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>WTP Operation Hours</td>
<td>hours</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Raw water storage</td>
<td>Hours</td>
<td>6 hours</td>
<td></td>
</tr>
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<td>3.3</td>
<td>Terminal pressures at Discharge point (FSL of OHSR of existing Water Works)</td>
<td>meters</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3.4</td>
<td>Peak Day Demand Factor for Conveyance</td>
<td></td>
<td>1.0 or more</td>
<td></td>
</tr>
<tr>
<td>3.5</td>
<td>Supply hours</td>
<td>hours</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>3.6</td>
<td>Service storage</td>
<td>hours</td>
<td>as per the mass curve subject to minimum 30% of demand</td>
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</tr>
<tr>
<td>4</td>
<td>Power supply</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sl. No</td>
<td>Description</td>
<td>Unit</td>
<td>Criteria</td>
<td>Remarks</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------</td>
<td>------</td>
<td>---------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>4.1</td>
<td>Is dedicated power supply to be provided</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>Power supply tariff for water</td>
<td>Rs</td>
<td>Energy Charge – Rs. 7.2 per Kwh; electricity Duty-0.10 per KWH; and, fixed electricity charge –Rs.125.00 per Kva per month</td>
<td></td>
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</table>
Appendix 1C Minimum Number of Valves and Bulk Flow meter for Transmission main

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Description</th>
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<th>Amritsar</th>
</tr>
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<tbody>
<tr>
<td>(1)</td>
<td></td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td></td>
<td>VALVES AND APPURTENANCES</td>
<td></td>
<td></td>
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<tr>
<td>1.01</td>
<td>Resilient soft DI sluice Valves for isolation</td>
<td>Nos.</td>
<td>14</td>
</tr>
<tr>
<td>1.02</td>
<td>100mm dia</td>
<td>Nos.</td>
<td>14</td>
</tr>
<tr>
<td>1.03</td>
<td>150mm dia</td>
<td>Nos.</td>
<td>25</td>
</tr>
<tr>
<td>1.04</td>
<td>200mm dia</td>
<td>Nos.</td>
<td>33</td>
</tr>
<tr>
<td>1.05</td>
<td>250mm dia</td>
<td>Nos.</td>
<td>22</td>
</tr>
<tr>
<td>1.06</td>
<td>300mm dia</td>
<td>Nos.</td>
<td>22</td>
</tr>
<tr>
<td>1.07</td>
<td>350mm dia</td>
<td>Nos.</td>
<td>13</td>
</tr>
<tr>
<td>1.08</td>
<td>400mm dia</td>
<td>Nos.</td>
<td>16</td>
</tr>
<tr>
<td>1.09</td>
<td>450mm dia</td>
<td>Nos.</td>
<td>12</td>
</tr>
<tr>
<td>2.01</td>
<td>DI Double flanged Butterfly valves</td>
<td>Nos.</td>
<td>12</td>
</tr>
<tr>
<td>2.02</td>
<td>600mm dia</td>
<td>Nos.</td>
<td>9</td>
</tr>
<tr>
<td>2.03</td>
<td>700mm dia</td>
<td>Nos.</td>
<td>10</td>
</tr>
<tr>
<td>2.04</td>
<td>750mm dia</td>
<td>Nos.</td>
<td>3</td>
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<td>2.05</td>
<td>800mm dia</td>
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<td>6</td>
</tr>
<tr>
<td>2.06</td>
<td>900mm dia</td>
<td>Nos.</td>
<td>3</td>
</tr>
<tr>
<td>2.07</td>
<td>1000mm dia</td>
<td>Nos.</td>
<td>6</td>
</tr>
<tr>
<td>2.08</td>
<td>1100mm dia</td>
<td>Nos.</td>
<td></td>
</tr>
<tr>
<td>2.09</td>
<td>1200mm dia</td>
<td>Nos.</td>
<td>4</td>
</tr>
<tr>
<td>2.10</td>
<td>1300mm dia</td>
<td>Nos.</td>
<td>2</td>
</tr>
<tr>
<td>2.11</td>
<td>1400mm dia</td>
<td>Nos.</td>
<td>2</td>
</tr>
<tr>
<td>2.12</td>
<td>1500mm dia</td>
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</tr>
<tr>
<td>2.13</td>
<td>1600mm dia</td>
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</tr>
<tr>
<td>2.14</td>
<td>1650mm dia</td>
<td>Nos.</td>
<td>15</td>
</tr>
<tr>
<td>2.15</td>
<td>1700mm dia</td>
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</tr>
<tr>
<td>2.16</td>
<td>1800mm dia</td>
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<td></td>
</tr>
<tr>
<td>3.01</td>
<td>Air valves</td>
<td>Nos.</td>
<td>191</td>
</tr>
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<td>3.02</td>
<td>50mm dia</td>
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<td>28</td>
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<tr>
<td>3.03</td>
<td>80mm dia</td>
<td>Nos.</td>
<td>9</td>
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<tr>
<td>3.04</td>
<td>100mm dia</td>
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<td>14</td>
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<td>4.01</td>
<td>Scour valves (Sluice Valves)</td>
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<td>46</td>
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<td>4.02</td>
<td>100mm dia</td>
<td>Nos.</td>
<td>39</td>
</tr>
<tr>
<td>4.03</td>
<td>200mm dia</td>
<td>Nos.</td>
<td>16</td>
</tr>
<tr>
<td>4.04</td>
<td>300mm dia</td>
<td>Nos.</td>
<td>4</td>
</tr>
<tr>
<td>4.05</td>
<td>400mm dia</td>
<td>Nos.</td>
<td>4</td>
</tr>
<tr>
<td>4.06</td>
<td>500mm dia</td>
<td>Nos.</td>
<td></td>
</tr>
<tr>
<td>Sl No</td>
<td>Description</td>
<td>Unit</td>
<td>Amritsar</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------</td>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td>5</td>
<td>DI Double flanged Butterfly valves for Scouring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.01</td>
<td>600mm dia</td>
<td>Nos.</td>
<td>8</td>
</tr>
<tr>
<td>5.02</td>
<td>700mm dia</td>
<td>Nos.</td>
<td>8</td>
</tr>
<tr>
<td>5.03</td>
<td>800mm dia</td>
<td>Nos.</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Electromagnetic Bulk Flow Meters</td>
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<td></td>
</tr>
<tr>
<td>6.01</td>
<td>80mm dia</td>
<td>Nos.</td>
<td>20</td>
</tr>
<tr>
<td>6.02</td>
<td>100mm dia</td>
<td>Nos.</td>
<td>14</td>
</tr>
<tr>
<td>6.03</td>
<td>150mm dia</td>
<td>Nos.</td>
<td>18</td>
</tr>
<tr>
<td>6.04</td>
<td>200mm dia</td>
<td>Nos.</td>
<td>14</td>
</tr>
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<td>6.05</td>
<td>250mm dia</td>
<td>Nos.</td>
<td>12</td>
</tr>
<tr>
<td>6.06</td>
<td>300mm dia</td>
<td>Nos.</td>
<td>11</td>
</tr>
<tr>
<td>6.07</td>
<td>350mm dia</td>
<td>Nos.</td>
<td>5</td>
</tr>
<tr>
<td>6.08</td>
<td>400mm dia</td>
<td>Nos.</td>
<td>4</td>
</tr>
<tr>
<td>6.09</td>
<td>450mm dia</td>
<td>Nos.</td>
<td>2</td>
</tr>
<tr>
<td>6.10</td>
<td>500mm dia</td>
<td>Nos.</td>
<td>2</td>
</tr>
<tr>
<td>6.11</td>
<td>600mm dia</td>
<td>Nos.</td>
<td>2</td>
</tr>
<tr>
<td>6.12</td>
<td>700mm dia</td>
<td>Nos.</td>
<td>2</td>
</tr>
<tr>
<td>6.13</td>
<td>800mm dia</td>
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<td>1</td>
</tr>
<tr>
<td>6.14</td>
<td>1200mm dia</td>
<td>Nos.</td>
<td>2</td>
</tr>
</tbody>
</table>
3 SITE INFORMATION

The work will be executed in Amritsar City in the state of Punjab. The city corporation area is nearly 139 Sq km in spread. Various land parcel within the City has been identified for construction of WTP and OHSRs which are as described below.

3.1 Water Treatment Plant

The water works will be executed at Vallah Village. The water works site i.e. where the intake point, pre-treatment facility and Water treatment plant will be constructed at land available near Vallah Village within Amritsar city.

Land is 40 acres of contiguous land parcel located adjoining to the UBDC canal. The land is presently under agricultural use and shall be made available at the time of the execution of the Project.

3.2 Existing Overhead Reservoir

There are existing 40 OHSR under Municipal Corporation Amritsar and 2 OHSR which have been abandoned. The List of the existing OHSR and their capacities is given in Appendix 2A.

3.3 Proposed Overhead Reservoir

As per the design requirement 53 sites have been identified for construction of OHSRs. All these proposed sites are in possession of MCA land or land is with other Government Departments. The List of the location of OHSRs is given in Appendix 2B.
## Appendix 2A - List of Sites of Existing OHSRs

<table>
<thead>
<tr>
<th>S.No.</th>
<th>W.No.</th>
<th>Name of Area where OHSR is Located</th>
<th>Capacity (m$^3$)</th>
<th>Staging Height (in Metre) upto FSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26</td>
<td>Ajitnagar</td>
<td>455</td>
<td>30 to 35 mtr.</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>Kesaribagh</td>
<td>909</td>
<td>30 to 35 mtr.</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>Kesari bagh-1 (steel)</td>
<td>455</td>
<td>20 to 25 mtr.</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>Kesari bagh-2 (steel)</td>
<td>455</td>
<td>20 to 25 mtr.</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
<td>Kesari bagh-3 (steel)</td>
<td>455</td>
<td>21 to 25 mtr.</td>
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<tr>
<td>6</td>
<td>25</td>
<td>Kesari bagh-4 (steel)</td>
<td>455</td>
<td>22 to 25 mtr.</td>
</tr>
<tr>
<td>7</td>
<td>29</td>
<td>Azad nagar</td>
<td>909</td>
<td>30 to 85 mtr.</td>
</tr>
<tr>
<td>8</td>
<td>30</td>
<td>Daburjil. kanwar. Avenue (JNNURM)</td>
<td>455</td>
<td>30 to 35 mtr.</td>
</tr>
<tr>
<td>9</td>
<td>33</td>
<td>Kotmit singh (JNNURM)</td>
<td>455</td>
<td>30 to 35 mtr.</td>
</tr>
<tr>
<td>10</td>
<td>49</td>
<td>Hall gate (pink plaza)</td>
<td>909</td>
<td>30 to 35 mtr.</td>
</tr>
<tr>
<td>11</td>
<td>48</td>
<td>Lahori gate zonal office</td>
<td>909</td>
<td>30 to 35 mtr.</td>
</tr>
<tr>
<td>12</td>
<td>37</td>
<td>Gilwali gate</td>
<td>455</td>
<td>30 to 35 mtr.</td>
</tr>
<tr>
<td>13</td>
<td>39</td>
<td>Shaktribagh</td>
<td>909</td>
<td>30 to 35 mtr.</td>
</tr>
<tr>
<td>14</td>
<td>39</td>
<td>Kotmahna singh</td>
<td>909</td>
<td>30 to 35 mtr.</td>
</tr>
<tr>
<td>15</td>
<td>45</td>
<td>Shakti nagar</td>
<td>909</td>
<td>30 to 35 mtr.</td>
</tr>
<tr>
<td>16</td>
<td>49</td>
<td>Katramoti ram</td>
<td>909</td>
<td>30 to 35 mtr.</td>
</tr>
<tr>
<td>17</td>
<td>59</td>
<td>Fatehpur (JNNURM)</td>
<td>455</td>
<td>30 to 35 mtr.</td>
</tr>
<tr>
<td>18</td>
<td>59</td>
<td>Fateh singh colony (JNNURM)</td>
<td>455</td>
<td>30 to 35 mtr.</td>
</tr>
<tr>
<td>19</td>
<td>59</td>
<td>Bharariwal (JNNURM)</td>
<td>455</td>
<td>30 to 35 mtr.</td>
</tr>
<tr>
<td>20</td>
<td>3</td>
<td>Nikka singh colony</td>
<td>909</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>21</td>
<td>52</td>
<td>Gowal mandi</td>
<td>909</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>22</td>
<td>4</td>
<td>Guru Amar Dass avenue (JNNURM)</td>
<td>455</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>23</td>
<td>4</td>
<td>Mahallan (JNNURM) ETT school</td>
<td>455</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>24</td>
<td>4</td>
<td>Beauty avenue (JNNURM)</td>
<td>455</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>25</td>
<td>4</td>
<td>Mahallan village royal estate</td>
<td>455</td>
<td>20 to 25 mtr.</td>
</tr>
</tbody>
</table>
## Employer’s Requirement

<table>
<thead>
<tr>
<th>S.No.</th>
<th>W.No.</th>
<th>Name of Area where OHSR is Located</th>
<th>Capacity (m³)</th>
<th>Staging Height (in Metre) upto FSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>50</td>
<td>Green avenue</td>
<td>909</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>27</td>
<td>22</td>
<td>Company Bagh</td>
<td>909</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>28</td>
<td>6</td>
<td>Ranjit Avenue</td>
<td>909</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>29</td>
<td>14</td>
<td>Diamond Avenue</td>
<td>455</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>30</td>
<td>10</td>
<td>Nehru colony (Gopal Nagar)</td>
<td>909</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>31</td>
<td>15</td>
<td>Mustafabad</td>
<td>909</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>32</td>
<td>18</td>
<td>Mohkampura (JNNURM)</td>
<td>455</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>33</td>
<td>20</td>
<td>Tehsilpura</td>
<td>909</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>34</td>
<td>31</td>
<td>Focal Point</td>
<td>455</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>35</td>
<td>31</td>
<td>Focal point</td>
<td>227</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>36</td>
<td>17</td>
<td>Vallah (JNNURM)</td>
<td>455</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>37</td>
<td>21</td>
<td>Kangra colony</td>
<td>909</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>38</td>
<td>2</td>
<td>Khandwala,</td>
<td>909</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>39</td>
<td>63</td>
<td>Japani mills</td>
<td>909</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>40</td>
<td>62</td>
<td>Guru kiwadali (JNNURM)</td>
<td>455</td>
<td>35 to 40 mtr.</td>
</tr>
<tr>
<td>41</td>
<td>25</td>
<td>Kesaribagh (under ground)</td>
<td>1818</td>
<td>-</td>
</tr>
<tr>
<td>42</td>
<td>23</td>
<td>Ram bagh</td>
<td>1364</td>
<td>Abandoned</td>
</tr>
<tr>
<td>43</td>
<td>53</td>
<td>Islamabad</td>
<td>1364</td>
<td>Abandoned</td>
</tr>
</tbody>
</table>
## Appendix 2B—Tentative List of sites of proposed OHSRs

<table>
<thead>
<tr>
<th>S. No.</th>
<th>WTP/OHSR</th>
<th>Location (With nearest Landmark)</th>
<th>Coordinate X</th>
<th>Coordinate Y</th>
<th>Site Availability Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>WTP Site</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>W1-P1</td>
<td>Power Colony</td>
<td>74.8099</td>
<td>31.6302</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>3.</td>
<td>W2-P1</td>
<td>Government Polytechnic College</td>
<td>74.8170</td>
<td>31.6380</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>4.</td>
<td>W2-P2</td>
<td>Government Polytechnic College</td>
<td>74.8170</td>
<td>31.6380</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>5.</td>
<td>W5-P1</td>
<td>Guru Ram Dass Avenue</td>
<td>74.8455</td>
<td>31.6735</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>6.</td>
<td>W5-P2</td>
<td>Improvement Trust Land</td>
<td>74.8553</td>
<td>31.6615</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>7.</td>
<td>W6-P1</td>
<td>Opposite Shemford Little Stars , Ranjit Avenue</td>
<td>74.8611</td>
<td>31.6480</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>8.</td>
<td>W7-P1</td>
<td>Improvement Trust Land nr. Bhullar Colony</td>
<td>74.8712</td>
<td>31.6677</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>9.</td>
<td>W8-P1</td>
<td>Backside Trillium Mall</td>
<td>74.8793</td>
<td>31.6604</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>10.</td>
<td>W9-P1</td>
<td>ENT Hospital</td>
<td>74.8865</td>
<td>31.6452</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>11.</td>
<td>W11_P1</td>
<td>TB Hospital</td>
<td>74.8864</td>
<td>31.6444</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>12.</td>
<td>W13-P1</td>
<td>ESI Colony</td>
<td>74.8897</td>
<td>31.6558</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>13.</td>
<td>W14-P1</td>
<td>Near Mai Bhago Government Polytechnic</td>
<td>74.8942</td>
<td>31.6691</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>14.</td>
<td>W17-P1</td>
<td>PWD office Batala Road</td>
<td>74.9105</td>
<td>31.6495</td>
<td>Within six Months of Mobilisation of Contractor</td>
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<tr>
<td>15.</td>
<td>W17-P2</td>
<td>Land Near Vallah</td>
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<td>31.6304</td>
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<tr>
<td>16.</td>
<td>W18-P1</td>
<td>Power Colony, Mustafabad</td>
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<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>17.</td>
<td>W20-P1</td>
<td>Park near Government Saragarhi Memorial Secondary School</td>
<td>74.9022</td>
<td>31.6260</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>18.</td>
<td>W20-P2</td>
<td>Government Saragarhi Memorial Secondary School</td>
<td>74.9015</td>
<td>31.6244</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>S. No.</td>
<td>WTP/OHSR</td>
<td>Location (With nearest Landmark)</td>
<td>Coordinate X</td>
<td>Coordinate Y</td>
<td>Site Availability Schedule</td>
</tr>
<tr>
<td>-------</td>
<td>----------</td>
<td>---------------------------------</td>
<td>--------------</td>
<td>--------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>19.</td>
<td>W26-P1</td>
<td>Park Near Chamrang Road</td>
<td>74.8910</td>
<td>31.6206</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>20.</td>
<td>W28-P1</td>
<td>New Tehsilpura, Near Railway Line</td>
<td>74.8896</td>
<td>31.6311</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>21.</td>
<td>W30-P1</td>
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<td></td>
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<td>22.</td>
<td>W30-P2</td>
<td>Kanwar Avenue</td>
<td>74.9291</td>
<td>31.5994</td>
<td>On day of Mobilisation of Contractor</td>
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<tr>
<td>23.</td>
<td>W31-P1</td>
<td>New Amritsar Park</td>
<td>74.9244</td>
<td>31.6190</td>
<td>Within six Months of Mobilisation of Contractor</td>
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<tr>
<td>24.</td>
<td>W31-P2</td>
<td>Park Shubham Enclave</td>
<td>74.9434</td>
<td>31.6038</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>25.</td>
<td>W32-P1</td>
<td>Green Belt near Sultanwind Chowk</td>
<td>74.9015</td>
<td>31.6066</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>26.</td>
<td>W33-P1</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.</td>
<td>W34-P1</td>
<td>Park near East Mohan Nagar</td>
<td>74.8928</td>
<td>31.6174</td>
<td>On day of Mobilisation of Contractor</td>
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<tr>
<td>28.</td>
<td>W35-P1</td>
<td>Near KotKarnail Singh</td>
<td>74.8894</td>
<td>31.6127</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>29.</td>
<td>W37-P1</td>
<td>Fateh Singh Colony</td>
<td>74.8661</td>
<td>31.6007</td>
<td>On day of Mobilisation Of Contractor</td>
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<tr>
<td>30.</td>
<td>W38-P1</td>
<td>Green Belt near Sultanwind Chowk</td>
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<td>Within six Months of Mobilisation of Contractor</td>
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<tr>
<td>31.</td>
<td>W38-P2</td>
<td>Green Belt near Sultanwind Chowk</td>
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<td>31.5975</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>32.</td>
<td>W40-P1</td>
<td>Near Ram Singh Colony, Sultanwind Road</td>
<td>74.8861</td>
<td>31.6124</td>
<td>Within six Months of Mobilisation of Contractor</td>
</tr>
<tr>
<td>33.</td>
<td>W41-P1</td>
<td>Sultanwind</td>
<td>74.8844</td>
<td>31.6180</td>
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<td>34.</td>
<td>W42-P1</td>
<td>Shakatri Bagh</td>
<td>74.8767</td>
<td>31.6100</td>
<td>On day of Mobilisation of Contractor</td>
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<tr>
<td>35.</td>
<td>W43-P1</td>
<td>Sant Nagar Park</td>
<td>74.8663</td>
<td>31.6120</td>
<td>On day of Mobilisation of Contractor</td>
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<tr>
<td>36.</td>
<td>W44-P1</td>
<td>Hakima Gate</td>
<td>74.8626</td>
<td>31.6121</td>
<td>On day of Mobilisation of Contractor</td>
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<tr>
<td>37.</td>
<td>W46-P1</td>
<td>Bhagtauala</td>
<td>74.8709</td>
<td>31.6099</td>
<td>On day of Mobilisation of Contractor</td>
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<tr>
<td>38.</td>
<td>W47-P1</td>
<td>Inside Khazana Gate</td>
<td>74.8625</td>
<td>31.6159</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>S. No.</td>
<td>WTP/ OHSR</td>
<td>Location (With nearest Landmark)</td>
<td>Coordinate X</td>
<td>Coordinate Y</td>
<td>Site Availability Schedule</td>
</tr>
<tr>
<td>--------</td>
<td>-----------</td>
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<td>--------------</td>
<td>--------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>39.</td>
<td>W50-P1</td>
<td>Shastri Nagar Park</td>
<td>74.8745</td>
<td>31.6559</td>
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<tr>
<td>40.</td>
<td>W52-P1</td>
<td>Varenium Park</td>
<td>74.8506</td>
<td>31.6413</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>41.</td>
<td>W54-P1</td>
<td>Swaroop Rani Government College for Women</td>
<td>74.8253</td>
<td>31.6298</td>
<td>Within six Months of Mobilisation of Contractor</td>
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<tr>
<td>42.</td>
<td>W54-P2</td>
<td>Near DilawariStreet,Putligarh</td>
<td>74.8446</td>
<td>31.6303</td>
<td>Within six Months of Mobilisation of Contractor</td>
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<tr>
<td>43.</td>
<td>W55-P1</td>
<td>Near Vilk Milk Point, Kot Khalsa</td>
<td>74.8268</td>
<td>31.6223</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>44.</td>
<td>W56-P1</td>
<td>Sohan Avenue, Kot Khalsa</td>
<td>74.8283</td>
<td>31.6208</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>45.</td>
<td>W57-P1</td>
<td>Park near Gurbax Nagar</td>
<td>74.8576</td>
<td>31.6178</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>46.</td>
<td>W58-P1</td>
<td>Opp. Bhadrakali Mandir, Khazana Gate</td>
<td>74.8612</td>
<td>31.6175</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>47.</td>
<td>W59-P1</td>
<td>Near Government School, Fatehpur</td>
<td>74.8381</td>
<td>31.5990</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>48.</td>
<td>W61-P1</td>
<td>Guru Ram Dass Colony, Kot Khalsa</td>
<td>74.8271</td>
<td>31.6250</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>49.</td>
<td>W62-P1</td>
<td>Chehharta Park</td>
<td>74.7948</td>
<td>31.6215</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>50.</td>
<td>W62-P2</td>
<td>Kot Khalsa</td>
<td>74.8210</td>
<td>31.6259</td>
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</tr>
<tr>
<td>51.</td>
<td>W64-P1</td>
<td>MCA Zone Office</td>
<td>74.8038</td>
<td>31.6284</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
<tr>
<td>52.</td>
<td>W65-P1</td>
<td>Chehharta Park</td>
<td>74.7948</td>
<td>31.6215</td>
<td>On day of Mobilisation of Contractor</td>
</tr>
</tbody>
</table>
4 ENVIRONMENTAL AND SOCIAL (ES) REQUIREMENTS

4.1. Contractor's Superintendence

The contractor shall submit a staff Organisation plan in accordance with the GCC. This plan shall be updated and resubmitted whenever there are changes of the staff. The plan shall show the management structure and state clearly the duties, responsibilities and authority of each staff member.

The site in-charge/ supervisors shall have experience and qualification appropriate to the type and magnitude of the works. Full details shall be submitted of the qualification’s and experience of all proposed staff to the engineer for his approval.

4.2. Checking of The Contractor's Temporary Works Design

The contractor shall, prior to commencing the construction of the temporary works, submit a certificate to the engineer signed by him certifying that the temporary works have been properly and safely designed and checked and that the contractor has checked the effect of the temporary works on the permanent works and has found this to be satisfactory.

4.3. The Site

Works areas are those areas identified for construction of water treatment plant, intake lines between canal and Water Treatment Plant (WTP), transmission lines up to OHSRs and construction of OHSRs. The construction of regulator on the canal system may be undertaken by irrigation department.

4.3.1. Use of the site

i. The site or contractor's equipment shall not be used by the contractor for any purpose other than for carrying out the works in the scope of this contract, except that, with the consent inwriting of the engineer, the site or contractor's equipment such as batching and mixing plants for concrete and bituminous materials.

ii. Rock crushing plant shall not be established on the site.

iii. The location and size of each stockpile of materials, including excavated materials, within the site shall be as permitted by the engineer. Stock piles shall be maintained at all times in a stable condition.

iv. Entry to and exit from the site shall be controlled and shall be available only at the locations for which the engineer has given his consent.

4.3.2. Access to the site

The contractor shall make its own arrangements, subject to the consent of the engineer, for any further access required to the site.

In addition, the contractor shall ensure that access to every portion of the site is continually available to the employer and engineer.

4.3.3. Access to outside the site

The contractor shall be responsible for ensuring that any access or egress through the site boundaries are controlled such that no disturbance to residents or damage to public or private property occur as a result of the use of such access or egress by its employees and
subcontractors.

4.3.4. **Survey of the site**

A survey shall be carried out of the site to establish its precise boundaries and the existing ground levels within it. This survey shall include a photographic survey sufficient to provide a full record of the state of the site before commencing the work with particular attention paid to those areas where reinstatement will be carried out later on. The survey shall be carried out before the site clearance and the commencement of any work in any works area. The survey shall be carried out by the contractor and agreed with the Engineer.

4.3.5. **Barricades and signboards**

   a. The contractor shall erect barricades as per approved drawing and gates around its areas of operations to prevent entry by unauthorized persons to his works areas and necessary identity cards/permits should be issued to workers and staff by the contractor. The contractor shall submit proposal for barricades of the complete perimeter of all works areas to the engineer. Painting of the barricades shall be carried out to the design and color as directed by the engineer and the contractor shall carry out re-painting of the entire barricades frequently on regular basis. No work shall be commenced in any works area until the engineer has been satisfied that the barricades installed by the contractor are sufficient to prevent, within reason, unauthorized entry. The cost of all the barricades is included in quoted price.

   b. Project signboards shall be erected not more than four (4) weeks, or such other period as the engineer has given his consent, after the date of commencement of the works. The types, sizes and locations of project signboards shall be agreed with the engineer before manufacture and erection. Other advertising signs shall not be erected on the site.

   c. The consent of the engineer shall be obtained before hoardings, fences, gates or signs are removed. Hoardings, fences, gates and signs which are to be left in positions after the completion of the works shall be repaired and repainted as instructed by the engineer.

   d. Hoardings, barricades, gates and signs shall be maintained in clean and good order by the contractor until the completion of the works, whether such hoardings, fences, gates and signs have been installed by the Contractor or by others and transferred to the Contractor during the period of the Works. All the fencing, hoardings, gates and signs etc. shall be mopped minimum one in a week and washed monthly.

   e. All hoardings, barricades, gates and signs installed by the Contractor shall be removed by the Contractor upon the completion of the Works, unless otherwise directed by the Engineer.

   f. Hoarding/ barricades can be reused after removing from one place to other locations/sites provided they are in good condition and approved by Engineer.

   g. Damage/ worn-out barricades/ hoarding shall be replaced by contractor within 24 hours. Engineer's decision regarding need for replacement shall be final and binding and if no action is taken by contractor, the Engineer may get it repaired through other agency and the cost of any repairs will be deducted by the Engineer from any payment due to the Contractor.

4.3.6. **Clearance of the Site**

All Temporary Works which are not to remain on the Site after the completion of the Works shall be removed prior to completion of the Works or at other times instructed by the Engineer. The Site shall be cleared and reinstated to the lines and levels and to the same condition as existed before the Works started except as otherwise stated in the
4.4. Safety, Health and Environmental Requirements

The Contractor shall comply with in the conditions stipulated in the Conditions of contracts on Safety, Health and Environment.

4.5. Safety Measures

4.5.1. Site Safety & Health Plan and Site Environment Plan

The Contractor shall, within 3 weeks of the date of Notice to Proceed, prepare and submit to the Engineer for review his proposed Site Safety & Health Plan and Site Environment plan which shall contain as a minimum those items set out in Conditions of Contract on Safety, Health and Environment Plan.

4.5.2. Fire Regulations and Safety

1. The Contractor shall provide and maintain all necessary temporary fire protection and fire fighting facilities on the Site during the construction of the Works, and shall comply with all requirements of the Amritsar Fire Services Department. These facilities may include, without limitation, sprinkler systems and fire hose reels in temporary site buildings, raw water storage tanks and portable fire extinguishers suitable for the conditions on the Site and potential hazards.

2. The Contractor shall submit details of these facilities to the Engineer for review prior to commencement of work on the Site.

3. If, in the Engineer's opinion, the use of naked lights may cause a fire hazard, the Contractor shall take such additional precautions and provide such additional firefighting equipment's (including breathing apparatus) as the Engineer considers necessary. The term "naked light" shall be deemed to include electric arcs and oxyacetylene or other flames used in welding or cutting metals.

4. Oxyacetylene burning equipment will not be permitted in any confined space. Burning equipment of the oxy-propane type shall be used.

4.5.3. Hazard and Risk Assessments

Explosives

1. Explosives shall not be used without prior written consent of the Engineer. Before consent to blasting is granted, the Contractor shall prepare a Specification as to the size of charge, the method of firing and any other restrictions that may be imposed from time to time.

2. Where the Engineer has consented to the use of explosives, the Contractor shall be responsible for obtaining the requisite licenses and permits for complying with all statutory requirements for blasting.

3. The storage, transportation and use of explosives shall at all times be governed by the Explosives Acts and such other statutory regulations which may be applicable and as imposed by the Statutory Authorities.

4.5.4. Standby Equipment

The Contractor shall provide adequate stand-by equipment to ensure the safety of personnel, the Works and the public. These measures shall include as a minimum the following:

a) stand-by pumping and generating equipment for the control of water;

b) stand-by equipment and spares for illumination of the Works; and
c) Stand-by generating equipment and equipment for the lighting for the works.

4.5.5. Co-operation
The Contractor shall provide full co-operation and assistance in all safety surveillance carried out by the Engineer or the Employer. Any breaches of the Site Safety Plan or the statutory regulations or others disregard for the safety of any persons may be the reason for the Engineer to exercise his authority to require the site agent’s removal from the Site.

4.6. Care of The Works
i. Unless otherwise permitted by the Engineer all work shall be carried out in dry conditions.

ii. The Works, including materials for use in the Works, shall be protected from damage due to water. Water on the Site and water entering the Site shall be promptly removed by temporary drainage or pumping systems or by other methods capable of keeping the Works free of water. Silt and debris shall be removed by traps before the water is discharged and shall be disposed of at a location or locations to which the Engineer has given his consent. No water from site shall go the existing canal in the vicinity of WTP site.

iii. The discharge points of the temporary systems shall be as per the consent of the Engineer. The Contractor shall make all arrangements with and obtain the necessary approval from the relevant authorities for discharging water to drains, watercourses etc. The relevant work shall not be commenced until the approved arrangements for disposal of the water have been implemented.

iv. The methods used for keeping the Works free of water shall be such that settlement of, or damage to, new and existing structures do not occur. Measures shall be taken to prevent flotation of new and existing structures.

4.7. Protection of the Works from Weather
i. Work shall not be carried out in weather conditions that may adversely affect the Works unless proper protection is provided to the satisfaction of the Engineer.

ii. Permanent Works, including materials for such Works, shall be protected from exposures of weather conditions that may adversely affect such Permanent Works or materials.

iii. During construction of the Works storm restraint systems shall be provided where appropriate. These systems shall ensure the security of the partially completed and ongoing stages of construction and in all weather conditions. Such storm restraint systems shall be installed as soon as practicable and shall be compatible with the right of way, or other access around or through- out the Site.

iv. The Contractor shall at all times program and order progress of the work and make all protective arrangements such that the Works can be made safe in the event of storms.

a. Protection of the Work

v. The finished works shall be protected from any damage that could arise from any activities on the adjacent site/ works.

4.8. Damage and Interference
i. Work shall be carried out in such a manner that there is no damage to or interfere with:

(a) watercourses or drainage systems; (b) utilities; (c) structures (including foundations), roads, including street furniture, or other properties; (d) public or private vehicular or pedestrian access; (e) monuments; (f) trees, (g) graves or burial grounds other than to the extent that is necessary for them to be removed or diverted to permit the execution of the Works. Heritage structures shall not be damaged or disfigured on any account. The Contractor shall inform the Engineer as soon as practicable of any items which are not stated in the Contract to be removed or diverted but which the Contractor considers need to be removed or diverted to enable the Works to be carried out. Such items shall not be removed or diverted until the consent of the Engineer to such removal or diversion has been obtained.

ii. Items which are damaged or interfered with as a result of the Works and items which are removed to enable work to be carried out shall be reinstated to the satisfaction of the Engineer and to at least the same condition as existed before the work started. Any claims by Utility Agencies due to damage of utilities by the Contractor shall be borne by the Contractor.

4.8.1. Utilities

The Contractor shall immediately inform the Engineer of any damage to structures, roads or other properties.

4.8.2. Access

Alternative access shall be provided to all premises if interference with the existing access, public or private, is necessary to enable the Works to be carried out. The arrangements for the alternative access shall be as agreed by the Engineer and the concerned agency. Unless agreed otherwise, the permanent access shall be reinstated as soon as practicable after the work is complete and the alternative access shall be removed immediately as it is no longer required, and the ground surfaces reinstated to the satisfaction of the Engineer. Proper signage and guidance shall be provided for the traffic / users regarding diversions.

4.8.3. Trees

The Contractor is not permitted to cut any trees without the permission of the Employer. Necessary documents w.r.t tree cutting permission including land for compensatory forestation shall be ensured by MCA. Contractor shall facilitate/ liaison with the respective department. The trees requiring to be felled will be removed from ground level up by the Contractor prior to commencement of the works. The Contractor will not be permitted to cut or remove any further trees. If for the purposes of the works additional trees are required to be cut/trimmed or removed, the Contractor must notify the Engineer of further tree felling requirements. Subject to compliance with the aforementioned act, arrangements for permission from Forest Department for tree felling shall be done by the contractor. The payment of tree cutting, removal, transportation (upto 30Km lead) required in this item shall be paid in relevant schedule of BOQ.

4.8.4. Removal of Graves and Other Obstructions

If any graves and other obstructions are required to be removed in order to execute the Works and such removal has not already been arranged for, the Contractor shall draw the Engineer's attention to them in good time to allow all necessary arrangements
and authorizations for such removal, and it shall not itself remove them unless the Engineer has given consent.

4.8.5. **Protection of the Adjacent Structures and Works**

The Contractor shall take all necessary precautions to protect the structures or works being carried out by others adjacent to and, for the time being, within the Site from the effects of vibrations, undermining and any other earth movements or the diversion of water flow arising from its work.

4.9. **Work on Roads**

4.9.1. **Traffic Management Plan**

The Contractor shall develop a detailed Traffic Management Plan for the work under the contract. The purpose is to develop a Traffic Management Plan to cope with the traffic disruption as a result of construction activities by identifying strategies for traffic management on the roads and neighborhoods impacted by the construction activities. The Contractor shall implement the Traffic Management Plan throughout the whole period of the Contract.

4.9.2. **Principles for Traffic Management**

The basis for the Plan shall take into consideration four principles:

- to minimize the inconvenience of road users and the interruption to surface traffic through the area impacted by the construction activities;
- to ensure the safety of road users in the impacted area;
- to facilitate access to the construction site, and to maintain reasonable construction progress.
- to ensure traffic safety at each construction site.

4.9.3. **Integrated Traffic Management Plan**

The Contractor shall prepare an integrated plan showing the arrangements to be made for accommodating road and pedestrian traffic, at individual construction sites and continuously along the alignment, to smooth traffic operations and for the safety of both construction workers and road users. The Plan shall consider different measures such as:

- proper phasing and timing of traffic signals;
- modifications to intersection geometry;
- changes in lane usage;
- parking prohibitions;
- re-location of bus stops;
- reducing width of footpaths and median;
- right-turn prohibition;
- work site access management;
- minimizing the duration of any road closure;
- reversible lane operations;
- modification of roadway alignment affected by the construction, which shall be in conformance with the requirements and regulations defined by the relevant authorities and may include widening of roads, Construction of temporarily new road etc.
- other traffic engineering measures as may be applicable.

4.9.4. Mitigation of Traffic Disturbances

The Contractor shall manage the vehicular and pedestrian right of way during the period of construction. The Contractor shall take account of the need to maintain essential traffic requirements, as these may influence the construction process. The Contractor shall include local traffic diversion routes and assess traffic impacts caused by the construction in the affected areas. Signage layout shall be included to ensure that adequate motorist information will be provided for traffic diversions.

Where it becomes necessary to close a road or intersection, or supplementary lanes are required to satisfy the traffic demands, traffic diversion schemes to adjacent roadways shall be developed with quantitative justifications. The Contractor shall co-ordinate with all relevant authorities.

4.9.5. Other considerations include:

- The minimum lane widths for fast traffic and mixed traffic shall follow the regulations of the different authorities.
- Any roads or intersections that have no alternative access shall not be fully closed for construction.
- Emergency access to all properties shall be maintained at all times.
- Access to business premises and properties shall be maintained to the extent that normal activities are not seriously disrupted.
- Minimum footpath width shall be 1.5 m, unless otherwise indicated. The footpath shall be separated from vehicle traffic and not necessarily immediately adjacent to vehicle traffic;
- Where existing footbridges and underpasses are demolished or closed, provisions shall be made for pedestrian crossing to minimize the conflicts between a traffic lane.
- Construction traffic shall be separated from other traffic wherever possible;
- Any traffic related facilities (bus stops, parking etc.) which are affected by the construction works shall be maintained or relocated to appropriate locations;
- Motorists, pedestrians, workmen, plant and equipment shall be protected from
accident at all times;

- Roadway designs, traffic management schemes, and installation of traffic control devices shall be in conformance with the requirements and regulations defined by the relevant authorities; and

- Where applicable, utility diversions shall be incorporated in the traffic management plan.

4.9.6. Approval for Temporary Traffic Arrangements and Control

The Contractor shall make all arrangements with and obtain the necessary approval from the transport authorities and the Police Department for temporary traffic arrangements and control on public roads. In the event that the Contractor, having used its best endeavors, fails to secure the necessary approval from the transport authorities and the Traffic Police Department for temporary traffic arrangements and control on public roads, then the Employer will use its best endeavors to assist the Contractor to secure such approval but without responsibility on the part of the Employer to do so.

4.9.7. Temporary Traffic Arrangements and Control

- Temporary traffic diversions and pedestrian routes shall be surfaced and shall be provided where work on roads or footpaths obstruct the existing vehicular or pedestrian access. The relevant work shall not be commenced until the approved temporary traffic arrangements and control have been implemented.

- Temporary traffic arrangements and control for work on public roads and footpaths shall comply with the requirements of the Traffic Police. Copies of documents containing such requirements shall be kept on the Site at all times.

- Temporary traffic signs, including road marking, posts, backing plates and faces, shall comply with the requirements of the Traffic Police and should be in accordance with the requirements of Ministry of Surface Transport. Pedestrian routes shall be illuminated at night to a lighting level of not less than 50 lux.

- Adequate number of traffic marshals shall be deployed for smooth regulation of traffic.

- Temporary traffic arrangements and control shall be inspected and maintained regularly, both by day and night. Lights and signs shall be kept clean and legible. Equipment which are damaged, dirty, incorrectly positioned or not in working order shall be repaired or replaced promptly.

4.9.8. Particulars of Temporary Traffic Arrangements and Control

The following particulars of the proposed temporary traffic arrangements and control on public roads shall be submitted to the Engineer for consent at least 14 days before the traffic arrangements and control are implemented:

- details of traffic diversions and pedestrian routes;
- details of lighting, signage, guarding and traffic control arrangements and equipment;
- any conditions or restrictions imposed by Traffic Police or any other relevant authorities, including copies of applications, correspondence and approval.
4.9.9. Use of Roads and Footpaths

- Public roads and footpaths on the Site in which the work is not being carried out shall be maintained in a clean and passable condition. Regular brooming, removal of collected debris is the responsibility of contractor.
- Measures shall be taken to prevent the excavated materials, silt or debris from entering gullies on roads and footpaths; entry of water to the gullies shall not be obstructed.
- Surfaced roads on the Site and leading to the Site shall not be used by tracked vehicle unless protection against damage is provided.
- Contractor's Equipment and other vehicles leaving the Site shall be loaded in such a manner that the excavated material, mud or debris will not be deposited on roads. All such loads shall be covered or protected to prevent dust being emitted.
- The wheels of all vehicles shall be washed when necessary before leaving the Site to avoid the deposition of mud and debris on the roads.

4.9.10. Reinstatement of Public Roads and Footpaths

Temporary diversions, pedestrian access and lighting, signing, guarding and traffic control equipment shall be removed immediately when they are no longer required. Roads, footpaths and other items affected by temporary traffic arrangements and control shall be reinstated to the same condition as existed before the work started or as permitted by the Engineer immediately after the relevant work is complete or at other times permitted by the Engineer.

The Contractor shall submit his design for the reinstatement to the relevant authorities and obtain their prior approval to carrying out the work. Reinstatement works shall include:

- Parking bays
- Footpath and Krebs
- Road Signage
- Street Lighting
- Landscaping
- Traffic Lights and Control Cable
- Road painting

4.10. Contractor's Site Accommodation

- The Contractor shall provide and maintain its own site accommodation at locations consented to by the Engineer. Offices, sheds, stores, mess rooms, garages, workshops, toilets and other accommodation on the Site shall be maintained in a clean, stable and secure condition.
- The Contractor shall provide toilets and wash places for the use of its personnel and all persons who will be on the Site. The size and disposition of toilets and wash places shall accord with the numbers and dispositions of persons entitled to be on the Site, which may necessitate their location on structures and, where necessary there shall be separate facilities for males and females.
The capacities and layout shall be subject to approval of the Engineer. The Contractor shall arrange regular disposal of effluent and sludge in a manner that shall be in accordance with local laws/regulations.

4.11. Site Utilities and Access

- The Contractor shall be responsible for providing water, electricity, telephone, sewerage and drainage facilities for contractor’s site offices,
- The contractor shall be responsible for provision of power supply for his works including for launching girder and the like. The Employer cannot guaranty provision of adequate, continuous power supply however assistance will be given in obtaining the necessary permissions for site generators and the like.
- Access roads and parking areas shall be provided within the Site as required and shall be maintained in a clean, acceptable and stable condition.

4.12. Security

- The Contractor shall be responsible for the security of the Site for the full time the Site is in its possession. The Contractor shall with the consent of Engineer provide the specific points only at which entry through the security fence can be effected, and shall provide gates and barriers at such points of entry and whereby maintain a twenty four (24) hours security guard, and such other security personnel and patrols elsewhere as may be necessary to maintain security.
- The Contractor shall maintain all site boundary fences in first class condition, and shall so arrange site boundary fences at all access drainage points of work areas that it's use of such access points etc., are not restricted by the system or method of achieving the required security measures. Notices shall be displayed at intervals around the Site to warn the public of the dangers of entering the Site.
- During the progress of the Works the Contractor shall maintain such additional security patrols over the areas of the Works as may be necessary to protect its own and its subcontractor's work and equipment and shall co-ordinate and plan the security of both the work under this Contract and the work of others having access to and across the Site and the Works.
- In order to operate such a security system it will be necessary to institute the issue of unique passes to personnel and vehicles entitled to be on the Site, and which may need to be separately identifiable according to the shifts being worked on Site. The Contractor shall at the outset determine, together with the Engineer, a system and the design of passes to suit the requirements of the foregoing and to suit the methods of work to be adopted by the Contractor. The Contractor shall at all times ensure that the Engineer has an up to date list of all persons entitled to be on the Site at any time. The contractor shall also introduce a system of issue passes to any outsider or person/vehicles belonging to agencies other than employer/Engineers who may have to visit the site in connection with work.
- Security and checking arrangements as felt necessary shall be provided with advise and help of Police.

The contractor shall take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation.

During continuance of the contract, the contractor and his sub-contractors shall abide at all times by Employer’s ESHS Policy (Enclosed as Appendix at the end of this section), all existing enactments on environmental protection and rules made there under, regulations,
notifications and bye-laws of the State or Central Government, or local authorities and any other law, bye-law, regulations that may be passed or notification that may be issued in this respect in future by the State or Central Government or the local authority.

The Contractor shall ensure that emissions, surface discharges and effluent from the Contractor’s activities shall not exceed the values stated in the Specification or prescribed by applicable Laws.

The Contractor shall obtained all the requisite statutory permits and licenses including labour license, NOC from State Pollution Control Board for batching plant and hot-mix plant and shall renew from time to time till construction period.

The Contractor shall observe all the site specific mitigation measures, as minimum provided in the Appendix-“ENV-A”.

4.12.1. Salient features of some of the major laws that are applicable are given below

The Water (Prevention and Control of Pollution) Act, 1974. This provides for the prevention and control of water pollution and the maintaining and restoring of wholesomeness of water. ‘Pollution’ means such contamination of water or such alteration of the physical, chemical or biological properties of water or such discharge of any sewage or trade effluent or of any other liquid, gaseous or solid substance into water (whether directly or indirectly) as may, or is likely to, create a nuisance or render such water harmful or injurious to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health of animals or plants or of aquatic organisms.

The Air (Prevention and Control of Pollution) Act, 1981. This provides for prevention, control and abatement of air pollution. ‘Air Pollution’ means the presence in the atmosphere of any ‘air pollutant’, which means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment.

The Environment (Protection) Act, 1986. This provides for the protection and improvement of environment and for matters connected therewith, and the prevention of hazards to human beings, other living creatures, plants and property. ‘Environment’ includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property.

The Public Liability Insurance Act, 1991. This provides for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling hazardous substances and for matters connected herewith or incidental thereto. Hazardous substance means any substance or preparation which is defined as hazardous substance under the Environment (Protection) Act 1986, and exceeding such quantity as may be specified by notification by the Central Government.

The applicability of different acts and rules in the project pertaining to environmental safeguards is presented below:

<table>
<thead>
<tr>
<th>Acts, Policies and Notifications</th>
<th>Key requirement</th>
<th>Applicability</th>
<th>Type of permit and stage of applicability</th>
<th>Administrative Authority and indicative time frame</th>
<th>Responsibility</th>
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<tbody>
<tr>
<td>Environment Protection Act 1986</td>
<td>To protect and improve overall Environment.</td>
<td>Applicable</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>EIA Notification 14th Sep 2006 and amendments till date</td>
<td>To protect and improve Environment. Requires prior environmental clearance for new, modernization and expansion projects listed in schedule 1 of the EIA Notification</td>
<td>Not Applicable</td>
<td>Environment Clearance not required for the construction of the additional spill way. **</td>
<td>State EIAA during construction phase 6 months</td>
<td>Contractor</td>
</tr>
<tr>
<td>Air (Prevention and Control of Pollution) Act, 1981, 1987</td>
<td>An act to prevent and control Air pollution</td>
<td>Applicable</td>
<td>Consent to Establish (CTE) &amp; Consent to Operate (CTO) for Batching plant &amp; stone crushers</td>
<td>Punjab Pollution Control Board (PPCB) for establishment of Batching plant &amp; stone crushers 3 to 4 months</td>
<td>Contractor</td>
</tr>
<tr>
<td>Water Prevention and Control of Pollution) Act, 1974, 1988</td>
<td>An act to prevent and control water Pollution.</td>
<td>Applicable</td>
<td>Consent to Establish &amp; Consent to Operate for Batching plant &amp; stone crushers</td>
<td>Punjab Board (PPCB) for establishment of Batching plant &amp; stone crushers 3 to 4 months</td>
<td>Contractor</td>
</tr>
<tr>
<td>Noise Pollution (Regulation and Control Rules) 2000 and till date amendments</td>
<td>Ambient Noise Standards for different areas and zones</td>
<td>Applicable</td>
<td>No permits issued under this act. However the Contractor has to comply with the standard limits during construction</td>
<td>Punjab Board (PPCB)</td>
<td>Contractor</td>
</tr>
<tr>
<td>Hazardous &amp; Other Wastes (Management, Storage and Trans-boundary Movement) Rules, 2016</td>
<td>The rules prescribe management requirements of hazardous wastes from its generation to final Disposal.</td>
<td>Applicable</td>
<td>Authorization for storage and handling Hazardous waste</td>
<td>CPCB and PPCB</td>
<td>Contractor</td>
</tr>
<tr>
<td>MSIHC Rules, 1989</td>
<td>Usage and storage of hazardous material</td>
<td>Applicable</td>
<td>No specific permit is required, however precautions defined under the material safety datasheets</td>
<td>CPCB and PPCB</td>
<td>Contractor</td>
</tr>
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<td>Key requirement</td>
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<tr>
<td>The Bio-Medical Waste Management Rules, 2016</td>
<td>To control storage, transportation and disposal of Bio Medical Waste.</td>
<td>Applicable</td>
<td>Comply with the handling and disposal Requirements of the rules.</td>
<td>--</td>
<td>Contractor</td>
</tr>
<tr>
<td>Construction and Demolition Waste Management Rules, 2016</td>
<td>To manage the construction and demolition waste</td>
<td>Applicable</td>
<td>Approval required from local authorities, if waste generation is &gt;20 tons in a day or 300 tons in a month</td>
<td>PPCB</td>
<td>contractor</td>
</tr>
<tr>
<td>Plastic waste Management Rules, 2016</td>
<td>To manage the plastic waste generated</td>
<td>Applicable</td>
<td>No authorization to be obtained. Waste Management and Minimization to be done. Fee to be paid to local bodies, if applicable</td>
<td></td>
<td>Contractor</td>
</tr>
<tr>
<td>The Batteries (Management and Handling) Rules 2001</td>
<td>To regulate the disposal and recycling of lead acid batteries</td>
<td>Applicable</td>
<td>No specific registration Required. Compulsion to buy and sale through Registered authorized vendors only</td>
<td>PPCB</td>
<td>Contractor</td>
</tr>
<tr>
<td>The Forest (Conservation) Act, 1980 and amendments The Forest (conservation) Rules 1981 and Amendments till date</td>
<td>To protect forest by restricting conversion of forested areas into non-forest areas and deforestation</td>
<td>Not Applicable</td>
<td>Forest Clearance for diversion of Forest Land for Non-forest use</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tree Cutting in Non-forest area</td>
<td>To regulate tree cutting</td>
<td>Applicable</td>
<td>Permission to be taken and plant 10 X saplings for compensatory afforestation</td>
<td>Plantation in consultation with Forest Department</td>
<td>Contractor</td>
</tr>
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<tr>
<td>Public Liability and Insurance Act 1991</td>
<td>Protection from liability arising due to accidents from handling of hazardous chemicals.</td>
<td>Applicable</td>
<td>No permits issued under this act. Owner of project should take Insurance policies for contracts providing insurance so that he is insured against liability to give relief, before handling any such hazardous material</td>
<td>Dist. Collector</td>
<td>Contractor</td>
</tr>
<tr>
<td>Explosive Act 1884 &amp; Explosive Rules, 2008</td>
<td>Safe transportation, storage and use of explosive material, blasting site and safe distance</td>
<td>Applicable</td>
<td>Permission for storage and usage of explosive</td>
<td>DC, Chief Controller of Explosives, Govt. of India</td>
<td>Contractor</td>
</tr>
<tr>
<td>Central Motor Vehicle Act 1988 and amendments &amp; Central Motor Vehicle Rules, 1989 and amendments till date</td>
<td>To minimize the road accidents, penalizing the guilty, providing compensation to victim and family and check vehicular air and noise Pollution.</td>
<td>Applicable</td>
<td>No permit issued under this Act however the contractor has to ensure proper license, permits &amp; PUC, as required</td>
<td>Motor Vehicle Licensing Authority of the Region.- Regional Transport Officer</td>
<td>Contractor</td>
</tr>
<tr>
<td>The Gas Cylinder Rules 2004</td>
<td>To regulate the storage of gas / possession of gas cylinder more than the exempted quantity</td>
<td>Applicable</td>
<td>License to store gas cylinder more than the regulated quantity</td>
<td>Chief Controller of Explosives, Govt. of India</td>
<td>Contractor</td>
</tr>
<tr>
<td>Building &amp; Other Construction workers (Regulation of Employment &amp; Condition of Service)</td>
<td>To regulate the employment and condition of service of building and other construction workers and to provide for their safety, health and welfare</td>
<td>Applicable</td>
<td>Registering all workers</td>
<td>Dist. Labour Commissioner</td>
<td>Contractor</td>
</tr>
</tbody>
</table>
In addition to the above Acts and Rules, the Contractor has to comply with the various Labour Rules such as Factories Act, 1948; Employees State Insurance Act, 1948; Workmen’s Compensation Act, 1923; Minimum Wages Act, 1948 The Inter-state Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979, etc. The contractor has to implement all the provisions and take all mitigation measures specified in Table 1-4 of Appendix ENV-A. Cost implications for implementation of environment management plan shall be an integral part of the conditions of contract and all costs to this item shall be considered by contractor while submitting the tender.

4.13. Environmental Monitoring:
The Contractor shall carry out Monitoring of environmental attributes in terms of Air, Noise, Water and Soil quality at different location as stipulated in Environmental Monitoring Plan of Environmental Management Plan Table 1-5 of APPENDIX-ENV-A to compare the changes in the quality of environmental attributes caused due to the construction activities. The Contractor shall comply by all obligations and make sure that there are no deviations from them or from the Contract. Cost implications for environmental monitoring shall be an integral part of the conditions of contract and all costs to this item shall be considered by contractor while submitting the tender.

Measurement of Payments
The unit number of Ambient Air, Ambient Noise, Surface water, Ground water and Soil shall be measured and shall be verified by the Engineer.

Payment for each item based on measurement shall be paid on unit rates stated in Bill of Quantity and/or as per Requirements/ESHS Specification’s subject to required control while recording the readings/ measurements, testing in NABL/ MoEF & CC approved testing laboratory as approved by the Employer’s Engineer-In-Charge.

Rate
The contract rate for environmental monitoring shall be included in its various rates/ amount quoted & include the sampling and analysis of environmental components and submission of test reports to the Engineers and the sampling and report submission shall only be done by NABL/ MoEF & CC approved Labs.
A1. Introduction

The present chapter details the Environmental Management Plan for proposed PMSIP Water supply Improvement in Amritsar city, Punjab. The project has been proposed for the improvement of water supply and switch from ground water to canal based surface water clean water supply. The Project has been categorized as High Risk (Environmental) and Substantial Risk (Social) project as per World Bank classification; the project required project specific Environmental and Social Impact Assessment study with objective to identify environmental and social risks and impacts of the project and their mitigation measures. A preliminary ESIA has been prepared for this project and based on the study, a preliminary environmental and social management plan (ESMP) has been formulated. A thorough ESIA will be prepared along with the design of the project.

Canal base Water supplier in Amritsar City as the prioritized objective of the project, the State Government while implementing the project intend to establish an equitable balance between the project activities, maintenance of good environmental quality consistent with social compatibility.

Environmental and Social Management Plan (ESMP) in this study document thus equips the project proponents [PMIDC/GoP] to effectively address the environmental concerns of the project spread throughout the project cycle i.e. planning, execution and operational phases. The ESMF tool for PMSIP has been used for incorporation of environmental and social safeguards in the present project documents, followed along with the Resource management, Engineering and Institutional interventions.

For better effectiveness of the project Management, a well-developed Environmental and Social Management Plan [ESMP] has been prepared after adequately strengthened by a carefully structured Environmental and Social Monitoring Action Plan [ESMAP]. The plan formulation, associated approach and methodology as well as implementation strategy etc are described in the following paragraphs.

A1.1. Objective of The Environmental And Social Management Plan [ESMP]

The objective of the Environmental and Social Management Plan [ESMP] is to minimize the stress on the existing eco-system while ensuring the Socio-Economic living standards of the people especially the poor & vulnerable groups.

In the present context, a site specific management plan has been prepared not only to improve the environmental conditions but also to mitigate the adverse impacts on quality of life of affected families. The ESMP, thus is designed by taking Design stage, Construction Stage and Operation Stage into consideration. Those considerations at each stage are given below;

**Design Stage**
- To keep land acquisition and building demolition at a minimum
- To provide maximum safety to the communities
- To develop a design that incorporates environmental and social safeguards and
- To provide mitigation measures to all expected environmental degradation

**Construction Stage**
- To prevent and reduce the negative environmental and social risks and impacts of the project by implementable mitigation measures, to be carried out by the Contractor.
- To ensure that the provisions of the ESMP are strictly followed and implemented by strengthening implementation arrangements.

**Operation Stage**
- To prevent deterioration of environment components of air, water, soil, noise, etc.

The Environmental and Social Management Plan (ESMP) thus comprises of two distinct components/parts.
- Formulation of ESMP
- Implementation of ESMP

**A1.2. Formulation Of EMP:**
This part takes care of the following initiatives/activities.

**A1.3. Preparation of the Management Plan:**
- The engaged team of experts from Environmental and Social disciplines have acted to transcribe Baseline information’s into positive and negative impacts, followed with appropriate mitigation measures.
- Care has been taken to chart out the management methods in due compliance with the policy, Acts and Local legislation of the state as well as policy guidelines of the World Bank.
- Most management methods, especially against critically impacted areas are quantitatively enumerated as far as practicable with frequency of occurrence and estimated cost.
- The project authorities are required to rationally incorporate the environmental and social management costs in the project cost estimate and ensure budgetary provision/annual outlay for subsequent implementation action.
- In the process, all management interventions are to be scrupulously integrated with the items of work inter-alia execution of works either through contractor agency or departmentally.

The critical environmental and social components of the project were identified on the basis of the assessment of the potential impacts due to the proposed project and activities. These issues need to be addressed carefully in the Environmental and Social Management Plan.

1. **Components Considered in the EMP:**
   Based on the Identification of Environmental and Social Impacts during ESIA study and their mitigations measures a site specific Environmental and Social Management will be prepared.
In the process the management interventions are considered for three recognized phases of the project cycle; i.e.

- ESMP for Design and preconstruction Phase
- ESMP for Construction Phase
- ESMP for Post-construction/Operation Phase

[A] **ESMP Components Design and Preconstruction Phase:**
- Acquisition of land for WTP
- Tree felling in non-forest area
- Resettlement and Rehabilitation of Affected People, Relocation of utility services, religious/ cultural properties and Common Property Resources
- Establishment of construction workers camp
- Establishment & Operation of Concrete Batching plants, hot mix plant, Stone crushers, etc.
- Barricading the boundaries of work place

[B] **ESMP Components of Implementation/ Construction Phase:**
- Land Contamination
- Soil erosion, Loss and contamination of Topsoil
- Management of Water Environment
- Management of Air Environment
- Management of Noise Pollution
- Monitoring of Environmental Attributes
- Waste Management (Solid Waste & Effluent from site)
- Risks, Accidents & Safety Management
- Occupational Health & Safety Management
- Camp site management
- Restoration of impacted public utility services

[C] **ESMP Components of Post Implementation/ Operation Phase**
- Performance Monitoring
- Safety during Project Operations
- Reservoir operation management
- Effective communication network

**A1.4. Implementation of ESMP:**
Implementation part of the management Plan includes the following considerations.

- Organizational Support
- Implementation Strategy

**A1.4.1. Organizational Support:**
Conforming to the Policy Guidelines, the project IA/ MCA (PMSIP) are required to consult the line departments of Punjab Government for Execution/ compliance of the management
plan. This is required for smooth implementation of the proposed environmental mitigation Plan.

Table 1.1: List of Line departments are:

<table>
<thead>
<tr>
<th>Issues</th>
<th>Line Departments</th>
</tr>
</thead>
<tbody>
<tr>
<td>• For Land Acquisition matters associated</td>
<td>- The District Collector/ RRO as well</td>
</tr>
<tr>
<td>with ESMP</td>
<td>as other District Law &amp; Order Authorities.</td>
</tr>
<tr>
<td>• For pollution control issues</td>
<td>- State Pollution Control Board.</td>
</tr>
<tr>
<td>• Traffic Management</td>
<td>- Traffic Police</td>
</tr>
<tr>
<td>• Archeological and Heritage Sites</td>
<td>- ASI and Religious Management Committees</td>
</tr>
<tr>
<td>• Canal water intake and structures</td>
<td>- Irrigation Department</td>
</tr>
</tbody>
</table>

A1.4.2. Institutional Arrangement for Implementation of ESMP

The key institutions relevant for ESMF implementation are shown in the below figure. Reporting, instructions, liaison/consultation and advice/inspection channels are also shown. PMU/PIU and PMC, if hired, of the project will have the most important role for ESMF implementation and updating.
A1.4.3. Organogram of the Project Authority

Institutional arrangement for project implementation

Thus reporting will be as follows:

- Reporting by the Contractor to the PMC (if hired).
- Reporting by PMC to ES Specialists of PIU (MCA).
- Reporting by ES Specialist for the information of all interested parties, including PMU (PMIDC).
A1.4.4. Formation of Project Level Monitoring Unit

The present organisation structure will be strengthened by formation of Project Management Unit for construction of Additional spillway by way of inducting one independent consultant for Design review, construction supervision MIS, etc.

In the event of implementation of Project the present PMSIP organogram may be further strengthened with new addition of Divisional Engineers and staff to Monitor Environmental Management Plan & Pursue the Resettlement Action Plan (RAP).

A1.4.5. Roles and Responsibility

Table 1.2: Key Roles and Responsibilities of Implementing Institution

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Organization</th>
<th>Responsibility</th>
</tr>
</thead>
</table>
| 1     | World Bank       | • Review, approve and disclose ESMF, ESCP, ESIA, ESMP on WB’s website.  
• Review and approve RPF, RAP, SEP, LMP.  
• Conduct implementation support and supervision missions in order to ensure that the Project is in compliance with WB ESF requirements and standards. |
| 2     | PMIDC (PMU)      | • Prepare and implement the ESMF and submit for Bank approval  
• Disclose the ESMF on PMIDC, PIU website.  
• Prepare ESMPs according to ESMF  
• Perform the quality control and review of ESMPs.  
• Perform inspections of the implementation of ESMPs, make recommendations and decide whether additional measures are needed.  
• In case of non-compliance, ensure that the agreement with beneficiaries and procurement eliminates the noncompliance and inform the WB about the noncompliance and follow up.  
• Prepare, update and implement a Stakeholder Engagement Plan (SEP) that considers vulnerable groups in addition to paying attention to the gender aspect of the Project. |
| 3.    | Construction Contractor | • The contractor shall develop site specific ESMP before construction, as part of their method statement and submit to PIU for reviewing and approval;  
• The contractor has to submit a monthly report on the implementation of E&S, mitigation measures, and results throughout the construction period. In case of unexpected problem, the contractor will consult PIU and PMC;  
• Ensure that the construction work is complied with the approved EIA/EMP and the site EMP;  
• Control and minimize environmental impacts;  
• Ensure that all staff and workers understand the procedure and their tasks in the environmental management program; |
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Organization</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• Ensure environmental hygiene.</td>
</tr>
</tbody>
</table>
| 4.    | Amritsar Municipal Corporation ULB (PIU) | • In order to effectively manage ESMP implementation, an ESMP management team will be established and made operational along with awarding the contract to contractor.  
• Project Director will be the head of team and will be assisted/guided by the PMC.  
• Hold consultation meetings and prepare and distribute leaflets or other informative documents to inform communities.  
• Set up a multi-level GRM, monitor and address grievances related to the project under specified timelines. |
| 5.    | Project Management Consultants (PMC)/ Chief Engineer MCA assisted by E & S experts | • Responsible for monitoring the contractor’s activities and to ensure adequate implementation of the ESMP by contractor.  
• Providing guidance to the PMU regarding any environmental and social issues which may arise during pre-construction and construction phase.  
• Keep track of contractor’s day to day activities, their commitment for implementation of ESMP, quality of work, adherence to safety guidelines and method statements.  
• Review the Environment Management Action Plan (EMAP) submitted by contractor and should check adequacy as per the ESMP for this project. This EMAP should be amendable and can be updated time to time by PMC  
• Evaluate Safety, Health and Environmental (SHE) plan covering various construction activities, health of workers/ laborers to be submitted by contractor for each activity. This plan should include evacuation plan, emergency management & response plan  
• Ensure that all construction and site vehicles should abide by the latest emission norms of the country.  
• Monitor that all workers & labor of contractor should have valid ID cards to assess the site.  
• Monitor that adequate safety trainings are being given to the workers, adequate mock drills are conducted at site by contractor, availability of emergency evacuation plan, emergency assembly area, availability of certified first aid trainer at all the construction site  
• Recommend to the PMU to take punitive action in non-compliance of ESMP & SHE Plan |
| 6.    | Environmental Social Specialists | • ES Specialists will report to Chief Engineer, who will be responsible for the successful implementation of the Project.  
• The Chief Engineer is also the Project Director in the set up for the implementation of the project.  
• The Project Director (PD) will be assisted by Superintendent Engineer of Environment and Social Management Unit |
Organization (ESMU), who further will have support from Construction Management Unit (CMU) at site and Experts (Environmental Officer, Social Development officer, EHS Officer, etc) at the head office.

A1.4.6. Implementation Strategy:

It is already stated that, implementation of Environmental Management Plan against environmental degradation and disaster risks are to be integrated with the sustainable development framework and to be carried out conjunctively. Besides the organizational preparedness, the approach technique priorities the following few aspects:

- Availing of approval / clearances from competent authorities.
- Ensuring smooth fund flow with adequate budgetary support.
- People’s participation in the management proceedings and training program.
- Public consultation (PAPs and stakeholders).

(i) Obtaining approval/ clearances from Competent Authorities:

In conformity with Acts Rules & Regulations, prior permission/clearance from the appropriate / competent authorities is necessary before commencement of the construction activities. Some of the important items are mentioned below in Table No. 1-3:

Table No. 1-3: Statutory permissions and clearance on Environmental Issues applicable in the project

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Activities / Issues</th>
<th>Clearance/Permits /Licenses Required</th>
<th>Regulatory Authority</th>
<th>Responsibility</th>
</tr>
</thead>
</table>
A1.4.7. Environmental and social management action plan

This section describes the Environmental and Social Management Action Plan during different stages of project. The Environmental and Social mitigation measures have been incorporated at all the stages of the project right from Designing phase to Construction and Operational Phase. All care has been taken to provide mitigation measures for all expected environmental degradation at different stages. The Environmental and social Management action plan has been formulated for the present project for mitigation/management/avoidance of potential adverse impacts and the enhancement of the various environmental and social components along with its location, timeframe of implementation, and overseeing/supervising responsibilities. The safeguard measures identified for different phases are tabulated in Table No. 1-4.
### Table No. 1-4: Environmental Management Action Plan

<table>
<thead>
<tr>
<th>Project Activity</th>
<th>Impacts</th>
<th>Probable Mitigation Measures</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High reliance on non-local labour for meeting labour requirements for all</td>
<td>• Contractor’s EHS Officer in consultation and with requisite approvals from MCA and/or private land owners shall identify suitable lands, which can be used as material stack yards and work camp sites for storage of construction materials by the contractor during construction phase.</td>
<td></td>
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<tr>
<td></td>
<td>construction, augmentation and repair activities may lead to Influx of non-local labour affecting project areas - especially WTP and OHSR/OSR sites that are in proximity to small residential communities with low absorptive capacity.</td>
<td>• The contractor will submit to PIU the lease agreement with private/community/government owner for setting up campsites at suitable locations at WTP site and along transmission alignments and mandatorily restore it to its previous state at completion of construction.</td>
<td></td>
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<tr>
<td></td>
<td>Adverse impacts in the form of additional burden on public infrastructure such as health services, utilities (i.e. water and electricity), sanitation facilities/housing and social conflicts are likely to occur.</td>
<td>• The contractor shall submit location specific lay-out plan of all temporary establishment including labour camps with details of facilities proposed for approval of PIU. No temporary establishments shall be operated without consent of the MCA/PIU.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other related impacts would be increased risk of communicable diseases, increased cases of GBV and risks of SEA of female labourers.</td>
<td>• The contractor shall be responsible to provide any mitigation and management measures to prevent induced impacts from such establishment due to waste water/sludge, solid waste, clogging of streams, soil and water contamination. Any claims or complaints arising due to contractor actions shall be addressed in amicable way by the contractor at their own cost.</td>
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<td></td>
<td></td>
<td>• Detailed labour management procedures (LMP) for camp and worksite/influx management and supervision will be developed to guide access/exit, facilities (including additional/separate facilities for female labourers like accommodation, toilets, crèches, drinking water, resting areas) and Worker’s conduct at construction sites.</td>
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<tr>
<td></td>
<td></td>
<td>• GBV mitigation plans will be developed covering issues around SEA of female labourers, along with monitoring and supervision protocols to ensure compliance with provisions of national labour laws and adherence to steps proposed under the LMP and GBV plans.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Key provisions of the LMP will be made part of the standard bid.</td>
<td></td>
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<table>
<thead>
<tr>
<th>Planning and Execution</th>
<th>Supervision &amp; Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Manager of the Contractor</td>
<td>Social Specialist at PIU/Third Party Monitoring Agency/Environmental officer, RAP implementing Agency,</td>
</tr>
<tr>
<td><strong>Project Activity</strong></td>
<td><strong>Impacts</strong></td>
</tr>
<tr>
<td>----------------------</td>
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</tr>
</tbody>
</table>
| Construction activity at WTP and OHSR/OSR sites across the city | Risk of gender-based violence on local community arising from influx of migrant laborer’s, Risk of sexual exploitation and abuse of female laborer’s, especially female migrant laborer’s who are intersectional disadvantaged groups | • Stakeholder engagement process with the local communities to include orientation of host communities regarding labour influx related risks and desired precautions  
• Preparation of LMP and GBV mitigation plans to ensure setting up of labour camps as per procedures with proper facilities for women workers  
• Supervision and monitoring to ensure compliance with labour laws and effective implementation of GBV mitigation plan  
• GBV mitigation plans will be developed covering issues around SEA of female laborer’s, along with monitoring and supervision protocols to ensure compliance with provisions of national labour laws and adherence to steps proposed under the LMP and GBV plans  
• Periodic training and sensitization of laborer’s and supervisors on worker code of conduct, local customs/ expectations/ interactions with host communities and provisions of LMP, including separate orientation of female workers  
• Key provisions of the LMP will be made part of the standard bid documents for contractors  
• Establishment of a site specific GRM for project workers and appointment of focal points for each construction site to ensure that all grievances are duly registered and addressed within reasonable timeframes. | Contractor  
ES Specialists of E&S Specialists at PIU, Third Party Monitoring Agency. |
| Occupational Health and Safety Hazard | Handling and disposal of hazardous & non-hazardous waste during implementing various subprojects and from different construction related activities, including management of accidents. | • LMP shall be followed in engaging and managing labour in all project activities.  
• Provision of LMP shall be included in all the bidding documents as conditions of contract.  
• Local people should be deployed for the construction work to the maximum extent possible, and the migrated workers from other areas should be taught to respect local customs in order to facilitate good relationships with local people.  
• The compliance of clauses in the contract document related to LMP shall | Contractor.  
E&S Specialists at PIU, / Third Party Monitoring Agency. |
<table>
<thead>
<tr>
<th>Project Activity</th>
<th>Impacts</th>
<th>Probable Mitigation Measures</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Response Plan &amp; Disaster Management Plan</td>
<td>Accident from different project activities &amp; natural disaster</td>
<td>• During construction work due to technological failure hazards like; fire, electric power or gas cut, chemical hazard, spills of flammable liquids, accidental release of toxic substances, social conflicts, threat, hostage incident, loss of water supply etc. may take place at site as well as natural hazards like flood and earthquake, etc. can occur since its located in earthquake and flood prone area Zone-IV as per BIS</td>
<td>Contractor</td>
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<td></td>
<td></td>
<td>For Flood</td>
<td>E&amp;S Specialists at PIU, Third Party Monitoring Agency.</td>
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<tr>
<td></td>
<td></td>
<td>• Evacuate the people from flooded area and place them to a safe area.</td>
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<td></td>
<td>• Switch of the power supply from effected area.</td>
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<td>• Coordinate with local Emergency Response Team and take action as per their guidelines.</td>
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<td></td>
<td>• In case of any accident, ensure presence of first aid team and get medical attention as soon as possible.</td>
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<td></td>
<td></td>
<td>• Ensure presence of nearby fire brigade team system in case of worst or out of control situation.</td>
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<td></td>
<td></td>
<td>For Earthquake</td>
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<td></td>
<td></td>
<td>• Isolate electrical supply wherever it is possible.</td>
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<tr>
<td></td>
<td></td>
<td>• All electric connection of the Economic Zone should be cut off during cyclone. Safe evacuation is important for everybody and measures should be taken accordingly.</td>
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<tr>
<td></td>
<td></td>
<td>• Have to evacuate as per evacuation plan</td>
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<td></td>
<td>• Project should have Rescue Team to help the injured employees. And they will also take the injured employees for treatment.</td>
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<td></td>
<td></td>
<td>• Isolate all pipelines of steam, gas pipeline, compressed air, fuel and CO₂ when they are not in use.</td>
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<td></td>
<td></td>
<td>• Empty the tanks that are installed in vertical and relatively unstable conditions.</td>
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<tr>
<td></td>
<td></td>
<td>• Ensure the flammable liquids i.e. Petrol, Diesel and other</td>
<td></td>
</tr>
<tr>
<td>Project Activity</td>
<td>Impacts</td>
<td>Probable Mitigation Measures</td>
<td>Responsibility</td>
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<td></td>
<td></td>
<td>petroleum products are stored under secondary containment with due precautions</td>
<td>Planning and Execution, Supervision &amp; Monitoring</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>For Fire</strong>&lt;br&gt;&lt;ul&gt;&lt;li&gt;Evacuate the people from Fire hazard area and send them to a safe exit direction.&lt;/li&gt;&lt;li&gt;Remove unwanted combustible material.&lt;/li&gt;&lt;li&gt;Keep cool and do not panic.&lt;/li&gt;&lt;li&gt;Inform the substation and electrician to get the affected area isolated from power supply.&lt;/li&gt;&lt;li&gt;Keep Fire Hydrant accessible.&lt;/li&gt;&lt;li&gt;Keep newest and good conditioned fire hoses and Fire Extinguishers readily available.&lt;/li&gt;&lt;li&gt;Ensure one operator is always present at Hydrant system area when using the fire Hydrant system.&lt;/li&gt;&lt;li&gt;If the fire is very small, use the correct Fire Extinguisher for extinguishing the fire.&lt;/li&gt;&lt;li&gt;Try to isolate the fire by removing the surrounding inflammable material around.&lt;/li&gt;&lt;li&gt;In case of big fire use local Hydrant system for extinguishing the fire.&lt;/li&gt;&lt;li&gt;If the fire is beyond the control, inform the security or higher authority to call local fire Brigade and Inform Emergency Response Team.&lt;/li&gt;&lt;li&gt;On arrival of the fire brigade, help them to reach the site of fire.&lt;/li&gt;&lt;li&gt;In case of any accident of human, ensure immediate medical attention as soon as possible.&lt;/li&gt;&lt;/ul&gt;</td>
<td></td>
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<td></td>
<td><strong>Fatal Accidents</strong>&lt;br&gt;&lt;ul&gt;&lt;li&gt;During emergency operation, if there is any injured person, carry out victim/causality to the security room or Conference room or even to OHS room beside the support of contractor recommended nursing home.&lt;/li&gt;&lt;li&gt;Ensure attendance of First Aid Team and carry out the first aid.&lt;/li&gt;&lt;/ul&gt;</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Project Activity</td>
<td>Impacts</td>
<td>Probable Mitigation Measures</td>
<td>Responsibility</td>
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<td></td>
<td></td>
<td></td>
<td>Planning and Execution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Inform the Emergency Response Team.</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If the accident is severe, ensure emergency vehicle for taking the victim to local hospital or recommended nursing home, phone numbers should be available in the site.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Accident report should be prepared with the help of witness and preserve it to the Emergency Response Team.</td>
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<td></td>
<td></td>
<td>Utilities Failure</td>
<td></td>
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<td></td>
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<td>• For emergencies and potential danger, the control room of the respective utilities to be informed.</td>
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<tr>
<td></td>
<td></td>
<td>• Turn off equipment, machines and computers.</td>
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<tr>
<td></td>
<td></td>
<td>• Assist disabled persons, women and children at earlier stage.</td>
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<td></td>
<td></td>
<td>Stay at the designated evacuation area until the fire department or designated representative has given the —all clear to re-enter the project site.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>During Pre-Construction and Construction Phase (ESS 3- Resource Efficiency and Pollution Prevention and Management)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Air Quality</td>
<td>Air pollution will occur due to: Site preparation, stack yards and labour shed, construction, hauling of equipment/Dust generation from earthworks such as levelling, grading, excavation works and movement of vehicles across unpaved roads, especially during windy conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ensure that all trucks, vehicles, and electrical devices used in the project area will comply with technical and environmental safety regulations</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Schedule the operation times for vehicles, machines working in the construction area to reduce air emissions</td>
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<td>• Use of adapted Personal Protection Equipment like; ear plugs, goggles, helmets, gloves, masks etc.</td>
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<td>• Regular watering and sprinkling for dust suppression are to be done properly.</td>
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<td>• Stockpiles of dusty materials will be covered by polythene or tarpaulin to prevent the escape of dust during loading and transportation.</td>
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<td>• No stockpiles will be maintained outside, and maximum possible distance between the stockpiles and receptors will be maintained;</td>
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<td>• Covering and/or watering of all stockpiles of dusty materials such as excavated spoils to avoid fugitive dust emissions;</td>
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<td>• During construction, the approach road will be kept clean, free from mud and slurry;</td>
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| Water Resources (Surface and Ground Water) and Quality | Surface and groundwater can be contaminated by sewage & wastewater from labour camp and effluent disposal from washing of construction vehicles as well as due to improper housekeeping of hazardous waste | • Labour camp should be constructed at a safer distance from the waterbody;  
• Arrangement of mobile toilets may be set at work / camp sites  
• Waste disposal is prohibited into waterbodies. proper disposal mechanism should be adopted  
• Proper sanitation facilities should be made available.  
• Channelize water from labour sheds and work place to nearby drains after passing through settling ditches to segregate sediments and solids  
• Labour camp shall be set up at safe distance from either any water body or settlement areas,  
• Camp site sewage disposal will be ensured by constructing septic tanks and soak wells  
• Periodical training needs to be provided to workers for best utilization of water;  
• Recycle/reusing of waste to the extent possible;  
• Fuel, oil and used oil storage areas shall be contained in concrete floor;  
• Re-fuelling will be carried out in designated areas using strict protocols;  
• Project staff will not be permitted to utilize any water sources (canal, river, or other water bodies) for the purposes of bathing or washing;  
• Construction vehicles and equipment will be serviced regularly at off-site |

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<td>Contractor</td>
<td>E&amp;S Specialists at PIU, Third Party Monitoring Agency.</td>
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<td><strong>Soil &amp; Sediment Pollution</strong></td>
<td>Project site soil and sediment can be polluted due to disposal of solid and liquid waste of diversified construction works. In addition, due to operation of equipment may impact soil texture etc. Further, sediment at intake point can contaminate due to oil spillage/setting up and waste debris.</td>
<td>• Soil conservation measures will be undertaken during stockpiling, preservation of topsoil or gravel for the remediation of disturbed areas; • Construction vehicles will remain on designated and prepared compacted gravel roads; • Fuel, lubricating oil, and used oil storage areas will be in the designated area. • On-site sanitation system shall be adapted for latrines and sewage treatment. • Spill containment and clean up kits will be available in the site and to be cleaned up appropriately. • Construction vehicles and equipment will be under servicing in a regular interval. • The Contractor will prepare guidelines and procedures for immediate clean-up actions following any spillages of oil, fuel or chemicals; • Contractor shall ensure daily collection and disposal of construction waste, debris, metal cutting wastes, used oil etc. • Special care needs to be taken during the road construction to maintain standard slope, and to maintain proper compaction of the road soil;</td>
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<td><strong>Noise pollution</strong></td>
<td>Noise pollution may occur because of: Operation of vehicles and equipment during the site preparation.</td>
<td>• Perform the pre-construction activities within the day time and minimize night time working. • Regulate the speed for traffic in and around the project areas. • Regularly carry out maintenance and routine inspections on vehicles and</td>
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|                       | stack yards and labour shed construction, hauling of equipment/Transportation of construction materials, plant materials, machinery and personnel/Operation of DG sets/Operation of batching plant i.e. concrete at WTP/OHSR | - construction machineries to ensure the technical standards.  
- The contractor shall ensure the construction equipment are with proper silencer and muffler.  
- The contractor shall consider the noise emission characteristics of equipment when selecting equipment for the project and select the least noisy machine available to perform the respective work;  
- Mobile noise sources such as cranes, earth moving equipment shall be routed in such a way that there is minimum disturbance to receptors (birds and fauna around);  
- Only limited construction activities shall be carried out during night-time;  
- Restrict the night time vehicle movement through the access road;  
- The number of equipment operating simultaneously should be reduced as far as possible;  
- Equipment known to emit noise strongly in one direction should be orientated so that the noise is directed away from nearby receptors as far as practicable;  
- Rubber padding/noise isolators will be used for construction equipment;  
- Temporary noise barriers shall be provided surrounding the high noise generating construction equipment;  
- The personnel involved in high noise generating activities shall be provided with personal protective devices like ear plug to minimize their exposure to high noise levels; | Planning and Execution / Supervision & Monitoring |
| Sourcing of Construction material | Project would support development of water supply assets and would require various construction material in large quantities. Some of these raw materials can be supplied by the Primary suppliers. Selection of source of these raw materials need to be properly assessed as per the guide line of WBG/EHSG. Necessary condition has to be included in the bidding document so that if Primary Suppliers are engaged for supply of raw materials, the source of such material would be assessed as per the guide lines of the WBS/EHSG. The source shall be approved mining quarry opened with statutory environmental clearance. | contractor E & S Specialists of PIU./ Third Party Monitoring Agency |
### Project Activity

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<td>materials needs to be carefully assessed.</td>
<td>Stakeholder engagement process to inform local residents/establishments about scheduled activities, time period of construction, likely inconveniences and steps taken by project to minimize or avoid adverse impacts and seek support from the community.</td>
<td>Contractor</td>
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<td>Traffic &amp; Transportation</td>
<td>Increased traffic should follow the traffic scheduled to avoid traffic congestion.</td>
<td>E&amp;S Specialists at PIU, Third Party Monitoring Agency</td>
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<td>Materials carrying vehicles and construction vehicles (truck etc.) may damage environment in the construction area and may be a disturbance to nearby structures. Without proper traffic management accidents may also occur.</td>
<td>Place traffic sign/cautionary signage to avoid undue traffic congestion and associated traffic control measures to limit possible disruption; At the points where traffic is to be deviated from its normal path (whether on temporary diversion or part of the width of the carriageway), the channel for traffic shall be clearly marked with the aid of pavement markings, painted drums, or a similar device to the directions of the vehicles. At night, the passage shall be delineated with LED lights. For regulation of traffic, the flagmen shall be equipped with red and green flags especially near at intersection. For notification of construction activities, at least two signs shall be put up for each road, one close to the point of where carriageway begins, and another will be placed at the end of the carriageway. Traffic safety is to be ensured as per the traffic management plan. During construction for laying of transmission lines it shall be ensured that excavation-laying-refilling shall be completed at any place within two week time to minimize the disturbance to local populace.</td>
<td>Contractor</td>
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<td>Community Health and Safety</td>
<td>Prior to start of the construction activities contractor will inform the local community; Regular health check-up of the workers and awareness training about</td>
<td>Contractor</td>
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<td>Community Health and Safety can hamper due to different construction works</td>
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<td>E&amp;S Specialists at PIU, Third Party Monitoring Agency</td>
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### During Pre-Construction and Construction Phase (ESS 4-Community Health and Safety Risks)
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|                 | & traffic movement | safety measures and communicable diseases;  
- Proper lighting at the project site and labour camps during night time;  
- Installation of CCTV cameras at key locations in labour camp;  
- Monitoring of movement of labour;  
- Restriction of use of liquor and tobacco and other drugs in labour camps;  
- Contractor should comply with the Traffic Management Plan and develop site specific mitigation plans. | Planning and Execution | Agency |
| Hazardous and non-hazardous waste | The Project will generate both solid non-hazardous and hazardous wastes throughout the construction phase. The anticipated non-hazardous waste types include top soil, construction material, waste-water. While hazardous waste may include used oil, empty drums or replaced parts of the construction machinery, used battery, chemical for concreting like admixture etc.  
There are potentially a number of risks to human health and the environment that may be associated with the handling, storage and disposal of waste, both on and off-site. | The hazardous waste generated at camp sites is to be collected in steel drums and stored in a segregated roofed area and periodically disposed as per National Regulations to CPCB/ PPCB authorized recyclers and waste disposal facilities.  
- The camp site shall have composter plant for treating organic waste and separate bins for collecting the segregated MSW as per colour coded containers and shall be disposed at nearest MSW disposal sites. | Contractor | ES Specialists of MCA and PMC |
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<td><strong>During Pre-Construction &amp; Construction Phase (ESS- 5 Land Acquisition and Involuntary Resettlement)</strong></td>
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| Land purchased for WTP construction | Physical and Economic Displacement of land owners, tenants, agricultural labourers and seasonal pastoralists using the land | • Fair compensation to the land owners selling their land through willing seller/ voluntary negotiation based on RPF/RAP guidance for land and assets, which is at par with the replacement cost.  
• Resettlement based on guidance provided in the RAP to minimize adverse impacts owing to temporary relocation/ economic displacement  
• RAP to estimate indirect adverse impacts of WTP operation on owners of adjoining land parcels (in terms of productivity losses and other adverse impacts) and ensure that they are duly compensated  
• Adequate compensation to dependent families for loss of livelihoods (tenants/ laborer’s) or loss of access to farm resource (pastoralists) | PMU/ PIU/ Contractor |
| Site clearance of WTP site | Likely impacts of the WTP construction and operation on adjoining land parcels/ communities | • Initiation of construction work only after the entire resettlement and compensation disbursement has been completed for all those impacted.  
• Protection and separate stacking of top soil for further use after completion of project construction for development of Green Belt and compensatory afforestation.  
• Stakeholder engagement process to ensure negotiation is based on free will/ choice, compensations are based on rational/ objective criteria  
• Creation of GRM for the project affected persons to ensure that all grievances are duly registered and addressed within stipulated timeframes.  
• Establishment of mechanism for monitoring and control of Gender based Violence among labour as well as local community. | E&S consultant/ MCA, Social- Community Development officer, RAP implementing Agency, Project Manager of the Contractor |
| Clearance of structures and establishments along the transmission alignments and sites identified | Temporary or permanent loss of livelihood/place of occupation for petty shop owners, hawkers and street vendors  
Impacts on those squatting along transmission pipeline | • Resettlement based on guidance provided in the RPF/ RAP to minimize adverse impacts owing to temporary relocation or economic displacement.  
  
  Implementation of RAP and disbursement of compensation to those facing temporary impacts in the form of loss of livelihoods and relocation.  
  
  Contractor to ensure that no body along transmission line is affected for more than 2 weeks due to laying of the lines. | Social- Community Development officer, RAP implementing Agency, Project Manager of the Contractor |
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<td>for OHSR/ OSR construction</td>
<td>RoW and municipal roads where construction work under the project is proposed.</td>
<td>- RAP to ensure identification of all PAPs through a detailed socio-economic census and special/additional provisions for those differentially impacted like socially marginalized communities, PwDs, WHH and Antoyodaya (poorest of poor).&lt;br&gt;- Provisions in the Standard Bid Documents to ensure turnaround (from road-cutting, laying of pipelines, earthwork and road repair) within a fixed timeline and clear disincentives/sanctions for delays to minimize duration of relocation/displacement.&lt;br&gt;- Construction schedule for transmission alignment to be phased-to enable completion of work along a specific stretch/chainage before initiating further work along the alignment.&lt;br&gt;- Stakeholder engagement process to ensure inclusion of feedback and suggestions from PAPs during preparation of RAP and fixing of compensations (based on rational/objective criteria).&lt;br&gt;- Stakeholder engagement strategy will include prior consultations with those affected before initiation of construction/earthwork/clearance of alignment routes and advance dissemination of information about construction schedules, timelines and likely impacts/inconveniences.&lt;br&gt;- Creation of GRM for the project affected persons to ensure that all grievances are duly registered and addressed within stipulated timeframes.</td>
<td>Contractor</td>
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<td>Transmission pipeline laying, trenching and road-cutting</td>
<td>Impacts like damage to residential buildings, establishments and common property/public utilities due to burrowing, road-cutting and trenching operations for laying pipelines</td>
<td>- Stakeholder engagement process to ensure consultations with parties likely to get impacted and prior notice to buildings/structures along the transmission alignment.&lt;br&gt;- Transmission lines proposed on Public Roads, government land. Affected PAPs would be encroachers/squatters.&lt;br&gt;- They will be affected for a limited time of two weeks.&lt;br&gt;- Contractor should ensure adoption of best/safe practices to minimize damages to structures.&lt;br&gt;- Compensation to structure owners as per the provisions of RPF provisions in case of full or partial damage to buildings/structure due to project.</td>
<td>PIU, Health and Safety Officer/Social-Community Development officer of PIU, RAP implementing Agency, E&amp;S Specialists at PIU, Third Party Monitoring Agency</td>
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|                  | Disruption to utilities/services such as existing water supply, power supply due to trenching and laying of connections | • Stakeholder engagement process to ensure consultations with parties likely to get impacted and prior notice to buildings/structures along the transmission alignment  
• Restore the services within 10 days of effect and provide alternative source of supply during interim period. | Contractor  
MCA-PIU and Contractor.  
E&S Specialists at PIU and Contractor.  
E&S Specialists at PIU, PIU and PMU, Third Party Monitoring Agency |
|                  | Disruption to access from houses and shops to roads for the residents, especially Old-aged, children, Persons with Disabilities  
Safety Issues for both Children and the Old-aged | • Stakeholder engagement process to ensure consultations with residents/establishment owners likely to get impacted along the transmission alignment  
• Requirement to provide temporary access over the trenches at convenient points for PwDs, Old-aged and Children to be included in the bid documents  
• Restoration of access and road repair/restoration within specified timeframe to be part of contractor bid documents  
• Implementation of road safety requirements like adequate signage, rumble strips/cordonning off area, restoration based on the approved Traffic and Road Safety Management Plan | MCA-PIU and Contractor.  
E&S Specialists at PIU and Contractor.  
E&S Specialists at PIU and PMU, Third Party Monitoring Agency |
|                  | Negative Impacts on Ecosystem and Biodiversity (Aquatic & Terrestrial Ecology) may occur because of spillage or disposal of solid & liquid wastes from onsite development activities, especially near the Canal Off-take point and WTP site close to the Source/Canal. | Mitigation Measures are given below:  
• Proper disposal and management of construction waste with no waste disposal into water bodies during construction without proper treatment  
• Wastewater from labour camps and construction sites not to be disposed into the waterbodies  
• Site should be kept clean so as no pollutant from site should enter the waterbodies along with run-off or wind  
• Storage of raw material at construction site should be avoided near waterbodies.  
• Noise generating activities should be scheduled during daytime  
• Movement of construction and transport vehicles should be restricted to | Contractor  
ES Specialists of PIU |

**During Pre-Construction & Construction Phase (ESS 6- Bio-Diversity Conservation and Sustainable Management)**
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<td>dedicated paths to minimize any harm to small mammals near the proposed site.</td>
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<td>Damage to the natural topography and landscape should be minimized;</td>
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<td>Strict prohibition should be implemented on trapping, hunting or injuring wildlife</td>
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<td>Keep present condition of canals functional in project site for aquatic species</td>
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<td>For intake point construction, a zone of 30 m is to be left along the canal so that aquatic species, as well as migratory birds’ habitat are not affected.</td>
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<td>If any tree is to be cut, then plantation should be undertaken as per national regulation minimum ratio</td>
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<td>No untreated solid or liquid waste shall be discharged into the waterbodies</td>
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<td>Septic tanks/soak pit should be provided to treat sewage to be generated from labour camps and prevent its disposal into the water bodies.</td>
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<td>Alternatively, Bio-toilets may be used in labour camps.</td>
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<td>Toilets should be provided at site to prevent contamination of water due to open defecation in nearby areas.</td>
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<td>Vehicle washing/equipment cleaning should not be allowed in/near the canal</td>
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<td>Transmission line trenching and filling should be carried out in phased manner to minimize exposure of loose earth for longer duration</td>
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<td>Temporary storm water drainage system should be developed at site to channelize the storm water away from excavation/filling area, debris storage area and raw material storage area</td>
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<td>All the raw material and debris should be stored in covered sheds on paved surfaces to minimize the contamination of rainfall run-off</td>
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<td>Diesel, cements etc. should not be stored near the canal/water bodies</td>
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<td><strong>During Pre-Construction &amp; Construction Phase (ESS8- Cultural Heritage)</strong></td>
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<td>Services of a local cultural heritage expert to be procured by the Contractor</td>
<td>PIU-MCA &amp; Chief of PIU</td>
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| work, excavation and other physical changes during the laying of the transmission alignments | cumulative risks to the cultural heritage, especially in the walled City which has a large number of sites and structures with significant religious, cultural, archaeological and historical importance | during earthwork in the walled part of the city to handle chance findings and workers orientation on handling chance findings  
- All artifacts, structures, articles of antiquity value and other remains of cultural/ religious and archaeological significance to be handled as per the Ancient Monuments and Archaeological Sites and Remains Act, 1958 (Amendment Act 10 of 2010), other relevant policies and chance find procedures  
- The PIU/PMC will seek direction from Archaeological Survey of India (ASI) before recommendation of work at that site.  
- Seek permission from ASI if work has to be carried out within 300 from boundary of any archaeological/ heritage site. | Contractor with E&S experts |
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<td><strong>Post Construction/ Operation Phase</strong></td>
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| Occupational Health and Safety | The handling of waste water, emissions during holding and treatment, discharge of pollutants, transportation and storage of raw materials are the activities of WTP, that are likely to have an impact on occupational health and safety. | • Monitoring devices will be installed to regularly monitor and check any leakages.  
• Care will be taken to avoid all sources of ignition at the places of flammable material storage areas through erection / display of appropriate sign boards.  
• Adequate PPE’s (earmuffs, protective clothing, helmets, goggles, shoes, gloves, etc.) will be provided to people working in the vicinity of these areas.  
• Operational manual of WTP shall be prepared considering all the aspect of health and safety of workers.  
• Material Safety Data Sheet (MSDS) of Chlorine Gas shall be kept handy at WTP office. All precautionary measures shall be taken in advance.  
• Disaster management Plan for Chlorine leakage shall be prepared for WTP site. | E&S unit of PIU & Contractor / E&S Specialists at PIU / Third Party Monitoring Agency |
| Land Resources and Soil Quality | Leakage from WTP, mixing of leachate from sludge drying bed may contaminate the soil quality. Waste generated from the WTP operations may impact the quality of soil in adjoining areas | • Solid/ hazardous waste generated from the WTP operation shall be properly handled with adequate solid/ hazardous waste management facilities with pucca flooring and covered shed;  
• After physio-chemical testing and complying with the norms of manure, generated slurry of biogas plant can be used as manure for green belt.  
• Steps to ensure that waste generation and its impact on adjacent land parcels is minimized so as to prevent productivity losses and adverse health related impacts | Contractor / E&S Specialists at PIU / Third Party Monitoring Agency |
| Air Quality | Operation of Diesel Generator (DG) set, generation of fugitive dust, due to vehicle movement for transportation of raw material, hazardous waste | • The DGs will be operated only during emergencies when there is failure of power supply;  
• Monitoring devices will be installed to regularly monitor and check any leakages;  
• Continuous disposal of sludge, Proper operating condition will be maintained; | Contractor / E&S Specialists at PIU / Third Party Monitoring Agency |
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|                  | and spreading of odour from settlement tanks may cause degradation of air quality at WTP site. | • Usage of PPEs by all employees shall be ensured;  
• Establishing frequent waste collection schedules and optimize waste collection routes to minimize distance travelled and overall fuel use and emissions;  
• Enclose leachate drains to reduce the emission of odors;  
• Ensure covered transportation of segregated waste | Contractor |
| Noise Quality    | During the operation phase, the source of noise shall be working equipment such as pumps, blowers, DG sets and treatment machinery. Noise can also be generated from the loading and unloading activities. | • The noise producing machinery placed in acoustic enclosures/acoustic rooms to reduce the noise levels;  
• Arrangement of ear plug shall be arranged for the worker,  
• Periodical noise monitoring shall be carried out to ensure that ambient noise levels are restricted to permissible limits;  
• DG Sets shall be provided with acoustic enclosures and shall be used only in case of power failure/emergency. | E&S Specialists at PIU / Third Party Monitoring Agency |
| Surface and Ground Water Quality | If solid and liquid waste from WTP are not collected and treated, leachate can spread temporary storage area and contaminate surface water and ground water. Leachate penetration from sludge drying bed to underground water which may decline the ground water quality. Further, storm water drain may degrade the outfall water quality if drain water carries toxic pollutants. | • Treated effluent will be discharged only after achieving norms prescribed by the SPCB;  
• Proper storage area will be proposed with lining to avoid leakage;  
• Potential ground water quality impacts arising from leachate generation, collection, treatment and reuse/discharge will be managed;  
• Drain outlet should be regularly cleaned to maintain proper discharge into outfall as if no backflow can take place;  
• Regular monitoring of WTP effluent for important parameters and heavy metals  
• Monitoring of surface and ground water sources around WTP site. | Contractor |
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| Ecosystem and Biodiversity | Solid and liquid waste from the operation of various shared infrastructure such as effluent treatment plant, may pollute water of the water bodies and may negatively impact aquatic fauna.                                                                                                                                                                                                 | • Effluent quality of WTP has to be monitored regularly to check whether all the parameters are within the acceptable limit.  
• Water quality of the water bodies also needs to be monitored.                                                                                                                                     | Contractor                                                                                                  | E&S Specialists at PIU / Third Party Monitoring Agency |
| Equitable access to Water Supply Services for vulnerable groups | Exclusion of from water supply services due to inability to pay water tariff  
Non-coverage of unorganised/unrecognised urban settlements and slums in Amritsar that are usually underserviced by public utilities/services, including water supply.                                                                                               | • Stakeholder engagement process to ensure inclusion of the voices of the socially and economically vulnerable - based on their requirement and ability to pay  
• Robust mechanism for identification of most vulnerable households getting tariff concessions or tariff exemptions on water supply  
• Inclusion of slums and settlements of migrants/urban poor in the water supply services through public or private supplies  
• Differential pricing of water- to be based on an objective assessment of the ability and willingness to pay  
• Periodic use of community monitoring and social accountability tools like Social Audits/Citizens Report Cards to ensure satisfactory delivery of WSS services  
• Creation of GRM and related awareness generation to ensure that issues related to exclusion, water availability and service quality are duly addressed by project authorities                                                                 | Contractor & PIU / Water Utility Company                                                                                                                              | E&S Specialists at PIU / Third Party Monitoring Agency |
| Operations of OHSR/OSRs | Safety related issues for residents/citizens near OHSR/OSR sites  
Wellbeing related impacts of OHSR/OSRs located.                                                                                                                                                    | • Proper fencing and cordonning of the OHSR/OSR premises to prevent entry of unwanted/unauthorised persons on the tanks/reservoirs  
• Availability of trained pump operators/watchmen at each OHSR/OSR to ensure compliance with all safety measures in place                                                                 | Contractor & PIU / Water Utility Company                                                                                                                              | E&S Specialists at PIU / Third Party Monitoring Agency |
<table>
<thead>
<tr>
<th>Project Activity</th>
<th>Impacts</th>
<th>Probable Mitigation Measures</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>within residential colonies due to reduced open space for recreation/ walking for children and old aged</td>
<td>• Investments on beautification of these residential parks and public lands</td>
<td>Planning and Execution</td>
</tr>
</tbody>
</table>

- Investments on beautification of these residential parks and public lands.
A1.4.8. **Environmental Monitoring Program:**

Environmental and social monitoring provides an essential tool to make necessary recommendations and adopt suitable control strategies so that menace of rising environmental degradation could be minimized and a relief be extended to the people including labor’s in case of any damage caused under occupational health hazards. The monitoring is necessary for the following reasons:

**The broad objectives are:**
1. To evaluate the performance of mitigation measures proposed in the ESMP.
2. To evaluate the adequacy of environmental and social assessment.
3. To suggest ongoing improvements in management plan based on the monitoring and to devise fresh monitoring based on the improved ESMP.
4. To enhance environmental and social quality through proper implementation of suggested mitigation measures.
5. To meet the requirements of the existing environmental and social regulatory framework and community obligations.

A1.4.9. **Environmental Monitoring Plan**

A1.4.9.1. **Performance Indicators (PIS)**

Environmental and social components identified as significant in affecting the environment & society/community at critical locations have been suggested as performance indicators (PIs). For example, near the construction site, a thick layer of dust over the nearby vegetation/leaf is an indication that the dust control measures are not effective. The performance indicators shall be evaluated under three heads as:

- Environmental & social condition indicators to determine efficacy of environmental management measures in control of air, noise, water and soil pollution.
- Environmental & social management indicators to determine compliance with the suggested environmental management measures.
- Operational performance indicators have also been devised to determine efficacy and utility of the proposed mitigation measures.

Details of the performance indicative parameters for each of the component have to be identified and reported during all stages of the implementation. The performance indicators and monitoring plans prepared for the Amritsar water supply improvement project are presented below:

- Air quality
- Surface (Canal) & Ground water quality
- Noise Level
- Sludge, Solid & Hazardous Waste Management
- Soil Quality
- Drinking Water Quality
- Sanitation and Hygiene at Construction Labour Camps and Construction Site
- Gender Based Violence (GBV)
- Labour Influx
- Employment
- Grievance Redress Mechanism (GRM)

These indicators will be evaluated periodically based on the monitoring results, baseline conditions, predicted risks & impacts and mitigation measures. Monitoring of Performance Indicators.

A1.4.10. Ambient Air Quality (AAQ) Monitoring

Ambient air quality parameters which are recommended for monitoring of widening and strengthening of state highway are PM$_{10}$ (Particulate Matter having less than 10 micron size) or PM$_{2.5}$ (Particulate Matter having less than 2.5 micron size), Sulphur Dioxide (SO$_2$), Oxides of Nitrogen (NOx) and Carbon Monoxide (CO). These parameters are to be monitored at selected locations such as plant and machinery sites, crusher sites, excavation works, etc. starting from the commencement of construction activity. Data should be generated once in a season at the selected monitoring locations in accordance with National Ambient Air Quality (NAAQ) Standards 2009. (ANNEXURE-ENV9).

A1.4.11. Ambient Noise Monitoring

The measurement for monitoring the noise levels to be carried out at sensitive locations and at construction sites along the project road in accordance to the Ambient Noise Standards formulated by Central Pollution Control Board (CPCB) (ANNEXURE - ENV10). Sound pressure level would be monitored on twenty-four hourly basis. Noise shall be recorded at “A” weighted frequency using digitized noise monitoring instrument.

A1.4.12. Water Quality

Water quality of local water resources that is used by local community shall be monitored. The physical and chemical parameters recommended for analysis of water quality relevant to road project are pH, total solids, total suspended solids, total dissolved solids, COD, BOD, DO, Oil and Grease, Chloride, Iron, etc. The monitoring of the water quality will be carried out at all locations identified along the project road during construction and operation phase. Monitoring parameters will be as per IS-10500 (ANNEXURE- ENV11) for ground water quality and for surface water quality as per CPCB Guidelines for used based surface water classification (ANNEXURE- ENV12)
A1.4.13. Soil Quality

The soil quality of the surround fields close to the construction site and plant site will be monitored to understand the impact of soil quality. The physic-chemical parameters recommended for analysis are physical Parameter: Texture, Grain Size, Gravel, Sand, Silt and Clay and Chemical Parameter: pH, Conductivity, Calcium, Magnesium, Sodium, Nitrogen and Absorption Ratio.

Safety at Works

Monthly Auditing of safety at works including supply and use of PPEs, Safe working conditions, first Aid facilities, incidence report, safety trainings, etc will be carried out by the Engineer-In-Charge to check the effectiveness of safety measures at site.

Waste Management and Debris Removal:

Visual observation on management of waste and debris at different site will be made on regular basis by the Engineer-In-Charge.

Gender Participation in works:

A genuine integration of gender and their participation into projects activities needs to be done at each stage of the project cycle, i.e. from participatory planning, to implementation, monitoring and evaluation. The project authority should explore the approach taken at getting involvement of women in different activities. Furthermore, the project authority should observe that women were under represented or over represented in various activities and what constrains or facilitates their participation by the agency.

Verification of Labour records followed by random checking at site will be conducted to analyse the gender participation mainly with respect to female workers.

Site Restoration:

Visual observation will be made to verify the site restoration activities after completion of works by Engineer-In-Charge before recommending completion of works.

HIV/AIDS Awareness Program

The records of conducted program as per agreed schedule by the Contractor and list of participants will be checked. The representative of Engineer-In-Charge must witness each program and maintain the records of it.


An Environmental Monitoring Plan (ES-MoAP) has been framed for both implementation and post-implementation phases covering monitoring of major pollution parameters, frequency, methods, indicators and institutional arrangements pertinent to the above ES-MoAP is furnished in Table No. 1-5 below.
## Table No. 1-5: Summary table for Environmental and Social Monitoring Action Plan (ESMoAP)

<table>
<thead>
<tr>
<th>Project Stage/Affected Component</th>
<th>Environmental/social Issue</th>
<th>Parameters to be Monitored</th>
<th>Location</th>
<th>Measurements</th>
<th>Standards/Guidelines</th>
<th>Frequency</th>
<th>Responsible Agency Implemented by</th>
<th>Supervised by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-construction and Construction Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>Engaging local labour</td>
<td>Workers employment roster</td>
<td>Camp site</td>
<td>Consultation with local labour</td>
<td>World Bank and GoI</td>
<td>Weekly</td>
<td>Supervision Engineer/Contractor</td>
<td>MCA</td>
</tr>
<tr>
<td>Women Worker/Vulnerable/Disadvantaged</td>
<td>GBV</td>
<td>Wage, increment, working hour, incidents of GBV etc.</td>
<td>Camp site</td>
<td>Consultation with female labour, Vulnerable,</td>
<td>World Bank and GoI</td>
<td>Monthly</td>
<td>Supervision Engineer / Contractor</td>
<td>MCA</td>
</tr>
<tr>
<td>Community or labour</td>
<td>Social conflict and labour rest – temporary or permanent, BPL, old aged, children to be impacted, health risks</td>
<td>GRM Env. &amp; Social related measures will be covered in RAF &amp; RAP including entitlement matrix</td>
<td>Project Site/Work site, WTP, along water pipe line network ROW, around OHSR sites</td>
<td>Complaint box and discussion with labour/Contact No., email</td>
<td>World Bank and GoI</td>
<td>Monthly</td>
<td>Contractor / PIU, Health and Safety Officer/Community Development officer / Environmental officer of PIU, RAP implementing Agency</td>
<td>E&amp;S Specials at PIU Third Party Monitoring Agency</td>
</tr>
</tbody>
</table>
| Top Soil                        | Soil Pollution              | • Check liquid waste is carried out by experienced personnel and in proper way  
 • Careful and proper handling of oil and | Project Site | Visual inspection of all active work areas | Monitoring | Quarterly | Contractor | PIU |
<table>
<thead>
<tr>
<th>Project Stage/ Affected Component</th>
<th>Environmental/ social Issue</th>
<th>Parameters to be Monitored</th>
<th>Location</th>
<th>Measurements</th>
<th>Standards/ Guidelines</th>
<th>Frequency</th>
<th>Responsible Agency Implemented by</th>
<th>Supervised by</th>
</tr>
</thead>
</table>
| Waste                           | Liquid waste, Solid Waste | • Check storage, transportation, disposal, handling of hazardous waste  
• Waste and effluents to be collected and disposed safely of camp.  
• Wastes and garbage from construction sites to be disposed safely | Project Site | Visual inspection of all active work areas | Monitoring | Daily | Contractor | PIU |
| Ecology                         | Terrestrial and aquatic flora and fauna | • Tree and Aquatic Species | WTP, Intake point sites, Canals and OHSR | Visual inspection | Monitoring | Once for tree prior to starting construction and yearly aquatic monitoring | Contractor | PIU |
| Occupational Health and Safety   | Workers Health & Safety | • Check quality of food and accommodation at construction camp;  
• Check safe water supply, hygienic toilet at camp, construction of drain at campsite;  
• Check toilets are close to construction | Construction Camp & Construction area | Visual inspection of all active work areas | Monitoring | Daily | Contractor | PIU |
<table>
<thead>
<tr>
<th>Project Stage/Affected Component</th>
<th>Environmental/social Issue</th>
<th>Parameters to be Monitored</th>
<th>Location</th>
<th>Measurements</th>
<th>Standards/Guidelines</th>
<th>Frequency</th>
<th>Responsible Agency Implemented by</th>
<th>Supervised by</th>
</tr>
</thead>
</table>
| Community Health and Safety     | Community disturbance and potential safety hazard due to road traffic | site;  
- First Aid Box with required tools and medicines;  
- The heavy construction material to handled and stored safely putting due care on public safety;  
- Heavy construction materials at construction site to be stored and handled safely; and  
- Check of personal protective equipment (PPE) for worker at the sites | Approach Road | Incidents, accidents, and community complaints | Monitoring Based on occurrence | Contractor | PIU |
<p>| Operational Phase               | Female Worker, disadvantaged and vulnerable people | GBV | Wage, increment, working hour etc. | Project site | Consultation with female labour | World Bank and GoI | Monthly | Contractor /PIU | PIU |</p>
<table>
<thead>
<tr>
<th>Project Stage/Affected Component</th>
<th>Environmental/social Issue</th>
<th>Parameters to be Monitored</th>
<th>Location</th>
<th>Measurements</th>
<th>Standards/Guidelines</th>
<th>Frequency</th>
<th>Responsible Agency Implemented by</th>
<th>Supervised by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community or labour</td>
<td>Social conflict and labour rest</td>
<td>GRM</td>
<td>MCA/PIU office</td>
<td>Complain box and discussion with labour</td>
<td>World Bank and GoI</td>
<td>Weekly</td>
<td>Contractor /PIU</td>
<td>PIU</td>
</tr>
<tr>
<td>Disaster Management Plan (DMP) Monitoring</td>
<td>Earthquake</td>
<td>Structure Design</td>
<td>Project Area</td>
<td>As per project DMP</td>
<td>Not Specific</td>
<td>Continuous</td>
<td>Contractor / Operation &amp; Maintenance Unit</td>
<td>PIU</td>
</tr>
<tr>
<td>Flooding</td>
<td>Structure Design</td>
<td>Project Area</td>
<td>As per project DMP</td>
<td>Not Specific</td>
<td>Continuous</td>
<td>Operation &amp; Maintenance Unit</td>
<td>PIU</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1-6: Environmental Monitoring Plan for Air, Water, Noise and Soil**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Timing</th>
<th>Parameter</th>
<th>Ref. Method</th>
<th>Standards</th>
<th>Frequency</th>
<th>Duration</th>
<th>Location</th>
<th>No of Samples</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Constructi on</td>
<td>PM$<em>{10}$, PM$</em>{2.5}$, CO, NOx, and SO$_{2}$</td>
<td>High Volume sampler to be located about 50 m from the plant/OHSR in the downwind direction. Use method specified by CPCB for Analysis</td>
<td>CPCB Guidelines (NAAQMS/Volume-I/2013-14)</td>
<td>Every month at 3 locations for WTP and 1 location for each OHSR (Max 6 month for construction at each site).</td>
<td>24 hours sampling for 48 hours Twice a month</td>
<td>3 locations around WTP Site and 53 OHSR sites during construction at site</td>
<td>3x2x2x36= 432 samples for WTP and 53x2x2x6 =1272 totaling 1704 samples</td>
<td>Contractor</td>
</tr>
<tr>
<td>Attribute</td>
<td>Timing</td>
<td>Parameter</td>
<td>Ref. Method</td>
<td>Standards</td>
<td>Frequency</td>
<td>Duration</td>
<td>Location</td>
<td>No of Samples</td>
<td>Implementation</td>
</tr>
<tr>
<td>-----------</td>
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<td>----------------</td>
</tr>
<tr>
<td>Water</td>
<td>Operation</td>
<td></td>
<td></td>
<td>Once every month for three years</td>
<td>Within WTP Boundary in downwind direction</td>
<td>12x3= 36 samples</td>
<td>PIU</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction</td>
<td>As per Drinking Water Standards</td>
<td>Grab sample collected from source and analyses as per standard methods for examination</td>
<td>Indian standards for inland surface waters (IS:2296,1982) and for drinking water (IS:10500-2012)</td>
<td>Every month at 3 locations-1 GW and 2 surface water</td>
<td>As per Grab Sampling guidelines</td>
<td>Drinking water samples from the labour camps and Surface water from the water courses near the work site and Canal.</td>
<td>GW 36 and SW2x36 = 72 total 108 samples</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td>Operation</td>
<td>Waste water standard</td>
<td></td>
<td>Once in 6 months for 3 years</td>
<td></td>
<td>Waste water</td>
<td>36</td>
<td>PIU</td>
<td></td>
</tr>
<tr>
<td>Noise</td>
<td>Construction</td>
<td>Noise Levels on dB (A) scale</td>
<td>Equivalent noise levels using, and integrated noise level meter kept at 15 m from edge of pavement</td>
<td>Noise rules 2000 by CPCB</td>
<td>Twice a month at 2 locations for 24 hours for 3 years</td>
<td>Leq, Lmax, Lmin, L10, L50 and L90 in dB(A) of daytime and nighttime</td>
<td>Near the working zones, sensitive receptors and WTP construction sites Twice a month at each OHSR construction site for 6 months.</td>
<td>2x2x12x3 =144 2x6x53 = 636 Totaling 780 samples of 24 hours.</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td>Operation</td>
<td></td>
<td></td>
<td>Once every season for 3 year after completion of construction activity</td>
<td></td>
<td></td>
<td>In the vicinity of WTP</td>
<td>4x3 =12 samples</td>
<td>PIU</td>
</tr>
<tr>
<td>Attribute</td>
<td>Timing</td>
<td>Parameter</td>
<td>Ref. Method</td>
<td>Standards</td>
<td>Frequency</td>
<td>Duration</td>
<td>Location</td>
<td>No of Samples</td>
<td>Implementation</td>
</tr>
<tr>
<td>-----------</td>
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<td>-------------</td>
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<td>----------------</td>
</tr>
<tr>
<td>Soil</td>
<td>Construction</td>
<td>Monitoring of Pb, SAR and Oil and Grease</td>
<td>Sample of soil collected to acidified and analyzed using absorption spectrum (IS): 2720 for 'Method of Test for Soils'</td>
<td>During the pre &amp; post monsoon season every year</td>
<td>On-site Sampling</td>
<td>WTP Construction sites &amp; productive agricultural lands Total 3 sites</td>
<td>3x 6= 18 samples</td>
<td>Contractor</td>
<td></td>
</tr>
</tbody>
</table>
A1.4.15. Environmental and Social Monitoring Budget:

In the pre-implementation/planning stage, a monitoring has to be drawn up considering various environmental and social components. The estimate should include expenditure on account of manpower engaged, sampling, laboratory testing and supervision of environmental and social parameters. The budget has been given in Table 1.10 as part of ESHS Budget.

A1.5. Reporting System of Environmental Monitoring:

Reporting system for the suggested monitoring program operates at two levels:

1) Reporting for environmental condition indicators and environmental management indicators
2) Reporting for operational performance indicators at the Environmental Social Specialist level of PIU

Environmental monitoring involves regular checking of the environmental management issues detailed in the ESMP and to ascertain whether the mitigation measures are achieving their objectives, according to the EMP, with the progress of the works. It provides the necessary feedback for Project management to keep the program on schedule. The Contractor, PMC and ESMU operate the reporting system for environmental conditions and environmental management indicators. The reporting system is presented in Table 8.6. Reporting formats for Contractors have been prepared, which will form the basis of the implementation by the Contractor and monitoring by the PMC and ESMU. The list of reporting formats prepared for the Project is presented in Table 1-7 and Table 1-8.

- The reporting system will start with the Construction Contractor who is the main executor of the implementation activities. The Contractor will report to the Project Management Consultant, who in turn shall report to the ES Specialist of PIU.
- The Contractor will submit monthly and quarterly environmental compliance reports along with formal monthly and quarterly reporting to the PIU.
- The PIU will submit separate quarterly environmental monitoring reports to ES Specialist in addition to submission of the summary of the activities of the month in the formal monthly report including any deviations and corrective actions.
- ES Specialist/PIU will be responsible for the preparation of the targets for identified non-compliances.
- Solutions for further effective implementation may also emerge as a result of the compliance monitoring reports.
- Environmental Management Compliance Certificate will be issued by Environment Specialist of PIU during the submission of each Interim Payment Certificate (IPC). This certificate will be based on compliance status of environmental measures during that tenure for which IPC has been produced.
- Photographic records will be kept, to provide useful environmental monitoring tools. All material source locations, debris disposal locations, construction, trenching locations, Construction camp locations, etc. will have a complete photographic record. Photographs for all these establishments will be taken prior to establishment activities begin, during the establishment and operation process and after rehabilitation. The record will be submitted to PMC/ES specialists half yearly and will also be availed to PMC/ES Specialist, as and when required.
- A full record of construction activities will be kept as a part of normal Contract monitoring system.
The operation stage monitoring reports may be annual, provided the Project Environmental Completion Report shows that the implementation was satisfactory.

This reporting will be as follows:

- Reporting by the Contractor to the PIU.
- Reporting by PIU to ES Specialist of PMU /PMIDC
- Reporting by ES Specialists for the information of all interested parties, including PMU /PMIDC.
## Table 1.7: Reporting System

<table>
<thead>
<tr>
<th>Items</th>
<th>Contractor Implementation &amp; Reporting to PMC</th>
<th>Project Management Consultant Supervision</th>
<th>ESMU/PIU Reporting to PIU</th>
<th>ESMU/PIU Oversee Compliance Monitoring</th>
<th>World Bank (WB) Report to WB</th>
<th>Desired Supervision</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction Stage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring of WTP/OSR</td>
<td>Before start of work</td>
<td>Regular</td>
<td>Monthly</td>
<td></td>
<td>Quarterly</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Construction Site</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trenching/Pipeline Route</td>
<td></td>
<td>Regular</td>
<td>Monthly</td>
<td></td>
<td>Quarterly</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Construction Camp</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pollution Monitoring</td>
<td>As required</td>
<td>As required</td>
<td>Quarterly</td>
<td></td>
<td>Quarterly</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Debris Disposal Area</td>
<td>Weekly</td>
<td>Regular</td>
<td>Monthly</td>
<td></td>
<td>Quarterly</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Monitoring of Enhancements</td>
<td>Implementation</td>
<td>As required</td>
<td>Quarterly</td>
<td></td>
<td>Quarterly</td>
<td>Yearly</td>
</tr>
<tr>
<td>Tree Cutting</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>Quarterly</td>
<td>Yearly</td>
</tr>
<tr>
<td><strong>Operation Stage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pollution Monitoring</td>
<td></td>
<td></td>
<td>As per monitoring plan/ PPCB</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
Table 1.8: Summary Details of Reporting Formats

<table>
<thead>
<tr>
<th>Format No.</th>
<th>Item</th>
<th>Stage</th>
<th>Contractor</th>
<th>Project Management Consultant (PMC)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Implementation &amp; reporting to PMC</td>
<td>Supervision</td>
</tr>
<tr>
<td>F 1</td>
<td>Approval of Construction Camp/ WTP/OSR Site/ Pipeline Row and its Management Plan</td>
<td>Pre-Construction</td>
<td>One Time</td>
<td>One Time</td>
</tr>
<tr>
<td>MF 2</td>
<td>Construction Camp and Site Management</td>
<td>Construction</td>
<td>Monthly</td>
<td>Regular</td>
</tr>
<tr>
<td>MF 3</td>
<td>Pollution Control and Construction sites</td>
<td>Construction</td>
<td>Monthly</td>
<td>Regular</td>
</tr>
<tr>
<td>MF 4</td>
<td>Vehicles and Pollution Control</td>
<td>Construction</td>
<td>Monthly</td>
<td>Regular</td>
</tr>
<tr>
<td>MF 5</td>
<td>Details of the DG Sets and Pollution Control</td>
<td>Construction</td>
<td>Monthly</td>
<td>Regular</td>
</tr>
<tr>
<td>MF 6</td>
<td>Working at Canal &amp; Pollution Control</td>
<td>Construction</td>
<td>Monthly</td>
<td>Regular</td>
</tr>
<tr>
<td>MF 7</td>
<td>Details of Water Extraction</td>
<td>Construction</td>
<td>Monthly</td>
<td>Regular</td>
</tr>
<tr>
<td>MF 8</td>
<td>Details of Personal Protective Equipment</td>
<td>Construction</td>
<td>Monthly</td>
<td>Regular</td>
</tr>
<tr>
<td>MF 9</td>
<td>Status of Consent for Water Extraction</td>
<td>Construction</td>
<td>Quarterly</td>
<td>Quarterly</td>
</tr>
<tr>
<td>MF 10</td>
<td>Deviations and Corrective Actions</td>
<td>Construction</td>
<td>—</td>
<td>Monthly</td>
</tr>
<tr>
<td>RF 12</td>
<td>Grievance Redressal Mechanism during</td>
<td>During Construction</td>
<td>Monthly</td>
<td>Regular</td>
</tr>
</tbody>
</table>
The Environment Specialist of PMC can make required changes in the formats specified of ESMP to ensure effective reporting of environmental issues. For making any required changes in the frequency of reporting and change in the contents of the report for effective and simple for implementation and monitoring, PMC should discuss the reporting formats with the Contractor and PIU. This will not only ensure that the environmental provisions are addressed but also link the satisfactory compliance to environmental procedures prior to approval of the Interim Payment Certificate (IPC) by the Engineer. In the regular monthly meeting, the environmental aspects should also be discussed and the staff responsible for the implementation of the environmental management from the Contractor, ES Specialist and PMC should also be present.

Social monitoring indicators will be indicated as part of the Resettlement Action plan.

**A1.6. Training & Capacity Building Strategy**

The training program will be implemented as per training modules provided in Table 1-8. These training programs are not part of the Contractors plan and estimates but will be a part of the project cost that includes institutional strengthening, capacity building and training. Training module can be changed during construction phase based on requirements by ESMU. The basic objective of giving training to different Stakeholder is to enhance their capabilities for implementation of Environmental Management and Monitoring Plan. It is recommended that training be given at least 4 times both off-site and on site.

- Before Start of Construction Work
- During Construction
- Before demobilization of Contractor
- After Construction before Start of Monitoring
## Table 1.9: Training Module

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Training Recipients</th>
<th>Mode of Training</th>
<th>Environmental and Social Aspects to be covered in training modules</th>
<th>Training Conducting Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Before Start of Construction Work by ESMU)</td>
<td></td>
</tr>
<tr>
<td><strong>One day</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>Staff of Environment and Social Management Unit (ESMU) and Construction Management Unit (CMU)</td>
<td>Lecture Session, presentation &amp; discussion</td>
<td>World Bank’s Environment and Social Management Framework</td>
<td>Environment Specialist, ESMU</td>
</tr>
<tr>
<td>2</td>
<td>Staff of ESMU and CMU</td>
<td>Lecture Session, presentation &amp; discussion</td>
<td>Legal requirements of the project, ESCP, etc.</td>
<td>Environment Specialist, ESMU</td>
</tr>
<tr>
<td>3</td>
<td>Staff of ESMU and CMU</td>
<td>Lecture Session, presentation &amp; discussion</td>
<td>Specific Environment and Social Management Plan and ESCP</td>
<td>Environment Specialist, ESMU</td>
</tr>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(Before Start of Construction Work)</td>
<td></td>
</tr>
<tr>
<td><strong>Day-1 (Session-I)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Staff of ESMU, staff of PMC, Engineering Staff of Contractor and Collaborating Government Agencies</td>
<td>Lecture Sessions, Presentation and discussion</td>
<td>Overall generic Environment Issues, Regulations &amp; Statutory requirements and Mitigation Measures, ESCP</td>
<td>PIU</td>
</tr>
<tr>
<td>2</td>
<td>Staff of ESMU, staff of PMC, Engineering Staff of Contractor and Collaborating Government Agencies</td>
<td>Lecture Sessions, Workshops &amp; Presentation</td>
<td>Institutional Set Up, Role and Responsibility of Stake Holders and Contractual obligations</td>
<td>PIU</td>
</tr>
<tr>
<td><strong>Day-1 (Session-II)</strong></td>
<td></td>
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</tr>
<tr>
<td>4</td>
<td>Staff of ESMU, staff of PMC, Engineering Staff of Contractor and Collaborating Government Agencies</td>
<td>Lecture Sessions, Workshops &amp; Presentation</td>
<td>Biodiversity Management; Concept, scopes and measures in the project</td>
<td>PIU</td>
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<tr>
<td><strong>Day-2 (Session-I)</strong></td>
<td></td>
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<tr>
<td>1</td>
<td>Staff of ESMU, staff of PMC, Engineering Staff of Contractor and other Concerned Agencies</td>
<td>Lectures; Demonstration sessions</td>
<td>Project related environmental issues and mitigation measures</td>
<td>PMC</td>
</tr>
<tr>
<td>2</td>
<td>Staff of ESMU</td>
<td>Group Discussions</td>
<td>Environmentally Sound</td>
<td>PIU</td>
</tr>
<tr>
<td>S. No.</td>
<td>Training Recipients</td>
<td>Mode of Training</td>
<td>Environmental and Social Aspects to be covered in training modules</td>
<td>Training Conducting Agency</td>
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</tr>
<tr>
<td>(Nodal Level), staff of PMC, Engineering Staff of Contractor.</td>
<td>and action plan for the project</td>
<td>Construction Management &amp; Environmentally, Sustainable operations of Water Supply Development</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Day-2 (Session-II)**

| 3 | Staff of ESMU staff of PMC, Engineering Staff of Contractor. | Lectures; Group Discussions | Supervision and Monitoring, Reporting Formats | PMC |
| 4 | Staff of ESMU, staff of PMC, Engineering Staff of Contractor and Collaborating Government Agencies. | Lecture Sessions, Workshops & Presentation | Occupational Health and Safety, Community Health and Safety | PMC |

**Module for Training During Construction**

*(Immediately after Commencement of Construction activities)*

**Day-1**

| 1 | Staff of ESMU involved in the project, staff of PMC, involved in construction, contractor | Lecture Sessions, Presentation & Workshops | Implementation of Environment Management Plan, Environment friendly Construction Methodology and Workers Safety during Construction | PIU/ PMC |
| 2 | Staff of ESMU involved in the project, staff of PMC, involved in construction, contractor | Lecture Sessions, Workshops & Presentation | Interactive discussion, Monitoring and Reporting System | PIU/PMC |

**Day-2**

| 5 | Staff of ESMU staff of PMC, Engineering Staff of contractor. | Lectures; | Occupational and Community Health and Safety; Introduction, Scope and management measures | PIU/ PMC |
| 6 | Staff of ESMU staff of PMC, Engineering Staff of contractor. | Lectures; | Stake holder’s engagement procedures, Grievance redressal mechanism | PMC |

**Module for Training during Construction**

**One day**

| 1 | ESMU, Staff of PMC, All Staff of contractor | Lecture Sessions, Workshops & Presentation | Environment friendly Construction Methodology and Workers Safety | PIU /PMC |
| 2 | ESMU, Staff of PMC, All Staff of contractor. | Practical on Site | Traffic and Safety Management during construction; Safety Practices | PIU / PMC |

**Module for Training before Contractor Demobilization**
A1.7. **Grievance Redressal Mechanism:**

Efficient Grievance redress mechanism will be developed to assist the PAPs resolve their queries and complaints. Each RP will detail specific grievance redress mechanisms. Grievances of PAPs will first be brought to the attention to the site office level of the PIU which shall be redressed within two weeks from the receipt of complaints. Grievances not redressed by the PIU staff (field level) will be brought to the Grievance Redress Committee (GRC) which shall be redressed within four weeks from the date of receiving the complaint at ESMU level. The GRC will have representatives from PAPs, ESMU, field level staff, district magistrate/commissioner, local administration, revenue authority and local community. The main responsibilities of the GRC will be to: (i) provide support to PAPs on problems arising from land/property acquisition; (ii) record AP grievances, categorize, and prioritize grievances and resolve them; (iii) immediately inform the PMU of serious cases; and (iv) report to PAPs on developments regarding their grievances and decisions of the GRC and the PMU. Other than disputes relating to ownership rights under the court of law, GRC will review grievances involving all resettlement benefits, compensation, relocation, replacement cost and other assistance.

The GRC will meet every month (if grievances are brought to the Committee), determine the merit of each grievance, and resolve grievances within a month of receiving the complaint. Records will be kept 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 affected and final outcome. The GRCs will continue to function during the life of the Project including the defects liability period. For the PUGWSIP, the most likely complaints will be from the public as regards construction works, transmission line laying, burrowing, trenching, adjacent land parcel impacts, material transport, waste dumping, visual & environmental quality deterioration, social rights etc.

The proposed GRM structures are described below:-
Grievance Procedure

As the GRM works within existing legal and cultural frameworks, it is recognized that the GRM will comprise project level and Punjab judiciary level redress mechanisms. Most project related grievances could be minor and site-specific. Most grievances are to be received directly on-site by the designated site representative of PMIDC that will attempt to resolve them satisfactorily on-site. The designated site representative will inform the PIU of these complaints and their outcomes, and of others not satisfactorily resolved so that they could be escalated. All offline complaints will need to be logged in the site Complaints Register and periodically compiled at the city level for analysis and reporting purposes.

On receipt of each complaint, the representative will note the date, time, name and contact details of the complainant, and the nature of the complaint in the Complaints Register and will inform the complainant about the timeframe within which to expect a response/ redress. In case the representative is not able to redress the grievance within the project specified timeframe, it will be his/ her responsibility to escalate it to the PIU at the municipal corporation. Should the PIU be unable to resolve the complaint to the satisfaction of the aggrieved persons, it will then refer the complaint directly to the PMU at PMIDC.

Steps:
1. Registration: This should be the first step and will involve the social contact person/institution receiving the complaint from the complainant. The complainant is expected to fill out and return a “complainant form” to the social Contact person/institution who in turn will acknowledge receipt of the complaint within 2 business working days.

2. Verification: The verification will determine among other things whether the matter has any relationship with the Project and whether the level at which it is presented can handle it. This will mean a quick referral of the case either to the next level or the traditional rulers or to law enforcement. Part of investigation will also be assessing the cost of loss or risk involved in the grievance.

3. Processing: The processing step is when options for the approach to resolving the case are weighed and determined. Parties involved in the case are brought together for a first attempt at resolution with suggestion from the parties by the social contact personnel. The social personnel at a certain level then decide where the case should go to for hearing and resolution if complainant decides to pursue the matter further. This should happen within five days from investigation.

4. Implementation and case closing: The social contact personnel then refer the case to the responding authority within the level for GRM implementation. This authority may be the chairman of the GRC or the officers with direct responsibility over the nature of the case within the PMU. Putting this in writing makes the appeal process faster in case of dissatisfaction on the part of the complainant. And in the case of satisfaction, it is an instrument to compel execution of decision. The outcome of the Grievance Redress process is therefore communicated to the complainant and other concerned party. The result of the
process can vary. The request of the complainant may be turned down, compensation may be recommended, or Management may simply apologize to the grievant.

In addition to this GRM, communities and individuals who believe that they are adversely affected by the WB supported project may submit complaints to the WB’s Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB’s independent Inspection Panel which determines whether harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank’s attention, and Bank Management has been given an opportunity to respond.
ANNEXURE-A

Format for Grievance Redressal Mechanism Register:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Complainant</th>
<th>Unique complaint number</th>
<th>Address &amp; Contact No.</th>
<th>Gist of the Complaint</th>
<th>Forwarded to whom</th>
<th>Whether grievance redressed or not</th>
<th>If yes, Gist of disposal</th>
<th>If rejected, gist of reasons</th>
<th>If not attended reasons</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

ANNEXURE-B

Monthly status Report:-

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the unit</th>
<th>No. of pending complaints at the end of previous month</th>
<th>No. of complaint received during the month</th>
<th>Action initiated during the month</th>
<th>Completed during the month</th>
<th>No. of complaints pending at end of month</th>
<th>No. of grievance redressed</th>
<th>No. of dismissal</th>
<th>Total</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>
ANNEXURE- ENV1

SCHEME FOR COMPENSATORY PLANTATION

1.1. Selection of site
A site will be selected preferably in the periphery of WTP Site.

1.2. Details of The Site Selected
The site presently is agricultural fields having good fertility. Here most of the native species can be planted as Green belt and also for compensatory plantation. The compensatory plantation can also be taken up on canal bank. Care has to be taken to carryout plantation in the vicinity of the existing tree which is felled due to the project.

The proposed Compensatory Plantation Area will be surveyed and demarcated in the field by the Contractor/ AMC. The Compensatory Area will have to be protected by engaging watchers for 3 years, i.e. till establishment of the planted trees and saplings.

1.3. Plantation
It has been intended to fell about 50 trees from route between canal and WTP and about 100 trees in the vicinity of proposed OHSRs in Amritsar city. The proposed native species for plantation are:

1. Asan
2. Karanja
3. Neem
4. Amla
5. Pipal
6. Mango etc

Different operations those will be taken up for plantation is as follows:-

i) Plantation:
Saplings of 45cm will be preferred for plantation. The saplings will be planted in the dugout pits with initial dose of manure. Plantation should be taken up after first regular shower of monsoon and should be completed by the end of July. Species should be planted as per the suitability of the soil condition. NPK fertilizer @ 30gms per plant should be given as basal dosage. Anti-termite insecticide should also be applied to each pit while planting. Casualties if any noticed should be replaced with the excess saplings. During second year also casualty replacement will be done for which seedling shall be raised. Seedlings required for this project may be procured from DFO, Amritsar Division’s nursery.

ii) Weeding, Soil working & manuring:
For establishment and better growth of the planted sapling, circular weeding, soil working and manuring are necessary. It is prescribed that two weddings; soil working
and manuring will be done during the first year and second year of plantation and one
weeding and soil working during third year. During the first year and second year first
weeding and manuring shall be carried out during August-September and the second
one during October-November. First weeding shall be an entire area weeding
(scraping) and the second will be of strip weeding along the contour. The weeding of
third year will be a strip weeding which will be carried out during August. Each
weeding will be followed by a soil working around each plant at a radius of 0.5 m and
manuring of each plant will be done @ 30 gram of NPK per plant.

iii) Application of insecticides.
The plantation site after planting good healthy sapling may cause influx of insects,
which usually eat and damage the roots of the plants. To get rid of such insects attack
application of the insecticides will be taken up in required doses at desired intervals.
Spraying of insecticides shall be done preferably in a sunny day in the afternoon.
1.1. Introduction:
Risk assessment is a systematic method of identifying and analyzing the hazards associated with an activity and establishing a level of risk for each hazard. The hazards cannot be completely eliminated and thus there is a need to define and estimate an accident risk level possible to be presented either in quantitative or qualitative way. Risk assessments will help to prioritize risks and provide information on the probability of harm arising and severity of harm by understanding the hazard, combine assessments of probability and severity to produce an assessment of risk and it is used in the assessment of risk as an aid to decision making.

1.2. Environmental Risk Management:
Most projects despite being designed with the environmental and social sustainability are not altogether free from Risks and hazards which may appear during the entire implementation period. Due importance is therefore attached to the review of environmental considerations, identification of areas involving risks and hazards along with appropriate mitigative measures in the management plan. This approach proceeds from the conviction that the development objectives cannot be materialized fully unless disaster mitigation is built-in the development process.

1.2.1. Risk Management
Risk as defined is the probability of harm or likelihood of harmful occurrence being released and its severity. An environmental hazard entails a set of circumstances which lead to the direct or indirect degradation of the environment and becomes a cause of damage to the life of people, property or environment.

A. Assessment - Approach:
- To identify the potentiality hazardous areas so that necessary safety measures can be adopted to minimize the probability of accidental events & failure of design.
- To identify the potential areas of environmental disasters. This can be prevented by proper design of installations and controlled operation.

B. Management Procedure:
- Set up a committee of experts to foresee and predict the possibility of failure, causes of such events, estimate the probable losses and suggest remedial measures for implementation so that in future such events or similar events do not occur in the project.

1.3. Risks Assessment during Construction Period:
The construction of the WTP and OHSRs shall primarily comprise of the following activities:
Volume 2 - Employer’s Requirement

- Leveling and excavation of the WTP area, which will involve use of earth moving equipment like dozers, scrappers, excavators, diggers etc.
- Construction will involve masonry and concrete work. For this purpose Heavy duty trucks shall be used for transport of building material like cement, sand, stone chips, rods etc. Cranes may be used for haulage of material.

Risks and Hazards involved during the construction process can be of significant magnitude if due care is not taken to be minimized through proper mitigation measures. These are broadly discussed below in Table No. 1.

**Table No. 1: Potential Environmental Hazards and Mitigation Measures**
<table>
<thead>
<tr>
<th>Project Activity</th>
<th>Potential/Expected Environmental &amp; Social Risk and Impacts</th>
<th>Proposed Mitigation</th>
<th>Institutional Responsibility</th>
<th>Monitoring Duration (Start-End)</th>
<th>Indicator Parameter</th>
<th>Frequency of monitoring</th>
<th>Location</th>
<th>Record Keeping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition of land for WTP, etc</td>
<td>The process to be followed for voluntary transactions, including and how those will be compensated to potential sellers will be as per and consistent with ESS5 principles. The term and condition should be transparent and mechanism to monitor the compliance should be put in place. The agreed compensation amount should not be lower than what is available under eminent domain to ensure fair compensation under voluntary land transaction. The seller To mitigate</td>
<td>Implementing Agency</td>
<td>Prebid</td>
<td>As per ESS5</td>
<td></td>
<td></td>
<td>WTP, OHSR tanks</td>
<td>IA</td>
</tr>
</tbody>
</table>
the risk under this approach, the voluntary land transaction should be completed and land transferred in favor of Government prior to invitation of bids.

Separate RPF for the project and RAP for Amritsar will be prepared covering the potential land acquisition and resettlement impacts.

<table>
<thead>
<tr>
<th>Site Clearance (clearing of the site so that it becomes accessible for further works)</th>
<th>Potential increase in soil erosion</th>
<th>Restrict site clearance to the required extent as part of the design</th>
<th>Planners</th>
<th>From commencement of Site Clearance Activities till end of site clearance activities</th>
<th>Site Clearance Area (m²)</th>
<th>During each phase of the project</th>
<th>Project Area</th>
<th>Daily logbook stating clearance status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation loss (mainly grass/shrubs but also possibly some trees) in Transmission line route &amp; OHSR sites</td>
<td>Preserve trees, if present, as far as practicable</td>
<td>Primary: Construction I/C Secondary: Planners</td>
<td>Vegetation Loss Area (m²)</td>
<td>During phases of the project requiring clearance of vegetation</td>
<td>Project sites</td>
<td>Map and list of trees and vegetation at the site prior to commencement of field activities; details of trees / vegetation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Vegetation loss (mainly grass/shrubs but also possibly some trees) in Transmission line route & OHSR sites
<table>
<thead>
<tr>
<th>Waste generation (excavated earth)</th>
<th>Utilization of earth for backfilling and dispose off the balance at designated sites</th>
<th>Construction I/C</th>
<th>Waste type, quantity generated</th>
<th>Daily</th>
<th>Project site area being cleared</th>
<th>Storage, reuse or disposal proof (manifests)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Pollution due to vehicular movement, and dust emissions from debris stockpiles</td>
<td>Water sprinkling Compaction of soil Covering of debris and waste stockpiles Ensure well maintained vehicles Ensure reduced idling time for vehicles Barricading of portion of site where work is being carried out Ensure that trucks plying in the area are loaded to rated capacity optimize number of trips</td>
<td>Primary: EHS Supervisor Secondary: Construction I/C</td>
<td>Air: PM2.5, PM10, PM2.5, SO2, NOX and CO</td>
<td>Air: Once a week for 48 hours continuously</td>
<td>Air: 100 m from the edge of the clearance area</td>
<td>Keeping record water quantity used for sprinkling, By keeping record of air monitoring analysis results</td>
</tr>
<tr>
<td>Noise from vehicles, Clearing and cutting activities</td>
<td>Barricading of portion of site where work is being carried out Operations to be carried out during the day time only Equipment and vehicles to be operated as per standard noise</td>
<td>Primary: EHS Supervisor Secondary: Construction I/C</td>
<td>Noise: dB(A) Leq (night) and dB(A) Leq (day)</td>
<td>Noise: 24 hours, once a week</td>
<td>Noise: At the site nearest to the location where works are going on</td>
<td>Record of noise monitoring analysis results</td>
</tr>
<tr>
<td>Volume 2 - Employer’s Requirement</td>
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<tr>
<td><strong>Water pollution (of the canal) due to intake point site clearance activities</strong></td>
<td>Level (&lt;85 dB(A) at 1.5 m from source) Ensure that trucks plying in the area are loaded to rated capacity optimize number of trips</td>
<td>Contractor</td>
<td>SS, pH, TDS, COD, BOD, Chloride, Sulphates, O &amp; G</td>
<td>Water: At the intake project site wherever the works are going on</td>
<td>Water quality records</td>
<td></td>
</tr>
<tr>
<td><strong>Aquatic and canal bottom impact</strong></td>
<td>Construction of temporary separation/isolation walls will reduce impact.</td>
<td>Project I/C Civil works</td>
<td>From commencement of Intake point development till end of activities</td>
<td>Water Pollution: Once in a week</td>
<td>Water: At the intake project site wherever the works are going on</td>
<td></td>
</tr>
<tr>
<td><strong>Water pollution (of the Canal) due to Intake point development activities</strong></td>
<td>Suitably manage the solid wastes, debris generated as per regulatory requirements</td>
<td>Primary: EHS Supervisor Secondary: Construction I/C</td>
<td></td>
<td></td>
<td>Random checking around river side by keeping record of surface water sample analysis results</td>
<td></td>
</tr>
<tr>
<td>Mobilization of Construction Equipment and Materials</td>
<td>Congestion and risk of accidents due to increase in vehicles and machines, and traffic</td>
<td>Stage delivery of required materials and equipment Store all construction equipment and materials at “off road” sites Post signs along the roads Move heavy machines only early mornings and late evenings</td>
<td>Primary: EHS Supervisor Secondary: Construction I/C</td>
<td>From commencement of transportation till end</td>
<td>Trained staff for traffic management and control</td>
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</tr>
<tr>
<td>Air Pollution due to vehicular movement, and dust emissions</td>
<td>Water sprinkling Ensure well maintained vehicles Ensure reduced idling time for vehicles Barricading of portion of site where loading and unloading carried out Ensure that trucks plying in the area are loaded to rated capacity optimize number of trips Dry and dusty materials stored in sealed containers or prevented from blowing</td>
<td>Primary: EHS Supervisor Secondary: Construction I/C</td>
<td>Air: PM$<em>{2.5}$, PM$</em>{10}$, SO$_2$, NOx and CO</td>
<td>Air: Once a month for 48 hours continuously</td>
<td>Air: 100 m from the edge of the working area</td>
<td>Air quality records</td>
</tr>
<tr>
<td>Noise from vehicles, power sources (DG sets) and trenching activities</td>
<td>Barricading of portion of site where loading and unloading is being carried out. Installation of equipment with noise enclosures (mufflers) as far as possible. Operations to be carried out during the day time only. Equipment and vehicles to be operated as per manufacturer’s maintenance schedule. Traffic Signage will be placed at several places within premises. Traffic Marshals shall be provided to guide movement of vehicles.</td>
<td>Primary: EHS Supervisor Secondary: Construction I/C</td>
<td>Noise: dB(A) Leq (night) and dB(A) Leq (day)</td>
<td>Noise: 24 hours, once a week</td>
<td>Noise: At the project boundary nearest to the location where works are going on</td>
<td>Maintain register for working hours. Trained staff for traffic management and control. Noise data.</td>
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</tr>
<tr>
<td>WTP Construction</td>
<td>Soil Pollution due to Construction materials especially cement should Spillage should be controlled by using tarpaulin. Reuse in reclaimed area, stored separately.</td>
<td>Primary: EHS Supervisor Secondary: Construction I/C</td>
<td>From commencement of construction activity to till end of pH, Exchange Sodium Percentage</td>
<td>Soil Sample collection: Once in a month</td>
<td>Soil: 100 m near site</td>
<td>By keeping record of Soil analysis result.</td>
</tr>
<tr>
<td></td>
<td>not spill on soil as it is highly alkaline and may deteriorate soil. Pollution on adjacent land parcels.</td>
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<tr>
<td>Water Pollution due to construction material spill and leakages to ground water.</td>
<td>Reuse in reclaimed area, stored separately.</td>
<td>Primary: EHS Supervisor. Secondary: Construction I/C.</td>
<td>SS, pH, TDS, COD, BOD, Chloride, Sulphate, O &amp; G, Turbidity, Alkalinity.</td>
<td>Water Pollution: Once in a week. Water: At the project site wherever the works are going on. By keeping record of Surface Water analysis result.</td>
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<tr>
<td>Air Pollution due to vehicular movement, and dust emissions.</td>
<td>Water sprinkling. Ensure well maintained equipment’s. Ensure reduced idling time for vehicles. Barricading of portion of site where loading and unloading carried out. Ensure that trucks plying in the area are loaded to rated capacity. Optimise number of trips. Dry and dusty.</td>
<td>Primary: EHS Supervisor. Secondary: Construction I/C.</td>
<td>Air: Pm2.5, PM10, PM2.5, SO2, NOX and CO.</td>
<td>Air: Once a week for 48 hours continuously. Air: 100 m from the edge of the clearance area. Air quality records.</td>
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<tr>
<td>Influx of construction workers</td>
<td>Risk of Communicable Diseases increased</td>
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<td>Contractor</td>
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<td>Noise: dBA Leq (night) and dBA Leq (day)</td>
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<td>Noise: 24 hours, once a week</td>
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<td>Noise: At the project boundary nearest to the location where works are going on</td>
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<td>Checking commencement time and end time of machineries Noise monitoring analysis results</td>
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<td>Materials stored in sealed containers or prevented from blowing</td>
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<td>Material will be covered during transportation except steel, iron, pipes, etc.</td>
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<td>Traffic controlled by trained staff</td>
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<td>Noise from vehicles, power sources (DG sets) and other activities</td>
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<td>Barricading of portion of site where loading and unloading is being carried out</td>
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<td>Installation of equipment with noise enclosures (mufflers) as far as possible</td>
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<td>Operations to be carried out during the day time only</td>
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<td>Acoustic Enclosure will be provided around D.G. Set</td>
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<td>Primary: EHS Supervisor</td>
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<tr>
<td>Secondary: Construction I/C</td>
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<tr>
<td>Checking commencement time and end time of machineries Noise monitoring analysis results</td>
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<tr>
<td>Contractors should be encouraged to recruit locals; Initial screening of</td>
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<td></td>
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<tr>
<td>Record of incidents</td>
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<tr>
<td>pressure for water</td>
<td>workers health; Provide camp clinics and regular screening of workers at six month interval for infection; Provision of drinking water and sanitation facility; Follow Occupational Health and Safety Plan, prescribed work safety measures; Workers must be informed of risks at workplace, Minimize hazards at the workplace; Use signage and barricades at risky sites.; Ensure proper transportation, storage of hazardous materials; Maintain record of accidents; Personal Protective Equipment’s (PPEs) such as helmets, ear plugs and safety goggles shall be provided to the</td>
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</tbody>
</table>
construction workers as per their job profile and its usage shall be ensured and supervised;
First Aid room with First Aid Kit will be provided and basic first aid training to supervisors will be given;
There will be a Doctor on call whose number will be displayed prominently and circulated with all workers;
Safety Harness or scaffoldings will be used during work on height;

Effective gender mainstreaming;
GBV impacts, accessing project benefits to vulnerables and disadvantaged groups will be explored as part of ESIA process and mitigation measures
<p>| Water Pollution: water quality impact due to waste generation from construction camps | Prevent washing of equipment / vehicles / clothes directly on the canal &amp; local water bodies. Set up a suitable water collection, treatment and storage facility for the construction phase to supply water for construction. Provide suitable sanitation facilities to all personnel staying at the site. Establish and maintain a wastewater treatment plant that ensures that discharged water meets norms set by the local authorities Re-use treated wastewater for sprinkling and flushing purposes Suitably manage the solid wastes generated from the waste water treatment facilities as proposed in ESMP. | Primary: EHS Supervisor Secondary: Construction I/C | SS, pH, TDS, COD, BOD, Chloride, Sulphate, O &amp; G | Water Pollution: Once in a week Water: At the project site wherever the works are going on and at the inlet and outlet discharge point of treatment plant Water sample analysis result |</p>
<table>
<thead>
<tr>
<th>OHSR Development</th>
<th>per regulatory requirements</th>
<th>Local administration</th>
<th>Air: PM2.5, PM10, PM2.5, SO2, NOX and CO</th>
<th>Air: Site</th>
<th>By keeping record of Air monitoring analysis results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Pollution due to vehicular movement, Demolition of old reservoirs</td>
<td>Traffic controlled by trained staff. Appropriate stack height will be provided if DG set is used as power back up.</td>
<td>On regular basis as per describe for each parameter</td>
<td>Noise: dB(A) Leq (night) and dB(A) Leq (day)</td>
<td>Noise: Site 24 hours, once in a six month</td>
<td>Noise: Site By keeping record of noise monitoring analysis results</td>
</tr>
<tr>
<td>Noise Pollution due to vehicular movement and Labour activities</td>
<td>Traffic controlled by trained staff. Acoustic Enclosure will be provided around D.G. Sets if used Proper signage for entry, exit &amp; vehicle’s parking. No horns in sensitive zones.</td>
<td></td>
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</tr>
<tr>
<td>Visual Aesthetics, Restriction to movement, traffic management</td>
<td>Prior, transparent information disclosure, schedule of work, Traffic management, Alternate routes, Barricading of construction sites, Grievance resolving.</td>
<td>Regular checking and taking feedback from local community.</td>
<td>Regular inspection</td>
<td>Site &amp; surrounding</td>
<td>Feedback &amp; Grievance records</td>
</tr>
<tr>
<td>Soil Pollution due to improper demolition, construction/solid waste</td>
<td>The solid waste/debris will be segregated. The recyclable waste will be sold off to authorized recyclers.</td>
<td>Local administration</td>
<td>Exchange Sodium Percentage, Electric Conductivity</td>
<td></td>
<td>By keeping record of C&amp;D and solid waste segregation</td>
</tr>
<tr>
<td>Clean Water Transmission</td>
<td>Air Pollution due to trenching, borrowing, top soil removal storage, vehicular movement, traffic congestion, wind-blown dust</td>
<td>Prior information to local community &amp; feedback mechanism</td>
<td>Primary: EHS Supervisor, Secondary: Construction I/C</td>
<td>From commencement of construction activity to till end of construction</td>
<td>Air: PM$<em>{2.5}$, PM$</em>{10}$, SO$_2$, NOx and CO</td>
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<tr>
<td>management, C&amp; D Waste management</td>
<td>the biodegradable waste, if any, will be collected and disposed as per PPCB norms</td>
<td>Water sprinkling</td>
<td>Ensure well maintained equipment’s</td>
<td>Ensure reduced idling time for vehicles</td>
<td>Barricading of portion of site where loading and unloading carried out</td>
</tr>
</tbody>
</table>

Volume 2 - Employer’s Requirement
<table>
<thead>
<tr>
<th>Topic</th>
<th>Action</th>
<th>Primary</th>
<th>Secondary</th>
<th>Noise Info</th>
<th>Timeframe</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise from vehicles, power sources (DG sets if used) and labour other activities</td>
<td>Barricading of portion of site where loading and unloading is being carried out</td>
<td>EHS Supervisor</td>
<td>Construction I/C</td>
<td>Noise: dB(A) Leq (night) and dB(A) Leq (day)</td>
<td>24 hours, once a week</td>
<td>Noise: At the project boundary nearest to the location where works are going on</td>
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<tr>
<td></td>
<td>Installation of equipment with noise enclosures (mufflers) as far as possible</td>
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<td>Checking commencement time and end time of machineries</td>
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<td>Operations to be carried out during the day time only. Acoustic Enclosure will be provided around D.G. Set</td>
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<td>Noise monitoring analysis results</td>
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<td>Proper Traffic Signage will be placed at several places within premises</td>
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<tr>
<td>Visual Aesthetics, Restriction to movement, traffic</td>
<td>Prior, transparent information disclosure, schedule of work disclosure, Traffic management, Alternate routes, Barricading of construction sites, Grievance resolving</td>
<td>EHS Supervisor</td>
<td>Construction I/C</td>
<td>Regular checking and taking feedback from local community</td>
<td>Regular inspection</td>
<td>Site &amp; surrounding feedback &amp; Grievance records</td>
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<tr>
<td>Incomplete removal of Project/constructio n materials</td>
<td>Clean-up of all worksites/work camps after project completion</td>
<td>Contactor</td>
<td></td>
<td></td>
<td>Site Inspections</td>
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<tr>
<td></td>
<td>Risk of soil, water, waste impacts from residuals left after project</td>
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<tr>
<td>Project Phase: Operation</td>
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<tr>
<td><strong>WTP</strong></td>
<td>Water pollution due to runoff of WTP effluent into surface water bodies</td>
<td>Suitably manage the WTP effluent, solid wastes, debris generated as per regulatory requirements</td>
<td>O&amp;M Staff/ Operator/ PIU</td>
<td>SS, pH, TDS, COD, BOD, Chloride, Sulphates, O &amp; G</td>
<td>Water Pollution: Once in month</td>
<td>Water: ETP analysis, inlet &amp; outlet</td>
</tr>
<tr>
<td></td>
<td>Runoff from solid waste storage</td>
<td></td>
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<td></td>
<td>Water pollution:</td>
<td></td>
<td>O&amp;M Staff/ Operator/ PIU</td>
<td>pH, TDS, Chloride, Sulphates, Heavy metals, Organics</td>
<td>Every month</td>
<td>Site well, nearby wells</td>
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<tr>
<td></td>
<td>Once in month</td>
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<td>Water:</td>
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<td></td>
<td>ETP analysis, inlet &amp; outlet</td>
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<td></td>
<td>Water quality records</td>
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<tr>
<td>Air Emission and Community risk due to Chlorine leakage</td>
<td>Disaster Management Plant &amp; Emergency Preparedness. Manage as per MSDS for chlorine gas.</td>
<td>Operating Unit/ Local administration</td>
<td>Regular checking &amp; maintenance</td>
<td>Leak test parameters</td>
<td>Every week</td>
<td>Refill system, Storage tanks &amp; delivery system</td>
</tr>
<tr>
<td>Sludge generation, Ground water contamination by percolation of solid/ hazardous waste dumps leachate</td>
<td>Solid &amp; hazardous wastes to be handled, identified segregated, stored, transported &amp; disposed as per the National regulation, MoEFCC/ CPCB guidelines Storage of hazardous wastes, sludges on impermeable material &amp; isolated</td>
<td>O&amp;M Staff/ Operator/ PIU</td>
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<tr>
<td>Downstream impact due to different competitive users</td>
<td>Estimation of different competitive users</td>
<td>IA, irrigation Dept.</td>
<td>Flow check downstream,</td>
<td>Flow rate upstream and</td>
<td>Quarterly/ lean season</td>
<td></td>
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<tr>
<td>extraction of water downstream including for irrigation, and to maintain flow sustainable even after projected population and water supply till 2055. It is broadly estimated that the project will draw about 10% of water flow in the canal. All precautions shall be taken in consultation with Irrigation department.</td>
<td>allocation/abstraction data, specially during lean seasons</td>
<td>downstream</td>
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</tbody>
</table>
1.3.1. **Anticipated Hazards and Mitigation Measures:**

1. **Air Pollution:**
   - The earth moving machinery, cranes and transporting truck should conform to permissible BS standard i.e. BS IV so as to limit the emission level of pollutants like SO$_2$, NOx etc.
   - The idling running of construction equipment’s should be avoided to reduce greenhouse gas emission.
   - Regular maintenance of vehicles and construction equipment’s/machines should be done.
   - To prevent dust pollution on roadways the material being transported in trucks need to be covered
   - The operators must be trained ones with valid license.

2. **Accidents during handling of Materials:**
   While handling materials mechanically suitable safety appliances should be used. Rigging and hauling jobs to be carried out by suitably trained and certified operators.

3. **Safe Operation and Safe Maintenance Procedures:**
   Safe operation procedures and safe maintenance procedures should be issued to operators, maintenance personnel and the contractual workers who are engaged in operation and maintenance/construction jobs. The documents should incorporate subjects like fire safety, housekeeping, safety in material handling, motor vehicle operational safety, safety in entering and working in a confined space, electrical safety, welding and cutting metals, ladder safety, road safety etc.

4. **Portable Electrical Appliances:**
   Electrical appliances like Hand lamps, electrical hand drills etc can cause electrocution. Such appliances must be thoroughly checked before being handled.

5. **Operation of Cranes:**
   Operation of cranes must be done by trained operators who must pass the specified test. The placement of crane vis-a-vis the boom length, load and placement distance must be supervised by qualified engineer for lifting of load. The cranes must be load tested and certified by competent person authorized by Director of Factories and Boilers, Punjab.

6. **Hot Mix Plant:**
   The hot mix plant shall be operated by skilled operators. Operation procedure must be explained to the persons handling the plant

1.4. **Risks Assessment Process:**
The PMIDC, MCA and Contractor shall review and take care of remedial measures for the Risk Analysis and Disaster Management Plan related with the water supply project in Amritsar.

1.4.1. Anticipated hazards of Natural Calamities

The project may be subjected to risks of extreme natural calamities like Flood and Earthquake etc. Mitigation measures against these extreme meteorological events are highlighted below.

**Table No. 2: Risks & Mitigation measure**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Potential Indicators</th>
<th>Period of Occurrence</th>
<th>Likely Risk &amp; Disasters</th>
<th>Mitigation Measures Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Flood due to excessive Rainfall</td>
<td>In WTP area never experienced</td>
<td>- Flooding of plant in case of excessive rains</td>
<td>• No such flood recorded in past.</td>
</tr>
<tr>
<td>2.</td>
<td>Cyclone</td>
<td>Periodic Occurrence</td>
<td>• No risks to structures</td>
<td>• No severe cyclone recorded in past decades.</td>
</tr>
<tr>
<td>3.</td>
<td>Earthquake (Seismic Zone IV)</td>
<td>Rare Occurrence</td>
<td>Moderate Risks to above ground structures</td>
<td>• The structures will be designed with recommended seismic coefficient as per BIS</td>
</tr>
</tbody>
</table>

1.4.2. Disaster due to Structural failure:

Disaster due to failure structures is a remote possibility as because the proposed, WTP and OHSR structures will be constructed with concrete and masonry over competent rock foundation.

1.5. Disaster Management Plan.

Disaster is an unexpected event due to sudden failure of the system, external threats, internal disturbances, earthquakes, fire and accidents. The first step is to identify the causes which develop/ pose unexpected danger to the structural integrity. The potential causes are cracks, accident, leakage of Chlorine gas etc. Additionally, there may be possibility of flooding in project during construction and Fire outbreaks during construction and Operation and Maintenance. Mitigation plans will be required before start of construction.

1.5.1. Preventive Action

Once the likelihood of a disaster is suspected, action has to be initiated to prevent a failure. Engineers responsible for preventive action should identify sources of repair equipments, materials, labour and expertise for use during emergency.

1.6. Reporting Procedures
The level at which a situation will be termed a disaster shall be specified. This shall include the stage at which the surveillance requirements should be increased both in frequency and details.

1.7. Communication System
An efficient communication system is absolutely essential for the success of any disaster management plan. This has to be worked out in consultation with local authorities. More often, the entire communication system gets disrupted when a disaster occurs. The damage areas need to be clearly identified and provided with temporary and fool proof communication system.

1.8. Emergency Action Committee
To ensure coordinates action, an Emergency Action Committee should be constituted. The civic administrator may be the Chairman of this Committee. The committee may comprise of:

- WTP In charge,
- Police Officer of the area,
- Amritsar Transport Corporation Representative,
- Home Guard representative,
- Fire Brigade representative,
- Health Department representative,
- Department of Information and Publicity, and
- Non-Governmental Organization of the area

Emergency Action Committee will prepare the evacuation plan and procedures for implementation based on local needs and facilities available. The plan should include:

- Demarcation of the areas to be evacuated with priorities,
- Safe route to be used, adequacy of transport for evacuation, and traffic control,
- Safe area and shelters,
- Security of property left behind in the evacuated areas,
- Functions and responsibilities of various members of evacuation teams, and
- Setting up of joint control room

All personnel involved in the Emergency Action Plan should be thoroughly familiar with all the elements of the plan and their responsibilities. They should be trained through drills for the Emergency Action Plan. The staff at the site should be trained for problem detection, evaluation and emergency remedial measures. Individual responsibility to handle the segments in emergency plan must be allotted.

Success of an emergency plan depends on public participation, their response to warning notifications and timely action. Public has to be educated on the hazards and key role in disaster mitigation by helping in the planned evacuation and rescue operations. It is essential to communicate by whom and how a declared emergency will be terminated. There should be proper notification to the public on de-alert signals regarding termination of the emergency. The notification should be clear so
that the evacuees know precisely what to do when re-entering or approaching the affected areas.

1.9. **Emergency Measures**

The emergency measures are adopted to avoid any failure in the system such as lights, fire, means of escape etc. The aim of Emergency Action Plan is to identify areas, population and structures likely to be affected due to a catastrophic event of accident. The action plan should also include preventive action, notification, warning procedures and co-ordination among various relief authorities. These are discussed in following sections.

1.10. **Emergency Lighting**

The emergency lights operated on battery power should be provided at affected area. The battery system should supply power as per electricity Rules, at least 25% of the lights at the plant/ OHSR for a period of 2 hours.

1.11. **Fire Protection**

The building materials should be of fire resistance standard. The fire resistance period should be at least 2 hours for surface or over head structures as per fire rules. Wood shall not be used for any purpose, excluding artificial wood products, which are flame resistant. The materials which have zero surface burning characteristics need to be used. The electrical systems shall be provided with automatic circuit breakers activated by the rise of current as well as activated by over current. The design of a station will include provision for the following:

- Fire prevention measures,
- Fire control measures,
- Fire detection systems,
- Access for fireman, and
- Means of fire fighting
- Means of escape.

A. **Fire Prevention Measures**

Fire prevention measures will be designed and implemented to minimize the risk of outbreak of fire by appropriate choice, location and installation of various materials and equipment. In plant and OHSR planning, potential sources of fire can be reduced by:

- Use of Non-combustible or smoke retardant materials where possible,
- Provision of layout which permits ease of maintenance for equipment and cleaning of the station premises,
- Prohibition of smoking in fire prone areas,
- Provision of cigarette and litter bins, and
- Good housekeeping.

B **Fire Control Measures**

Following provisions will be required from fire safety point of view:
• Automatic sprinkler/detection system to be provided if floor area exceeds 750 sq.m.
• Portable fire non-aqueous extinguishers of Carbon Dioxide, chemical dry powder etc. at suitable places.
• Automatic smokes venting facilities.
• Two separate means of exit shall be provided, if more than 10 persons are working.
• Fire resisting doors shall be provided at appropriate places along the escape routes to prevent spread of fire and smoke.
• The travel distance for fire escape shall not exceed 20 m where escape is available in more than one direction; the distance could be upto 40 m.

C Fire Alarm and Detection System
A complete fire detection system with equipment complying with the requirements of Amritsar Fire Services shall be provided throughout the plant and ancillary buildings including entrance and passageways etc. to give visual and audible indication of alarm conditions actuated by the operation of break glass contact or fire sensors e.g. detector heads, linear heat detecting cables etc. The system shall be operated from 24 V DC Power sources.

Smoke probe units shall be installed in rooms/ compartments. When an alarm point is operated, the fire pump shall start to operate automatically. A fire control and indicating panel shall be provided and installed in the plant controllers room, for the control, indication and monitoring of the whole detection and fire fighting systems. While designing the fire fighting system, Amritsar Fire Services shall be taken into account for linking with the same.

D Fire Control Measures
Control of the spread of fire and smoke will be achieved by partition of fire risk areas, planning for smoke extraction, and arrangement for smoke containment. Partition is aimed at limiting the extent of a fire. The openings must be capable of being sealed in the event of fire. With the exception of public areas, a fire compartment will not exceed 1500 m². The fire resistance period of this separated area should be about 3 hours.

E Access for Fireman
A secondary access to the plant, not used by workers for evacuation, shall be available to fireman should the need arise. The entry point shall be easily accessible from the road. The minimum width of the stairs is 1.0 m and maximum tread height should not exceed 25 cm.
ENVIRONMENT HEALTH SAFETY MANAGEMENT PLAN

The Contractor will prepare their own Safety manual on Occupational Health and Safety for the safety of all personnel working under the project and will be in line with the General Rules and Regulations on Occupational Health and Safety (OHS) in Building and Other Construction Workers (Regulation of Employment and Condition of Service) Act, 1996 and World Bank EHS guidelines on health and safety.

1. SAFETY OF WORKERS:

The Occupational Health and Safety program will aim to ensure that the workplace is safe and healthy by addressing the hazards and risks at the workplace; outlining the procedures and responsibilities for preventing, eliminating and minimizing the effects of those hazards and risks; identifying the emergency management plans for the workplace or workplaces; and, specifying how consultation, training and information are to be provided to employees at various workplaces.

Some of the risks/hazards associated with workplaces are due to working close to excavation area and associated with the various project construction activities. Other risks associated with the project construction phase include risk of increase of vector borne and other different diseases.

1.1 PPEs Requirement:

Risks to the health and safety of workers can be prevented by provision of Personal Protective Equipment (PPEs) to all workers. This will be included in the construction cost for the Contractor. Depending on the nature of work and the risks involved, contractors must provide without any cost to the workers, the following protective equipment:

i. Helmet shall be provided to all workers, or visitors visiting the site, for protection of the head against impact or penetration of falling or flying objects.

ii. Safety belt shall be provided to workers working at heights (more than 20 ft) such as plant roofing, painting, and plastering and OHSRs.

iii. Safety boots shall be provided to all workers for protection of feet from impact or penetration of falling objects on feet.

iv. Ear protecting devices shall be provided to all workers and will be used during the occurrence of extensive noise.

v. Eye and face protection equipment shall be provided to all welders to protect against sparks.

vi. Respiratory protection devices shall be provided to all workers during occurrence of fumes, dusts, or toxic gas/vapor.

vii. Safety nets shall be provided when workplaces are more than 25 feet (7.5 m) above the ground or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors or safety belts is impractical.
viii. Well equipped First Aid Box with all essential first aid items will be kept and maintained at the work site.

ix. The Contractor will have arrangement with nearby doctor/health center for attending injured person due to accident.

The specific PPE requirements for each type of work are summarized below.
Table 1: PPE Requirement List

<table>
<thead>
<tr>
<th>Type of Works</th>
<th>Type of PPEs requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevated work</td>
<td>Safety helmet, safety belt (height greater than 20 ft), footwear for elevated work.</td>
</tr>
<tr>
<td>Handling work safety</td>
<td>Helmet, leather safety shoes, work gloves.</td>
</tr>
<tr>
<td>Welding and cutting work</td>
<td>Eye protectors, shield and helmet, protective gloves.</td>
</tr>
<tr>
<td>Grinding work</td>
<td>Dust respirator, earplugs, eye protectors.</td>
</tr>
<tr>
<td>Work involving handling of chemical Substances</td>
<td>Dust respirator, gas mask, chemical-proof gloves. Chemical proof clothing, air-lined mask, eye protectors.</td>
</tr>
<tr>
<td>Wood working</td>
<td>Hard hat, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.</td>
</tr>
<tr>
<td>Blasting, if required for demolition of damaged OHSRs</td>
<td>Hard hat, Safety Shoes, eye and hearing protection</td>
</tr>
<tr>
<td>Concrete and masonry work</td>
<td>Hard hat, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.</td>
</tr>
<tr>
<td>Excavation, heavy equipment, motor graders, and bulldozer operation</td>
<td>Hard hat, safety boots, gloves, hearing protection.</td>
</tr>
<tr>
<td>Quarries and Borrow area operations, if done by contractor</td>
<td>Hard hat, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.</td>
</tr>
</tbody>
</table>

2. **PROPOSED HEALTH MANAGEMENT PLAN**

Health management plan for people in the adjoining area of the project and workmen engaged in the project is prepared based on the information collected on the existing health status, prevailing disease and other information on the health and hygiene. There are adequate health facilities in the project affected area (Amritsar city) with hospitals both Government as well as private.

**Likely impacts on health due to the project:**

There may be possible impacts on health of the local resident and impacts on the workmen engaged in construction site place. Due to the running of Construction Machinery and Heavy Vehicles, emissions like SO2, NOx. Dust and particulate emission due to movement of heavy vehicles and Earth Moving equipment will also take place. The emissions may cause respiratory problems like asthma and other disease.

**Mitigation Measure:**
Proper road has to be constructed along canal a little away from canal bank facilitating movement of vehicles and equipment’s for construction and operation of the proposed Water Treatment Plant.

- Wet excavation of exposed surfaces shall be adopted. Frequent water sprinkling at least thrice a day shall be carried out in the project activity area.
- The heavy vehicles like trucks, excavators, diggers, scrappers, dozers etc shall comply to the BS IV standard.
- The vehicles are to be maintained routinely to avoid untoward emission
- Idle running vehicles and construction equipment should be avoided.

2.4 Anticipated Health impacts due to Water Pollution

- To accommodate the influx of labor force during construction make-shift arrangements shall be provided. The sanitation of the labor camp area is normally not kept hygienic and tidy. This may cause water born dieses like Typhoid, Cholera & Gastroenteritis etc.
- The localized stagnation of water in borrow pit areas is expected during construction which may spread bacteria related dieses if suitable preventive action is not taken

Mitigation Measures:

- Proper sanitation and hygiene facilities will be provided at camp site to avoid disease related to sewage pollutants.
- Antibacterial insecticides need be sprayed on accumulated water in borrow pits during rainy season
- The project proponent shall undertake various awareness programs by organizing different camps where awareness on prevention and control of various diseases such as Malaria, Dengue, Cholera, Gastroenteritis, STD, AIDS, and Cancer etc. shall be focused.
- Temporary labor camps shall be provided with sewage facilities and the hygiene of the camp shall be looked onto.
- The laborers shall be provide with fuel gas for cooking gas
- Construction site will have health/first aid facility including adequate supply of sterilized dressing materials and appliances and suitable transport to take the injured person to the nearest hospital.
- Drinking Water used by the construction workers in the project or the people in the adjoining area whether form ground water

Controlling Water borne diseases

Various measures recommended for control of water borne diseases are given below.

- It is recommended that details of incidence of various water borne diseases in the project areas, blocks be collected and detect to defect any particular trend.
- Detailed water quality monitoring program be designed and implemented. In areas showing incidence of water-borne diseases, intensive water quality monitoring need to be done.
- Adequate training at village level needs to be given. Drinking water must be regularly tested for the following tests;
- Ortho-tolodine tests for chlorine
• Lead Acetate paper test for bacterial infection.
• Development of sanitation facilities in the project area
• Disposal of solid waste and sewage from various sources at appropriate sites located at suitable distance from drinking water sources. The sites can be selected in consultation with the local administration
• Provision of onsite chlorination facilities at appropriate locations in the area.
• Provision of chlorine tablets to the population which cannot be served with chlorinated water.
• Regular monitoring and surveillance of drinking water.

2.5 Health Impacts due to improper Solid Waste Disposal:
Solid Wastes if not disposed off or dumped properly may case air or water pollution which will affect health and hygiene of the residents in the area.

Waste Management Plan
• People or labor staying during construction and operation phase of the project site may generate wastes from different sources. Wastes are the Primary problems during the construction phase of the project which may affect the human life as well as the construction process and the environment.
• After completion of the project, the site will be covered with vegetation. Landscaping will be done in open areas with gentle gradient in the land surfaces so as to avoid soil erosion.
• Water drainage system for draining the surface runoff will be provided. Proper storage of the construction materials will be ensured.
• Waste collection site to be maintained for the collection of the construction waste. Construction waste will be dumped in the designated area.
• Paint brushes, roller, excess paints and containers of paints will be disposed off as per Hazardous waste management Rule 2016. Similarly solid waste generated in the site due to human activities will collected and disposed properly.
• Construction and Demolition Waste shall be done as per Construction and demolition Waste Rules 2016.

2.6 Anticipated Health Impacts in Operation phase and Health Facilities:
• The existing hospital facility at Amritsar will cater to the needs of the staff
• In the operation phase of the project solid waste generated from different sources properly collected and disposed to maintain hygiene condition.
• No indiscriminate disposal of garbage will be allowed within the complex. Proper waste collection system shall be maintained.
• Solid waste generated from the residential area will be separated as biodegradable and non bio degradable which will collected and stored differently. Stored bins send to the approved agency for final disposal.
• All hazardous waste will be disposed as per hazardous waste management and handling rules.

To ensure good health of the Workmen and local people in the area the following activities also will be looked into Public Awareness Program. It is proposed that a
detailed health awareness program be implemented in the project and the surrounding areas. The objectives of the program are to:

- Enhance knowledge, awareness about various diseases and actions to be taken in case of an epidemic.
- Develop community education messages to provide the community with information about recognizing the illness, how to prevent transmission and when to seek treatment.
- Initiate proper communication with the community as soon as epidemic or public health problem is identified.

As a part of the awareness program, locals should be made aware of the following measures about various commonly prevalent diseases in the area.

- Signs and symptoms of the disease
- Feasible and cost-effective preventive measures
- When to come to the health facility for consultation and treatment
- Immunization recommendations, if any.

The message should be clear and concise in local language. Special care should be taken that sentiments and cultural beliefs of the target population are not hurt. The awareness programs could use the following means of communication.

- Radio
- Television
- Newspaper
- Meeting with health personnel, community, religious and political leader.
- Posters
- Presentations at markets, health centers, schools women’s & other community groups, service organizations, religious centers.

Select and use a community liaison or health staff to serve as spokesperson for interaction within media, and provide information related to the epidemics and Vaccination Program:

The borrow pits developed due to construction activities provide harboring ground for increase of mosquito population and develop the risk of malaria, dengue and elephantiasis during rains. Proper preventive measures need be taken to maintain hygienic conditions in the area. Besides, arrangement must be made for distribute medicines and anti malaria drugs as and required. Various vaccination programs shall be arranged periodically for workmen and locals of the project site.

**Health Check up of Workmen of the Project and adjoining areas:**

In spite of various mitigation measures to abate air, noise and water pollution, still health of workmen and locals may be affected. Therefore, periodic health checkup need to be done. The project authorities should plan for check up of heart, lung, eye and audiometric test, existence of Communicable diseases among the work force etc.

**Health Extension Activities**

The health extension activities will have to be carried out in the villages situated within the study area. It is important to inculcate hygienic habits of environmental sanitation especially with respect to water pollution by domestic wastes. There would be possibility of the transmission of communicable diseases due to migration of labor population from other areas at the construction site. It is proposed to strengthen the
health institutions like community centers and primary health centers already available in these blocks. The project authorities can take the initiative and release certain funds at least for first five years to streamline the medical assistance for malaria and gastro enteritis disorders. Following medical facilities are available in the blocks.

**Medical facilities available in the locality:**

The doctors from the Hospitals and Health Centers may be organized to work as a part of the city health system and the dispensaries in various parts will make regular visits to the villages and organize health promotional activities with the active participation of the local leaders, NGOs and available local health functionaries. The health functionaries would undertake the following tasks as a part of health promotional activities;

- Maintain close surveillance on incidence of communicable diseases in the area.
- Maintain close liaison with the community leaders and health functionaries of different departments, so that they can be mobilized in case of an emergency.

**Disease Prevention**

**Communicable Diseases:**

Communicable diseases pose a significant public health threat worldwide. Health hazards typically associated with large development projects are those relating to poor sanitation and living conditions, sexual transmission and vector-borne infections. Communicable diseases of most concern during the construction phase due to labor mobility are sexually-transmitted diseases (STDs), such as HIV/AIDS. Recognizing that no single measure is likely to be effective in the long term, successful initiatives typically involve a combination of behavioral and environmental modifications has been suggested and mentioned below:

**Recommended interventions at the project level include:**

- Providing surveillance and active screening and treatment of workers
- Preventing illness among workers in local communities by:
  - Undertaking health awareness and education initiatives, for example, by implementing an information strategy to reinforce person-to-person counseling addressing systemic factors that can influence individual behavior as well as promoting individual protection, and protecting others from infection, by encouraging condom use.
  - Training health workers in disease treatment
  - Conducting immunization programs for workers in local communities to improve health and guard against infection.
  - Providing health services.
  - Providing treatment through standard case management in on-site or community health care facilities. Ensuring ready access to medical treatment, confidentiality and appropriate care, particularly with respect to migrant workers
  - Promoting collaboration with local authorities to enhance access of workers families and the community to public health services and promote immunization

**Vector-Borne Diseases:**

- Reducing the impact of vector-borne disease on the long-term health of workers is best accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease. Project sponsors, in close
collaboration with community health authorities, can implement an integrated control strategy for mosquito and other arthropod-borne diseases that might involve:

- Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements.
- Elimination of unusable impounded water.
- Increase in water velocity in natural and artificial channels.
- Considering the application of residual insecticide to dormitory walls.
- Implementation of integrated vector control programs.
- Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites.
- Use of chemoprophylaxis drugs by non-immune workers and collaborating with public health officials to help eradicate disease reservoirs.
- Monitoring and treatment of circulating and migrating populations to prevent disease reservoir spread.
- Collaboration and exchange of in-kind services with other control programs in the project area to maximize beneficial effects.
- Educating project personnel and area residents on risks, prevention, and available treatment.
- Monitoring communities during high-risk seasons to detect and treat cases.
- Distributing appropriate education materials.
ANNEXURE-ENV4
CONSTRUCTION AND LABOUR CAMPS MANAGEMENT

1.0 Introduction
The scope of this guideline pertains to the siting, development, management and restoration of construction and labour camps to avoid or mitigate impacts on the environment. The area requirement for the construction camp shall depend upon the number of labourers employed and the extent of machinery deployed. The following sections describe the siting, construction, maintenance, provision of facilities in the camps and finally rehabilitation of the construction and labourers camps. These are described in three stages, pre-construction and construction stage.

2.0 Pre-Construction Stage
Identification of site for construction and labour camps is the first task. The Contractor shall identify the site for construction camp in consultation with the individual owners in case of private lands and the concerned department in case of Government lands. The suitable sites shall be selected and finalized in consultation with the Engineer in charge.

The contractor will work out arrangements for setting up his facilities during construction period with the land owner/concerned department. These arrangements shall be in the form of written agreement between the contractor and the land owner (private/government) that would specify:

a) Photograph of the proposed camp site in original condition;
b) Activities to be carried out in the site;
c) Environmental mitigation measures to be undertaken to prevent land, air, water and noise pollution;
d) Detailed layout plan for development of the construction and labour camp that shall indicate the various structures to be constructed in the camp including temporary drainage and other facilities; and
e) Restoration plan of camp site to pre-camp conditions.

The arrangements will be verified by the Engineer in charge to enable redressal of grievances at a later stage of the project cycle.

2.1 Setting up of labour camp:
The contractor shall provide free of cost in the camp site, temporary living accommodation to all the migrant workers employed by him till completion of construction/maintenance work is in progress. The Contractor will comply with the statutory requirements as per Building and Other Construction Workers (Regulation of Employment and conditions of Service) and the World Bank guidelines on accommodation facility for workers

- The Contractor agency will setup their camping locations at different places as would be identified.
- Each labour camp may house 50 labourers.
• These camps should be located away from the existing village or semi urban households to prevent likely social conflicts.
• Necessary permissions may be obtained from the respective revenue/municipal authorities.
• Temporary house structures should be provided by the contractor agencies to accommodate the laborer’s and their families, with provision of minimum infrastructure facilities, like water supply, sanitation and electricity etc.
• A minimum area of 6 sq. m per person shall be provided.
• The rooms of labour shall be well lighted and ventilated.

The facilities to be provided for the laborer’s are discussed below:

a) Drinking Water
Towards the provision and storage of drinking water at the construction camp, the contractor shall ensure the following.

• The contractor shall provide for a continuous and sufficient supply of potable water in the camps, in earthen pots or any other suitable containers.
• If any water storage tank is provided, the bottom of the tank will be kept at least 1mt. above from the surrounding ground level.
• The contractor shall identify suitable community water sources for drinking. Only in the event of non-availability of other sources of potable water, the Contractor shall obtain water from an unprotected source only after the testing for its potability. Where water has to be drawn from an existing open well, the well shall be properly chlorinated before water is drawn from it for drinking. All such wells shall be entirely closed in and be provided with dust proof trap door.
• Every water supply or storage shall be at a distance of not less than 15m from any wastewater / sewage drain or other source of pollution. Water sources within 15m proximity of toilet, drain or any source of pollution will not be used as a source of drinking water in the project.

b) Washing and Bathing Facilities
In every site, adequate and suitable facilities for washing clothes and utensils shall be provided and maintained for the use of contract labor employed therein. Separate and adequate bathing shall be provided for the use of male and female workers. Such facilities shall be conveniently accessible and shall be kept in clean and hygienic conditions.

c) Toilets Facilities
Each labour camp should be provided with community toilets with septic tank and soak pit arrangement or use of bio-toilets. Sanitary arrangements, latrines and urinals shall be provided in every work place separately for male and female workers. The arrangements shall include:

• A latrine for every 15 labourer’s or part thereof.
• Every latrine shall be under cover and so partitioned as to secure privacy, and shall have a proper door and fastenings.
• Where workers of both sexes are employed, there shall be a pictorial display board of “For Men Only” or “For Women Only” outside each block of latrine and urinal in the language understood by the majority of the workers.
• The latrines and urinals shall be adequately lighted and shall be maintained in a clean sanitary condition at all times and should have a proper drainage system.
• Water shall be provided in or near the latrines and urinals by storage in suitable containers.

d) Supply of Free Fuel
• The project authorities would ensure supply of free fuel to these labourers through the contract agencies so as to prevent unscrupulous activities of cutting trees and bushes for meeting their fuel wood requirement which would destroy the adjacent green cover and affect the local ecology.
• Arrangement may be made with the local Civil Supply Authorities for Supply of kerosene oil at a fixed quota.
• Use of LPG gas cylinders may also be encouraged for intending labourers.

The contract specification should include these fuel supplies free of cost to the labour force within the bid value of relevant contract items.

e) Waste Disposal
• Disposal of sanitary wastes and excreta shall be into septic tanks.
• Kitchen waste water shall be disposed into soak pits/kitchen sump located preferably at least 15 meters from any water body. Sump capacity should be at least 1.3 times the maximum volume of wastewater discharged per day. The bottom of the pit should be filled with coarse gravel and the sides shored up with board, etc. to prevent erosion and collapse of the pit. New soak pits shall be made ready as soon as the earlier one is filled.
• Solid wastes generated in the kitchen shall be reused if recyclable or disposed off in land fill sites.
• Provide segregated garbage bins in the camps and ensure that these are regularly emptied and disposed off in a hygienic manner as per the Comprehensive Solid Waste Management Plan approved by the Environmental Expert of PMU.
• The camping area should be periodically sprayed with Bleaching powder and other disinfectants.

f) Medical and First Aid Facilities
Medical facilities shall be provided to the labourers at the construction camp. Visits of doctor shall be arranged twice a month wherein routine checkups would be conducted for women and children. A separate room for medical checkups and keeping of first aid facilities should be built. The site medical room should display awareness posters on safety facilitation hygiene and HIV/AIDS awareness.
First Aid Box will be provided at every construction camp site and under the charge of a responsible person who shall always be readily available during working hours. He shall be adequately trained in administering first aid-treatment. Formal arrangement shall be prescribed to carry injured person or person suddenly taken ill to the nearest hospital.

The first aid box shall contain the following.

- 6 small sterilized dressings
- 3 medium size sterilized dressings
- 3 large size sterilized dressings
- 3 large sterilized burns dressings
- 1 (30 ml) bottle containing 2% alcoholic solution of iodine
- 1 (30 ml) bottle containing disinfectant like Dettol/ Savlon or similar.
- 1 snakebite lancet
- 1 (30g) bottle of potassium permanganate crystals
- 1 pair scissors
- Ointment for burns
- A bottle of suitable surgical antiseptic solution

In case, the number of labour exceeds 50, the items in the first aid box shall be doubled.

g) Provision of Shelter during Rest

The work place shall provide four suitable sheds, two for meals and two for rest (separately for men and women). The height of the shelter shall not be less than 3.0m from the floor level to the lowest part of the roof. These shall be kept clean.

h) Crèches:

In case 20 or more women workers are employed, there shall be a room of reasonable size for use of children under the age of six years. The room should have adequate light. A caretaker is to be appointed to look after the children. The use of the room shall be restricted to children, their mothers and the caretaker.

2.2 Fire Fighting Arrangement

The following precautions need to be taken:

- Demarcation of area susceptible to fires with cautionary signage;
- Portable fire extinguishers and/or sand baskets shall be provided at easily accessible locations
- In the event of fire; Contractor shall educate the workers on usage of these equipment’s.

2.3 Interactions With Host Communities

To ensure that there is no conflict of the migrant labor with the host communities, the contractor shall issue identity cards to laborer’s and residents of construction camps.

3.0 Construction Stage

Construction camps shall be maintained free from litter and in hygienic condition. It should be kept free from spillage of oil, grease or bitumen. Any spillage should be
cleaned immediately to avoid pollution of soil, water stored or adjacent water bodies. The following precautions need to be taken in construction camps.

- Measures to ensure that no leaching of oil and grease into water bodies or underground water takes place.
- Wastewater should not be disposed into water bodies.
- Regular collection of solid wastes should be undertaken and should be disposed off safely.
- All consumables as the first aid equipment, cleaning equipment for maintaining hygiene and sanitation should be recouped immediately.
- The debris/scrap generated during construction of camp site should be kept in a designated and barricaded area.

The Engineer in charge will monitor the cleanliness of construction camp sites and ensure that the sites are properly maintained throughout the period of the contract.

4.0 Post Construction Stage

At the completion of construction, all construction camp facilities shall be dismantled and removed from the site. The site shall be restored to a condition in no way inferior to the condition prior to commencement of the works. Various activities to be carried out for site rehabilitation include:

- Oil and fuel contaminated soil shall be removed and transported and buried in waste disposal areas.
- Soak pits, septic tanks shall be covered and effectively sealed off.
- Debris (rejected material) should be disposed off suitably.
- Underground water tank in a barren/non-agricultural land can be covered. However, in an agricultural land, the tank shall be removed.
- If the construction camp site is on an agricultural land, top soil can be spread so as to aid faster rejuvenation.
- Proper documentation of rehabilitation site is necessary. This shall include the following: –
  - Photograph of rehabilitated site;
  - Land owner consent letter for satisfaction in measures taken for rehabilitation of site;
  - Undertaking from contractor; and Certification from Engineer in charge.

In cases, where the construction camps site is located on a private land holding, the contractor would still have to restore the campsite as per this guideline. Also, he would have to obtain a certificate of satisfaction from the landowner.
### ANNEXURE-ENV5

National Ambient Air Quality Standard (as per MoEF Notification of 16 Nov., 2009)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Pollutant</th>
<th>Time Weighted Average</th>
<th>Concentration in Ambient Air</th>
<th>Methods of Measurement</th>
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</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td>Industrial, residential, Rural and Other Area</td>
<td>Ecologically Sensitive Area</td>
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<td>20 80</td>
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<td>Particulate Matter (size &lt; 10µm or PM10) µg/m³</td>
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<td>Ozone (O₃) µg/m³</td>
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<td>Lead (Pb) µg/m³</td>
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<td>8</td>
<td>Ammonia (NH₃) µg/m³</td>
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<td>Nickel (Ni), ng/m³</td>
<td>Annual *</td>
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<td>20</td>
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</tbody>
</table>

* Site taken twice a week 24 hourly at uniform intervals.
** 24 hourly or 08 hourly or 01 hourly mentioned values, as applicable, shall be complied with 98% of the time in a year, 2% of the time; they may exceed the limits but not on two consecutive days of monitoring.
## ANNEXURE-ENV6

### Ambient Noise Standards

#### SCHEDULE

(see rule 3(1) and 4(1))

<table>
<thead>
<tr>
<th>Area Code</th>
<th>Category of Area / Zone</th>
<th>Limits in dB(A) Leq*</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Day Time</td>
</tr>
<tr>
<td>(A)</td>
<td>Industrial area</td>
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<tr>
<td>(B)</td>
<td>Commercial area</td>
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</tr>
<tr>
<td>(C)</td>
<td>Residential area</td>
<td>55</td>
</tr>
<tr>
<td>(D)</td>
<td>Silence Zone</td>
<td>50</td>
</tr>
</tbody>
</table>

**Note:**
1. Day time shall mean from 6.00 a.m. to 10.00 p.m.
2. Night time shall mean from 10.00 p.m. to 6.00 a.m.
3. Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority.
4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

* dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

A "decibel" is a unit in which noise is measured.

"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq: It is an energy mean of the noise level over a specified period.
## PHYSICO-CHEMICAL PARAMETERS OF GROUND WATER SAMPLES

<table>
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<td>Odour</td>
<td>AL</td>
<td>AL</td>
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<td>3</td>
<td>Taste</td>
<td>AL</td>
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<td>4</td>
<td>Turbidity</td>
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<td>21</td>
<td>Arsenic (as As)</td>
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<tr>
<td>22</td>
<td>Cyanide (as CN)</td>
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<td>0.05</td>
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<tr>
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<td>Lead (as Pb)</td>
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<td>Zinc (as Zn)</td>
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<td>25</td>
<td>Total Chromium (as Cr)</td>
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<td>26</td>
<td>Total Alkalinity as (CaCO₃)</td>
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<tr>
<td>27</td>
<td>Aluminum (as Al)</td>
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<tr>
<td>28</td>
<td>Boron (as B)</td>
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</tr>
</tbody>
</table>

NB: CL-Colourless, AL-Agreeable
## PHYSICO-CHEMICAL PARAMETERS OF SURFACE WATER SAMPLES

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Test Parameters</th>
<th>Unit</th>
<th>Max. Tolerance Limit as per IS 2296 : Class C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Colour, Max.</td>
<td>Hazen</td>
<td>300</td>
</tr>
<tr>
<td>2</td>
<td>pH value @ 25°C</td>
<td>-</td>
<td>6.5 to 8.5</td>
</tr>
<tr>
<td>3</td>
<td>Iron as Fe, Max.</td>
<td>mg/l</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>Chloride as Cl, Max.</td>
<td>mg/l</td>
<td>600</td>
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<td>5</td>
<td>Total Dissolved Solids, Max.</td>
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<td>6</td>
<td>Dissolved Oxygen, Min.</td>
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<td>7</td>
<td>BOD for 3 days at 27°C, Max.</td>
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<td>3</td>
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<tr>
<td>8</td>
<td>Oil &amp; Grease, Max.</td>
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<tr>
<td>9</td>
<td>Copper as Cu, Max.</td>
<td>mg/l</td>
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<td>10</td>
<td>Sulphate as SO₄, Max.</td>
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<td>11</td>
<td>Nitrate as NO₃, Max.</td>
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<tr>
<td>12</td>
<td>Fluoride as F, Max.</td>
<td>mg/l</td>
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</tr>
<tr>
<td>13</td>
<td>Anionic detergent</td>
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<tr>
<td>14</td>
<td>Cadmium as Cd, Max.</td>
<td>mg/l</td>
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</tr>
<tr>
<td>15</td>
<td>Selenium as Se, Max.</td>
<td>mg/l</td>
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<tr>
<td>16</td>
<td>Arsenic as As, Max.</td>
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<tr>
<td>17</td>
<td>Cyanide as CN, Max.</td>
<td>mg/l</td>
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</tr>
<tr>
<td>18</td>
<td>Phenolic compound as C₆H₅OH, Max.</td>
<td>mg/l</td>
<td>0.005</td>
</tr>
<tr>
<td>19</td>
<td>Lead as Pb, Max.</td>
<td>mg/l</td>
<td>0.1</td>
</tr>
<tr>
<td>20</td>
<td>Zinc as Zn, Max.</td>
<td>mg/l</td>
<td>15</td>
</tr>
<tr>
<td>21</td>
<td>Hexavalent Chromium as Cr⁶⁺, Max.</td>
<td>mg/l</td>
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</tr>
<tr>
<td>22</td>
<td>Total Coliform, Max.</td>
<td>MPN/ 100ml</td>
<td>5000</td>
</tr>
</tbody>
</table>
PART 2
SECTION-VII

F - SAFETY PROVISIONS
SECTION- VII-F

SAFETY PROVISIONS

The Contractor shall be responsible for ensuring throughout the contract period all the safety measures at site of work so as to prevent loss of life, property and damage of partially or completed works.

Safety Precautions

The Contractor shall comply with any safety instruction given by the Engineer-in-Charge. In the performance of the works, the Contractor shall exercise every reasonable precaution to protect persona or property from injury. The contractor shall erect and maintain all necessary temporary fencing, barricades, barriers, sign and lights and provide the alarm, fire extinguishing and firefighting services at strategic points on the site. The Contractor shall adopt and enforce such rules and regulations as may be necessary, desirably or proper to safeguard the public and all personal engaged in the work and its supervision.

Safety Officer

The Contractor shall constantly assign, during the progress of the works, and employee qualified in safety and familiar with the type of work being performed, whose assignment shall include initiation of measures for the protection of health and the prevention of accidents and who shall see, by personal inspection, that all safety rules and regulations are enforced. The contractor shall hold regularly safety meetings with contractor’s workers/ labour, supervisors and foremen for “work instructions” on daily basis and also with JE/ AE on daily basis, at least once each month scheduled with the Engineer-in-Charge. When directed additional meetings will be held. The Contractor will keep the Engineer-in-Charge advised as to when these meetings are to be held and shall provide the Engineer-in-Charge with a copy of the proposed meeting with action plan with copy of minutes of his daily meeting & to seek his directions.

Safety Measures

The Contractors shall at his own expense provide and erect, to the approval of the Engineer-in-Charge, such export as may be required to protect efficiently all structures or works which may be endangered by the execution of the works and he shall remove such supports on completion of the works or otherwise take such permanent measures may be required by the Engineer-in-Charge to protect the structures or works.

The Contractor is to execute the works in such a manner that he does not damage or interfere with existing services which are located in proximity to the site. The Contractor shall be responsible for any damage or interference shall be caused to these services due to the execution of the works and shall carry out all necessary repairs at his expense and to the satisfaction of the Engineer-in-Charge.

The safety measures taken by Contractor shall include but shall not be limited to the following-

a) Temporary Fencing

The Contractor shall erect, maintain and remove suitable and approved temporary fencing to enclose such areas of the Permanent works and areas of land occupied by
the Contractor within the site as may be necessary to implement his obligations under the contract, to the satisfaction of the Engineer-in-Charge. Where any temporary fence has to be erected alongside a public road, footpath etc. it shall be of the type required by and shall be erected to the satisfaction of the Government authority concerned. The contractor may erect boundary walls around WTP site as per specifications in advance to save expenses for temporary fencing of WTP site.

b) **Lighting** – The Contractor shall provide sufficient lighting in all places where work is in progress, such that –

i) Safe working conditions are provided both for the Contractor’s personnel, subcontractor’s personnel and for personnel of the Engineer-in-Charge.

ii) The works can be constructed in complete compliance with the contract and

iii) A complete inspection of all works in progress can be made by the Engineer-in-Charge.

c) The minimum service luminance on ground or working surfaces to be provided for the various operations or work areas shall be as directed by the Engineer-in-Charge.

d) The Contractor shall supply a suitable instrument to the Engineer-in-Charge for measuring the intensity of illumination.

e) All mobile equipment or plant used during night operations, as and when approved by the Engineer-in-Charge, shall be equipped with sufficient lights and reflectors to ensure safe working conditions.

f) Not less than fourteen (14) days before the start of night operations, the Contractor shall submit his proposals for lighting in the areas in which he proposes to work at night to the Engineer-in-Charge. The Contractor shall modify the proposals if required by the Engineer-in-Charge, and shall not begin operations at night until the proposals for lighting (in and amended form if required) have been approved.

g) Approval of the Contractor’s proposals for lighting shall not relieve the Contractor of any of his liabilities or obligations under the Contract.

h) Work in the vicinity of electrical equipment – In the interest of safety and security, the Contractor shall complete the erection of any safety fencing around electrical and mechanical apparatus by the time that the said apparatus is connected to any electricity supply.

i) **Safety Instructions** – The Contractor shall at his own cost supply and issue to his employees and those of his subcontractors and the staff of the Engineer-in-Charge The Safety printed booklets, of pocket size, on the scale of one per person, in English/ Hindi and/or in other languages used by his employees at site, instructions based on good practice. Within sixty (60) days of the Engineer-in-Charge’s written order to commence the works at site, proof copies of the booklet shall be submitted for approval before printing and amendments shall be made to the booklet to his entire satisfaction. The Contractor shall issue the booklet immediately after printing as required by this clause and ensure that all employees are fully conversant with the instructions. Safety instruction shall deal with all safety including –

- Protective clothing, headgear and footgear.
- Use of lifting equipment.
- Use of drilling equipment.
• Contract with and use of electrical equipment.
• Use and storage of explosives.
• Compressed air.
• Welding.
• Routine for accidents or fires and
• Watchmen, warning notices and barriers.

The Contractor shall arrange for 50 booklets per year for the use.

j) The Contractor shall provide for the Engineer-in-Charge’s supervisory staff the protective clothing, headgear and footwear necessary for the proper discharge of their duties on site.

k) **Accident Report** - The Contractor shall promptly report to the Engineer-in-Charge, all accidents involving death or serious injury to staff or workmen, and furnish monthly reports of all accidents to staff or workmen involving loss of time, giving such information as may be prescribed by the Engineer-in-Charge.

l) The Contractor shall provide all necessary signs for the works. These shall include, but not be limited to –

- Use of sirens before blasting and all clear indication
- Standard road signs
- Warning signs
- Danger signs
- Control signs
- Safety signs and
- Direction signs

m) Wording on all signs shall be in English/ Regional and other approved languages. The size, colour, lettering and location of all signs will be subject to approval and attention shall be paid to international signs.

n) The Contractor shall maintain all signs placed by him as well as those placed by the Employer.

o) If the Engineer-in-Charge considers that the system of signs provided by the Contract is inadequate to ensure safety, or unsatisfactory in other respects, the contractor shall add to amend, or otherwise change the system to the satisfaction of the Engineer-in-Charge.

p) The Contractor shall at his own cost make suitable replacement as directed by the Engineer-in-Charge in case of loss or damage to any signs provided by the contractor under this Sub.-Clause.

q) The Contractor shall at his own cost adopt such measures as the Engineer-in-Charge may consider reasonable and necessary to minimize nuisance from dust, noise or other disturbance created while or in carrying out the works.

**Separate payment will not be made for complying with the provisions of this clause(s)** and all costs shall be deemed to be included in the various rates in the priced Bill of Quantities. Safety equipment’s for Workforce Safety: The Contractor will maintain minimum 350 sets of Personal Protective Equipment’s at all times and will ensure that the
(1) Safety Helmets/ proper rating helmets
(2) Safety harness
(3) Day glow waist coat
(4) Industrial goggles
(5) Safety boots
(6) Gloves
(7) Nasal masks
(8) Ear plugs

In case failure to provide the equipment’s within 2 weeks time from the commencement of works, penalty @ Rs. 2000/- per item there off in addition to the actual cost of the above items will be imposed.

**Measurement of Payments**

The unit number of PPEs shall be measured and the stock shall be verified by the Engineer.

**Fire prevention :**

The Contractor shall provide and maintain adequate fire- fighting equipment and take adequate fire precautions measures for the safety of all personnel, temporary and permanent works, and shall take action to prevent damage to or situation by fire of trees, shrubs or grasses.

**Separate payment will not be made for the provision of fire prevention measures.**

**First Aid & Medical Facilities :**

**General :**

The Contractor shall in all respects be fully responsible for ensuring necessary first aid services to his employees and employees of the subcontractors, including transport for injured personnel to hospital or other appropriate accommodation as and when required.

**Health Checkups and AIDS/HIV Awareness Program:**

The contractor shall conduct quarterly health and safety awareness programs focusing on HIV/AIDS and other sexually transmitted and other communicable diseases through NGOs or other medical experts.

**Staff :**

To enable fulfillment of the obligations under this clause, the contractor shall engage qualified resident field staff, and shall arrange for the treatment of causalities on the site in first aid units and for removal by ambulance of injured or site employees to hospitals or their homes.
Separate payment will not be made for first aid and medical facilities provided by the Contractor for his employees and the employees of his subcontractors. The facilities shall be also available for the use of staff of Engineer-in-Charge.

Contractor with the help of local medical department should conduct AIDS awareness Campaign for every month to bring awareness to the labour employed by him. Safety coordinator shall monitor and ensure implementation of Health, Safety and Environment measures through Safety personnel located at job sites. Besides the enforcement of engineering measures and management control, the Personal Protective Equipment (PPE) as per needs of the operation and conforming to relevant Indian Standards/International Standards are provided to employees. Inspection and safety audits are conducted periodically.

Safety awareness among employees is created and sustained through regular training programs.

Safety Activities

- Continuous efforts of Contractor’s Safety Officer ,& concerned E-I-C’s representative ,
- Safety forums accident prevention program & 100% PPE.
- Project Safety Committee all participative safety forums.
- Safety committees in contracting agencies as per BOCW act. Emergency Management Plan & Training.
- Safety Awareness Camps on monthly basis & pep-talks on Daily basis on start of work by Safety Officer.
- Safety audits by internal & external agency.
- Best Safety Worker of the Month Awards.
- Safety & Housekeeping Awards to sub -Contracting agencies.
- Conducting Safety training program.,
- Safety Training Calendar.
- Safety & First aid training.
- “Periodical medical check-up of construction workers”.
- National Safety Day.
- Medical & first aid facilities ambulances.
- Review of Safety matters by Engineer.
- Implementation of all recommendations of previous audit report.
- Mobile Phone at office & residence, vehicle.

Team Work:

- Rescue team to be formed and proper training to be imparted to the team to rescue the entrapped workers/personnel in case of any emergency/ collapse.
- Rescue equipment like BA sets, emergency lamps etc., should be available at the site for rescue operations.
- Communication system should be perfect during the tunneling operation/ work.
• Use of appropriate PPE to be ensured.
• Electrical equipment’s to be perfectly earthed and away from wet area.

**Portable Electrical Equipment/Hand tools:**

- Electrical portable equipment & hand tools are to be checked for their healthiness by a qualified electrical personnel of Electrical Erection Dept., of Engineer.
- The electrical connections/supply points need proper attention.
- Electrical cables/wirings

**Safety Officer/Representatives:**

- To impart training to those safety representatives. Minimum One (1)-day training program(s) for.

**Heavy Earthmoving Equipment & Operators:**

- The heavy earth moving equipment/crane operators needs eye examination as per statutory norms.

**Storing of Light Diesel Oil**

Safety among others shall include :-

**Hazardous Materials:**

- The Contractor shall prohibit employees from unauthorized use of explosives, poaching wildlife and cutting trees. The contractor shall be responsible for the action of his employees.
- The Contractor shall not store hazardous materials near water surface. The Contractor shall provide such protective clothing or appliances when it is necessary to use hazardous substances.
- High concentration of airborne dust resulting in deposition and damage to crops and water resources shall be provided. The contractor shall take every precaution to control excessive noise resulting in disruption to wildlife and human population.

**Provision and Maintenance of Stores and Equipment’s**

- Space allocated for storage of materials such as cement, gabion wire, reinforcing wire etc. shall in general be damp-free, rainproof and away from petroleum products storage.
- Written information must be given to, and approval be taken from, the Engineer-in-Charge regarding the paper establishment and maintenance of such stores & safety measures. Failure to comply with the Engineer’s instruction in respect of overall standards will lead to the reduction or withholding of payment.

**Reinstatement of Environment**
The Contractor shall arrange and execute works as well as related activities in such a way that environmental solutions are reinstated. He may be required to carry out filling, removal and disposal works, along with planting of grass and trees at identified locations to reinstate environment as directed by the Engineer.

**Payment for ESHS requirements**

The payment for personnel and public Safety requirements during contract period at different locations shall be a subsidiary obligation of the Contractor covered under the prices quoted for other Bill of Quantity items. However, few items as stated above have been identified in BOQ for which payment shall be made upon execution. The rate quoted shall be applicable for quantities required for EMP implementation irrespective of their variation in quantity. Therefore the clause in variation in quantities shall not be applicable for safety requirements.
APPENDIX-P

ENVIRONMENT, SOCIAL, HEALTH AND SAFETY POLICY OF PMIDC

PMIDC Punjab - has developed their Environmental, Social, Health and Safety policies that will be applied to the project. The Contractor has to prepare their ESHS plan and implement the safeguards in consonance with the ESHS Policy of the PMIDC. The ESHS Policy of PMIDC is attached below:

Environment, Social, Health and Safety Policy
The PMIDC recognizes the importance of sustainable development through Environmental and Social Protection, conservation of natural resources, protection of Social groups, personnel and public safety along with the highest quality of works in its every projects and activities.

The PMIDC is committed to conduct all its activities in such a manner as to avoid harm to employee, contractor and other associated agencies, environment and community. The organisation shall strive to improve continuously its environmental and social practices and performance in all its projects. Accordingly in persuasion of its activities, the Organisation will ensure that such procedures and control measures for protection of environment and health and safety of their employee, consultant, contractor, including labour force and the public are in place.

To achieve the above objective, the Organisation is by:

1. Integrating environmental, occupational health and Safety considerations at the planning, design, construction and operational stage of all the projects and to provide and maintain a healthy and safe work environment and safe systems of work;
2. Complying with all relevant legal requirements pertaining to environment, safety and social including labor rules.
3. Applying good international industry practice to protect and conserve the natural environment and to minimize unavoidable impacts through optimizing resource utilization and reduction in emissions and waste
4. Ensuring safe and healthy environment with necessary infrastructure and systems of work;
5. Promoting equal opportunity for employment regardless of gender and strictly monitoring facilities and benefits to both women and men in project implementation;
6. Taking strict action and enforce disciplinary measures against illegal activities, Gender based violence, child sacrifice, child defilement, and sexual harassment by our employee or associates
7. Cooperating with end users of the Works, relevant authorities, contractors and local communities;
8. Consolation with affected persons and organisations and be responsive to their concerns, with special regard for vulnerable, disabled, and elderly people;
9. Fostering openness in understanding and mitigating operational risk, pollution and unsafe operations
10. Enhancing the awareness, skill and competency of employees and other associates
through effective communications and need based training
11. Minimizing the risk of HIV transmission and to mitigate the effects of HIV/AIDS associated with the execution of the Works through creation of awareness among all the stakeholders of the projects including the labourers;
12. Ensuring that this policy is actively followed by all our Consultants, contractors, sub-contractors and vendors.

The PMIDC will continually improve its performance on ESHS aspects through continuous monitoring and reviewing the measures taken and conduct its activities in responsible manner towards environment and safety clearly reflecting a commitment to fostering sustainable development.
## 5 CONTRACTOR’S REPRESENTATIVE AND KEY PERSONNEL AND EQUIPMENT

### 5.1 Key Personnel

The Operator shall provide all expertise needed to carry out the Design Build Services including the Key Staff specified below.

In case the Operator intends to change the any Key Staff, such change will be subject to approval from the Employer on justification provided by the Operator. The proposed replacement shall have to be of equivalent or higher qualification and experience specified above for the respective Key Staff.

<table>
<thead>
<tr>
<th>Item No</th>
<th>Position/specialization</th>
<th>Relevant academic qualifications</th>
<th>Minimum years of relevant work experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Project Manager (for design and construction Phase)</td>
<td>B.E. Civil/Mech works</td>
<td>20 Years Exp. in PHE</td>
</tr>
<tr>
<td>a.</td>
<td>Deputy Project Manager (Design)</td>
<td>B.E. Civil/Mech</td>
<td>10 Years Exp. in PHE works</td>
</tr>
<tr>
<td>2</td>
<td>WTP process Expert</td>
<td>B.E. Civil/Chemical</td>
<td>12 Years Exp. in WTP design works</td>
</tr>
<tr>
<td>3</td>
<td>Structural Engineer (2 Nos)</td>
<td>M Tech Structural</td>
<td>12 Years Exp in design of water retaining structures</td>
</tr>
<tr>
<td>4</td>
<td>Electrical Engineer</td>
<td>B.E. Electrical</td>
<td>10 Years Exp. with minimum 7 years relevant experience in WTP/ Water works</td>
</tr>
<tr>
<td>5</td>
<td>Mechanical Engineer</td>
<td>B.E. Mech</td>
<td>10 Years Exp. with minimum 7 years relevant experience in WTP/ Water works</td>
</tr>
<tr>
<td>6</td>
<td>Instrumentation Engineer</td>
<td>B.E. electrical/ instrumentation</td>
<td>10 Years Exp. with minimum 7 years relevant automation b experience in WTP/ Water works</td>
</tr>
<tr>
<td>7</td>
<td>Hydraulic Modeler</td>
<td>B.E. Civil</td>
<td>7 Years Exp. in PHE works</td>
</tr>
</tbody>
</table>

b. **Key Personnel for Construction**

<table>
<thead>
<tr>
<th>Item No</th>
<th>Position</th>
<th>Academic Qualifications</th>
<th>Minimum experience of</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Construction Manager – (2 Nos)</td>
<td>BE(Civil)</td>
<td>15 years</td>
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<tr>
<td>2</td>
<td>Project Engineer - Civil (Minimum 3 Nos)</td>
<td>BE (Civil)</td>
<td>10 years in Similar</td>
</tr>
<tr>
<td>Item No</td>
<td>Position/specialization</td>
<td>Relevant academic qualifications</td>
<td>Minimum years of relevant work experience</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------</td>
<td>----------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>3</td>
<td>Project Engineer - Electrical/Mechanical Engineer (Minimum 2 Nos)</td>
<td>BE (Electrical/Mechanical)</td>
<td>minimum experience of 7 years in Similar Projects.</td>
</tr>
<tr>
<td>4</td>
<td>Instrumentation Engineers (Minimum 1 Nos)</td>
<td>B.E (Instrumentation Automation)</td>
<td>minimum experience of 7 years in Similar Projects.</td>
</tr>
<tr>
<td>5</td>
<td>Environmental Specialist</td>
<td>M. Sc in Environment Science/ BE (Environmental Engineering)</td>
<td>minimum experience of 10 years’ experience and 7 years in with similar Projects</td>
</tr>
<tr>
<td>6</td>
<td>Social Expert t Cum community liaison Specialist</td>
<td>M.A in Sociology or Masters in Social Work</td>
<td>minimum experience of 10 years’ experience and 7 years in with similar Projects</td>
</tr>
<tr>
<td>7</td>
<td>Quality Assurance and QC Manager – Civil (2 Nos)</td>
<td>BE(Civil)</td>
<td>minimum experience of 10 years in similar Project and role</td>
</tr>
<tr>
<td></td>
<td>Quality Assurance and QC Manager Electrical/Mechanical</td>
<td>BE(Electrical/Mechanical)</td>
<td>minimum experience of 10 years in similar Project and role</td>
</tr>
<tr>
<td>8</td>
<td>Health and Safety Specialist</td>
<td>BE / B.Sc. with experience in EH&amp;S management</td>
<td>minimum experience of 10 years’ experience and 7 years in with similar Projects</td>
</tr>
<tr>
<td>9</td>
<td>Communication Specialist</td>
<td>BA/MA (Mass Communications)</td>
<td>minimum experience of 7 years.</td>
</tr>
<tr>
<td>10</td>
<td>Site Manager, &amp; billing Engineer</td>
<td>BE (Civil)</td>
<td>minimum experience of 7 years in Similar Projects.</td>
</tr>
<tr>
<td>11</td>
<td>Planning &amp; Monitoring &amp;</td>
<td>BE (Civil)</td>
<td>minimum experience of 7 years in Similar Projects.</td>
</tr>
<tr>
<td>12</td>
<td>Material Purchase Manager</td>
<td>BE (Civil)</td>
<td>minimum experience of 7 years in Similar Projects.</td>
</tr>
<tr>
<td>13</td>
<td>Site Supervisors</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Key Personnel for operation service

<table>
<thead>
<tr>
<th>Item No</th>
<th>Position/specialization</th>
<th>Relevant academic qualifications</th>
<th>Minimum years of experience in water supply project</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project Manager</td>
<td>Graduation in Civil Engineering</td>
<td>15 years’ experience in water supply project</td>
</tr>
<tr>
<td>2</td>
<td>Operation Manager</td>
<td>Graduate in any Engineering Discipline</td>
<td>10 years’ experience in water supply O&amp;M</td>
</tr>
<tr>
<td>3</td>
<td>Assistant Manager</td>
<td>Graduate in any Engineering Discipline</td>
<td>Least 7 years’ experience in water supply O&amp;M</td>
</tr>
<tr>
<td>4</td>
<td>Junior Engineer (Civil)</td>
<td>Graduate/Diploma in Civil Engineering Discipline</td>
<td>least 3 years’ experience in water supply O&amp;M</td>
</tr>
<tr>
<td>5</td>
<td>Junior Engineer (Mechanical &amp; Electrical)</td>
<td>Graduate/Diploma in Mechanical/Electrical Engineering Discipline</td>
<td>least 3 years’ experience in water supply O&amp;M</td>
</tr>
<tr>
<td>6</td>
<td>EHS Manager</td>
<td>BE / B.Sc. with experience in EH&amp;S management</td>
<td>least 5 years’ experience</td>
</tr>
<tr>
<td>7</td>
<td>Community Relations Manager</td>
<td>BA/MA (Mass communication)</td>
<td>least 5 years’ experience</td>
</tr>
</tbody>
</table>
**Note:**
1. Any personnel other than above list, if required for successful and timely completion of work shall be deployed by the contractor as and when required.
2. The Junior staff to be deployed by contractor shall be as per the requirement
3. Number of staff mentioned above is minimum and contractor shall propose his assessment of staff.

### 5.2 Contractors Equipment

Proposer need to confirm its plan for deployment of ‘Construction Equipment’ and thereafter for ‘O & M’ period of 3650 days & its authorised extension along with its additional equipment deployment at FORM EQP in its Proposal at Section IV Volume I.

<table>
<thead>
<tr>
<th>SN</th>
<th>Details of Equipment</th>
<th>Minimum Capacity</th>
<th>Maximum age as on date of submission of Offer (in years)</th>
<th>Minimum Number Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hydraulic pipeline excavators</td>
<td>1.0m³-1.5m³</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Concrete Vibrators (electrical+ diesel)</td>
<td>20 mm -60 mm (Needle)</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>Water Tanker</td>
<td>5000-10000 Lit.</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Pneumatic Vibrator</td>
<td>20 mm -60 mm (Needle)</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>Air Compressor (Diesel)</td>
<td>250 cfm approx.</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Air Compressor (Tire mounted)</td>
<td>150 cfm approx..</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Water Pumps</td>
<td>3 HP to 25 HP</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>Welding Machine</td>
<td>Single phase, Input 5KVA, Output-20 to 160Amp.</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>Automatic Batching Plant</td>
<td>30 m³/hr.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Mobile Self Loading, Weigh-Batching</td>
<td>6.0 m³</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Shuttering &amp;centering - steel plates</td>
<td>10000 Sqm. (0.60x1.20)m</td>
<td>1year</td>
<td>10000 Sqm.</td>
</tr>
<tr>
<td>12</td>
<td>Shotcrete Machines (standard make) for SFRS (when required)</td>
<td>Dry &amp; Wet</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>Mixing &amp; Transporting Mixtures</td>
<td>5.0 M</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>Grout Equipment – Complete (when required)</td>
<td>Set</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>15</td>
<td>Cranes: Hydra/ Groove</td>
<td>10 T, 25T &amp; 50T</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>16</td>
<td>D.G. sets</td>
<td>40 KVA</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>17</td>
<td>The deployment of Vehicle Bolero Car/ Jeeps with two shift drivers, fitted with GPRS, official Mobile &amp; post-paid no. regular service of vehicle with battery recharger &amp; for use at various Sites for Staff of Employer.</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Ambulance</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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### Minimum Equipment to be deployed during Operation & Maintenance Service Period.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Equipment</th>
<th>Unit</th>
<th>Quantity (minimum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Computers and Printers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Server Computer</td>
<td>Nos.</td>
<td>1</td>
</tr>
<tr>
<td>(b)</td>
<td>Desktop Computers</td>
<td>Nos.</td>
<td>4</td>
</tr>
<tr>
<td>(c)</td>
<td>All in one Desktop Laser colour Printer for routine printing capable of printing A3 size, scanner, copier</td>
<td>Nos.</td>
<td>1</td>
</tr>
<tr>
<td>(a)</td>
<td>Software</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MS Office latest version</td>
<td>Nos.</td>
<td>4</td>
</tr>
<tr>
<td>(b)</td>
<td>AutoCAD</td>
<td>Nos.</td>
<td>3</td>
</tr>
<tr>
<td>(c)</td>
<td>GIS</td>
<td>Nos.</td>
<td>1</td>
</tr>
<tr>
<td>(d)</td>
<td>Maintenance Management System latest version</td>
<td>Nos.</td>
<td>1</td>
</tr>
<tr>
<td>(a)</td>
<td>Customer Service Centres –</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tables</td>
<td>Nos.</td>
<td>As per requirement</td>
</tr>
<tr>
<td>(b)</td>
<td>Chairs</td>
<td>Nos.</td>
<td>As per requirement</td>
</tr>
<tr>
<td>(c)</td>
<td>Almirah</td>
<td>Nos.</td>
<td>As per requirement</td>
</tr>
<tr>
<td>(d)</td>
<td>Cabinet for storing drawings</td>
<td>Nos.</td>
<td>As per requirement</td>
</tr>
<tr>
<td>(e)</td>
<td>Communications, telephones, internet</td>
<td>Nos.</td>
<td>1 set</td>
</tr>
<tr>
<td>(f)</td>
<td>Networking &amp; its Costs</td>
<td>Nos.</td>
<td>1</td>
</tr>
<tr>
<td>(g)</td>
<td>EPBX</td>
<td>Nos.</td>
<td>As required</td>
</tr>
<tr>
<td>(h)</td>
<td>Sign Boards, Leaflets</td>
<td>Set</td>
<td>1</td>
</tr>
<tr>
<td>(a)</td>
<td>Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Leak detection ground phones</td>
<td>Nos.</td>
<td>2</td>
</tr>
<tr>
<td>(b)</td>
<td>Electronic Pipe locaters</td>
<td>Nos.</td>
<td>2</td>
</tr>
<tr>
<td>(e)</td>
<td>Mobile Generator</td>
<td>Nos.</td>
<td>1</td>
</tr>
<tr>
<td>(f)</td>
<td>Dewatering pumps</td>
<td>Nos.</td>
<td>3</td>
</tr>
<tr>
<td>(g)</td>
<td>Ultrasonic Portable Flow meter</td>
<td>Nos.</td>
<td>1</td>
</tr>
<tr>
<td>(a)</td>
<td>Transport</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water Tankers 2000 litres capacity</td>
<td>Nos.</td>
<td>1</td>
</tr>
<tr>
<td>(b)</td>
<td>Car for Operational Managers &amp; Engineers</td>
<td>Nos</td>
<td>2</td>
</tr>
<tr>
<td>(c)</td>
<td>Multi-utility 4x4 pick up</td>
<td>Nos</td>
<td>1</td>
</tr>
<tr>
<td>(d)</td>
<td>Motorable transport for operational staff</td>
<td>Nos</td>
<td>As required</td>
</tr>
</tbody>
</table>
Note:

(i) Based on the studies carried out, the minimum suggested major equipment to attain the completion of works & during “O & M” time periods.

(ii) The equipment’s shall be further augmented as per requirements & directions of the Engineer.
6 SPECIFICATIONS

6.1 General Technical Specifications

6.2 Structural Design Requirements

This section specifies the Design requirements pertaining to Civil RCC Structural works. The Civil General Technical Specifications and Standard Specifications included in the tender shall be read in conjunction with these requirements.

6.2.1 Design Submissions

The Contractor shall submit 5 (Five) copies of complete detailed design calculations of each of the components such as substructure and superstructure together with general arrangement drawings, construction drawings and explanatory sketches as required by the Employer. Separate calculations for substructures or superstructures submitted independent of each other shall be deemed to be incomplete and will not be accepted by the Employer.

The design considerations described hereunder establish the minimum basic design requirements of plain and reinforced concrete structures, architectural details, masonry structures and structural steel works. However, any particular structure shall be designed for the satisfactory performance fulfilling the functions for which the same is being constructed. The Contractor shall also check the stability of completed structures to be used for the project.

6.2.2 Design Standards

All designs shall be based on the latest Indian Standard (I.S.) Specifications or Codes of Practice. The design standards adopted shall follow the best, modern and sound Engineering practice in the field based on any other international standard or specialist literature subject to such standard reference or extract of such literature in the English language being supplied to and approved by the Employer’s Representative.

All the designs of reinforced concrete structures shall generally confirm to the recommendations made in the following ‘latest’ publications (latest versions) of the Bureau of Indian Standards:

i. IS : 456: Code of Practice for plain and reinforced concrete

ii. IS: 875: Code of Practice for design loads for buildings and structures other than Earth Quake loads (Part 1 to 5).

iii. IS: 3370: Code of Practice for concrete structures for the storage of liquids (Part I to IV)

iv. IS: 1893: Criteria for earthquake resistant design of structures.

v. IS: 2974 Code of Practice for design and construction of machine foundations (Part 1 to 4)
vi. IRC: 6 Part II Standard specification and Code of Practice for road bridges Loads and Stresses

vii. SP: 34: Handbook on concrete reinforcement and Detailing.

All structural steel design shall generally conform to the following recommended latest publications of the Indian Standards Institution:

i. IS : 800 :Code of Practice for general construction in steel

ii. IS : 806 :Code of Practice for use of steel tubes in general building construction

6.2.3 Design Life

The minimum design life of all structures and buildings shall be 60 years.

6.2.4 Design Loads

All buildings and structures shall be designed to resist the worst combination of the following loads/stresses under test and working conditions; which includes dead load, live load, wind load, seismic load, stresses due to temperature changes, shrinkage and creep in materials, dynamic loads.

6.2.5 Dead Load

This shall comprise loads arising due to all permanent construction including walls, floors, roofs, partitions, stairways, fixed service equipments and other items of machinery. In estimating the loads of process equipment all fixtures and attached piping shall be included, but excluding its contents.

The minimum Dead Loads shall be as per IS: 875 (Part 1).

6.2.6 Live Load

Live loads shall be in general as per IS: 875 (Part 2). However, the following minimum loads shall be considered in the design of structures:

i. Live load on roofs : 1.50 kN/m²

ii. Live load on floors supporting equipment such as pumps, blowers, compressors, valves etc. : 10.00 kN/m²

iii. Live load on all other floors, walkways, stairways and platforms. : 5.00 kN/m²

In the absence of any suitable provisions for live loads in I.S. Codes or as given above for any particular type of floor or structure, assumptions made must receive the approval of the Employer’s Representative prior to starting of the design work. Apart from the specified live loads or any other load due to storage of materials, any other equipment load or possible overloading during maintenance or erection/construction in part or full, most critical condition shall be considered in the design.
6.2.7 Wind Load

Wind loads shall be as per IS: 875(part 3).

6.2.8 Earthquake Load

This shall be computed as per IS: 1893. The project area falls in seismic zone 2.

6.2.9 Dynamic Load

Dynamic loads due to working of plant items such as pumps, blowers, compressors, switch gears, traveling cranes, etc. shall be considered in the design of structures.

6.3 Mechanical Design Requirements

6.3.1 Horizontal Split Casing Centrifugal Pump

The contractor shall select suitable pumps for operation of clear water pump in the specified operating range. All the pumps shall be of similar characteristics at every pump station.

The type of pumps shall be Horizontal Split Casing type & all the pumps shall be provided with suitable motors and accessories.

The static head for the design of clear water pumps at pump Station will be the difference in centre line of inlet at CWR and highest water level in the OHSR.

The pump shall have a stable head curve, i.e. the total head-capacity curve shall be continuously rising towards the shut off head. The shut off head shall be at least 10% more than pump head at intersecting point of the pump curve with the upper range system head curve.

A minimum overall (combined) efficiency as 72% for each clear water pump set and motor selection shall be made.

The required pump NPSH at duty point shall be at least 0.5 meters less than the available NPSH. The horizontal split casing pumps shall be used with positive suction head.

Pump must be suitable for operating in parallel over the entire operating range. The pump shall operate satisfactorily at any point between the maximum and minimum system resistance.

The pumps shall be capable of reverse rotation due to back flow of water, without damage or loosening of threaded components. The ratio of reverser runaway speed to rated speed at 100% BEP head wrt specific speed of pump shall be limited as per Hydraulic Institute standards (HIS) for centrifugal pumps.

The specifications for flanges shall be as per the relevant IS code.

Spare parts supplied with the pump shall be identical to respective pump components and shall be from original manufacturer.

Pumps shall run smooth without undue noise or vibration. Noise levels and velocity of vibrations shall be within acceptable limits. Noise level shall be limited to 85 dba at a distance of 2 m. Velocity of vibrations shall be within 4.5 mm/s as per relevant Hydraulic Institutes Standards and IS.
Unless otherwise specified the drive unit power rating shall be the maximum of the following requirements:

A. Required margin/factor as given below over the pump shaft input power required at duty point.
   - Pump shaft input power 15-75 KW  - 1.20
   - Pump shaft input power >75 KW  - 1.20

B. Pump shaft input power at (-) 25 % of duty head.
C. Pump shaft input in the operating range corresponding to minimum & maximum water level in the CWRs

6.4 Electrical Design Requirements

6.4.1 Major Electrical Components of the Contract

The following is a brief description of the major components of the Contract. This is to be complemented and read with the details provided in the subsequent subsections of this document.

The works component included are as defined below but shall not be limited to:

6.4.2 Raw Water Pumping Station, 440 MLD Water Treatment Plant and Clear Water Pumping Station

11kV outdoor substation consisting of lightning arresters, current transformers, voltage transformers, dis-connectors, fuses, insulators, ACSR conductor, clamp and connectors with necessary metering and protection arrangement including steel structure.

1. 11/0.433 , Dyn11, ONAN transformers with OCTC
2. VFD for LV motors
3. Starters for LV motors
4. LV Switchboard/ Distribution Board/ Lighting Panel
5. Local Push Button Station
6. HV and LV cables
7. LV capacitor with APFC panel
8. Lighting system
9. Cabling system
10. Earthing and lightning protection system
11. Diesel Generator with PLC Based AMF
6.5 **Instrumentation, Automation and Control System Design Requirements**

6.5.1 **Design Requirements for Instrumentation, Control, Automation and SCADA Systems**

The instrumentation, control, automation SCADA installations shall fully comply with design standards, regulations and the material and workmanship requirements of the Specification.

The electrical plant installations associated instrumentation control and automation systems shall also comply with and be tested in accordance with the latest edition of BS 7671 or equivalent Indian standards.

All equipment and materials incorporated in the system shall be selected, designed and rated to operate under the defined performance duties and specified site conditions and to maintain a high level of operational reliability.

The instrumentation control and monitoring system equipment and materials shall have an operational life of not less than 15 years, unless otherwise approved by the Engineer.

6.5.2 **General Design Requirements**

a) Instrumentation and Control system shall be designed, manufactured, installed and tested by an experienced system integrator to ensure high standards of operational reliability. Instruments mounted in field and on panels shall be suitable for continuous operation. All electronic components shall be adequately rated and circuits shall be designed so that change of component characteristics shall not affect plant operation.

b) All I&C equipment shall be new, of proven design, reputed make, and shall be suitable for continuous operation. Unless otherwise specified, all instruments shall be tropicalized. The outdoor equipment shall be designed to withstand tropical rain and temperature variation from 0 to +50°C. Wherever necessary, space heaters, dust and waterproof cabinets shall be provided. Instruments offered shall be complete with all the necessary mounting accessories. The control equipment installed inside the control room should be designed to work at 35°C and the instruments in sheltered place outside the control room at 45°C.

6.6 **PARTICULAR TECHNICAL REQUIREMENTS – WATER TREATMENT PLANT**

6.6.1 **New Water Treatment Plant Process Technical Requirements General Arrangement of the Works: Site Development**

The land for construction of Water Treatment Plant (WTP) is identified adjacent to the UBDC canal. The finished ground level for the plot shall be finalized based on the hydraulic design of the WTP submitted and approved. A 440mld capacity water treatment plant is to be constructed under present scope of Tender.

The scope includes Design and Construction of New Water Treatment Plant of 440mld capacity and subsequent Operation and Maintenance of plant for a period of ten years after Design Build period (Construction). Construction of all required facilities as per the approved drawings, by providing material, equipment, manpower whatsoever required for timely completion of work.
Bidders Scope will broadly consist of, but not restricted to following.

I. Unit processes and services

- Intake works
- Raw water main and pumping station
- Raw Water Inlet Chamber
- Raw Water Channel
- Flow measuring device
- Coagulant addition and flash mixing Tank;
- Distribution Chambers
- Clari-flocculators / Tube-settlers
- Rapid Gravity Sand Filters & Filter house Building
- Pre and post chlorination system, including all accessories.
- Chlorine Contact Tanks
- Wastewater handling system
  a. Filter backwash holding tank
  b. Clarifier sludge recirculation system
  c. Mechanical sludge dewatering system
  d. Storage facility for dewatered sludge
  e. Recovered water storage tank and pumping for recycling

The process of wastewater recovery system is indicative only. The bidder may offer his own design based on his experience.

The mechanical sludge dewatering shall be designed based on maximum of 16 hrs of operation.

- Chemical House, Laboratory & Office Building
- Chlorinator Shed
- Chlorinator Room
- Internal roads & pathways
- Interconnecting ducting & water channels
- Coagulant dosing arrangement.
- Air Blower
- Connecting pipe from post-chlorination to clear water reservoir

II. Civil and Building works for

- RCC structures for the aforementioned processes;
- Piping and conveyance systems
- Treatment plant roadways and associated drainage;
- Operation, maintenance and management of the treatment plant.
- Electrical power, control and instrumentation SCADA and Automation systems
- Mechanical systems.
- Mechanical, electrical and chemical building services.

The Works shall include but not limited to:

- process and hydraulic design
design and construction of all civil structures and building works

- design and manufacture, supply, testing at manufacturers’ works, storage when required, delivery to site, unloading and site transportation, erection, site testing, painting and finishing of the Plant
- water testing and commissioning of the water treatment plant;
- Provision of spare parts, special tools, operation and maintenance manuals and As-Built drawings;
- Provision of training for the Employer’s personnel.
- Operation and maintenance of the complete water treatment plant

III. Designing, manufacturing/procurement from approved vendor, transportation to site, installation testing and commissioning of equipment in proposed water treatment facilities, as per the specifications. This will include but not restricted to following

1. Agitator For Flash Mixing
2. Mechanism for Flocculation Cum Settling Tank (Clarifloculators / tube-sellers)
3. Air Blowers for filter backwash
4. Chlorination system & accessories
5. Clear Water Pumps for Back wash
6. Agitator for Chemical mixing
7. Filter Backwash storage tank with mixing arrangement
8. Mixing arrangement for Clarifier sludge/Tube Settler sludge
9. Mechanical sludge dewatering system including pumping of thickened sludge and addition of chemicals, if any.
10. Transfer pumps for recovered water

IV. All the operations of the water treatment system shall be controlled through a well planned SCADA system supported by PLC

V. Designing, manufacturing/procurement from approved vendor, transportation to site, installation, testing and commissioning of control instrumentation as per specifications.

VI. Designing, manufacturing/procurement from approved vendor, transportation to site, laying, jointing testing and commissioning of valves, pipes and pipe fitting as per specification and description given in the Tender.

VII. Designing, manufacturing/procurement from approved vendor, transportation to site, installation, testing and commissioning of Master Control Center (MCC) for controlling operations of all electrical equipment in the water treatment plant as per specifications and description given in this Tender.

VIII. Designing, procurement from approved vendor, transportation to site, laying, jointing, testing of electrical and instrumentation cables in the
proposed water treatment plant as per description and specifications given in this document.

IX. Providing Five (5) sets of test data & certificates for tests carried out on equipment, Electrical motors, instruments etc. at manufacturer’s shop.

X. Providing five (5) sets of operation, installation and maintenance manual along with necessary drawings for each of the equipment, Motor control Center, Instrument, etc.

XI. Conducting performance trials of the water treatment facilities for a period of three months, by providing skilled and unskilled labour, chemicals, lubricants, etc. to demonstrate the functioning of plant in general and performance of individual units and equipment items in particular.

XII. Giving performance tests of all equipment, electrical work, instrumentation, interconnecting piping etc. for a 144 Hours continuous operation at duty conditions.

XIII. Providing free of cost replacements and services for repairing the defective equipment, electrical work, and instrumentation, interconnecting piping etc., during Defect Liability Period of the Contract.

XIV. Providing operation and maintenance services, for a period of 120 months from the date of completion of work in all respect and successful completion of 144 Hours performance test, by providing all consumable like chemicals, lubricants, skilled and unskilled manpower, supervision, and laboratory analytical services, etc.

XV. A properly designed PLC system along with required instrumentation and provision for manual operation of the plant from operating console.

6.6.2 Scope of work

The Scope of works also covers following preliminary works to be undertaken by the Contractor:

- Based on the site visits, the Contractor shall carry out preliminary surveys to the satisfaction of the Employers Representative and prepare necessary working drawings and maps.
- On the basis of survey carried out temporary and permanent bench marks shall also be established for reference during working
- Contractor shall also arrange for taking trial pits and test for SBC’s of the strata
- Contractor shall also arrange for necessary labour and materials for carrying out of the works.
- The work shall be executed conforming to the approved designs and drawings and detail and levels to the perfect line and plumb in a highly professional
manner. The work shall progress successively as per the schedule / bar chart to be got approved before the commencement of the works.

- Monthly progress of the work shall be reported to the Employers Representative along with all other detail such as material consumption, test reports etc.

- As the works gets completed, all the record drawings / as built drawings shall be submitted to the Department.

- Necessary inspection of material/equipment’s, as per category shall be carried out well in advance.

- The payment for confirmatory survey, laboratory test, factory and performance tests, testing and commissioning shall be as per bid conditions. Wherever any survey or investigation is not mentioned specifically, the same shall be deemed to be included in the rates and prices of the physical works itemized and quantified in the bill of quantities. The payments are to be made for all supplies and physical works described in the bill of quantities according to the measured and agreed quantities executed.

6.6.3 Orientation

The Works shall be laid out within the confines of the Site in order to interface logically to the existing infrastructure of roadways and inlet and outlet pipework. Underground services (whether physically located on the Site or not) requiring to be relocated in order to accommodate the proposed site layout shall with the approval of the Employers Representative be relocated by the Contractor.

6.6.4 General Arrangement of Plant

The following general rules shall be followed in arranging the Plant units:

- sufficient room (of not less than 2.0 m wide) shall be allowed between items of Plant and adjacent Plant or fixed structures to permit safe and convenient access for operation and maintenance; for provision of appropriate structure foundations

- an area adjacent to all mechanical Plant shall be provided as a maintenance lay down area;

- fixed runways, lifting eyes or other means shall be provided to permit the removal of Plant Equipment that may logically be required to be removed during the course of its normal operational life for maintenance or any other purpose;

- areas where leakage is likely to occur whether in normal use or during maintenance shall be provided with covered drainage channels which shall direct spillage either to a suitable drain or to a sump from where it can be pumped to drain.

- plant where necessary shall be provided with removable acoustic coverings to limit the noise produced during normal operation to the limits detailed in the General Requirements;

- plant shall be arranged and the building designed to permit the removal of Plant items. Since the interconnecting conveyance channels of the plant are to be designed for
excess capacity in anticipation of future plant expansion, the plant shall be laid out such that there is space provision for future expansion units.

- all the units shall have drain valves. The drain valves of diameter less than 250mm shall be manually operated and higher than 250mm valve shall be electrically operated. For the valves located below ground level extended spindle shall be provided for ease of operation.

- Chemical pipework shall be secured to racks or trays to be fixed to duct walls or walls of tanks and buildings as necessary. The method of securing the pipes to the racks shall be by clips or something similar, facilitating ease of removal in such a way that individual runs can be changed without dismantling adjacent pipes.

- All chemical pipes shall be colour banded and suitably labelled to enable individual lines to be identified throughout their run. Particular attention shall be paid to the layout of the chemical pipework, which shall be functional and neat in appearance. Generally, where pipework is installed in ducts, it shall be supported not less than 150 mm clear of the floor.

- When selecting materials for pipework, the Contractor shall give consideration to the deteriorating effect of some of the synthetic materials due to the action of ultra-violet light. Where such materials are employed, they shall be shielded from direct sunlight.

6.6.5 Inlet to Works

Raw water shall be drawn from UBDC canal near to proposed WTP location. Raw water shall be carried to the sump of proposed Raw water Pump Station of WTP by open channel/pipeline having capacity to meet ultimate water demand and pumped to the proposed WTP.

6.6.6 Brief Description and Specifications for Treatment Plant Units

General

The WTP shall be designed for gravity flow from Raw Water Channel based on Constant/Declining rate of filtration. Layout shall be such that minimum 2 m space is maintained between two units and appropriate pathways and approaches are provided for each and every treatment plant unit. All interconnecting piping from one unit to other shall be laid below ground. Pipe and valves should not obstruct the approach pathways. Interconnecting pipes, valves on the pipes and channels shall be designed to carry 20% excess flow over normal design flow. Inlet and outlet of all the plant units shall also be suitable for passing 20% excess hydraulic flow without adversely affecting the treatment process. Work under this contract shall be carried out as per approved designs, drawings. Contractor will submit drawings along with design calculations reference codes, etc. for approval of Employer’s representative. Proposal shall be framed in line with salient specifications given in this tender document. Following ranges of designs are indicative and contractor shall design & propose units of WTP based on constant/declining rate filtration.
6.6.7 Inlet Chamber

Raw water pumped from Raw water pump station shall first be received in Inlet Chamber, with minimum detention time of 60 seconds at the maximum rate of flow. Purpose of this tank shall be to dampen the disturbances due inlet and facilitate near streamline flow in the channel leading to flow measuring device and then to flash mixer.

6.6.8 Flow Measuring Device

Flow measuring device shall be a Parshall Flume with ultrasonic flow meter to measure the levels. An indicator giving instant flow shall be installed near the Flume, while the indicator and integrator shall be mounted in remote control panel/PLQ panel as well as in the SCADA. The Flume should be designed to measure minimum 130% of design flow.

Pre-chlorination pipe line shall be provided to channel before flash mixer. Dosing of chlorine should be done as recommended in CPHEEO manual. Pre-chlorination shall be practiced only during the time the raw water contains microbiological contaminants that may interfere with normal operation of filtration or may have excessive coliforms or suspected bacterial contamination or has colour/foul odour. The pre-chlorination system should be capable of providing dosage of up to 5 mg/l.

6.6.9 Flash Mixer

A flash mixer shall be used to intimately mix the coagulant and the raw water as rapidly as possible. The flash mixing shall be done in a stirred tank constructed from reinforced concrete, rectangular in cross-section. Flash Mixing Tank shall be designed for retention time of 40-60 seconds. All internal and external surfaces of the Tank shall be provided with 20 mm thick smooth cement plaster in 1:4 CM. All internal surfaces shall also be provided with food grade epoxy paint. Inlet and outlet to flash mixer shall be designed so as that velocity of water flow remain in the range of 0.6 to 0.8 m/sec. Flash Mixing Tank shall be provided with suitable electrically operated mixing device.

The flash mixer design shall be such that short-circuiting is minimised and the coagulant is thoroughly mixed with the water in the flash mixer. Also there shall be perforated baffle at the Flash Mixer inlet zone, so as to avoid direct hydraulic shock to the Flash Mixer Impeller.

6.6.10 Agitator for Flash Mixer Tank

Electrically operated, Vertical top entry type, slow speed, propeller or turbine mixer shall be provided in Flash mixing Tank. Impeller diameter shall not be below 30% of the tank diameter. Mixer should be able to create velocity gradient of 450-s. Power input shall be in the range of 1.5 to 3 watts/m3/hour flow.

The mechanical equipment for flash mixers shall comprise stainless steel (SS-316) agitating paddles fixed on stainless steel (SS-316) shaft with thrust bearing support, driving gear consisting of a motor coupled to a reduction gear of appropriate ratio. The motor and gear box arrangement shall be appropriately covered and any spillage of oil from the gearbox shall be prevented from entering the raw water. Electrically operated Sluice Gates shall be provided to isolate each of the duty and standby flash mixers.
Motor, gear box and chain pulley assembly shall be provided with proper covers and shall be suitable for installation in open to sky condition. Electric motor shall be suitable for operation on three phase 415 V AC supply. Motor shall be TEFC with 'B' class insulation and IP 68 protection.

6.6.11 Distribution Chamber

A reinforced concrete chamber shall be provided at the outlet of the flash mixer to receive the raw water from the flash mixer and to convey the same by gravity to the individual rows of flocculator clarifiers via adjustable weirs or to bypass the clarifloculators and deliver the water directly in to clarified water channel, leading to filtration plant. The chamber shall be designed to minimize turbulence in the chamber and flow shall be provided with overflow facilities. The overflow shall be conveyed by gravity to the nearest /drain. The Contractor shall supply and install adjustable weir plates in the chamber to control flow to the clarifiers and for the overflow. The Contractor shall supply facilities to detect high water level in the chamber.

The contractor shall provide appropriate numbers of electrically operated sluice gates in the distribution chamber in order to ensure the flow control to the Clarifier and by-pass the flow to the filter unit.

6.6.12 Chemical House

Chemical House shall be minimum 2 storey and shall meet following requirement

I. Storage Tanks (minimum 2 nos for each type of coagulant/chemical proposed as per bidder’s design) constructed in RCC lined with Acid proof tiles and having minimum Storage for two months requirement

II. For housing Dosing Equipment

III. Chemical House shall be a RCC Frame structure with Brick walls.

IV. Provision shall be made to provide space for dosing pumps for coagulants/chemicals (as per bidder’s design) and control panel etc. near the Storage Tank.

V. Dosing of coagulants / chemicals shall be through constant rate dosing Pumps or by gravity from storage tanks using rotameter

VI. Due consideration shall be given to provide suitable architectural features to building. All door and windows frames shall be in heavy gauge aluminum. Window panes will be in glass in aluminum frame.

VII. Provision of specification of fan, light, toilet shall be made for the rooms. Provision for sufficient nos. of exhaust fans shall be made for chemical store.

Sump Pumps

A sump pump complete with all associated pipework, valves and fittings shall be supplied and installed in the chemical house to pump leakage and drainage water to the foul drainage system. The sump pump shall be of the submersible type and shall be complete with hard wired level controls for automatic start/stop. An alarm shall be raised if the level in the sump becomes high.
6.6.13 Clariflocculators

The following are suggestive criteria DBO contractor shall have flexibility in providing required process units to achieve desired treated water quality provided the process is a proven technology.

Minimum two Nos. Clariflocculators (Flocculator cum Settling tank) shall be provided for effective coagulation, flocculation and settling. Clariflocculators shall be a RCC water retaining structure. Each tank shall be designed for passing half of the normal design flow. Surface loading rate in settling tank shall not exceed 35 m/hour. HRT in settling zone shall not be less than 2.0 hours. Flocculation zone shall provide detention time of minimum 25 minutes. All internal and external surfaces shall have 20 mm thick water proof plaster in 1:3 CM laid in two layers. Floor of the tank shall have 1 in 12 slope form periphery to Centre. Floor shall be provided with 50 mm thick screening in CM. Flocculators and Sludge scrapping mechanism shall be fitted in clari-flocculator. Flocculation zone shall be separated from Clarifier zone by RCC baffle. Adjustable overflow V notch weirs in SS or FRP shall be provided in clarifier. Length of the weir shall be sufficient so that the loading rate at normal flow does not go beyond 300 m3/m/d. Design of flocculation and clarification shall be such that the clarified water shall not have turbidity above 5 NTU.

6.6.14 Specifications Flocculation cum Settling Tank Mechanism

Flocculator

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Two sets (In each tank)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Flocculation cum settling tank Clariflocculators</td>
</tr>
<tr>
<td>Type</td>
<td>Peripheral driven extended half way rotating Bridge, Flocculator Speed</td>
</tr>
<tr>
<td>Accessory</td>
<td>3 to 4 rpm</td>
</tr>
<tr>
<td></td>
<td>Walkway on Bridge with, handrail, Flocculation chamber, flocculators, Prime mover, reducer, brass/neoprene rubber squeegees, etc.</td>
</tr>
<tr>
<td>Duty</td>
<td>Flocculation of colloidal material and Scrapping of chemical sludge accumulated on the floor of the tank</td>
</tr>
</tbody>
</table>

Epoxy (Food grade) painted flocculation chamber will be concentrically placed in the tank.

6.6.15 Sludge scrappers

One set of sludge scraping mechanism shall be installed in each of the Flocculation cum settling tank. Mechanism shall be suitable for installation in RCC tank provided for flocculation and settling.

I. Scope

Vendor shall include the following in his scope

Design, manufacture, supply transportation to site and erection and testing of One set of sludge scraping mechanism and suitable numbers of flocculators in each of one RCC tanks as described above complete with following:

✓ Complete drive arrangement for sludge scraping mechanism including motor, gear box, drive head upper and lower bearing, turn table and all other components required for satisfactory functioning of drive mechanism.
Two numbers of flocculation mechanism for installing in to flocculation chamber that is concentrically placed in the RCC tank.

Extended half-length walkway bridge and support arrangement for Flocculators/scraper mechanism including handrail, etc.

Sludge scraper arms, squeegees etc. of appropriate material.

All nuts, bolts, fasteners, etc. required for assembling the mechanism and for placing it in the tank.

Vendor shall provide three sets of operation, installation and maintenance manual along with necessary drawings.

II. Specifications

i. Bidder shall offer centrally driven mechanism. Mechanism of approved make shall only be acceptable. The Design offered shall be proven one.

ii. Motor, gear box and chain pulley assembly shall be provided with proper covers and shall be suitable for installation open to sky.

iii. Electric motor shall be suitable for operation on three phase 415 V AC supply. Motor shall be TEFC with 'B' class insulation and IP 68 protection.

iv. Scraper arms, central rotating cage/ shaft, feed well, walkway and mechanism support shall be MS fabricated structure, fabricated from tested quality steel as per relevant IS code. All submerged part shall be provided with two 75-micron thick coats of zinc rich epoxy primer and two finish coats of 75-micron thick coal tar based epoxy paint. Structure above water level shall be provided with two coats of red oxide primer and two finish coat of synthetic enamel paint of approved shade and make. Feed well shall be in RCC.

v. Wherever painting is recommended, only primer shall be applied in the manufacturer’s workshop. Topcoat shall be applied at site on completion of erection work.

vi. Squeezes shall be of brass or neoprene rubber. Entire mechanism after installation in tank shall be tested in dry condition. It shall be designed and fabricated for non-fouling and noiseless operation in tank. Vendor shall have to rectify manufacturing defect noted at any time after installation of mechanism in tank.

vii. Flocculator paddle area shall not be 10-25 % of cross section area of flocculation Zone. Mechanism should be able to create velocity gradient of 40-45 m/s.

viii. All fasteners, nuts-bolts shall be of high quality GI material.

ix. All MS part shall be epoxy coated with minimum 250 micron thickness.

x. All underwater fasteners shall be of SS 316 grade.
6.6.16 Filters & Filter House

The following are suggestive criteria DBO contractor shall have flexibility in providing required process units to achieve desired treated water quality provided the process is a proven technology.

Appropriate numbers of Rapid Sand Gravity filters (Operating in Declining/Constant Rate Filtration mode) shall be provided for filtration of water at specified filtration rate. Filters shall be of constant/decline flow rate type. Filter box and ancillaries shall be in RCC construction. Provision for air scouring during backwash operation shall be provided. Air scouring and backwash water flow rate shall not be less than as indicated under recommended design norms. Provision of backwashing entire filter bed (both the beds if twin beds are proposed) at one time shall be provided. Wash water gutters, air inlet, wash water inlet, drain etc shall be adequately sized. Ratio of length and width of filter shall be in conformity with standard design practice. Filter beds and filter operation gallery shall be covered RCC frame structure. Provision for special Architectural features of Filter House shall be made. Back wash shall be carried out through backwash pumps. Suitable structural design shall be done. No of filter unit shall be such as to make one bed will be available whenever one unit will backwash. Other details of design shall be as per CPHEEO manual.

Filter media shall be confirming to IS 8419 (part D) latest version. Uniform size single media is recommended for filtration design. Effective size of sand shall be between 0.55 to 0.75 mm having uniformity coefficient between 1.7 and 1.3. Silica Content of the sand shall not be less than 90%. Depth of sand bed shall be so designed as to achieve best possible removal of turbidity and microorganism from the water. Depth of sand bed in filter shall not be less than 900 mm. The filter sand shall be supported gravel and coarse sand supporting media of suitable depth. Water depth in the filter box should be minimum 2 m.

The Declining filters should be operating at average rate of 6m³/m²/hr. Maximum flow rate through a freshly washed filter should not exceed 9m³/m²/hr while flow rate through the filter next in line for backwash should not be less than 3m³/m²/hr. Control of maximum flow through the filter may be achieved by placing a fixed orifice in the common outlet pipe of each filter.

In case of constant rate filtration, the rate of flow shall be 6 m³/m²/hr. And rate of flow shall be controlled through flow rate controllers placed at the outlet of each filter.

Contractor will have to take approval about source of filter media before procurement. Contractor shall be required to make arrangement for analysis filter media from selected source in a recognized and approved laboratory. Employer’s representative will draw sample of filter media from each supply and get it analyzed in laboratory of his choice. Media not conforming to IS 8419 shall be rejected.

Contractor will have to make arrangement for proper storage of media after receipt at site so as it does not get contaminated. Placement of media on filter bed shall be done in an orderly manner under expert supervision and as per guidance provided in CPHEEO Manual. After placement of media on filter bed all construction activities in the surrounding of filter bed shall stop. In case any work is being carried out in
the vicinity of the filter due care shall be taken to cover the filter bed. Media shall be thoroughly washed before putting to use.

One filter run shall not be less than 24 hours. Filter Outlet water shall have turbidity below 1.0 NTU in all seasons.

All control valves for each filter bed shall be motorized. Sizing of pipes, valves and pumps shall be done by giving due consideration to recommended velocity at each port. Operation of filter shall be automatic based on PLC system. A properly designed PLC system along with required instrumentation and provision for manual override shall be provided to facilitate the automatic operation of the plant from PLC or manual operation from operating console. Start signal for backwash shall be taken from flow sensing instrument placed in each filter as well as it should be based on time cycle. An operating console shall be provided for each filter to facilitate manual operation of valves.

Backwash water shall be drawn from common channel of filtered water. Air shall be blown from the bottom of filter beds to attain effective backwash. For this purpose blower shall be provided for filter backwash system with provision of 100 percent stand by capacity. Backwash system shall be designed in such a manner that mud balls are not formed in the filter beds. Backwash water storage Pumps etc shall be designed keeping above condition in mind. Provision shall be made for recycling Filter Backwash water.

The filter floor shall provide access to the filter installation and shall permit the observation of the water surface in each filter and to allow maintenance and necessary manual operation of the inlet and washwater outlet penstocks. Hand railing of stainless steel 304 shall be provided around each filter.

The backwash pumps, backwash air blowers and associated plant shall be located in a plant room area at any one end of the filter installation.

The filter building shall be provided with a control room for the plant. This shall be located on the filter floor in such a manner as to provide a clear view over the filter floor. It shall house the central HMI described elsewhere. The filters and associated superstructure shall be of reinforced concrete construction.

The filter power and control panel shall be located in an area accessible to the Contractor for effective and efficient operation of the plant. Filter washing consoles shall be located on the filter floor overlooking each filter pond.

An overflow shall be provided from the common inlet channel which shall discharge into the backwash water channel.

The outlet of each filter shall be fitted with a means of automatically limiting the flow rate immediately after backwash to a value which will not cause an unacceptable reduction in filtrate quality at the start of the run when the filter is clean. Each filter shall be fitted with a headloss indicator ultrasonic digital type. Each filter shall be fitted with a minimum drain gate valve to allow complete emptying of the filter.

The filters shall be designed for backwash by simultaneous air scour and water wash.
The Contractor shall decide the exact dimensions and layout of the filters, and the design of the filter floors and underdrains based on the design criteria and shall have approval of Employers Representative.

The filter house shall include a Filter annexe to accommodate air blowers/ compressors sets with acoustic enclosures, wash pumps and electrical switchgear, motive water pumps, service water pumps which would be visible from the walkway of the filter house. A travelling gantry crane shall run the full length of the Annexe.

6.6.17 Underdrain System

Filter under drain system comprised of PP/HDPE strainers fitted on filter media support slab. Adequate number of strainer at appropriate spacing shall be provided for uniform distribution of wash water during back wash and for uniform filtration over entire area of the filter. Strainer approved by Employer’s representative shall only be used for filter under drain work.

The Contractor shall be responsible for the detailed design of the filter floor and underdrains. The filters shall be designed for backwashing by the simultaneous use of air scour and wash water.

The water used for backwashing the filters should be chlorinated to keep the filter media free from biological growth. The filter media and underdrain system shall be designed to achieve uniform distribution of both filtrate and backwash water and air.

The filter underdrain system shall be of monolithic reinforced concrete slab, or SS plates supported on concrete dwarf walls. The means of collecting filtrate and distributing air shall be by use of nozzles set in the reinforced concrete floor. Polypropylene filter nozzles with fine slots shall be used for collecting filtrate and distributing backwash water and air. A uniform distribution of the nozzles of not less than 45 numbers per square metre shall be employed.

The nozzles shall:

- incorporate separate air and water entrances;
- be set at an exactly uniform level;
- be capable of replacement;
- be designed to avoid ingress of sand
- purge valve

All apertures in filter floors shall be plugged during construction to avoid ingress of debris to the under drainage system. The Contractor shall be responsible for ensuring that all debris in the region of the filter floors is avoided during construction of the floor.

6.6.18 Air Scour Blowers

Air for scouring shall be provided by positive displacement (Roots) blowers. Two blowers shall installed, one on duty and one as standbys in a filter house. An acoustic enclosure will be fitted over each air blower to reduce noise. A ring main will convey
the air to the filter under floor plenum. Typically, the air scouring rate shall be up to 50 m/h.

This ‘Roots’ type blower will be capable of delivering oil-free air at the specified output pressure and volume. The horizontal inlet and delivery lines shall be sized so that air velocity does not exceed 25 m/s. Blowers shall have the following components but not limited to

- Inlet silencer and filter
- Non-return valve in delivery branch
- Sluice valves resilient in both inlet and delivery branches
- Pressure relief valve or excess pressure safety device
- Bellows type couplings on inlet and delivery branches.
- Direct Coupling

The air blowers shall be installed at an elevation above outside finished ground level. The speed of the blowers shall not exceed 1000 rpm.

The delivery pipework shall be carried to a height above the maximum possible water level in the filters so that, under all circumstances, it is impossible for water to flow back to the blowers. The delivery pipework and valves shall be sized to limit the air velocity to a maximum of 25 m/s.

An electrically actuated air dump valve and flow meter with local indication shall be installed in the pipework feeding the filters. Each blower shall be fitted with an inlet air silencer and discharge air silencer, pressure relief valve, delivery pressure gauge, delivery isolating valve and non-return valves. The noise emitted from the blower shall not exceed 85 dBA at 1.86 m from the blower. (ISO 10816) The blower unit sizing and design of the blower room with acoustic enclosure shall be made such that the acceptable noise levels are met.

The blower room layout shall incorporate a minimum of 2.0 m clear access around the acoustic enclosure. The height of the room and main door shall permit use of the Electric hoists to effect removal of each acoustic enclosure outside the building.

The design of acoustic enclosure shall facilitate inspection and ease of access to components of the blowers requiring regular inspection and/or maintenance. The air blower, silencers, pipework and flexible connections shall be welded in accordance with BS 4870 or BS 4871.

6.6.19 Specification for Twin Lobe Type Rotary Air blower

<table>
<thead>
<tr>
<th>Table 3 Specification for Twin Lobe Type Rotary Air blower</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quantity</strong></td>
</tr>
<tr>
<td><strong>Duty</strong></td>
</tr>
</tbody>
</table>
Equipment shall be designed to provide clean, dry, Oil free air at optimum power consumption and least noise level. Twin Lobe type Rotary Air Blower, operating below 1500 RPM is recommended. There should be provision in the design to increase or decrease air output from the blower to the extent of 20%.

<table>
<thead>
<tr>
<th>Type</th>
<th>Twin Lobe Type Rotary air Blower.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>As per bidder’s design</td>
</tr>
<tr>
<td>Pressure</td>
<td>As per bidder’s design</td>
</tr>
<tr>
<td>Speed</td>
<td>1500 RPM or below</td>
</tr>
<tr>
<td>Noise level</td>
<td>Below 85 db at a distance of 1.86 M., from blower</td>
</tr>
<tr>
<td>Prime Mover</td>
<td>TEFC, horizontal, foot mounted electric motor with class B insulation, IP 55 protection, and suitable for operation on 415 Volts, 50 Hz AC supply. Motor Shall be Confiming to relevant IS Code</td>
</tr>
<tr>
<td>Transmission</td>
<td>By set of V belt &amp; Pulleys</td>
</tr>
<tr>
<td>Material Of Construction Of</td>
<td>a) Casing: High grade CI hardened and machined on internal Surfaces</td>
</tr>
<tr>
<td></td>
<td>b) Lobes: High Grade CI duly machined and dynamically balanced:</td>
</tr>
<tr>
<td></td>
<td>c) Internal Gears: High Grade CI duly Machined</td>
</tr>
<tr>
<td></td>
<td>d) Base Frame: Structural Steel Confirming to IS 226</td>
</tr>
<tr>
<td>Accessories:</td>
<td>Inlet and outlet Silencers, Pressure gauge, Safety Valve, Vibration Isolation Pads, Air Filter, etc. Safety Guard (covers) for V- belt &amp; pulley</td>
</tr>
<tr>
<td>Testing:</td>
<td>Blower to be tested for capacity, pressure, power consumption, noise level and vibration, etc. at vendors shop as per BS 1571. Dynamic Balancing of rotor and shaft shall be as per ISO 1940.</td>
</tr>
</tbody>
</table>

6.6.20 Filter Back wash Pumps

Pumps shall be horizontal centrifugal type. Discharge rate and head of pumps shall be suitable for effective backwashing of filters in minimum amount of time. Pump shall be of approved make and design.

Construction features of pumps shall be as per General specifications for centrifugal pumps. Pumps shall be provided with prime mover operating on 415 V supply.
All the pipes/channels in filtration plant shall be designed to carry 120% of the designed volume.

**Scope of Supply**

Following will be included in the scope of supply

a. Design, manufacture /procurement, transportation to the site installation testing and commissioning of pumps with all the accessories as described here below;

   - Supply cable of suitable length, duly connected to the motor and cable entry to the pump body duly sealed.

   - Coupling flange & other fittings.

   - Control panel and instrumentation for automatic operation of the pumps. Control panel shall have all the features as described in the specifications

Process Requirement Duty pump will be working as per the availability of water in the tank. Duty Pump shall start and stop automatically as water level in the sump. For start duty pump shall be selected alternately. Control panel shall have arrangement for the following

   - Automatic start of duty pump at first high level of water in the sump.

   - Automatic stop of working pump/pumps at low level

   - Automatic cyclic change of duty and stand by pump

   - Manual start from remote switch

   - Alarm for low level, first and second high level, seal failure, and other fault conditions with 'Mute' provision

   - Manual override switch

**6.6.21 Sump Pumps**

The Contractor shall provide a sump pump installation to remove pump gland leakage and drain down water produced during maintenance of the pumps and pipework. The sump pump/s shall be of the submersible type with pipe, valves etc, and the pump shall be complete with hard wired level controls for automatic start/stop. The pump shall be capable of delivering at least 10 cum/hr and shall be supplied complete with discharge pipework to discharge to the site drainage system.

An alarm shall be raised if the level in the sump becomes high.

**6.6.22 Backwash Water Handling Power and Control**

A combined MCC and control panel shall be provided and located in a suitable location protected from the weather and the effects of the process. The control panel shall provide facilities for the:

- display status associated with the backwash water handling system;
- duty pump selection;
- control mode selection;
- annunciate alarms associated with the backwash water handling systems.

6.6.23 Filter Building Lifting and Handling Equipment

The Contractor shall provide a comprehensive system of lifting beams, runways, pulley blocks, trolleys, slings, etc. to permit the removal of pumps, blowers, motors, valves and actuators for maintenance. The Contractor shall provide handling equipment to enable the removal of the aforementioned items from the building and to load it with ease onto a suitable vehicle. The Contractor shall demonstrate to the satisfaction of the Employers Representative the lifting and handling equipment and procedures to be adopted in using it to remove equipment from the filter building.

The electrically operated lifting/handling equipment and any plant provided shall also facilitate the placing and removal of filter media.

6.6.24 Filter Building Ventilation

Forced ventilation equipment shall be provided to give four changes of air per hour in the filter central gallery and plant room area.

6.6.25 Filtered Water Flow Monitoring

The Contractor shall provide a flow monitoring system to measure total flow from the Works. The flow meter shall be mounted in a factory prepared pipe section having an internal diameter equal to the internal diameter of the interconnecting pipework.

The flow meter shall be installed in accordance with the manufacturer’s recommendations. The flow meter shall be mounted within a ground chamber. The flow meter shall not be affected in the event of submersion. The flow meter converter unit shall be remote mounted within a control panel.

Water from filtered water channel shall flow by gravity to the Chlorine contact tank in closed conduit/Treated water channel.

6.6.26 Chlorine Contact Tank

A properly designed Chlorine Contact Tank (CCT) shall be provided after the filter. CCT will be RCC water retaining structure. CCT shall be designed to provide minimum 30 minutes Hydraulic retention time. All internal and external surfaces of CCT shall be provided with 20 mm thick smooth cement plaster in 1:3 C:M. Food grade epoxy paint shall be applied on all internal surfaces of the CCT. Suitable number vents shall be provided in the tank for ventilating free chlorine. Internal baffles shall be constructed in CCT for creating back mixing.

6.6.27 Chlorination System: Chlorinator Room and Chlorine Drum Store

The following description of units and requirements shall be provided for Pre and Post chlorination arrangement. The chlorine building will contain the facilities for storage and dosing of chlorine. A chlorinator Room & chlorine container store forming a chlorine building shall be provided at suitable location to facilitate dosing of chlorine
for pre and post chlorination in the plant. Both the rooms shall be located such that it facilitates easy handling, loading, and unloading of the containers. Chlorinator Room and Chlorine container Store shall be RCC frame structure.

Each Chlorination system comprise of following shall be provided

a. Two Nos. of Vacuum Type chlorinator (One Working + One Stand By)
b. Two Nos. of Motive Water pumps (One Working + One Stand By)
c. Ejector
d. Vaporizer (if required by the design)
e. Connector for duty and auxiliary Chlorine Toner and gas piping
f. Solution Piping and diffusers
g. Chlorine leak detectors
h. Safety equipment
i. All other accessories required for safe operation of the chlorine system

6.6.27.1 Chlorinator Room

Vacuum type chlorinators shall be suitable for dosing chlorine as per design when the plant is operating at rated capacity. Connector for tonners shall have automatic switch over arrangement from duty tonner to auxiliary toners when duty tonner gets emptied. Weighing arrangement for Duty and auxiliary toners shall be provided. Solution piping shall be in HDPE/PP. Solution piping shall be suitable for dosing at pre and post chlorination locations. Gaseous chlorine pipe should be of copper.

The chlorinator room shall be constructed adjacent to the container room but with no interconnecting door or other form of access i.e. there will be no internal access to the room containing the chlorine container.

Chlorinators and other equipment will be installed in this room. Chlorinators shall be free-standing, floor-mounted, ‘V’ notch type gas chlorinators or an equivalent approved disinfection system and shall have a turn down ratio of 10:1 over the full range of works operation.

Chlorinator Room shall be suitable for locating two nos. Vacuum type chlorinators and ancillary equipment’s. Room shall be provided with appropriate capacity roof extractor for venting out contaminated air. Exhaust fans and electric hooter should be provided both in chlorinator room and in PLC room.

Each chlorinator shall be equipped with a motorised plug positioned to be actuated by a 4 to 20 mA signal proportional to the total raw water flow as measured by the flume at the works inlet.

Each chlorinator shall have dedicated individual piping for gas feed, motive water, chlorine solutions, injectors and diffusers at the point of application.
Suitable water line, chlorine gas line, chlorine store line should be provided. Chlorine booster pump should be provided. All gaseous chlorine line should be of copper and chlorine solution line should be of PVC.

Remote vacuum regulators mounted in the container room shall ensure that chlorine gas in the chlorination room is under vacuum.

Mal-operation of the duty chlorination system shall be indicated in the chlorination room and the central HMI. The change to the standby system shall be carried out automatically in the event of a duty chlorinator failure.

Provision for manual setting of the dosing rate shall be built in the system in addition to automatic dosing adjustment and each chlorinator shall be equipped with a 0 to 5 mg/l scale and a manual dose setter over the complete range.

Post chlorination will be at a dose sufficient to leave a residual of at least 1.5 mg/l in the treated water reservoir. The system shall be designed to prevent freezing of the liquid chlorine at the maximum rate of withdrawal.

6.6.27.2 Chlorinator Booster Pumps

Each set (2 nos) of working chlorinators shall have minimum one duty booster pump. Similarly for each set (2 nos) of standby chlorinators, there shall be minimum one dedicated booster pump. One duty pump shall supply booster water for raw water pre-chlorination and the other duty pump shall supply booster water for post chlorination. The booster pumps shall draw their supply from a suitable chlorinated water source. The pumps shall be located adjacent to the backwash pumps in the filter plant hall.

6.6.27.3 Injectors

Four injectors shall be provided, two serving duty pair/two for standby pair of chlorinators. So both pre and post-chlorination put together 8 nos. of Injectors shall be provided. The injectors shall be located at the point of application. Injectors and booster pumps shall be provided to allow chlorination at the levels and to the dosing points specified taking into account the minimum water level at the suction of the booster pumps, the maximum water level at the dosing points and pressure losses in water and chlorine solution lines.

6.6.27.4 Chlorine Container room

Container room with crane shall be provided for the storage and handling of the chlorine drums. Gas lines from the container room into the chlorinator room shall run in ducts to be sealed after installation and prior to commissioning. Chlorine container store will have walls on three sides up to 1000 mm ht. Floor of Chlorine Container room shall be provided with ironite top finish.

Drum Storage shall be provided for at least 15 days usage at the maximum rate of application.

Drums on line, drums on standby and storage of full and empty drums, shall be stored in the drum room. Drum rollers shall be provided as required to position the duty and stand by drums. Drums not in use shall be stored on concrete cradles one for each tonner.
Provision for electrically operated hoist shall be made for loading and unloading of drums from the lorry as well as for handling of drums in the chlorine store. An overhead single girder electric travelling crane shall be provided in the chlorine drum room for the following functions:

- offloading (and reloading) of drums from trucks;
- transport of drums within the storage area.

The system shall serve the drum store width over the entire length including the loading/unloading area.

The hoist and traverse speeds shall be as follows;

- Long traverse speed : 10 m/min
- Cross traverse speed : not more than 10 m/min
- Slow lifting speed : 1 m/min
- High lifting speed : 10 m/min

The container lifting beam shall be specifically designed for handling chlorine containers and equipped with necessary shackles and hooks. Operation of crane system shall be from the floor level using independent push button pendant controls operating at a 110 volt AC supply.

Two lifting beams shall be provided (a duty and a spare) and one drum weigher to be suspended from the crane hoist. Each duty and standby drum assembly shall be connected to their respective chlorinators via an automatic drum changeover device located within the drum store.

When the pressure in the duty chlorine drums falling to less than 15 psig the automatic changeover device shall operate to isolate the empty drums and to bring the full standby drums on to line.

6.6.27.5 Safety Equipment

One set of safety equipment and emergency repair tool kit shall be provided in chlorinator Room as well as in drum store area. Safety charts and printed operating instruction in bold readable prints shall be paste on walls of Chlorine Drum Store and Chlorinator Room.

Chlorine safety equipment comprising of mask, canister leak detection etc. shall be provided in chlorine room.

Firefighting extinguishers, first aid equipment as per statutory requirement shall have to be provided in chlorine room and in chlorine store.

Materials and equipment necessary to ensure the safety of personnel operating the chlorination plant and others shall be provided.

The chlorination house and chlorine drum room shall have chlorine fume detectors and be force ventilated.
Other safety equipment shall be provided including emergency blowers, resuscitators, breathing apparatus and suits.

Provision for an alkali pit shall be made so as any leaking drum can be dumped into it by lifting and moving it by electrical hoist. A pit and alkali absorption system shall be provided to contain and neutralize chlorine in the event of a leak. The system shall comprise a pit located in the drum room and accessible by the overhead crane system. The pit shall be provided with load bearing covers which can be easily removed manually in an emergency and shall be surrounded with removable guard railing. The pit shall be kept full with a neutralizing solution of lime. The pit shall be capable of holding side by side two 1 tone nominal capacity chlorine drums. A pump shall be provided in the base of the pit to facilitate emptying.

Special consideration shall be given to any floor drainage system in the drum; adequate traps shall be provided to ensure that chlorine gas cannot escape into other system. All leader tubes carrying cables or pipes out of the building shall be sealed at either ends to prevent any chlorine gas leaking out.

The safety equipment shall include but shall not be limited to:

- two sets of approved self-contained breathing apparatus, each comprising an air set, carrying harness, face mask and valves and ancillary equipment. Each set shall be provided with three 200 litre capacity, 140 mm diameter, air cylinders;

- two sets of approved positive airline breathing apparatus, each comprising body harness, face masks and valves and 30 m of airline. One air trolley, comprising wheeled frame with two air cylinders, control manifold, airline hose and hose winding drum. Two spare cylinders suitable for changeover shall be provided;

- one portable electric motor driven air compressor for recharging air cylinders, complete with quick-release air hose couplings;

- two `instant action' resuscitators.

- four sets of safety clothing in various sizes, each comprising PVC overalls, wellington boots with steel toe caps, goggles, gloves and safety helmets.

Each set of safety equipment shall be mounted in a glass-fronted, non-locking PVC coated steel cabinet in approved locations on the outside of the building. Two emergency showers shall be provided and shall be installed outside on either side of the drum room. Each shower shall be operated automatically by a quick acting hand or foot valve.

Four eyebaths shall be supplied. Two eyebaths shall be adjacent to each of the showers. Water for the showers, etc, shall be drawn from the service water supply.

Contractor will have to obtain necessary approvals for storing of Chlorine Drums from Explosive Inspector’s office and all other statutory approvals required for handling, storage and use of chlorine gas in pressurized cylinder.

Design and safety features outlined in CPHEEO Manual should be adhered to.
6.6.27.6 Chlorine Leak Detectors

Leak detector with alarm system shall be located in Chlorinator Room as well as in Chlorine Drum Store. Signal from leak detector shall activate exhaust system. Not less than three chlorine gas leak detectors shall be provided each with a single detector cell. At least two sensors shall be located in the drum room and at least one sensor in the chlorination room.

The chlorine leak detectors in the drum room shall be mounted at each end of the drum room. The chlorine leak detectors shall have two adjustable alarm levels sensitive to chlorine concentrations above 1 ml/m³. The range of adjustment of alarm levels shall facilitate selection of the following alarms:

- low level 2 ml/m³
- high level 4 ml/m³

The low level alarm shall:

- initiate a local audible and visual alarm;
- start the ventilation fans in the drum and chlorination rooms;
- raise an alarm at the local control panel and at the central HMI.

The high level alarm shall:

- initiate local audible and visual alarm;
- initiate an audible and visual alarms outside the buildings (the alarm shall be sufficiently loud to be heard in all buildings located within the Water Treatment Plant Campus);
- raise an alarm at the local control panel and at the central HMI;
- shut down the chlorination systems;
- stop the drum room and chlorination room extract fans.

The chlorine detectors system shall be provided with a back-up power supply to maintain the units and alarm system in operation for 4 hours in the event of a power failure. The chlorine detectors shall have self-checking circuitry and detector failure. Alarms shall be provided at the local control panel and central HMI. Detector failure alarms shall not be combined with the leak alarms. Statutory warning notices relating to the storage and handling of chlorine shall be provided. The signs shall either be pictorial or provided in Hindi and English.

6.6.27.7 Ventilation System

Each area where chlorine is stored or used as gas or liquid shall be provided with a forced ventilation system. Air intakes shall be sized to allow uniform ventilation and positioned to prevent possible recirculation. Extract air shall be ducted from low level and discharged at high level.
The ventilation systems shall be designed to provide for general day to day use an air change rate of four per hour and a minimum of twenty changes of air per hour for use in the event that a chlorine leak is detected. Extract fans shall be heavy duty industrial pattern manufactured from chlorine resistant materials.

Ductwork shall be manufactured from U-PVC extruded sheets or circular sections complying with BS 3757 and BS 3506. Fan controls shall be linked to the gas leak detection system. Hardwired fan controls shall be provided and shall be manually controlled. An override shall be provided to operate the fans as required in the event of a chlorine leak alarm. Fan controls shall be grouped in an enclosure outside the ventilated area and shall include the following:

- fan off/on;
- fan running/failed indication lights;
- low and high gas leakage indication alarm light.

An override facility shall be provided to permit, under manual supervision only, the ventilation fans to be operated in order to disperse gas after isolation of a gas leak. Indicator lights shall be provided at the entrances to the chlorination room and the drum room to indicate whether the ventilation system running.

6.6.27.8 Chlorine Residual Monitors

Two chlorine residual monitors shall be provided for monitoring the raw water and final treated water downstream of the chlorine injection points.

The monitor installation shall be located in a covered location easily accessible for viewing and maintenance and shall be provided complete with sample pumps as necessary to ensure the continuity of the sample.

The sampling pipework complete with isolation valves etc. shall be designed to ensure the sample reaches the monitor in a time not greater than 1 minute. The monitor drainage pipework shall permit the visual checking of the presence of flow and shall discharge to the foul drain. Sample water not passed through the monitor shall be returned to the process.

The residual signals shall be displayed at the local control panel and at the central HMI. High and low chlorine residual levels shall raise alarms at the local control panel and at the central HMI.

6.6.27.9 Chlorination Power and Control

A combined MCC and control panel shall be provided and located in a suitable location protected from the weather and the effects of the process. The control panel shall provide facilities for the:

- display status and values associated with the chlorination systems;
- duty pump selection;
- annunciate alarms associated with the chlorination systems;
- operator adjustment of process set points.

The chlorination systems shall operate using a fixed manually/automated set dose rate. The quantity of chlorine dosed will therefore be adjusted in direct proportion to the process flow at the dosing point through PLC/SCADA. The chlorine residual monitors to be provided shall be used for monitoring and alarm purposes only.

The duty booster pumps shall be manually started at the control panel. The action of starting the duty booster pump shall start the chlorination process concerned. The operation of the room ventilation and fume detection systems shall be independent of any PLC controls and shall operate in any mode. Cable support systems throughout the chlorine installation shall be constructed of U-PVC.

6.6.27.10 Service Water System

The Contractor shall provide a complete service water system: A covered service water storage tank shall be mounted on the roof of the chemical house. The service water storage tank shall be fed by duty/standby service water pumps located in the filter plant room. The storage tank shall provide at least one hour's storage of service water at average usage rates.

The service water system shall supply water for:

- chemical makeup;
- tank cleaning and flushing;
- diluent flows for coagulants/chemicals;
- emergency showers and eyewashes;
- hose points at the coagulants/chemicals storage area.
- the domestic water system.

All service connections shall be provided with isolation facilities to permit work to be carried out at one point of supply without affecting other users.

An independent power and control panel shall be provided for the service water system. Status annunciation shall be carried out using discrete indicator lights located on the pump starter enclosures.

The duty pump shall be controlled by level probes located in the storage tank.

The following alarms shall be provided at the control panel and at the central HMI.

- duty pump failure;
- system failure (i.e. both pumps failed or a similar occurrence which prevents the system from working);
- storage tank high level.
6.6.28 **WTP Wastewater Recovery & Recycle System**

A wastewater recovery system shall be provided to reduce the water loss from the treatment process and thereby recover some quantity of water and also to handle the sludge coming out from the clarifiers / tube settlers. The sludge shall be dewatered and disposed safely to an identified secure landfill site in consultation with local municipal body and cited within a distance not more than 20km.

The Wastewater recovery & sludge treatment process shall primarily comprise of:

- Filter Backwash wastewater storage tank with mixing and pumping arrangement
- Recovered water storage and recycling pumps
- thickened sludge sump;
- centrifuge feed pumps;
- polyelectrolyte feeding pumps;
- mechanical sludge dewatering;
- Filtrate/centrate collection tank with pumps;
- sludge storage with periodic disposal to landfill.

The wastewater from the backwash from filters shall be collected in a storage tank with minimum capacity to hold waste water generated during two backwash.

The clarified water/supernatant shall be collected in a sump and pumped back to inlet chamber of WTP

Settled sludge from Clariflocculators/ Tube settlers shall be collected in a sludge holding cum thickener tank.

Overflow from this tank shall be taken to filter backwash wastewater storage tank, while the thickened sludge shall be collected in a sump and pumped to sludge dewatering machines along with chemical feeds if any.

Centrate/filtrate shall be collected in a sump and shall be pumped to Backwash wastewater storage tank or be used for gardening within the premises or discharged in to the drain.

Dewatered sludge cake should have dry solids concentration of minimum 20%. This shall be stored in a covered shed with concrete platform. (minimum storage facility shall be for 15 days). The stored sludge shall be periodically disposed off, as guided by Employer’s Representative, in consultation with local municipal body, to a disposal site located within 20 Kms from the WTP site.

Provision be made that if required, the filter backwash wastewater and clariflocculator waste sludge can be directly be discharged in to the drain.

Provision shall be provided throughout the installation to clear sludge blockage without the removal of pipework sections.
6.6.28.1 **Dewatering System Feed Pumps**

The Dewatering system feed pumps shall be fixed speed positive displacement pumps. Each pump shall be rated to pump in 16 hours the volume of thickened sludge to be dewatered by Dewatering System during the period of highest raw water turbidity.

6.6.28.2 **Polyelectrolyte Make up and Dosing Pumps**

Minimum Two metering pumps(1 Duty and 1 Standby pumps) and all associated polyelectrolyte make facilities, pipework and valves etc. shall be provided to dose polyelectrolyte from a polyelectrolyte storage tank into the thickener feed line at a rate of up to 5 kg per tonne of dry solids. Each dosing pump shall be dedicated to a thickener feed pump.

The metering pumps shall be of the diaphragm type driven by a fixed speed motor with manual stroke adjustment.

The maximum stroking speed shall be 100 rpm with a 10 to 1 turn down and an accuracy of ± 3% over the operating range.

The metering pump shall be selected as duty along with its corresponding thickener feed pump. The dosing pump shall start and stop simultaneously with the associated duty thickener feed pump.

6.6.28.3 **Mechanical Sludge Dewatering System**

It shall be located close to sludge thickener unit and shall consist of

- A thickened sludge storage tank with provision of constant stirring to keep solids in suspension. The capacity of this tank should be such as to permit 16 hour operation of dewatering unit
- Pumps to lift sludge to dewatering machine at required pressure
- Mechanical sludge dewatering machine including chemical addition system (storage and feeding system)
- Dewatered sludge collection and transport system
- Decanted water storage and pumping arrangement (either to put water in recovered water tank or for use in horticulture within WTP premised)
- The system hall be placed on a well covered platform
- For mechanical Dewatering, chemical feeding system and all pumps and accessories 100% standby capacities shall be provided.

The Dewatering System with 100% standby capacity having sufficient capacity to dewater during 16 hours of operation shall be provided.

The Dewatering System shall produce a dewatered sludge cake of no less than 20% dried solids. At least 98% of the solids shall be in the dewatered cake and less than 2% of the solids shall be in the centrate/filtrate
Operation of each dewatering unit and its associated dedicated sludge feed pumps, polyelectrolyte dosing system, and flushing system and other plant shall be automatic once the start-up procedure has been initiated by the Contractor.

6.6.28.4 Recovered water storage tank

Recovered water from filter backwash and clarifier sludge shall be collected in sump made of RCC. The tank capacity shall be so designed as to enable recycling of recovered water at uniform rate.

6.6.28.5 Sludge Storage Shed

Dewatered Sludge storage shed of 15 days capacity shall be constructed within the plant. Dewatered Sludge shall be stored on a platform with cemented floor and at least 30 cms above GL. The platform shall be provided with shed extending 60 cms beyond platform on all sides. Minimum height of shed should be 4m. Sloped approaches may be provided on all sides for proper loading and unloading of sludge. The floor shall be sloped in such a manner that filtrate, if any, from dewatered cakes may be collected in channels and discharged in to the channel on two sides of the platform.

6.6.28.6 Water and Sludge Sampling

The Contractor shall provide a suitable drained bench containing two clarity bowls complete with all interconnecting pipework, automatic sampling pumps and drainage facilities for drawing samples from:

- raw water at the inlet chamber;
- Clearwater water reservoir outlet.

The bench shall be sited by the Contractor in the onsite laboratory.

In addition, a further sample bench shall be provided and installed by the Contractor in the laboratory. Sampling equipment shall be provided to deliver continuous samples of the following to the aforementioned bench:

- raw water;
- raw water at the inlet;
- clarified water from each clarifier;
- filtered water from each filter;
- water from the clear water reservoir inlet;
- supernatant from each sludge thickener;
- centrate/filtrate from Dewatering System.
- Clarifier sludge
- Thickened sludge
- Dewatered sludge
The sampling arrangement shall include all interconnecting pipework, automatic sampling pumps and taps, adequate sink and drainage.

Convenient means shall be provided to obtain samples manually from each clarified water outlet, each tube settler outlet, each clarifier sludge outlet, each filter outlet, each filter backwash water outlet, treated water reservoir inlet, each thickener supernatant outlet, each thickener sludge outlet and each dewatering unit outlet.

Sample cocks shall be provided locally at both the filtered water holding tank outlet and the thickener feed pump outlet.

6.6.29 Sludge Treatment and Disposal Power and Control

A combined MCC and control panel shall be provided and located in a suitable location protected from the weather and the effects of the process. The control panel shall provide facilities for the:

- display status and values associated with the sludge treatment systems;
- duty pump selection;
- annunciate alarms associated with the sludge treatment systems;
- all necessary controls for Dewatering System installation.
- The centrifuge manufacturers proprietary control panel/s may be provided in addition to the above providing the requirements for Dewatering System status and alarm annunciation are fulfilled locally and at the central HMI.

6.6.30 List of Equipments/Instruments for Automatic operation of Water Treatment Plant

- Filter inlet works
- Filter outlet valves
- Backwash wash inlet valves
- Backwash water outlet valves
- Filter backwash water pumps (to be connected with level/operated switches on backwash water storage tanks)
- Clarifier desludging valves

6.6.31 Intercom System

An intercom system shall be provided between the following points within the treatment plant:

- control room
- The pump and compressor room with the adjacent main distribution panel room
- the laboratory
- the chemical house (chlorinator room, point close to the chlorine storage area)
- the filter operation gallery
- the pipe gallery of the filter house
- reception, office, store Room, MCC Room
- Administrative building, laboratory.

6.6.32 Laboratory and sampling system

The quality of the water entering, passing and leaving the treatment plant shall be monitored via HDPE sampling pipes DN 25 from the following points leading to the laboratory:

- raw water pipe at the inlet chamber (raw water)
- outlet channel of the clariflocculators (clarified water)
- end of the filtered water channel (filtered water of all filters)
- outlet of the chlorination chamber (treated water)
- pressure pipe of the clear water pumping station

The sampling pipes lead from the sampling point to small sampling pumps installed at a low area of the pipe gallery of the filters. From there, pressure pipes lead to the laboratory to the outlet points.

Sampling at individual units shall be made with the help of a sampling bottle in the case of open reservoirs or channels and from taps. Each sampling point shall be provided with an outlet convenient for the collection of samples for laboratory testing and for the connection of a portable turbidity meter.

The laboratory shall be housed in administrative building. It shall have the equipment, storage space and chemicals for the following chemical and bacteriological routine analyses:

- temperature
- turbidity
- suspended solids
- residual chlorine
- pH

The testing methods shall be as simple as possible (colorimeter, comparator, predefined test kits, etc.) and the equipment as robust as possible. The methods shall be described in a test manual.
The laboratory shall have 1.2 m high working granite platforms with sinks. The sampling pipes shall end at one of the sink. The taps shall be clearly labelled with the type and provenience of the water. A portable direct reading turbidity meter shall be provided for the measuring of the turbidity at the individual measuring points.

All the sampling points shall end in clarity Bowls in laboratory for easy collection and analysis.

6.6.32.1 Laboratory Equipments

Following minimum laboratory instruments/equipment shall be provided but shall not be limited to:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Equipment</th>
<th>Minimum Quantity to be provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>pH meter</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>NepheloTurbity Meter</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>Chlorine analyser (comparator)</td>
<td>1</td>
</tr>
<tr>
<td>4.</td>
<td>B.O.D. Incubator</td>
<td>1</td>
</tr>
<tr>
<td>5.</td>
<td>Pipettes, burettes and other glassware</td>
<td>As required</td>
</tr>
<tr>
<td>6.</td>
<td>Incubator</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>Autoclave</td>
<td>1</td>
</tr>
<tr>
<td>8.</td>
<td>Water Bath (serological)</td>
<td>1</td>
</tr>
<tr>
<td>9.</td>
<td>Binocular Microscope</td>
<td>1</td>
</tr>
<tr>
<td>10.</td>
<td>Electric balance</td>
<td>1</td>
</tr>
<tr>
<td>11.</td>
<td>Jar Test apparatus</td>
<td>1</td>
</tr>
<tr>
<td>12.</td>
<td>Magnetic Stirrer</td>
<td>1</td>
</tr>
<tr>
<td>13.</td>
<td>Distilled Water Plant</td>
<td>1</td>
</tr>
<tr>
<td>14.</td>
<td>Sampling Bottles (Reagent Bottles of 250 ml Capacity)</td>
<td>24</td>
</tr>
<tr>
<td>15.</td>
<td>Electric Oven</td>
<td>1</td>
</tr>
<tr>
<td>16.</td>
<td>Wire Baskets</td>
<td>6</td>
</tr>
<tr>
<td>17.</td>
<td>Suction flask (1 litre capacity)</td>
<td>1</td>
</tr>
<tr>
<td>18.</td>
<td>All types of laboratory glassware, accessories and other consumables and regents for minimum one year requirement</td>
<td>One Lot</td>
</tr>
<tr>
<td>19.</td>
<td>Sieve Analysis set with shaker</td>
<td>1</td>
</tr>
<tr>
<td>20.</td>
<td>Analytical balance</td>
<td>1</td>
</tr>
<tr>
<td>21.</td>
<td>Constant voltage transformer</td>
<td>1</td>
</tr>
<tr>
<td>22.</td>
<td>Vacuum cleaner</td>
<td>1</td>
</tr>
<tr>
<td>23.</td>
<td>Refrigerator (365 ltr.)</td>
<td>1</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Equipment</td>
<td>Minimum Quantity to be provided</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>24.</td>
<td>Colorimeter including UV and infrared range for chemical analysis.</td>
<td>1</td>
</tr>
</tbody>
</table>

**6.6.33 Brief Description of Instrumentation**

Providing following listed monitoring and control instrumentation is minimum requirement under this contract.

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Instrument</th>
<th>Type</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Water Flow Meter</td>
<td>Magnetic/ Ultra sonic type</td>
<td>Inlet line to plant</td>
</tr>
<tr>
<td>2</td>
<td>Water Flow Meter</td>
<td>Magnetic/ Ultra sonic type</td>
<td>Clear water rising main after Clear Water Pumps</td>
</tr>
<tr>
<td>3</td>
<td>Level sensor &amp; transmitter for filter beds</td>
<td>Ultra Sonic / Capacitance Type</td>
<td>One in each Filter bed</td>
</tr>
<tr>
<td>4</td>
<td>Level sensor Controller for water tanks</td>
<td>Float / Capacitance type</td>
<td>Clear Water Sump</td>
</tr>
<tr>
<td>5</td>
<td>Residual Chlorine Analyzer</td>
<td>On line type</td>
<td>Clear water rising main</td>
</tr>
<tr>
<td>6</td>
<td>Turbidity Analyzer</td>
<td>On line type</td>
<td>Raw water Line</td>
</tr>
<tr>
<td>7</td>
<td>Turbidity Analyzer</td>
<td>On line type</td>
<td>Clarifier water out let</td>
</tr>
<tr>
<td>8</td>
<td>Turbidity Analyzer</td>
<td>On line type</td>
<td>Filtered water out let</td>
</tr>
<tr>
<td>9</td>
<td>Level indicator</td>
<td></td>
<td>Coagulant/chemical Solution tanks</td>
</tr>
<tr>
<td>10</td>
<td>Pressure Gauges</td>
<td>Bourdon type</td>
<td>On all pump and air blower discharge lines</td>
</tr>
</tbody>
</table>

A PLC system shall be provided to monitor and control the operation of the plant. This system shall be suitable for real time display of status of plant units, on off position of various pumps and equipment open close position of valves, etc. monitoring parameters and shall be suitable for programming the auto operation of the filters as per the requirement. PLC system shall be provided with 100% redundancy, colour monitor, and dedicated UPS and a printer. Contractor will have to submit details of the system for approval of Employer’s representative before finalizing the design. Providing power supply, signal cables etc., whatsoever required for instrumentation work is included in the scope of contract.
6.6.34 Brief Description and specification for Interconnecting Piping

Supplying, laying jointing and testing of interconnecting piping and valves with all accessories like support brackets pipe racks etc. are included in the contractor’s scope of work. All the piping shall be carried out as per the specifications given in this tender document and following the relevant IS codes, using best quality material. Tenderers are advised to make their own assessment of the requirement of Pipes, Valves, fittings. Jointing material, gaskets, nuts bolts, and pipe supports etc. whatsoever is required for successful completion of the job as per the specifications.

Pipeline shall be design taking following into consideration

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Pipe details</th>
<th>MOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pipe from Raw Water Take off point to Inlet Chamber</td>
<td>DI</td>
</tr>
<tr>
<td>2</td>
<td>All interconnecting piping between plant units</td>
<td>DI</td>
</tr>
<tr>
<td>3</td>
<td>Filter Back wash water line</td>
<td>DI</td>
</tr>
<tr>
<td>4</td>
<td>Scour Air Line</td>
<td>MS</td>
</tr>
<tr>
<td>5</td>
<td>Sludge and Filter back wash water lines</td>
<td>DI</td>
</tr>
<tr>
<td>6</td>
<td>Chemical dosing line</td>
<td>HDPE/PP</td>
</tr>
<tr>
<td>7</td>
<td>Chlorine solution line</td>
<td>HDPE/PP</td>
</tr>
<tr>
<td>8</td>
<td>Clear Water pipes &amp; fittings within pump house</td>
<td>DI</td>
</tr>
</tbody>
</table>

All gravity flow line shall be design for fluid velocity of 0.6 to 1 m/sec. All Pressure lines to be designed for Fluid velocity of 1.5 m/sec. Scour air pipeline shall be designed for 25 m/sec fluid velocity. All fitting in HDPE/PP line shall be moulded/electrofusion joints.

6.7 Particular Technical Requirements – Civil Works

This section specifies the technical requirements pertaining to Civil works. The General Civil requirements and standard specifications included in the tender shall be read in conjunction with these requirements.

6.7.1 Joints

Movement joints such as expansion joints, complete contraction joints, partial contraction joints and sliding joints shall be designed to suit the requirements. However, contraction joints shall be provided at specified locations spaced not more than 7.5 m in both directions right angle to each other for walls and rafts.

Suitable gap at the location of expansion joints placed at a suitable interval not more than 30m shall be provided in walls, floors and roof slabs of all structures.
Construction joints shall be provided at right angles to the general direction of the member. The locations of construction joints shall be decided as per convenience of construction. To avoid segregation of concrete in walls, horizontal construction joints are normally to be provided at every 2 m height. Approved PVC water-stops of 150 mm width shall be used for walls and 230 mm width for base slabs.

Expansion joints for non-liquid retaining structures shall be provided as per IS 3414.

6.7.2 **Partly/Fully Underground Liquid Retaining Structures - Basis for Design**

All underground or partly underground liquid containing structures shall be designed for the following conditions:

i. liquid depth up to full height of wall and free board: no relief due to lateral soil pressure from outside to be considered;

ii. Reservoir empty (i.e. no liquid or any material inside the storage area): full lateral earth pressure at rest due to surrounding saturated soil and surcharge pressure as applicable, shall be considered;

iii. partition wall between dry sump and wet sump to be designed for full liquid depth up to full height of wall;

iv. partition wall between two compartments to be designed as one compartment empty and other full;

v. Structures shall be designed for uplift in empty conditions considering the depth of the highest water table recorded in the area.

vi. walls shall be designed under operating conditions to resist earthquake forces developed due to mobilization of earth and dynamic liquid loads;

vii. Underground or partially underground structures shall also be checked against stresses developed due to any combination of full and empty compartments with appropriate ground/uplift pressures on the base slab. A minimum factor of 1.2 shall be ensured against uplift or floatation.

6.7.3 **Foundations**

i. The minimum depth of foundations for all structures, equipment’s, buildings and frame foundations and load bearing walls shall be as per IS: 1904.

ii. Care shall be taken to avoid the interference of the foundations or any other component of the new building with the foundations of adjacent buildings or structure. Suitable adjustments in depth, location and sizes may have to be made depending on site conditions. The Employer’s Representative shall accept no extra claims for such adjustments.

iii. Base raft for underground structure shall be designed for uplift forces that are likely to be developed.
iv. Where there is level difference between the natural/ existing ground level and the foundations of structure or floor slabs, this difference shall be filled up in the following ways:

- In case of non-liquid retaining structures the natural top soil shall be removed till a firm stratum is reached (minimum depth of soil removed shall be 500 mm.) and the level difference shall be made up by compacted backfill as per specifications. However, the thickness of each layer of the backfill shall not exceed 150 mm. The area of backfilling for floor slabs shall be confined to prevent soil from slipping out during compaction. The safe bearing capacity of this well compacted backfilled soil for design calculations shall not exceed 100 KN/m².

- In case of liquid retaining structures, the natural top soil shall be removed as described above and the level difference shall be made up with Plain Cement Concrete (1:5:10)

6.7.4 Requirements for Reinforced and Plain Concrete Works (Structures)

The following are the design requirements for all reinforced or plain concrete structures:

a. All blinding and leveling concrete shall be a minimum 100 mm thick with minimum concrete M10 grade.

b. All structural reinforced concrete other than for water retaining structures shall at least be of M25 grade with 20 mm size downgraded coarse aggregates, for all structural members.

c. The minimum grade of concrete for water retaining structures shall be M30 having minimum cement content of 320 kg/m³ with 20 mm size downgraded coarse aggregates.

d. The minimum clear cover to all reinforcement including stirrups and links shall be 40 mm for all water retaining structures including the bottom of roof. For other structures the minimum clear cover shall be as specified in IS: 456.

e. Any structure or pipeline crossing below roads shall be designed for a minimum of Class A of IRC loading.

f. The bridges and supporting structure (for clarifiers, pipeline crossing river, etc.) shall be designed to safely withstand the loadings such as loads and torque transmitted through scrapper blades, motor, water force in the river, etc. depending on the arrangement offered besides other loads.

g. All pipes and conduits laid below the structural plinth, road works, river bed, nallah crossing, etc. shall be embedded in reinforced concrete of minimum grade M25 having minimum 300 mm thick concrete cover all around.

h. Approved quality water proofing compound (chloride free) shall be added during concreting of all liquid containing structure, in the proportion specified by manufacturer.
i. For walls of liquid retaining structures, the following shall be considered.
   - Minimum reinforcement shall be as per IS: 3370 part -2.
   - Maximum length of panel to be concreted considering partial construction joints shall be 7.5 m. The adjacent panels shall be poured with a minimum time gap of 4 days. Height of pour shall not exceed 2 m.

j. The following minimum thickness shall be used for different reinforced concrete members, irrespective of design thickness:

<table>
<thead>
<tr>
<th></th>
<th>Walls for liquid retaining structures</th>
<th>:</th>
<th>200 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>ii.</td>
<td>Roof slabs for liquid retaining structures</td>
<td>:</td>
<td>150 mm</td>
</tr>
<tr>
<td>iii.</td>
<td>Bottom slabs for liquid retaining structures</td>
<td>:</td>
<td>200 mm</td>
</tr>
<tr>
<td>iv.</td>
<td>Floor slabs including roof slabs, walkways, canopy slabs</td>
<td>:</td>
<td>150 mm</td>
</tr>
<tr>
<td>v.</td>
<td>Walls of cables / pipe trenches, underground pits etc</td>
<td>:</td>
<td>125 mm</td>
</tr>
<tr>
<td>vi.</td>
<td>Column footings</td>
<td>:</td>
<td>300 mm</td>
</tr>
<tr>
<td>vii.</td>
<td>Parapets, Chajja</td>
<td>:</td>
<td>100 mm</td>
</tr>
<tr>
<td>viii.</td>
<td>Precast trench cover</td>
<td>:</td>
<td>75 mm</td>
</tr>
</tbody>
</table>

### 6.7.5 Requirements for Building Works

Unless otherwise specified, all the building works shall generally comply with the following:

a. All buildings shall have Reinforced Concrete framework.

b. 75 mm thick RCC Damp Proofing Course in M15 shall be provided to all building walls.

c. Anti-termite treatment as per IS: 6313 part-III – 1971 with injection of chlorpyrifos mollifiable concrete (1%) timber care ground treatment chemically emulsion 1:3 and creating a chemical barrier under and around the column pits, wall trenches, basement excavation, top surface of plinth filling, junction of wall and floor along the external perimeter of building, expansion joints, surrounding of pipes and conduits etc.

d. All external walls shall be in 230 mm thick brick masonry built in cement mortar in (1:4). Transoms and mullions shall be of 115 mm x
230 mm size of cement concrete in M15 with four numbers 6 mm bars and 6 mm links at 150 mm c/c shall be provided to form panels not exceeding 3500 mm x 3500 mm in size.

e. All internal partition walls except for toilets shall be in 230 mm thick brick masonry built in cement mortar 1:4 with transoms and mullions as stated above. Toilet partition walls shall be in 115 mm thick brick masonry built in cement mortar 1:4 and shall have transoms and mullions as stated above to form panels not exceeding 1200 mm x 1200 mm size.

f. All internal masonry surfaces shall be finished with 12 mm thick smooth faced cement plaster in cement mortar (1:4).

g. All external masonry surfaces shall be plastered in two coats with sand faced cement plaster in cement mortar (1:4) and shall have total thickness of 20 mm. Waterproofing compound of approved make and quality shall be added to the cement mortar in proportions as specified by the manufacturer.

h. Bathroom/ W.C. floor slab shall be sunk and filled with brickbat coba (broken bricks set in lime) and provided with waterproofing as per the specifications of an approved specialist waterproofing company. The finished floor level in Bathroom / W.C. areas shall be normally 12 mm below the finished floor level on the outer side.

The toilet facilities shall include at least:

   i. 1 No. Water closet with white porcelain EWC/Orissa pan minimum 580 mm long with PVC flushing cistern of 10 liters capacity.

   ii. 1 No. Urinal of sizes 600 mm x 400 mm x 300 mm flat back type in white porcelain separated by a kota stone partition of size 680 mm x 300 mm shall be provided outside toilet.

   iii. 1 No. Washbasin of size 510 mm x 400 mm in white Porcelain with inlet, outlet with bottle trap.

   iv. 1 No. Mirror of size 400 mm x 600 mm PVC molding wall mounted type fitted over washbasins.

   v. 1 No. Plastic liquid soap bottles

   vi. 1 No. Chromium plated brass towel rails minimum 750 mm long.

   vii. All stopcocks, valves and pillar cocks shall be of chromium-plated brass, heavy duty.

   viii. All fittings such as ‘P’ or ‘S’ traps, floor traps, pipes, down-take pipes etc.
ix. The sewage from toilet blocks shall be led to a septic tank with soak pit till the sewerage system is developed and later connection to the sewer line as directed by the Employer. The Contractor, at a suitable location, shall provide a septic tank having appropriate capacity, as per specifications.

i. Wherever specified, staircases shall be finished with 25 mm thick Kota Stone treads and 20 mm thick Kota Stone skirting. The rise of stairs shall not exceed 170 mm and minimum width of the tread shall not be less than 275 mm. All steps shall have 20 mm nosing. R.C.C. stairways shall be provided to permit access between different levels within buildings. All roof tops and tops of overhead tanks shall be made accessible with ladder provision. Vertical ladders fitted with landing point extensions will be permitted where considered appropriate by the Employer’s Representative to access areas not frequently visited.

j. All floor cutouts and cable ducts, etc. shall be covered with pre-cast concrete covers in outdoor areas and G.I. chequered plates of adequate thickness in indoor areas. All uncovered openings shall be protected with G.I. hand railing fixed with two rails. Top railing and vertical of the G.I hand railing shall be 32 mm dia. G. I. Pipe of Class-A. The lower railing shall be 25 mm dia. G.I. pipe of Class A.

k. All staircases shall be provided with SS304 railing with PVC cover or wooden handrail.

l. The reinforced concrete roofs shall be made waterproof by application of approved cement/ lime based waterproofing treatment. The finished roof surface shall have adequate slope to drain quickly the rainwater to R.W down-take points.

m. For roofing drainage, PVC rainwater down-takes with khurra and door bend with grating at top shall be provided. For roof areas up to 40 m². minimum two nos. 100 mm diameter down-take pipes shall be provided. For every additional area of 40 m² or part thereof, at least one no. 100 mm dia. down take pipe shall be provided. The RW pipes shall be concealed.

n. Top surfaces of chajjas and canopies shall be made waterproof by providing a screed layer of adequate slope or application of an approved roof membrane and sloped to drain the rainwater.

o. Building plinth shall be minimum 450 mm above average finished ground level around building and shall not be less than plinth level of existing buildings.

p. All buildings shall have a minimum 1.0 m wide, 100 mm thick plinth protection paving in M15 grade concrete finished with stone slabs/ tiles. All plinth protection shall be supported on well-compacted stratum.
q. All concrete channels and ducts used for conveying liquid shall have smooth finish from inside. The width of concrete channels shall not be less than 500 mm. All open channels shall be provided with G.I. hand railings.

r. Kerbs to be provided below the hand railing on the catwalks/pathways should be as per relevant sections of the Factory Act.

s. All rooms in the treatment plant buildings shall be provided with appropriate signboards indicating the function of the rooms involved.

t. Wherever equipment and machinery is required to be moved for inspection, servicing, replacement etc., suitable movable gantry of required capacity shall be provided.

u. The design of buildings shall reflect the climatic conditions existing on site and it shall as far as possible permit the entry of natural light.

v. Emergency exit doorways shall be provided from all buildings in order to comply with local and international regulations. Stairways and paved areas shall be provided at the exit points.

w. Toilet blocks in process building shall be provided with two drinking water taps of 12 mm size and sink with appropriate drainage.

x. All chequered Plates shall be hot dip galvanized.

y. All types of opening such as doors, windows and ventilators shall be minimum 25% of the floor area.

z. Glass shall be minimum 5 mm thick, pin headed or opaque.

6.7.6 Concrete Reinforcement

All major structures, buildings, pump Station, water treatment plant, Electrical sub stations, canal crossing structures, thrust blocks, pillars and all water retaining structures including all other structures in the Contract will use Fe500 of approved make/manufacturer for concrete reinforcement.

6.7.7 Requirements at Water Treatment Plant

The buildings to be constructed other than required for WTP are listed below:-

1. Equipment Store room 1 no.
2. Security cabin 1 no.
3.

6.7.8 Administration and Control Building

The control building shall have the following rooms at the ground floor.

a) Administration and Control Building of plinth area not less than 200 m² shall be constructed comprising of one large hall (5m x 10m approx.) for administrative staff and at least four rooms for officers and senior plant manager. Administration and Control Building shall be provided with all civic amenities. All
areas in the Block under routine occupation shall be suitably Air-cooled. Minimum floor to ceiling height of these areas shall be 3.5 m.

b) Main control room for the whole treatment plant with control panel (not less than 40 m²). Minimum floor to ceiling height of these shall be 3.5 m.

c) Staff room with toilets (total size not less than 15 m²). Minimum floor to ceiling height of these areas shall be 3.5 m.

d) Canteen Room of minimum 20 m² area

e) Store Room of minimum 20 m² area

f) Lobby, corridors, staircase

The first floor of control building shall have:

a) Laboratory for the chemical and bacteriological analyses of the raw and Clear water (not less than 60 m²);

b) Staff toilets (Indian), visitors' toilets (Indian and western, urinal) (not less than 15 m²);

c) Outdoor observation platforms and access to the units of the plant

d) Corridors, staircase

The roof terrace shall be accessible for inspection via staircase. Finishing and other requirements are as in Requirement of Administration and Control building.
### 6.7.9 Buildings and site development Works

Table 4: Requirements for building units other than Administration and Control building, Officers and Staff Quarters

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Particulars</th>
<th>Specification to be adopted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Type of Structure</td>
<td>RCC framed Structure</td>
</tr>
<tr>
<td>2.</td>
<td>Damp Proofing Course</td>
<td>75 mm thick Reinforced Cement Concrete in M15</td>
</tr>
<tr>
<td>3.</td>
<td>Exterior Walls</td>
<td></td>
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<tr>
<td>(a)</td>
<td>Below G. L.</td>
<td>Stone masonry in CM 1:4 up to G. L.</td>
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<tr>
<td>(b)</td>
<td>Above G. L.</td>
<td>Brick Masonry Wall in C. M. 1:4 min 230mm thick.</td>
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<td>4.</td>
<td>Interior Walls</td>
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<tr>
<td>(a)</td>
<td>Below G. L.</td>
<td>Stone masonry up to G. L.</td>
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<td>(b)</td>
<td>Above G. L.</td>
<td>Brick Masonry Wall in C. M. 1:4 min 230mm thick.</td>
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<td>5.</td>
<td>Partition Walls</td>
<td>Half Brick in C. M. 1:4 reinforced properly</td>
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<tr>
<td>6.</td>
<td>Roofing</td>
<td>RCC / For flat roofs treatment shall be provided with brick bat coba and finishing coat of 25 mm thickness in CM 1:4 with Water Proofing Treatment</td>
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<td>7.</td>
<td>Interior Plaster</td>
<td>Cement Mortar 1:4, 12 mm thick</td>
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<td>8.</td>
<td>Exterior Finish</td>
<td>Combination of Grit Wash and Dholpur or Karauli Stone facing in front face and water proofing cement paint on side and back.</td>
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<td>9.</td>
<td>Interior Finish</td>
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<td>Unit</td>
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<td>a)</td>
<td>Bulk Chemical Storage building</td>
<td>CCH</td>
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<td>b)</td>
<td>Staff Toilet</td>
<td>KS</td>
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<td>Floor</td>
<td>Wall Finish</td>
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<td>Bulk Chemical Storage building</td>
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<td>b)</td>
<td>Staff Toilet</td>
<td>KS</td>
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<tr>
<td>Sr. No.</td>
<td>Particulars</td>
<td>Specification to be adopted</td>
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<td>c)</td>
<td>Lobby</td>
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<td>Chlorinator room</td>
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<td>Backwash pumps and compressor room with sump</td>
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<td>10.</td>
<td>Sanitary</td>
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<td></td>
<td>W. C.</td>
<td>Indian type Orissa Pan Size 540mm/EWC</td>
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<tr>
<td></td>
<td>Urinals</td>
<td>Flat Back size 610x400x80 with 25 mm G. I. Waste pipe</td>
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<tr>
<td></td>
<td>Flushing Cistern</td>
<td>Low Level 10 liter Capacity, PVC</td>
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<td></td>
<td>Wash Basin</td>
<td>Flat Back 550x400 mm</td>
</tr>
</tbody>
</table>
Table 5: Requirement of Administration and Control building

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Type of Building</th>
<th>Administration and Control building</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Brief Specifications</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Structure</td>
<td>RC framed Structure</td>
</tr>
<tr>
<td>2</td>
<td>Masonary in foundation and plinth</td>
<td>RR stone masonry in CM 1:4 Or minimum 230 thick Brick Masonry in CM 1:4</td>
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<tr>
<td>3</td>
<td>Damp proof course</td>
<td>RCC M15 with water Proofing Compound</td>
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<tr>
<td>4</td>
<td>Masonry in Superstructure</td>
<td>Brick Masonary in CM 1:4 230mm thick minimum for external walls and 115mm for Internal partition walls</td>
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<tr>
<td>5</td>
<td>Lintels sun-shadesetc</td>
<td>R.C.C. lintels and sun shades</td>
</tr>
<tr>
<td>6</td>
<td>Roofing Treatment</td>
<td>Brick bat coba with water proofing compound min. average 75mm thick.</td>
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<tr>
<td>7</td>
<td>Internal Plaster</td>
<td>12mm CM 1:4 for walls, 12 mm the CM 1:4 for ceiling</td>
</tr>
<tr>
<td>8</td>
<td>Exterior Finish</td>
<td>Combination of Grit Wash and Dholpur or Karauli Stone facing in front face and water proofing cement paint on side and back</td>
</tr>
<tr>
<td>9</td>
<td>Flooring</td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Beneath floor</td>
<td>C.C. 1:3:6 base concrete</td>
</tr>
<tr>
<td>b</td>
<td>Finish</td>
<td>Terrazzo Precast (Grey cement) tiles</td>
</tr>
<tr>
<td>10</td>
<td>Skirting and dados</td>
<td>10 cm. Height to match flooring</td>
</tr>
<tr>
<td>Sr. No.</td>
<td>Type of Building</td>
<td>Administration and Control building</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>11</td>
<td>Windows (frame, panels, wire gauging, safety bars)</td>
<td>Frame - Assam teak</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inner Shutters - Wired gauge Teak</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wood frame Outer Shutter - Glazed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>panel teak wood shutter</td>
</tr>
<tr>
<td>12</td>
<td>Doors (Frames and shutter)</td>
<td>Frame - Assam teak section 150 x 75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>mm Shutter - Fully paneled teak</td>
</tr>
<tr>
<td></td>
<td></td>
<td>wood door as per specifications and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>approved drawing</td>
</tr>
<tr>
<td>13</td>
<td>White/ Colour/Cement lime/ Decorative Finish</td>
<td>Oil bound Distemper</td>
</tr>
<tr>
<td>14</td>
<td>Painting of doors, Windows and walls</td>
<td>Synthetic enamel paint</td>
</tr>
<tr>
<td>15</td>
<td>Electrification (type of wiring, fittings and fixture)</td>
<td>PVC Conduit wiring as per drawing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and specifications</td>
</tr>
<tr>
<td>16</td>
<td>Sanitary and Water Supply</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(I) Indian WC</td>
<td>In servant quarters and in common</td>
</tr>
<tr>
<td></td>
<td></td>
<td>toilets</td>
</tr>
<tr>
<td></td>
<td>(ii) European WC</td>
<td>In attach toilets with room</td>
</tr>
<tr>
<td></td>
<td>(A) Wash Basins</td>
<td>In every toilets and in lounge</td>
</tr>
<tr>
<td></td>
<td>(iv) Sinks</td>
<td>Steel sink</td>
</tr>
<tr>
<td></td>
<td>(v) Other accessories</td>
<td>As per approved drawing</td>
</tr>
<tr>
<td>17</td>
<td>Other Specification</td>
<td>PVC frames and shutters in Bath</td>
</tr>
<tr>
<td></td>
<td></td>
<td>rooms/Toilets</td>
</tr>
<tr>
<td>18</td>
<td>Special fitting and fixture</td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Fans</td>
<td>In every Room</td>
</tr>
<tr>
<td>b</td>
<td>Tube light</td>
<td>In every Room</td>
</tr>
<tr>
<td>c</td>
<td>Exhaust fans</td>
<td>Kitchen / Bathroom</td>
</tr>
<tr>
<td>d</td>
<td>Coolers</td>
<td>In every Room</td>
</tr>
</tbody>
</table>

### 6.7.10 Clear Water Reservoir, Sump

Two clear water reservoir of capacity as mentioned in Section VII is to be constructed with two equal compartments. The two compartments shall receive water from inlet pipe of WTP. The inlet pipe will split near CWR and shall connect to two
compartments with separate inlet pipes and separate valves. The clear water reservoir shall have total live storage of as per the Section VII scope of Work above the water level required for pump with vortex free suction. The CWR roof shall be kept at least 1.00 meter above general ground level. Ventilators shall be provided in CWR roof at suitable location and all openings of CWR shall be kept covered. The ventilators shall be provided with MS grill and wire gauge net to prevent dust entering the clear water reservoirs. The live storage depth shall not exceed 5 meters.

6.7.11 Clear Water Pump Station

The clear water pump station building is to be constructed along with Electrical outdoor switchyard. The Pump Station shall have Pump Station, Duty room, Maintenance bay, Toilet block, PLC Control Room etc.

Table 6: The general requirement of pump Station buildings shall be as follows:

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Particulars</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Type of Structure</td>
<td>RCC frame Structure</td>
</tr>
<tr>
<td>b)</td>
<td>Plinth Level</td>
<td>Minimum 0.60 meters above finished ground level</td>
</tr>
<tr>
<td>c)</td>
<td>Minimum Height of building above finished floor Levels</td>
<td>As per design</td>
</tr>
<tr>
<td>d)</td>
<td>Retaining Walls</td>
<td>RCC</td>
</tr>
<tr>
<td>e)</td>
<td>External walls Below Ground Level</td>
<td>RR stone masonry in Cement Sand mortar 1:4</td>
</tr>
<tr>
<td>f)</td>
<td>External walls above Ground Level</td>
<td>Brick masonry 230 mm thick in Cement Sand mortar 1:4</td>
</tr>
<tr>
<td>g)</td>
<td>Internal load bearing Walls and partition wall around electrical/ battery rooms</td>
<td>Full Brick 230 mm in Cement Sand mortar 1:4</td>
</tr>
<tr>
<td>h)</td>
<td>Partition walls</td>
<td>Half Brick masonry in Cement Sand mortar 1:4</td>
</tr>
<tr>
<td>i)</td>
<td>Earth Filling for Reclamation of additional Land</td>
<td>With suitable earth with compacted to 95% modified proctor density</td>
</tr>
<tr>
<td>j)</td>
<td>Area for PLC Control Room with AC</td>
<td>40 m² having partitions with aluminum framed glazed panel partitions of height up to lintel level</td>
</tr>
<tr>
<td>k)</td>
<td>Area for duty room</td>
<td>70 m²</td>
</tr>
<tr>
<td>l)</td>
<td>External finish</td>
<td>Either of water proofing cement paint, sand face plaster, Dholpur/Karauli stone facing as per approved architectural plan</td>
</tr>
<tr>
<td>m)</td>
<td>Plaster</td>
<td></td>
</tr>
<tr>
<td>Sr. No</td>
<td>Particulars</td>
<td>Specifications</td>
</tr>
<tr>
<td>--------</td>
<td>------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>n)</td>
<td>Interior Plaster</td>
<td>12 mm thick in Cement Sand mortar 1:4</td>
</tr>
<tr>
<td>o)</td>
<td>Plaster on external Walls</td>
<td>20 mm thick in Cement Sand mortar 1:4, two coats</td>
</tr>
<tr>
<td>p)</td>
<td>Ceiling Plaster</td>
<td>8 mm thick in Cement Sand mortar 1:4</td>
</tr>
<tr>
<td>q)</td>
<td>Toilet</td>
<td>Ceramic tiles up to lintel level and plaster 20 mm thick in Cement Sand mortar 1:4 above</td>
</tr>
<tr>
<td>r)</td>
<td>False Ceiling</td>
<td>Required in PLC control room</td>
</tr>
<tr>
<td>s)</td>
<td>Flooring</td>
<td></td>
</tr>
<tr>
<td>t)</td>
<td>Pump/motor Room</td>
<td>Floor Hardener topping with CC base</td>
</tr>
<tr>
<td>u)</td>
<td>Switchgear Room</td>
<td>Kota stone with rubber mat</td>
</tr>
<tr>
<td>v)</td>
<td>Battery room and Battery charger Room</td>
<td>Acid resistant tiles for flooring and dado, Sink and eye wash</td>
</tr>
<tr>
<td>w)</td>
<td>Operator office space/ duty room/ stairs / office space/toilets and other areas</td>
<td>Kota stone</td>
</tr>
<tr>
<td>x)</td>
<td>PLC control room</td>
<td>Anti-static PVC flooring with CC flooring base</td>
</tr>
<tr>
<td>y)</td>
<td>Walk ways</td>
<td>GMS Chequered plates</td>
</tr>
<tr>
<td>z)</td>
<td>Corridors and stairs</td>
<td>Kota stone</td>
</tr>
<tr>
<td>aa)</td>
<td>Painting</td>
<td></td>
</tr>
<tr>
<td>bb)</td>
<td>Outer building area</td>
<td>Cement based paint</td>
</tr>
<tr>
<td>cc)</td>
<td>Inner areas of pump/motor room, office area and lobbies</td>
<td>Dry distemper</td>
</tr>
<tr>
<td>dd)</td>
<td>PLC Control room</td>
<td>Acrylic Plastic Emulsion Paint</td>
</tr>
<tr>
<td>ee)</td>
<td>Battery room</td>
<td>Acid resistant paint</td>
</tr>
<tr>
<td>ff)</td>
<td>Doors</td>
<td></td>
</tr>
<tr>
<td>gg)</td>
<td>PLC Control room</td>
<td>Glass paneled Aluminum Double door shutters with aluminum frame and single panel hinged shutters with door closures. The first gate shall be provided with air curtain of appropriate design to ensure dust proofing.</td>
</tr>
<tr>
<td>hh)</td>
<td>Main Entrance Doors</td>
<td>Glass paneled Aluminum door shutters with aluminum frame and double panel hinged</td>
</tr>
<tr>
<td>Sr. No</td>
<td>Particulars</td>
<td>Specifications</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>shutters with door closures.</td>
</tr>
<tr>
<td>ii)</td>
<td>Switchgear room/ Battery room</td>
<td>2 hour Fire rated door-HMPS(hollow metal pressed steel)</td>
</tr>
<tr>
<td>jj)</td>
<td>Toilet and other areas</td>
<td>Pressed steel frame with 40mm thick flush doors shutter</td>
</tr>
<tr>
<td>kk)</td>
<td>Windows</td>
<td>Glass paneled Aluminum shutters with aluminum frame and double panel shutters. (All windows in PLC room will be fixed without shutters of same specifications)</td>
</tr>
<tr>
<td>ll)</td>
<td>On Outer Front Walls and other windows opening in main entrances</td>
<td>Steel section window with wire gauge and safety grill</td>
</tr>
<tr>
<td>mm)</td>
<td>Other Windows</td>
<td></td>
</tr>
<tr>
<td>nn)</td>
<td>Cooling Arrangement</td>
<td>Fans</td>
</tr>
<tr>
<td>oo)</td>
<td>Entrance lobby</td>
<td>Fans and Coolers</td>
</tr>
<tr>
<td>pp)</td>
<td>Office rooms and duty room</td>
<td>Air washer</td>
</tr>
<tr>
<td>qq)</td>
<td>Pump Station</td>
<td>Fan and air-conditioners to maintain 24°C temperature throughout the year</td>
</tr>
<tr>
<td>rr)</td>
<td>PLC Control room</td>
<td>Taping to be taken from the general water Chlorination system installed for the WTP campus supply.</td>
</tr>
<tr>
<td>ss)</td>
<td>Drinking water arrangements</td>
<td>Water cooler 40 liter per Hour and storage capacity 80 liters with Zero –B, to be installed</td>
</tr>
<tr>
<td>tt)</td>
<td>Treatment and cooling</td>
<td></td>
</tr>
</tbody>
</table>

6.7.12 **Requirements for Other Area Development Works at Treatment Plant Campus**

The campus area of treatment plant is to be developed which includes landscaping, construction of boundary wall all around the campus, providing interior roads, piping and infrastructure for drinking water, electrification of campus area, providing drainage system, providing gates, development of gardens, plantation of trees etc.

6.7.13 **Preparatory Works**

The Contractor shall undertake the following works:

i) Approval of architecture, design and drawing of civil structures

ii) Approval of developmental plans and landscaping

iii) Approval of design and drawing of quarters and recreation facilities
iv) Drainage plans and designs
v) Electrification of campus area
vi) Pipe and piping work for potable water in campus area
vii) Other designs / plans required for campus area development

6.7.14 Boundary Wall and Gates

Construction of Boundary wall (average height 1.8 meters above ground and wire fencing of 0.6 meters) all along the periphery of the acquired land and providing and installation of gates and Gate lights, complete in all respect. The boundary wall shall be made in RR stone masonry in CM 1:4 and shall be pointed in CM 1:4. The top of wall shall be provided with 75 mm thick RCC coping. The section of the boundary wall & design of gates shall be got approved from the Employer’s Representative.

6.7.15 Horticulture and Landscaping

Horticulture and Landscaping shall be done according to the topography of the area and should be planned so as to make the campus a focal point. The open areas leaving expansion requirements must either be covered by tree plantation or must be suitably grassed. Shadow trees must be planted at a maximum distance of 15 m c/c along the periphery of the campus area and along the roads. The campus must be provided with gardens, with seasonal flowerbeds and decorative plants.

In case where unsuitable soil is met with, it shall be either removed or replaced or it shall be covered over to a thickness decided by Employer’s Representative with good earth.

The concrete tree guard of 1.5 m height shall be provided as specified by Employer’s Representative.

The planted trees, garden etc. so developed shall be maintained in good condition during the execution and maintenance period of the Contract without any additional costs. The Contractor shall ensure the safety of plants and shall take all the activities such as re-plantation, manuring, use of pesticides, mulching, cutting etc. for growth of trees / plants and maintenance of plants.

6.7.16 Roads, Paths and Hard-standings

A comprehensive road network shall be provided to provide appropriate connectivity of the buildings and utilities, pump Station and around New treatment plant units i.e. main entrance, chlorine tonner shed, bulk chemical storage house, chemical house, clear water pump station, clear water reservoir, and other important units of treatment plant to link with the main road and the existing road network to permit vehicular access to each unit of the plant for necessary maintenance, delivery of consumables and personnel access. The internal roads shall be made as specifications and along the road, pre-cast cement concrete kerbs of approved shape and size shall be provided.

The road layout shall have due consideration to the storm water drainage system so as to prevent standing water in the plant area.
Paved pedestrian access ways shall be constructed to provide a network of logical routes interlinking plant areas.

Hard standing areas shall be provided to permit the parking of vehicles involved in the delivery of consumables from blocking site roadways during unloading or loading. The road system shall be designed such that vehicles involved in the delivery of consumables can follow a continuous route through the plant area and leave again without going in reverse or carry out complicated maneuvers in order to exit the plant.

Damage to any existing roads on account of their use by the Contractor shall be made good to the satisfaction of the Employer’s Representative.

6.7.17 Security Cabins

Necessary security cabins shall be provided at each gate. The cabin building shall be of permanent type with minimum area of each cabin as 10 m². The detailed requirement is as given in “Requirements for building units other than Administration and Control building”.

6.7.18 Workshop

Workshop of minimum area 75 m² area shall be provided. The detailed requirement is as given in “Requirements for building units other than Administration and Control building”.

6.8 PARTICULAR TECHNICAL REQUIREMENTS – MECHANICAL WORKS

6.8.1 Horizontal Split Casing Centrifugal Pump

It is proposed to provide Horizontal Split Casing Centrifugal pump set of following specifications in all Raw water, Clear water & Distribution water pumping station.

Contractor has to design these pumps Stations complete for Civil, Mechanical, Electrical & Instrumentation works. The pump Stations shall be designed to accommodate installation of pump sets for different sections as per scope of work and as mentioned below.

6.8.1.1 General Features of Pumps

The clear water pumps shall have the following features:

a) Type of Clear Water Pump Sets,
Horizontal Split Case type pumps with squirrel cage LT Induction Motors of suitable ratings. Pump drive shall be of 0.415 kV rating.

b) NPSH
The NPSH provided by the installation of pumps (NPSHa) shall be at least 0.5 m more than that required for the pump (NPSHr) in all conditions of operation.

6.8.1.2 Specifications for Horizontal Split Casing Pumps

The design, manufacture and performance of the pumps specified herein shall comply with the requirements of the applicable Codes and Standards, as follows, but not limited to:

Table 7: Specification for Horizontal Split Casing Pumps

<table>
<thead>
<tr>
<th>No.</th>
<th>Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IS 6595 (Part II)</td>
<td>Horizontal centrifugal pumps for clear, cold and fresh water.</td>
</tr>
<tr>
<td>2</td>
<td>IS 9137</td>
<td>Code for Acceptance Tests for Centrifugal, Mixed flow and Axial pumps.</td>
</tr>
<tr>
<td>3</td>
<td>IS 13537</td>
<td>Technical specification for centrifugal pumps - Class 2</td>
</tr>
<tr>
<td>4</td>
<td>ISO 5199</td>
<td>Standards of the Hydraulic Institute of USA.</td>
</tr>
<tr>
<td>5</td>
<td>ISO 2373</td>
<td>Balancing of impeller.</td>
</tr>
<tr>
<td>6</td>
<td>IS 5120</td>
<td>Performance test of pumps</td>
</tr>
<tr>
<td>7</td>
<td>IS 11732</td>
<td>Mechanical Balancing</td>
</tr>
</tbody>
</table>

6.8.1.3 Features & Material of Construction

Table 8: Features and Material of Construction Split Casing Pumps
<table>
<thead>
<tr>
<th>Casing</th>
<th>Horizontal split casing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive</td>
<td>Direct</td>
</tr>
<tr>
<td>Flange Drilling</td>
<td>IS 1538</td>
</tr>
<tr>
<td>Prime mover</td>
<td>Electric Motor (Refer Electrical section)</td>
</tr>
<tr>
<td>Casing</td>
<td>Cast Iron IS: 210 – Gr. FG 260 with 2 % Ni</td>
</tr>
<tr>
<td>Impeller &amp; impeller rings</td>
<td>SS (CF8M)</td>
</tr>
<tr>
<td>Shaft</td>
<td>SS (AISI 410)</td>
</tr>
<tr>
<td>Shaft Sleeve</td>
<td>SS (AISI 410)</td>
</tr>
<tr>
<td>Casing rings</td>
<td>SS (CF8M, CA15)</td>
</tr>
<tr>
<td>Glands</td>
<td>Bronze grade LTB2 of IS 318</td>
</tr>
<tr>
<td>Gland Packing</td>
<td>Graphite Asbestos</td>
</tr>
<tr>
<td>Lantern Rings</td>
<td>CI</td>
</tr>
<tr>
<td>Gaskets</td>
<td>Manufacturer’s Standard durable.</td>
</tr>
</tbody>
</table>

**DRIVE DATA**

| Motor              | 0.415 KV motor, (TEFC) Squirrel cage induction motors For details refer to Motor Specifications |

### 6.8.1.4 Accessories Required To Be Supplied With Pump

The contractor is supposed to provide at least the following accessories:

- Base Plate
- Foundation Bolts
- Coupling

### 6.8.2 Valves

#### 6.8.2.1 Air Valve

The valve shall be capable of exhausting air from pipework automatically when being filled, the air being released at a sufficiently high rate to prevent the restriction of the inflow rate. Similarly the valve shall be capable of ventilating pipework automatically when being emptied, the air inflow rate being sufficiently high to prevent the development of a vacuum in the pipelines. The valve shall also automatically release air accumulating in pipework during normal working conditions.

Air valves shall thus be designed to automatically operate so that they will:

- positively open under internal pressure less than atmospheric pressure to admit air in bulk during pipeline draining operation;
- exhaust air in bulk and positively close as water, under low head, fills the body of the valve during filling operation;
- not blow shut under high velocity air discharge; and
- exhaust accumulated air under pressure while the pipe is flowing full of water

All air valves shall be constructed so that internal working parts which may become necessary for repairs shall be readily accessible, removable, and replaceable without use of special tools and removing the valve from the line.

Air valves shall be Kinetic double orifice type as per IS 14845 and tamper proof unless otherwise directed by the Employers Engineer. A buoyant rigid float shall seal the large orifice and the chamber housing shall be designed to avoid premature closing of the valve by the air whilst being discharged. Small orifice shall discharge small air volume during operation under full internal pressures. All air valves shall be provided with isolating sluice valve and flanged end connection.

The aperture of valves must be properly designed for which the Contractor shall submit design calculations for necessary approvals before the procurement of valves.

All branched outlets including air valve tees will be provided with one ½” BSP coupling duly plugged for measurement of pressure in due course. The closing plug shall be in Stainless Steel (AISI 304 or equivalent) with Hex. Head and shall be provided with copper washer for sealing.

Material of construction of air valve shall comply with following requirement.

<table>
<thead>
<tr>
<th>Material</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body and cover</td>
<td>Grade GGG 40</td>
</tr>
<tr>
<td>Float</td>
<td>Polycarbonate up to 50 NB / SS 304-above 50 NB</td>
</tr>
<tr>
<td>Internal Linkages</td>
<td>Stainless Steel 304</td>
</tr>
<tr>
<td>Gasket, seal ring, sealing face</td>
<td>EPDM</td>
</tr>
<tr>
<td>Vent valve</td>
<td>Brass</td>
</tr>
<tr>
<td>Coating</td>
<td>Electro-statically applied epoxy resin- Internally and externally (min 250 micron)</td>
</tr>
</tbody>
</table>

6.8.2.2 Non-Return Valve/ Rubber Flap Check Valve

i. The valve shall be suitable for mounting on a horizontal pipeline and flow direction shall be clearly embossed on the valve body.

ii. Valves shall possess high speed closing characteristics and be designed for minimum slam condition when closing.

iii. Dual plate check valves shall conform to API 594 and API 598. They shall have metal to metal sealing. The spring action shall optimize the equal closing rates of each plate especially when the friction coefficients are uneven due to one plate resting upon one another. The plates shall not drag on the seat while opening. The plates shall not vibrate under full or partial flow condition. Valves
shall possess high speed closing characteristics and be designed for minimum slam condition when closing.

iv. The minimum body-wall thickness shall conform to those given in Table 1B of API Standard 594.

v. The face-to-face dimensions of valves (including valves with ring-joint facings) shall conform to those mentioned in Table 2B of API Standard 594.

vi. The valve body shall be furnished with a clearly visible forged, machined-in, or die-stamped arrow to indicate the direction of flow through the valve.

vii. Maximum permissible seat leakage is 7cc/Hr/cm nominal diameter of valve.

viii. Material of construction of valves shall comply with following requirements.

<table>
<thead>
<tr>
<th>Pressure rating</th>
<th>Body</th>
<th>Plate</th>
<th>Hinge Pin /Stop Pin/wetted parts</th>
<th>Springs</th>
<th>Seat</th>
<th>Retainer</th>
</tr>
</thead>
<tbody>
<tr>
<td>PN 16</td>
<td>ASTM, A 395</td>
<td>ASTM, A 351 Gr CF8M</td>
<td>SS AISI 316</td>
<td>SS. ASTM A 313</td>
<td>SS AISI 316</td>
<td>SS-304</td>
</tr>
</tbody>
</table>

6.8.2.3 Gate Valve/Sluice Valve

Sluice valve shall generally confirm to IS 14846 and shall be resilient seated type. They shall be of non-rising spindle type except for the valves for bypass. The gate face rings shall be securely pegged over the full circumference. Valve of 400 mm and above shall be furnished with a bushing arrangement for replacement of packing without leakage. They shall also have renewable channel and shoe linings. The gap between the shoe and channel shall be limited to 1.5 mm. Valve of 200 mm and above shall be provided with thrust bearing arrangement for ease of operation.

Valve of diameter 400 mm and above shall be provided with enclosed gear arrangement for ease of operation. The operation gear of all valves shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified rating. Valve and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 200 N.

Valves spindles and hand wheels shall be positioned to give good access for operational personnel. Hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.

Valves shall have two position marked at the shut end of the scale, first one corresponding to the position of the gate tangential to the bore of the seating and the second position below the first, corresponding to the position of the gate as it sits on the seating after moving a further distance equal to the depth of the seating.

All valves on pump suction and delivery piping shall be with electrical actuators. All Sluice valves shall be open end tested.
The body and bonnet shall be of Ductile cast iron of grade GGG-40, wedge with fully encapsulated EPDM rubber W-270 (approved for drinking water) and seals of NBR. The valves should be with replaceable stem nut and replaceable sliding shoes. Valve stems shall be of single piece thread rolled. Valve shall have 3 “O” rings of NBR for stem sealing. Gate valve shall be compatible for buried applications without valve chamber. Face-to-face dimensions as per BS 5163-89/IS 14846-PD/EN 558F4 and flange connections as per IS 1538, Maximum Valve operating torque should be at least 40% less than the torque as stated in the standard EN 1074. Electrostatic epoxy powder/liquid coating (EP-P) inside and outside color blue RAL 5005 with minimum coating thickness of 250 microns. The EPDM rubber & Epoxy Powder should be approved by W 270.

**Material of Construction:**

<table>
<thead>
<tr>
<th>Body, Bonnet</th>
<th>Ductile Iron GGG 40 (EN-JS-1030) / Spheroidal Graphite Iron IS: 1865 Gr 400/12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wedge (fully rubber encapsulated)</td>
<td>Ductile Iron GGG 40 (EN-JS-1030) / Spheroidal Graphite Iron IS: 1865 Gr 400/12 encapsulated with EPDM rubber - W270 approved grade.</td>
</tr>
<tr>
<td>Spindle/Stem</td>
<td>SS: IS: 6603 12Cr13/22Cr 13; AISI 410/AISI 420</td>
</tr>
<tr>
<td>Stem Nut</td>
<td>Brass</td>
</tr>
<tr>
<td>Bonnet Gasket</td>
<td>EPDM rubber - W270 approved grade</td>
</tr>
<tr>
<td>Internal Fasteners</td>
<td>Stainless Steel SS316/304</td>
</tr>
<tr>
<td>Stem Sealing</td>
<td>Toroidal NBR sealing rings (Min 03 ‘O’ Rings)</td>
</tr>
<tr>
<td>Coating</td>
<td>Inside &amp; Outside epoxy powder coated; DFT minimum 250 micron, shade RAL 5005 (BLUE)</td>
</tr>
</tbody>
</table>

**6.8.2.4 Flow Control & Pressure Reducing Valves**

Flow control valve & Pressure Reducing valve shall be of either Plunger or Diaphragm type and shall be line with following specifications.

a) The control valves shall be designed for flow control applications for providing precise control over the flow rates / pressure range.

b) The body of control valve shall be designed and hydro tested for the applicable pressure rating considering surge pressure as per provision in the BS-EN-12266-1-2012 or any other equivalent standard.

c) The control valves shall be designed to cause minimum head loss. The calculation method confirming to ANSI/ISA75.01.01-2007 (IS/IEC 60534-2-1Mod)-2012, for flow equations for sizing of Flow Control/pressure reducing valves shall be adopted. Fisher's Control Valve Handbook, latest international standards/publications may also be referred in the above context.

d) The seal at the seat ring should give leak tight assembly. The valve shall pass through seat leakage test as per ANSI FCI-70-2-2006 class VI or any other equivalent standard.

e) Flange to flange (face to face) distance shall be as per ANSI B 16.1/ EN 558-1 and flange ends should be as per ANSI B -16.5, Class 150 and class 300/EN-1092-2.
f) The material of all the components of valve/ internal working parts shall be corrosion resistant for chlorinated water.
g) Wherever compatibility with SCADA or RTU/ Local PLC is required, digital communication port RS 232/485/fibre optics having connectivity as per Industry standard protocol should be provided.
h) Provision of Battery operated option should be there in a case of power failure.

A- **Plunger Type Flow Control/ Pressure Reducing Valve :-**

In addition to (a) to (h) above ---

I. Plunger Valves shall be provided with electrical actuator having the control facility for intermediate valve positioning by connecting external signal.

II. The electric actuators shall be designed to provide the required torque for operations in the flow and pressure conditions of the water transfer system. Gear assembly shall be provided as necessary.

III. The flow path with annular flow cross section in any open position shall be rationally symmetric. The movement of piston/plunger by means of crank/ shaft/spindle drives shall be Axial/Linear along with irreversible worm gear box including position indicator.

IV. The general design requirements of the valve, gear assembly, and electric actuators described in the tender will be applicable to the flow control valves also.

V. A hand wheel shall be provided with integral locking device to prevent operation by authorised personnel.

VI. A selector switch shall be provided on the actuator for remote/local/hand operation of the valve.

**Material of Construction for Plunger type flow Control Valves:-**

<table>
<thead>
<tr>
<th>Component</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body (Globe Type)</td>
<td>Ductile iron GGG 40-DIN 1693 or EN- JS 1030</td>
</tr>
<tr>
<td>Plunger/Piston</td>
<td>Stainless steel AISI-304/ GR 1.4301</td>
</tr>
<tr>
<td>Piston Guides</td>
<td>Bronze Welded Overlay/SS</td>
</tr>
<tr>
<td>Shaft/Crank/Spindle</td>
<td>Stainless Steel AISI-420 /Gr 1.4021</td>
</tr>
<tr>
<td>Seat Ring</td>
<td>Stainless Steel AISI-316, Bronze</td>
</tr>
<tr>
<td>Seal (O-ring/Quad ring)</td>
<td>Synthetic Rubber- Buna- N/ EPDM (FDA/WRAS approved)</td>
</tr>
<tr>
<td>Bearing Bush</td>
<td>Bronze</td>
</tr>
<tr>
<td>Bolts</td>
<td>SS A4</td>
</tr>
<tr>
<td>Eye Bolt for Lifting</td>
<td>Galvanised steel – 1.0401</td>
</tr>
<tr>
<td>Slotted cylinder/Strainer</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>Coating (Both inside &amp; outside)</td>
<td>Fusion bonded Epoxy, min 250 micron (NSF/FDA/WRAS approved)</td>
</tr>
</tbody>
</table>
A- **Diaphragm Type Flow Control/ Pressure Reducing Valve :-**

In addition to (a) to (h) above ---

I. Diaphragm type flow control/pressure reducing valves shall be of single /double chambered self-actuated Automatic valves i.e. operated from line fluid pressure itself. For continuous regulation or an intermediate positioning, the control valves shall be provided with two solenoid valves with the facility of connecting external signal.

II. Command/ Electric Signals for positioning the control valve (for SCADA compatibility) will be from RTU.

III. The “Diaphragm” shall be of nylon fabric reinforced (NBR) synthetic elastomer-BUNA –N/EPDM. The centre hole of the main valve stem must be sealed by vulcanization. The stem shall fully be guided at top and bottom to avoid any deflection with a removable stem cap at top.

IV. The diaphragm must withstand a Mullins Burst Test of a minimum of 25 bar per layer of nylon fabric and shall be cycle tested 100000 times to ensure longevity.

V. The entire actuator assembly (seal disk top cover) shall be removable from the valve as an integral unit.

VI. The internal valve component shall be accessible, removable and repairable without removing the valve body from pipeline.

VII. These valves should be of self-regulating type when power supply is not available.

**Material of Construction for Diaphragm type flow Control Valves:-**

<table>
<thead>
<tr>
<th>Body &amp; Cover (Globe Type)</th>
<th>Ductile iron ASTM-A-536 or DIN 1693 - GGG 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diaphragm and Resilient seal disc</td>
<td>Flexible, non-wicking nylon fabric reinforced synthetic elastomer-Buna-N/ EPDM (FDA /WRS approved)</td>
</tr>
<tr>
<td>Seat Ring</td>
<td>Cast Stainless Steel ASTM-A 351 GR. CF8M/AISI -316, replaceable inline and onsite.</td>
</tr>
<tr>
<td>Stem</td>
<td>Stainless Steel, AISI-316, raised, replaceable inline and onsite.</td>
</tr>
<tr>
<td>Spring &amp; Bearing Bush</td>
<td>Stainless Steel, AISI-316</td>
</tr>
<tr>
<td>Plunger/Piston</td>
<td>Stainless steel, AISI-304/ GR 1.4301</td>
</tr>
<tr>
<td>Disc guide, disc retainer &amp; diaphragm washer</td>
<td>Stainless steel, AISI-304/ 316/ Bronze and coated steel</td>
</tr>
<tr>
<td>Seal</td>
<td>Synthetic Rubber- Buna N/EPDM (FDA/WRAS approved)</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Pilot</td>
<td>Body: Stainless steel, AISI-304/CF8 or Brass/bronze Elastomer :NBR</td>
</tr>
<tr>
<td>Tubing</td>
<td>Stainless steel, AISI-304/Copper</td>
</tr>
<tr>
<td>Nut-bolts &amp; Studs</td>
<td>Stainless steel AISI-304/ASTM A193 B7</td>
</tr>
<tr>
<td>Solenoid Valve</td>
<td>Stainless steel AISI-316</td>
</tr>
<tr>
<td>Throttling Plug</td>
<td>To have the linear flow (non-turbulent flow), if required , V-Shaped or U-shaped throttling plug may be provided.</td>
</tr>
<tr>
<td>Coating (Both inside &amp; outside)</td>
<td>Fusion bonded Epoxy, min 250 micron (NSF/FDA/WRAS approved)</td>
</tr>
</tbody>
</table>

### 6.8.3 Brick Masonry valve chambers

Constructing masonry chamber in brick work in cement mortar 1:4 (1 cement : 4 coarse sand) for sluice valve, with C.I. surface box 100 mm top diameter, 160 mm bottom diameter and 180 mm deep (inside) with chained lid and RCC top slab 1:2:4 mix (1 cement : 2 coarse sand: 4 graded stone aggregate 20 mm nominal size), i/c necessary excavation, foundation concrete 1:5:10 (1 cement : 5 fine sand: 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12 mm thick, finished with a floating coat of neat cement complete as per approved design, drawing and specification of Employer’s Representative.

### 6.8.4 Electric Actuator

The actuators shall be suitable for use on a nominal volt phase Hz power supply and are to incorporate motor, integral reversing starter, local control facilities and terminals for remote control and indication connections housed within a self contained, sealed enclosure.

In order to maintain the integrity of the enclosure, setting of the torque levels, position limits and configuration of the indication contacts etc shall be carried out without the removal of any actuator covers over an Infra red interface. Sufficient commissioning tools shall be provided with the actuators and must meet the enclosure protection and certification levels of the actuators. Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage/authorised release. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool.

The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.
Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from 15 to 45 degree C, up to 100% relative humidity.

Actuators for hazardous area applications shall meet the area classification, gas group and surface temperature requirements specified in data sheet.

**Actuator sizing**

The actuator shall be sized to guarantee valve closure at the specified differential pressure and temperature. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. For linear operating valves, the operating speed shall be such as to give valve closing and opening at approximately 10-12 inches per minute unless otherwise stated. For 90° valve types the operating time should be specified.

**Enclosure**

Actuators shall be 0-ring sealed, watertight to /IP68 7m for 72hrs, NEMA 4, 6. The motor and all other internal electrical elements of the actuator shall be protected from ingress of moisture and dust when the terminal cover is removed for site cabling, the terminal compartment having the same ingress protection rating as the actuator with the terminal cover removed.

Enclosure must allow for temporary site storage without the need for electrical supply connection.

All external fasteners shall be zinc plated stainless steel. The use of unplated stainless steel or steel fasteners is not permitted.

**Motor**

The motor shall an integral part of the actuator, designed specifically for valve actuator applications. It shall be a low inertia high torque design, class F insulated with a class B temperature rise giving a time rating of 15 minutes at 40°C(104°F) at an average load of at least 33% of maximum valve torque. Temperature shall be limited by thermostats embedded in the motor end windings and integrated into its control. Electrical and mechanical disconnection of the motor should be possible without draining the lubricant from the actuator gearcase.

**Motor protection**

Protection shall be provided for the motor as follows:

- **Stall** - the motor shall be de-energized within 8 seconds in the event of a stall when attempting to unseat a jammed valve.

- **Over temperature** - thermostat will cause tripping of the motor. Auto-reset on cooling

- **Single phasing** - lost phase protection.

- **Direction** – phase rotation correction.
**Gearing**

The actuator gearing shall be totally enclosed in a oil-filled gearcase suitable for operation at any angle. Grease lubrication is not permissible. All drive gearing and components must be of metal construction and incorporate a lost-motionhammerblow feature. For rising spindle valves the output shaft shall be hollow to accept a rising stem, and incorporate thrust bearings of the ball or roller type at the base of the actuator. The design should be such as to permit the opening of the gearcase for inspection or disassembled without releasing the stem thrust or taking the valve out of service. For 90° operating type of valves drive gearing shall be self locking to prevent the valve backdriving the actuator.

**Hand operation**

A handwheel shall be provided for emergency operation, engaged when the motor is declutched by a lever or similar means, the drive being restored to power automatically by starting the motor. The handwheel or selection lever shall not move on restoration of motor drive. Provision shall be made for the hand/auto selection lever to be locked in both hand and auto positions. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in hand without damage to the drive train.

Clockwise operation of the handwheel shall give closing movement of the valve unless otherwise stated in the data sheet. For linear valve types the actuator handwheel drive must be mechanically independent of the motor drive and should be such as to permit valve operation in a reasonable time with a manual force not exceeding 400N through stroke and 800N for seating/unseating of the valve.

**Drive bushing**

The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox. input shaft. Normally the drive bush shall be positioned in a detachable base of the actuator. Thrust bearings, when housed in a separate thrust base should be of the sealed for life type.

**Torque and turns limitation**

Torque and turns limitation to be adjustable as follows:

- Position setting range – multi-turn: 2.5 to 100,000 turns, with resolution to 15 deg. of actuator output.

- Position setting range – direct drive part turn actuators: 90° +/-10°, with resolution to 0.1 deg. of actuator output.

- Torque setting: 40% to 100% rated torque.

Measurement of torque shall be from direct measurement of force at the output of the actuator. Methods of determining torque-using data derived from the motor such as motor speed, current, flux etc are not acceptable A means for automatic “torque switch bypass” to inhibit torque off during valve unseating and “latching” to prevent torque switch hammer under maintained or repeated control signals shall be provided.
The electrical circuit diagram of the actuator should not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit.

**Remote valve position/actuator status indication.**

Four contacts shall be provided which can be selected to indicate any position of the valve. Provision shall be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during handwheel operation when all external power to the actuator is isolated.

The contacts shall be rated at 5A, 250V AC, 30V DC.

As an alternative to providing valve position any of the four above contacts shall be selectable to signal one of the following:

- Valve opening, closing or moving
- Thermostat tripped, lost phase
- Motor tripped on torque in mid travel, motor stalled
- Remote selected

Actuator being operated by handwheel

Provision shall be made in the design for an additional 4 contacts having the same functionality. Provision shall be made in the design for the addition of a contactless transmitter to give a 4-20mA analogue signal corresponding to valve travel for remote indication when required. The transmitter will auto range to the set limits

**Local position indication**

The actuator display shall include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully closed in 1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipework to ensure that valve status is clearly interpreted. With main power on the display shall be backlit to enhance contrast at low light levels and shall be legible from a distance of at least 6 feet (2m).

Red, green, and yellow lights corresponding to open, closed, and intermediate valve positions shall be included on the actuator display when power is switched on. The digital display shall be maintained and updated during handwheel operation when all power to the actuator is isolated.

In addition, the actuator display shall include a separate text display element with a minimum of 32 characters to display operational, alarm and configuration status. The text display shall be selectable between English and one of the following languages: Hindi or Marthi. Provision shall be made to upload a different language without removal of any covers or using specialized tools not provided as standard with the actuator. Provision shall be made to orientate the actuator display through increments of 90degrees.
Local torque Indication:

The digital display shall be capable of indicating real time torque and valve position simultaneously, both being displayed in 1% increments of valve position and actuator rated torque. In addition torque shall also be displayed in horizontal bar graph form.

Integral starter and transformer

The reversing starter, control transformer and local controls shall be integral with the valve actuator suitably housed to prevent breathing and condensation. The starter shall be suitable for 60 starts per hour and of rating appropriate to motor size. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It shall have the necessary tappings and be adequately rated to provide power for the following functions:

- Energization of the contactor coils.
- 24V DC output for remote controls.
- Supply for all the internal electrical circuits.

Local controls

The actuator shall incorporate local controls for Open, Close and Stop and a Local/Stop/Remote mode selector switch lockable in any one of the following three positions: local control only, stop (no electrical operation), remote control plus local stop only. It shall be possible to select maintained or non-maintained local control.

The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

Provision shall be made to orientate the local controls through increments of 90 degree.

Control facilities

The necessary control, wiring and terminals shall be provided in the actuator for the following functions:

Open and close external interlocks to inhibit local and remote valve opening and/or closing control. It shall be possible to configure the interlocks to be active in remote control only.

Remote controls fed from an internal 24V DC supply and/or from an external supply between 20V and 120V AC or 20V and 60 V DC, to be suitable for any one or more of the following methods of control:

- Open, Close and Stop control.
- Open and Close maintained or “push to run” (inching) control.
- Overriding Emergency Shut-down to Close (or Open) valve from a normally closed or open contact.
- Two-wire control, energise to close (or open), de-energise to open (or close).
It shall be possible to reverse valve travel without the necessity of stopping the actuator. The motor starter shall be protected from excessive current surges during rapid travel reversal.

The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses of up to 2kV.

Provision shall be made for operation by distributed control system utilising the following network systems.

- Modbus
- Profibus
- Foundation Fieldbus
- DeviceNet
- Pakscan

**Monitoring facilities**

Facilities shall be provided for monitoring actuator operation and availability as follows:

Monitor (availability) relay, having one change-over contact, the relay being energized from the control transformer will de-energise under any one or more the following conditions:

- Loss of main or customer 24V DC power supply
- Actuator control selected to local or stop
- Motor thermostat tripped
- Actuator internal fault

Where specified, provision shall be made for contacts to provide discreet indication of one or more of the following:

- Remote selected
- Thermostat trip
- Actuator fault

Actuator text display indication of the following status/alarms:

- Closed Limit, open limit, moving open, moving closed, stopped
- Torque trip closing, torque trip opening, stalled
- ESD active, interlock active
- Thermostat trip, phase lost, 24V supply lost, Local control failure
• Configuration error, Position sensor failure, Torque sensor failure

• Battery low, power loss inhibit

  Integral datalogger to record and store the following operational data:

• Opening last/average torque against position

• Closing last/average torque against position

• Opening motor starts against position

• Closing motor starts against position

• Total open/closed operations

• Maximum recorded opening and closing torque values

• Event recorder logging operational conditions (valve, control and actuator)

  The datalogger shall record relevant time and date information for stored data.

  Datalogger data is to be accessed via non-intrusive IrDA communication. Sufficient standard intrinsically safe tools shall be provided for downloading datalogger and actuator configuration files from the actuators and subsequent uploading to a PC. The actuator manufacturer shall supply PC software to enable datalogger files to be viewed and analysed.

**Wiring and terminals**

Internal wiring shall be tropical grade PVC insulated stranded cable of appropriate size for the control and 3-phase power. Each wire shall be clearly identified at each end.

The terminals shall be embedded in a terminal block of high tracking resistance compound.

The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal and shall be provided with a minimum of 2 threaded cable entries with provision for a maximum of 4.

All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.

A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:

• Serial number

• External voltage values

• Wiring diagram number

• Terminal layout
The code card shall be suitable for the contractor to inscribe cable core identification alongside terminal numbers.

6.8.5 Expansion Bellows

The pipe work installation shall be so arranged to offer ease of dismantling and removal of pumps or other major items of equipments. Stainless steel AISI 304 expansion bellows which can take radial and axial misalignment of minimum 1 percent of valve nominal size with tie rods shall be included in the suction and delivery pipe work of all pumps as well as on delivery header for easy dismantling. All loose flange shall be secured to fixed flanges by suitable tie-bolts. All pipe work shall be adequately supported with purpose-made fittings. When passing through walls, pipe work shall incorporate a puddle flange or other suitable sealing device. The final outlet connection of the pipe work shall match the connecting point of the transmission main.

6.8.6 Dismantling Joints

CI Double flanged Dismantling joints shall be installed in such a manner that valves can be dismantled without stress to the joints. Dismantling joints shall be suitable for installation with all valves of different diameters.

The dismantling joint shall be designed for a hydrostatic pressure of 10 kg/sq.cm. The sliding flange shall be machined smooth and shall slide at least 30 mm to disengage fully mating flange. All the fasteners for the dismantling joint shall be of SS 304. These shall be completely leak proof with proper gasket arrangement. Flange dimensions shall conform to latest relevant IS code. Flanged specials shall be supplied with required nuts, bolts and rubber gaskets. The dismantling joint shall be internally and externally coated with hot applied (dip) bituminous paint.

6.8.7 Electrically Operated Hoists

Electric hoists shall be complete with hoisting motor, wire rope drum, wire rope, hook, necessary gearing, sheaves, electromagnetic brake for hoisting motion, weather & dust-proof push button station, contractor panel, all wiring, limit switches, etc.

Electric hoists shall conform to IS: 3938 and shall be suitable for outdoor application. All the parts of the hoist shall be designed to withstand surrounding atmospheric conditions without any deterioration.

Rope drums shall be either cast or welded to sustain concentrated loads resulting from rope pull. Drums shall be machine grooved right and left with grooves of a proper shape for the rope used.

Gears shall be cut from solid cast or forged steel blanks or shall be of stress-relieved welded steel construction or built-up from steel billets and welded together to form a one piece gear section.

Hoist ropes shall be extra flexible, improved plough steel rope with a well lubricated hemp core and having six strands of 37 a wires per strand with minimum ultimate tensile strength of 1.6 x 106 KN / Sq.m.

Hooks shall be solid, forged, heat treated alloy or carbon steel of rugged construction of the single hook type and provided with a standard depress type safety latch.
Hoisting motor shall be equipped with electrically released, spring set, friction shoe type brakes having torque capable of holding 125% of the full rated hook load. Brake shall apply when either the motor controller or the main power switch is in ‘OFF’ position or in the event of power failure.

Drive motors shall be designed for frequent reversal, braking and acceleration and shall be as per IS: 325. Pendant control switch, controllers and resistors, controls, electrical protective devices, cables and conductors, earthing guards etc. shall be as per IS:3938. Limit switches shall be provided for over-hoisting and over-lowering.

The electric hoists shall be of Class II duty.

25% overload test, speed tests, limit switch tests and brake test shall be conducted for the hoist and trolley at manufacturer’s works.

6.8.8 Hand Operated Hoists and Trolleys

Manual hoists shall be complete with hand-chain, trolley, pulley block, hook, hand and load chains, brake and other accessories. They shall comply with the latest applicable standards, regulations and safety codes in the locality where equipment will be installed.

Each hoist shall be operated on a monorail (I-Beam). The factor of safety shall not be less than 5. The load chain may be heat-treated to give ductility, toughness and conforming to I.S. 3109/B.S. 1663/B.S. 3114. The load wheel is to be made from heavy duty malleable castings. The hand chain is to Conform with B.S. 6405:1984 and hand chain wheel may be made from pressed sheet steel with roller type guarding. Gears shall be cut from solid cast or forged steel blanks or shall be stress relieved welded steel construction. Pinions shall be of forged carbon or heat treated alloy steel. Strength, Quality of Steel, heat treatment, face, pitch of teeth and design shall confirm to BS-436, BS-545 and BS-721. Spur and helical gears must comply with B.S. 436 and worm with B.S. 721. Bearing must be ball and roller type conforming to I.S. 2513/B.S.2525-32:1954. Proper lubricating arrangements are to be provided for bearings and pinions. The brake for the lifting gear shall be automatic and always in action.

The proof testing of each chain pulley block is to be carried out as per latest applicable standards. The safe working load is to be marked in such way that is clearly visible from the operating level.

6.8.9 Manually Operated Travelling Crane

The crane bridge shall consist of a single bridge girder carrying two wheels at each end of the span. Steel used shall be tested quality steel conforming to IS 2062. The girder shall have enough strength to carry the test load without causing undue stress or deflection.

The long travel bridge wheels shall be rim toughened, heat treated carbon steel or low alloy steel or C.I. They shall be double flanged type. The wheels shall have antifriction ball/roller bearings. The wheels shall be machined on their treads to match the runway rail section. The bridge shall have a geared shaft and pulley connecting to opposite wheels of the span, to achieve the long travel motion of the bridge, by means of a chain.
The runway rails of adequate strength and rigidity, rail clamps and other accessories for mounting the rails and suitable end stops for the bridge shall be supplied by the Contractor.

**Trolley and Chain Pulley Block**

The chain pulley block shall be operated on the lower flange of the bridge girder.

The load chain shall be made of alloy steel as per IS: 3109. It shall be heat treated to give ductility and toughness so that it will stretch before breaking. It shall be of welded construction with a factor of safety not less than 5.

The hand chains for the hoisting and traverse mechanism shall hang well clear of the hook and both the chains shall be on the same side. The hand chain wheel shall be made from pressed sheet steel and shall be provided with roller type guarding to prevent snagging and fouling of the chain.

All the gearing shall be totally encased. Proper lubricating arrangements shall be provided for bearings and pinions. Gears shall be cut from forged steel blanks. Pinions shall be of heat treated alloy steel. Gears shall be as per BS 436/IS: 4460.

The trolley track wheels shall be rim toughened, heat treated carbon steel or low alloy steel or C.I. and shall be single flanged and shall have antifriction ball bearings. The wheels shall be machined on their treads to match the flanges of the track joints.

The travelling trolley frame shall be made of rolled steel conforming to IS: 2062. The side plates of trolley frame shall extend beyond wheel flanges, thus providing bumper protection for the wheels. The two side plates shall be connected by means of an equalising pin.

Axles and shafts shall be made of carbon steel and shall be accurately machined and properly supported.

The lifting hooks shall be forged, heat treated alloy or carbon steel of rugged construction. They shall be of single hook type provided with a standard depress type safety latch. They shall swivel and operate on antifriction bearings with hardened races. Locks to prevent hooks from swivelling shall be provided. Hook shall be as per BS: 2903/IS: 3815

The brake for the lifting gear shall be automatic and always in action. It shall be of screw and friction disc type self-actuating load pressure brake. Brakes shall offer no resistance during hoisting.

Ratchet and Pawl mechanism shall be provided to arrest the full load from lowering due to gravity. The ratchet and pawl shall be of steel, hardened and tempered so as to attain required wear resistance and toughness.

**6.8.10 Electrically Operated Overhead Travelling Crane**

The crane shall be electrically operated, bridge type complete with all accessories including down shop conductor, crane rails and fixtures, and shall conform to BS 2573, IS:3177 or relevant internationally approved standards.
The crane bridge shall consist of bridge girders on which a wheeled trolley is to run. The bridge trucks and trolley frames shall be fabricated from structural steel. Access walkway with safe hand railing as is required along the full span length of the bridge girder. Steel shall be tested quality conforming to ASTM A36 except that, plates more than 20 mm thick shall conform to IS: 2062, BS: 4360 or relevant internationally approved standards. The bridge shall be designed to carry safely the loads specified in IS: 807, BS: 2573 or relevant internationally approved standards. All anti-friction bearings for bridge and trolley track wheels, gear boxes and bottom sheaves on hook shall be lubricated manually by hand operated grease pump through respective grease nipples.

Wheel base and structural frame of the wheel mounting of the end carriages shall be designed so as to ensure that the crane remains square and prevent skewness. Bridge and trolley track wheels shall be of forged steel and shall be double flanged type. The wheel diameter and rail sizes shall be suitable for the wheel loads. The crane rails shall be manufactured from wear resistant austenitic manganese steel. Mountings of the wheels shall be designed to facilitate easy removal for maintenance. Walkways shall be at least 500 mm clear inside width with a 6 mm thick non-skid steel plate surface. Steel rail stops to prevent rails from creeping and trolley from running off the bridge shall be abutted against ends of rails and welded to the girders. Bridge and trolley stops to match the wheel radius shall be provided before the buffer stops.

All exposed couplings, shafts, gear, wheels, pinions and chain drives etc. shall be safely encased and guarded completely to prevent any hazard to persons working around. All bearings and gears shall have a design life of 100000 hours. Electro-magnetic and hydraulic thruster brake shall be provided for the main hoist. One electro-magnetic brake shall be provided for each of the cross travel and long travel motions.

Hook shall be solid forged, heat treated alloy or carbon steel suitable for the duty service. They shall have swivels and operate on ball thrust bearings with hardened races. The lifting hooks shall comply with the requirements of IS 8610 or BS: 2903 / BS: 3017 or relevant internationally approved standards and shall have a safety latch to prevent rope coming off the hook.

Hoist rope shall be extra flexible, improved plough galvanized steel rope with well lubricated hemp core and having six strands of 37 wires per stand with minimum ultimate tensile strength of 1.6 X 106 kN/m2 of Right Hand Ordinary (RHO) lay construction. The ropes shall have a 6:1 safety factor on the specified safe working load, and shall conform to IS: 2266. Rope drums shall be grooved and shall be either cast iron or cast steel of or welded steel conforming to IS: 3177, BS: 466 or relevant internationally approved standards.

Gears shall be cut from solid cast or forged steel blanks or shall be stress relieved welded steel construction. Pinions shall be of forged carbon or heat treated alloy steel. Strength, quality of steel, heat treatment, face, pitch of teeth and design shall conform to BS: 436, IS: 4460 and BS: 721 or relevant internationally approved standards.

Name Plate showing the capacity, year of manufacture and rated capacity of hoist, in figures not less than 150 mm height, shall be placed on each side of the crane girder. The maximum deflection under full load shall not exceed 1/900 of the span (as per IS: 3177).
All accessory and auxiliary electrical equipment including drive motors, electrically operated brakes, controllers, resistors, conductors, insulators, current collectors, pendant push button station, protective devices, operating devices, cables, conduits, etc. necessary for the safe and satisfactory operation of the crane shall be provided.

Power to the crane shall be provided by down shop conductors manufactured from high conductivity hard drawn copper. Conductors shall be completely shrouded such that they have no exposed current carrying surfaces. Pendant type push button station shall be sheet steel enclosed and shall comprise the following push buttons and indicating lamps:

a. 'Start' and 'Stop'.
b. Long travel - 'Right' and 'Left'.
c. Cross travel - 'To' and 'Fro'.
d. Hook - 'Hoist' and 'Lower'.
e. Red indicating lamp for supply 'ON' indication.

Pendant type push button shall be supported independently of the electrical cable and shall be earthed separately, independent of the suspension. Automatic reset type of limit switches shall be provided to prevent overtravel for each of the following:

a. For 'UP' and 'Down' motions of the hook.
b. Long travel motion
c. Cross travel motion

Crane structures, motor frames and metal cases of all electrical equipment including metal conduit and cable guards shall be earthed. All motors, brakes, limit switches, panels, drum controllers, resistor unit sets shall be provided with two studs for earthing.

All motors shall be of the quick reversing type with electric mechanical brakes suitable for the duties specified. All movements shall be electrically powered suitable for operating with the hook loaded. Facilities shall be provided for the accurate location of the hook by means of `inchng' the cross travel and down shop travel motions.

Sufficient slings, ropes, shackles, lifting beams, etc shall be supplied to handle all items of plant covered by the crane. They shall be labelled or marked with the Safe Working Load (SWL) and the purpose for which they are intended.

The crane, and all slings, ropes, shackles and other lifting equipment supplied shall be tested by the manufacturer at his works. The tests shall be carried out at 125% of Safe Working Load, and Test Certificates shall be supplied.

The Contractor shall include with the cranes all necessary contactors, control cubicles and protection equipment necessary to operate the crane and provide adequate electrical protection against overload, phase and earth fault and fail-safe protection in the event of an interruption in the power supplies. All access ladders and platforms necessary to carry out maintenance and repairs shall be provided and installed by the Contractor.
All electrical equipment shall be fully tropicalised.

Site tests shall be carried out by the Contractor who shall supply the necessary materials for the test load. The test load shall be removed from site by the Contractor after successful tests have been carried out.
6.9 PARTICULAR TECHNICAL REQUIREMENTS – ELECTRICAL WORKS

6.9.1 General

The scope of work includes design, equipment selection, manufacture, inspection at Contractor's or his Sub-Contractor's works, supply, installation (including storing, unloading and transferring the material / equipment to Contractor’s storage area, maintaining equipment / material in safe custody and assembling the elements of the equipment and installing at the place of work), testing and commissioning of the plant equipment/ electrical system on ‘Design Build & Operate’ basis and dismantling of existing electrical equipment and handed over the existing equipment to Employer’s Representative at the location as directed by the Employer Representative. After successful commissioning and trial run of the plant, it should be handed over to the Employer. The Contractor shall also be responsible for Operation & Maintenance (O&M) of the plant for 5 years after it is formally taken over by the Employer. The Contractor shall submit their design calculations/ drawings based on ‘Design criteria for electrical equipment/system’ for Employer’s review and approval. These specification covers substations, transformers, HV/LV switchboards, energy efficient motors, soft starters, capacitors, HV and LV power cables and control cables, and other allied equipment, etc. along with the specifications for workmanship, laying cables, lighting system, earthing systems, lightning protection etc. for this water supply project. It shall be the responsibility of the Contractor to design the electrical system based on the selection of the mechanical equipment.

The Bidder shall make his own estimate of sizes, ratings and quantities for, substation equipment, all plant items and miscellaneous systems such as earthing, lightning protection, lighting, auxiliary power distribution, etc. Design of electrical system (i.e. Substation, transformers and other electrical equipment) shall be based on Stage-I (i.e. year up to 2033) only. However, facility for upgrade/ expansion of all equipment to cater Stage-II load shall have to be considered during design-engineering stage. Sufficient space in the switchyard and switchboard/ control room shall be provided for expansion/ up-gradation of switchyard/ electrical equipment/ switchboard for Stage-II load. It should be clearly understood that the Contract will be on ‘Design Build & Operate’ basis and no variation will be allowed for items of works not foreseen or omitted by the Bidder at the bidding stage, except where specifically indicated in the bid documents.

All equipment offered shall comply with the requirements specified in the latest editions of applicable Indian/ International Standards and shall also comply with the good engineering practices.

Contractor shall design the electrical system on the basis of ‘Design Criteria’ and to be submitted for Employer’s approval. Contractor shall incorporate any changes/ suggestions in the drawings to suit site conditions and design criteria and standard engineering practice and resubmit for approval to Employer’s Representative.

The Contractor shall possess the valid electrical Contractor’s license of appropriate class from the concerned statutory bodies governing the area of work place. The Contractor shall fully comply with the relevant statutory rules and regulations.
All type (as applicable), routine and acceptance tests shall be conducted in the presence of Employer/ Employer’s Representative / Third Party Inspector on all the equipment as per latest applicable IS/IEC at no extra cost. Typical type test reports for other equipment shall be submitted by the Contractor for approval by Employer/ Employer’s Representative.

All commissioning tests shall be carried out in the presence of Employer/ Employer’s Representative and approval for the same shall be obtained before commissioning and installation. All test reports shall be properly maintained by the Contractor duly approved by the statutory bodies and shall be handed over to the Employer after completion of the job. All instrument and accessories required for testing and commissioning of the equipment specified herein shall be provided by the Contractor at no extra cost to the Employer.

Liaison with State Electricity Board and other Government organization/ statutory bodies for obtaining Power supply/ other clearance shall be Contractor’s scope. After completion of installation work, the Contractor shall arrange for inspection and obtain approval from the concerned statutory bodies. Any fees that are to be paid to such statutory bodies for testing, inspection or calibration shall be paid by the Contractor. Any modification / revision in the equipment / installation of equipment as required by the statutory bodies shall be carried out by the Contractor. All such costs / fees for revisions / modifications shall be deemed to be included in the prices of supply, installation, testing and commissioning of equipment as quoted by the Contractor.

6.9.2 Transformer Size selection Criteria

The transformer size shall be determined from the estimation of the simultaneous maximum demand based on the power rating of motors and other loads and their operating / running periods.

The design shall be based on maximum nos. of main motors working and the corresponding auxiliary loads including WTPs shall be considered for sizing of transformer.

Appropriate values of load factor, diversity factor, power factor and efficiency shall be considered for each type of load. Improvement in power factor due to capacitors shall not be considered. Five percent (5%) contingency shall be added to the simultaneous maximum demand thus calculated and the next standard size of transformer as per IEC shall be selected.

Two such transformers shall be provided for 100 % redundancy at each site. The design calculations for transformer sizing shall be subject to the approval of the Employer’s Representative.

6.9.3 Electrical System for Proposed Intake works, Raw water system and 440 MLD Water Treatment Plant

A new reliable 11kV connection shall be taken for proposed Intake works, Raw water system and WTP near UBDC canal.
The new substation shall be capable for feeding the entire load for proposed WTP and Clear water pump station (up to Stage-II requirement) with adequate voltage and power quality.

Incoming 11 KV supply shall be step down by distribution transformers, which in turn shall feed the main LV indoor switchboard. 100% redundant transformers are proposed (i.e. one working + one standby) to feed the entire load of the proposed pump system. The transformer neutral is to be earthed to limit the earth fault current. The transformers (and the cables to the LV switchboard) shall be suitable for outdoor application.

Necessary metering, protection and indication/ annunciation are to be provided on all the switchboards.

6.10 PARTICULAR TECHNICAL REQUIREMENTS - INSTRUMENTATION, AUTOMATION AND CONTROL SYSTEM WORKS

6.10.1 GENERAL

This section outlines the particular requirements for the instrumentation, automation and control systems. Unless specified in this section to the contrary instrumentation Plant provided by the Contractor and workmanship shall comply with the General Instrumentation, Automation and Control Requirement Chapters of these Requirements.

THE SCOPE AND BATTERY LIMITS: Apart from automation in WTP and Pumping stations, feeder mains and OHSRs, Scope of SCADA includes PLC automation of operations to ensure equitable distribution of water to all OHSRs, generate data to enable water audit, Energy audit and water quality monitoring including, generation of data to verify if the performance standards are achieved. Scope also includes Reservoir Management System.

The scope of instrumentation, control and automation (ICA) works shall comprise the design, manufacture, programming and configuration, off site testing, delivery to site, installation and erection, testing, commissioning, setting to work and provision of documentation for a complete supervisory, instrumentation, control and automation system including the interfaces required to provide monitoring and control for a safe and efficient operation of plant, equipment and system.

The Contractor shall submit and obtain approval of the instruments and the system from the employer before beginning the detailed control system design.

The minimum scope of work shall include but not limited to:

- **MASTER CONTROL CENTRE (MCC) AT PROPOSED WTP**

Design, supply, install, test and commission a dual redundant control system. PLC, RTU & SCADA shall include but not limited to process controller including its central process units (CPUs), communication modules, input-output (I/O) modules, control networks, operator workstations with 32” LED display, engineering workstation with 60” LED display and printers.

This system shall be designed in order to control, operate and monitor the following:

- New water treatment plant
- Raw water reservoirs and pumping station
- Treated Water reservoirs and Pumping station

**Field Instrumentation**

Design, supply, install, test and commission field instrumentation for the Entire Water supply system including WTP, RWPS and CWPS.

**Instrumentation Schedule**

A listing of the basic instrumentation and control system to be supplied, installed, tested and commissioned under this water supply scheme shall include, but not be limited to, the list given in Table below.

<table>
<thead>
<tr>
<th>No</th>
<th>Service</th>
<th>Type of Instrument</th>
<th>Instrument Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td><strong>Flow Measurement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.</td>
<td>Flow measurement near plant inlet</td>
<td>Open channel flow meter (Ultrasonic)</td>
<td>Transmission, Indication and recording of flow rates and totalisation of flow.</td>
</tr>
<tr>
<td>v.</td>
<td>Flow measurement of air for filter wash</td>
<td>Anubar</td>
<td>Transmission, Indication and recording of flow rates and totalisation of flow.</td>
</tr>
<tr>
<td>vi.</td>
<td>Rate of flow for filter bed</td>
<td>Ultrasonic</td>
<td>Transmission, Indication and recording of flow rates and totalisation of flow.</td>
</tr>
<tr>
<td>II.</td>
<td><strong>Level Measurement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.</td>
<td>Water level in</td>
<td>Ultrasonic level</td>
<td>Monitoring of water level, continuous measurement</td>
</tr>
<tr>
<td>No</td>
<td>Service</td>
<td>Type of Instrument</td>
<td>Instrument Function</td>
</tr>
<tr>
<td>----</td>
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<td>-------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>clear water sump</td>
<td>measurement</td>
<td>trending of data and initiation of alarms</td>
</tr>
<tr>
<td>ii</td>
<td>Water level in Backwash water tank</td>
<td>Conductivity type level switches for high and low level detection</td>
<td>Tripping of pumps at low water level and generating an alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ultrasonic level measuring system</td>
<td>Monitoring of water level continuous measurement, trending of data and initiation of alarms</td>
</tr>
<tr>
<td>iii</td>
<td>Water level in clarified water channel</td>
<td>Conductivity type of level switches for high and low level detection</td>
<td>Tripping of pump at high water level and starting at low level, and generating alarms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ultrasonic level measuring system</td>
<td>Monitoring of water level continuous measurement and alarm</td>
</tr>
<tr>
<td>iv</td>
<td>Water level in filter water channel</td>
<td>Ultrasonic level measuring system</td>
<td>Monitoring of water level continuous measurement and alarm</td>
</tr>
<tr>
<td>v</td>
<td>Level in coagulant solution preparation tanks</td>
<td>Ultrasonic level measuring system</td>
<td>Monitoring of level in coagulant solution preparation tanks and generating alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conductivity type of level switches</td>
<td>As a backup protection to level sensing</td>
</tr>
<tr>
<td>vi</td>
<td>Level in coagulant service tanks and PE dosing tank</td>
<td>Sight glass</td>
<td>Indication of level in coagulant service tanks and PE dosing tank</td>
</tr>
<tr>
<td>vii</td>
<td>Level in thickened sludge tank</td>
<td>Ultrasonic level measurement</td>
<td>Monitoring of water level continuous measurement trending of data and intimation of alarm</td>
</tr>
<tr>
<td>viii</td>
<td>Level in CWR’s, and UGSR’s</td>
<td>Ultrasonic level measurement</td>
<td>Monitoring of water level continuous measurement trending of data and intimation of alarm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conductivity type of level switches for high and low level detection</td>
<td>Tripping of pump at high water level and starting at low level, and generating alarms</td>
</tr>
<tr>
<td>No</td>
<td>Service</td>
<td>Type of Instrument</td>
<td>Instrument Function</td>
</tr>
<tr>
<td>----</td>
<td>---------------------------------------------</td>
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<td>--------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td><strong>III</strong> Pressure Measurement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.</td>
<td>Head loss measurement across filter bed</td>
<td>DP transmitter and panel mounted indicator system</td>
<td>Differential level transmitter for filter bed for measuring head loss across bed</td>
</tr>
<tr>
<td>ii.</td>
<td>Pressure in BW water header</td>
<td>Pressure measurement system consisting of a pressure transmitter and panel mounted indicator system</td>
<td>Pressure transmission, monitoring and generating an alarm</td>
</tr>
<tr>
<td>iii.</td>
<td>Pressure in BW air header</td>
<td>Pressure measurement system consisting of a pressure transmitter and panel mounted indicator system</td>
<td>Pressure transmission, monitoring and generating an alarm</td>
</tr>
<tr>
<td>iv.</td>
<td>Pressure measurement on blower outlet</td>
<td>Pressure gauge</td>
<td>Pressure monitoring of air; manually</td>
</tr>
<tr>
<td></td>
<td><img src="image.png" alt="Image" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>IV.</strong> Water Parameter Monitoring Instruments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.</td>
<td>pH of water for raw water, clarified water and filtered water measurement</td>
<td>pH measuring instrument</td>
<td>Continuous monitoring of pH and generating alarm. Trending of data</td>
</tr>
<tr>
<td>ii.</td>
<td>Turbidity measurement</td>
<td>Turbidity meter</td>
<td>Continuous monitoring of turbidity and generating alarm. Trending of data</td>
</tr>
<tr>
<td>iii.</td>
<td>Chlorine residual</td>
<td>Chlorine residual analyzer</td>
<td>Continuous monitoring of residual chlorine and</td>
</tr>
<tr>
<td>No</td>
<td>Service</td>
<td>Type of Instrument</td>
<td>Instrument Function</td>
</tr>
<tr>
<td>----</td>
<td>----------------------------------------------</td>
<td>--------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>measurement</td>
<td></td>
<td>generating alarm. Trending of data</td>
</tr>
</tbody>
</table>

**V. Miscellaneous**

i. Chlorine leakage in chlorine / cylinder room  
   Chlorine leak detector  
   Monitoring Cl2 in air generating alarm at instance of leakage and switching on chlorine neutralization system

ii. Operating panel for filter bed  
    Console  
    Manual/automatic controlling washing sequence of bed

iii. Operating panel for Clariflocculators  
     Clarifier Panel  
     Manual/automatic control of clariflocculators

**VI. Automation**

I. Filter bed  
   PLC based instrument control panel  
   Monitoring, controlling, operation automatically, semi automatically

ii. Clariflocculators  
   PLC based instrument control panel  
   Monitoring, controlling, operation automatically, semi automatically

iii. Chemical dosing  
    PLC based instrument control panel  
    Monitoring, controlling, operation automatically, semi automatically

iv. Chlorination  
    PLC based instrument control panel  
    Monitoring, controlling, operation automatically, semi automatically

V. Sludge handling  
   PLC based instrument control panel  
   Monitoring, controlling, operation automatically, semi automatically

vi. Raw and Clear water pumping stations  
    PLC based instrument control panel  
    Monitoring, controlling, operation automatically, semi automatically

vii. SCADA  
     Software + Hardware  
     For monitoring, operation & control of plant

viii. Information  
      Software + Hardware  
      For inter connection raw water pumping station, clear water
<table>
<thead>
<tr>
<th>No</th>
<th>Service</th>
<th>Type of Instrument</th>
<th>Instrument Function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>technology</td>
<td></td>
<td>pumping station, WTP &amp; UGSRs &amp; Water distribution pump stations</td>
</tr>
<tr>
<td>ix</td>
<td>RTU panels</td>
<td>Hardware + Software</td>
<td>For data transmission of remote field instruments like flowmeters, pressure transmitters and level transmitters to MCC.</td>
</tr>
</tbody>
</table>

**• Communication Network**

Interface equipment to enable communication between field instruments, PLC’s, RTU’s, and SCC SCADA at WTP’s and UGSRs and Water distribution pump stations.

Supply, installation, testing commissioning of RTU’s along with GPRS at UGSR’s to transmit flow, level and pressure data to MCC for monitoring and control.

The communication equipment required to achieve this interfacing complete with all required accessories shall be supplied under this contract.

**• Data Acquisition and processing**

The data acquisition, processing and interfacing with the Master Control Centre of entire bulk water supply scheme is covered under this package.

**• System Console**

Control room furniture(system console) include but not limited to control console for placing dual redundant workstations and two printer compartments, desk for one engineering workstation, ODMS workstation and printer compartment and chairs. The system console design shall be submitted to the Employer for prior approval.

The Contractor shall be responsible for the design of each instrumentation and plant monitoring system, including the selection and design of appropriate transducers (on approval by the Employer’s Representative), transmitters, signal conditioning devices, indicators, alarm system programmable devices, communications, cable system etc. The Contractor shall take account in his design of all installation and environmental conditions prevailing at the site.

**6.10.2 Design Requirements for Instrumentation, Control, Automation and SCADA Systems**

The instrumentation, control, automation SCADA installations shall fully comply with design standards, regulations and the material and workmanship requirements of the Specification.

The electrical plant installations associated instrumentation control and automation systems shall also comply with and be tested in accordance with the latest edition of BS 7671 or equivalent Indian standards.
All equipment and materials incorporated in the system shall be selected, designed and rated to operate under the defined performance duties and specified site conditions and to maintain a high level of operational reliability.

The instrumentation control and monitoring system equipment and materials shall have an operational life of not less than 15 years, unless otherwise approved by the Engineer.

6.10.3 Design criteria for Instrumentation, Control, Automation and SCADA Systems

6.10.3.1 Instrumentation System

a) Electronic instruments shall utilize solid state electronic components, integrated circuits, microprocessors, etc., and shall be of proven design.

b) All instruments shall be suitable for continuous operation.

c) All digital outputs shall be volt free.

d) All instrumentation systems for use out of doors shall be protected to IP 65 for sensors and transmitters, while enclosures under submersible conditions shall be protected to IP68.

e) All analogue displays shall be of the digital type with no moving parts utilizing back lit liquid crystal diode technology.

f) For transmitting instruments, output signal shall be 4-20 mA DC linear having two wire system.

g) Unless otherwise stated, overall accuracy of all measurement systems shall be ±0.5% of measured value, and repeatability shall be ±0.5%.

h) After a power failure, when power supply resumes, the instruments and associated equipment shall start working automatically.

i) The instruments shall be designed to permit maximum interchangeability of parts and ease of access during inspection and maintenance.

j) The instruments shall be designed to work at extremes of the ambient conditions of temperature, humidity, and chlorine contamination that may prevail. The instruments shall be given enough protection against corrosion.

k) Lockable enclosure shall be provided for the field mounted instruments wherever required.

l) All field instruments, and cabinets / panel-mounted instruments shall have tag plates / name plates permanently attached to them.

m) The performance of all instruments shall be unaffected for the ±10% variation in power supply voltage and ±5% variation in frequency simultaneously.

n) All wetted parts of sensors shall be made out of non-corrosive material capable of working with chlorine content of 5 ppm.
o) For all instruments (transmitting analogue signals) installed in the field, surge protection devices (SPDs) shall be provided at both ends of the connecting cable for the protection against static discharges / lightning and electromagnetic interference.

p) Pressure transmitters shall be provided with two valve manifold and a test port, so that in situ calibration can be carried out.

q) Two wire transmitters shall be provided with on-line test terminals.

r) The ranges of all instruments shall be suitable for the application in the process.

s) Instruments of similar type shall be of same make for appropriate inventory of spares, ease of maintenance and training.

6.10.3.2 PLC System

PLC shall be provided as a Hot-Standby configuration to perform combinational and sequential logic functions, status monitoring and reporting functions with counter and timer facilities.

PLC Panel interrogation power supply should be fully redundant.

PLC shall comprise of necessary processors, input/output (I/O) modules, communication interface modules and man-machine interface (MMI) required to perform the desired functions.

Each PLC shall have memory protected built in historical archiving/data logging of system alarms & events and process variables. Data logger shall be able to log data based on time or an event PLC shall have enough memory allocated to allow 200,000 time and data stamped discrete and /or analog values to be archived. The historical archive shall allow the oldest data to roll off the system as memory is used keeping the 200,000 most current data points available. Process point time stamping frequency shall be selectable within the configuration software. It shall be possible for the archived data to be exported in CSV format allowing use with standard spreadsheet and data software applications

PLC shall have the following attributes as a Hot-Standby configuration.
- carry out sequential logic implementation for operations of plant;
- carry out computation and interfacing for data acquisition, data storage and retrieval;
- it shall accept downloaded program from a programmer;
- it shall have different functional modules to perform the desired functions;
- it shall scan the inputs in time cycles and update the status of its outputs.

6.10.3.3 RTU System

RTU shall be designed in accordance with this specification. The RTU shall be of proven design and suited for water supply and distribution SCADA applications.
RTU design should aim to minimize power consumption and heat generation. It should be designed to work in remote installation by being of robust physical construction with immunity to electrical noise.

The RTU shall be assembled from modular units, for example, power supply module, CPU and communications module, communication interface modules and modules for input/output purposes. I/O and serial cards shall be able to be arranged in the RTU rack in any order.

Modules shall be interconnected via a suitably robust plug and socket method. It shall not be necessary to unscrew individual wires/cables, both internal RTU wiring and I/O wiring, to replace faulty modules. The failure of one module will not affect the performance of any other module.

A marshalling terminal area shall be incorporated with each RTU to provide terminations for field cables. This area can be located in the RTU cubicle itself for an RTU replacement but for new locations there should be a separate marshalling cubicle. The RTU and marshalling cubicles shall normally be bolted together to form a 2-baycubicle suite. A separation plate may be located between the cubicles.

The RTU and the cubicles shall be designed to accommodate the actual number of input/outputs, plus spare capacity.

6.10.3.4 SCADA System

The SCADA shall be a fully dual redundant server integrated microprocessor based control and data acquisition system which will monitor, control, display, record and trend all assigned plant and water supply network inputs and outputs. The main process monitoring and control shall be by means of Visual Display Unit (min. 60 inch. LED monitor) based process operator workstations that shall be located in the central control room.

SCADA/HMI system shall be designed and implemented such that the failure of a central processor or HMI console does not inhibit continuous automatic control of the plant. In the event of such a failure, historical data shall be recoverable to a condition where a worst-case maximum of 15 minutes of historical data is lost.

Failure of a single outstation or communications to that outstation shall not affect control or operation of any other outstation, unless the failed outstation provides essential data to another outstation, in which case the non-failed outstations shall revert to a fail-safe mode.

6.10.3.5 Functional Design Specification (FDS, Sequence of Operation)

The Contractor shall propose the details of the sequence of operation for the water supply system, water treatment plant and pumping stations through careful study of the water supply scheme proposed. Further, the contractor shall be solely responsible to comply with any change/additional processes during the contractors design stages.

The Contractor shall submit a complete functional design specification (FDS) for approval by the Employer within 3 months of the award of the contract.
Functional design specification (FDS) for the SCADA system shall be combined with the FDS for instrumentation, control and automation to form a complete document and shall comply with the specification of the FDS for instrumentation, control and automation. This document shall serve as the primary mechanism by which the Employer may confirm that the Contractor possesses an accurate understanding of the system and its control requirements. The Contractor is encouraged to obtain any necessary clarifications and to suggest refinements to the control descriptions contained in this Specification.

The FDS shall include a detailed block diagram of the PLC, RTU & SCADA system with a description of the communications scheme to be provided. The FDS shall include operational details of the SCADA system which have an effect on plant operations, such as power failure response, communication failure response, and automatic shut-down and start-up of the system.

The FDS shall include a description of the interface of the SCADA system with any existing or planned future DAC (Digital Access Carrier) equipment.

The Contractor shall submit a preliminary FDS and obtain approval before the system architecture design is finalized or detailed design takes place. The Contractor shall formally notify the Employer for approval of any amendments or additions to the approved FDS. The final FDS shall be submitted for approval before submission of the factory acceptance test definition documents. The Contractor should take note of the importance of this obligation.

The FDS shall comprise an overall description of the system, its functioning and control, and a detailed description of each section of the control system covering modes of operation, manual overrides, set-point and parameter selection and adjustment. The detailed description shall include a step-by-step control description which defines the function of each piece of equipment and each control action and interlock, including details of the program in each programmable item.

The FDS shall describe the ‘fail-safe’ features incorporated into the design for the event of failure of a plant item or system, or loss of an input signal affecting a control loop or process sequence.

The FDS shall describe control actions taken and monitoring functions which remain available during a power failure, and any automatic controls or sequencing which take place during system start-up and shut-down.

The FDS shall be presented in a clear and precise manner and shall include figures or drawings where appropriate.

6.10.3.6 Reference Standards

Unless otherwise approved, instrumentation shall comply with relevant quality standards test procedures and codes of practice collectively referred to as Reference Standards including those listed in General Instrumentation, Automation and Control System in accordance with the requirements detailed elsewhere in this specification.
6.10.3.7 Specifications for online water quality monitoring systems

This section covers the specification required for online water quality sensors to be provided under the contract. The system should be user friendly that operates & analyze in minimum interval without any need of reagents, chemicals, consumables with low maintenance and calibration requirement. It should be capable of integration with the SCADA system.

Online multi-parametric pH, Conductivity/TDS, Turbidity, free Chlorine at various points of water distribution and the reservoirs.

The system proposed should have adequate channels to accommodate above measurements and should have capacity to display up to total 10 parameters to future-proof the system as it is not envisaged to upgrade the controller for next few years.

The system should have capability to accommodate any additional sensors viz. ORP, Dissolved Oxygen, Nitrite as may be required by the project authorities from time to time.

Parameters will be monitored at different location as mentioned below:

Water quality monitoring station will contain the sensors and equipment to measure the below mentioned parameters.

1. pH
2. Turbidity
3. TDS
4. Conductivity
5. Residual Chlorine
6. Flow
7. Pressure

6.10.3.8 Multi-parameter Controller System Specifications:

It should be equipped with the following minimum features:

- USB-interface for data transfer, upgrading firmware etc.
- Control unit with keys and toggle switch for the quick selection of software functions
- With colour graphic display with backlight
- With integrated backup controller function
- Input voltage 90 - 264 VAC 50/60 Hz
- Line power consumption approx. 25 VA
- Max. power delivery 18 Watt
- 6 galvanically separated current outputs (0/4-20 mA) that can be assigned arbitrarily
- MODBUS communication protocol for the data integration with PLC and SCADA
- With Sensor ID recognition
- High EMC interference immunity
- Integrated lightning protection
• Should have the latest features of highly advanced Multi parameter Controller having capability of handling at least 4 sensors in a single controller configuration and more as and when required.
• Display should be with improved reading precision through special backlit graphic display
• Easy User Intuitive operating keys: including keys for functions such as: Measurement, calibration, set/system settings, additional keys for: confirmation/switching menu O.K. (OK), Escape (ESC) etc.
• Internal integrated Data logger with minimum data memory for up to 500,000+ data sets
• The Controller should be able to power all the sensors and terminals or accessories attached to it without having to need any additional power sources in the system for increased protection against lightening and possible electromagnetic interference.
• The system should start automatically after the power is reset to the system (in case of power failure).
• The controller should be low power consuming with consumption of less than 5W.
• Sensors connected to the system shall be automatically detected and initialized.
• No extra system configuration should be needed for substitute / replacement sensors.
• The system should have Service mode for cleaning/calibration/maintenance activities.
• It should be possible to download the data via the USB interface an extremely fast data exchange to USB memory stick.
• The system should be fully programmable with multiple levels of access control with help of Electronic-Key for data security and protection against non-authorized access to avoid any tampering or changes to the system configuration by unauthorized access.
• The controller should store the sensor configurations and calibrations
• The controller should have Logbook to record the data
• The supplier should provide the firmware update free of cost as and when they are available for the life time of the system.
• The system should have a status LED that gives reliable and fast information regarding function and status of system. And the Controller/controller should show a LED for diagnostic purposes on the front. This LED should show normal and malfunctions of the system at a glance.
• Data Output to Control System: The System should have the capability to transmit the required 4-20 mA Analog Outputs as a minimum.
• In addition to above, the system should have ability to output Profibus, Modbus/RS 485, RS 232, LAN, GPRS, GSM compatible signals in future with addition of respective module as and when required.
• The system should be able to operate on AC Power (100-240 AC)
• Ambient Conditions Operating temperature: -4 °C … +55 °C
• Storage temperature: -10 °C … +65 °C
• Housing Material – Non corrosive e.g. Acrylonitrile-Styrene-Acrylosterpolymer or better
• Protection Rating IP 66 / equivalent to NEMA 4X for controller
Electromagnetic Compatibility: EN 61326, Class B; FCC Class A, EMC for indispensable operation
Integrated Lightning Protection: According to EN 61326 enhanced overvoltage protection for the entire system, implemented in each component

6.10.3.9 Sensor Specifications:

i. **pH Sensor Specifications:**
- Integrated temperature measurement and compensation should be provided in the pH sensor.
- Sensor check function to detect broken glass of the pH electrode.
- The pH sensor should have galvanically separated input.
- Calibration history should be stored automatically in the sensor.
- Sensor calibration can be done in the laboratory or field.
- The pH combination electrodes should require very little maintenance and there should be no electrolyte replacement.

**Technical Specifications:**

- Measuring Range: pH – 4.00- 12.00 at least considering the wastewater environment
- Signal Output –Digital
- Sensor Check function should be available in the pH sensor
- Power Consumption: less than 0.5 Watt
- Temperature Sensor should be integrated in the pH sensor
- Temp Compensation: -5 to +50 Deg C
- Transient Voltage Protection should be integrated in the sensor
- Sensor body: Stainless Steel or better
- protection type : IP 68 for both Sensor and Cable
- Sensor Cable Length: 7 meter

ii. **Conductivity/TDS Sensor:**
- The sensor should have high measuring accuracy 4-electrodedesign with no influence by polarization effects at higher conductivity values.
- Should have measuring range of 0.00 µS/cm to 500 mS/cm.
- TDS and salinity measurement should also be integrated.

**Technical Specifications:-**

- Measuring Range: Conductivity: 0-500 mS/cm; Salinity: 0-70; TDS: 0-2000 mg/l
- Signal Output –Digital
- Power Consumption: less than 0.5 Watt
- Temperature Sensor should be integrated with conductivity measurement.
- Temp Compensation: -5 to +50 Deg C
- Max Pressure for Sensor: 10 Bar
- Input Power: Powered by the Controller
- Transient Voltage Protection should be integrated into the sensor
- Sensor Body: Titanium or equivalent
- Protection type : IP 68 for both Sensor and Cable
- Sensor Cable Length: 15 meters

iii. **Turbidity Analyzer Specification:**

Turbidity sensor shall be connected to the multi-parameter measuring system. It shall be equipped with the following features:

- Automatic cleaning system or better maintenance less and consumables free cleaning system
- Scattered light measurement
- Scratch-resistant sapphire measurement windows
- Sensor monitoring function
- Integrated lightning protection
- With screw / plug connector for connection of the sensor connection cable

- Measuring range (selectable): 0 to 1000 NTU
- Process variation coefficient according to DIN 38402 part 51: in the range up to 2000 FNU less than 1 %
- Repeatability or repeating limit DIN ISO 5725 or DIN 1319: less than 0.015 % or min. 0.006 FNU

**Temperature range:**

Operating range: 0 °C ... 60 °C
Storing range: -5 °C ... 65 °C

**Material:**
Measurement window: Sapphire
Enclosure shaft: V4A stainless steel 1.4571

**Type of protection:** IP 68 (with the sensor connection cable connected)

iv. **Residual Chlorine Analyzer specification:**

- Module for measuring free chlorine in water for use on raw/treated water panel with controller Useable in media with constant pH between 6-8.

**Chlorine electrode:**

- Range: 0-10 mg/l
- Resolution: 0.01 mg/l
- pH-Range: pH 6-8
- Electrochemical principle
- Temperature range: 5 - 45°C

**Material:**

- PVC, Silicone, Polycarbonate

**Current of water needed:**

In flow thru armature approx. 30 l/h.

**Maximal pressure:** Armature with electrode: max. 1 bar overpressure

v. **Level Sensor:**
Ultrasonic type level transmitters shall be microprocessor based and shall use digital signal processing technique for signal conditioning. The transmitter shall have facilities for storing the echo profile, manipulation of the echo profile to remove noise, multiple profile-averaging etc.

The transmitter shall have the capability to use statistical filtering techniques, wherever required, to compensate for rotating agitator blades or to suppress false signal due to heavy dust or fill-stream interference.

In very dusty applications or in silo/ bunker, etc. filling applications, high power and long range (i.e., low frequency) transducer shall be used to overcome the detrimental effect of the dust. This type of instrument shall not be used for level measurement in process medium consisting of particles of sizes (-6 mm diameter).

Ultrasonic transmitter shall be have 4-20mA (24V DC loop powered) / Field bus compatible and possible to calibrate through hand held universal and field bus configurator also.

The sensor shall have in-built temperature sensor for ambient temperature compensation.

Chemical compatibility of the sensor material with the process material shall be ensured, to avoid corrosion.

In applications, where material build-up on the sensor is expected, the transducer shall have suitable build-up compensation (i.e. repetitive, pulsating displacement at its face shall be used to remove the material build-up).

Ultrasonic transmitters shall be supplied along with necessary calibration software, noise suppression software, plug connector, cable, profibus to RS232C modem etc. for calibration/ noise suppression through laptop / desktop PC.

Adjustable mounting arrangement shall be provided for proper aiming of ultrasonic sensors. Suitable protection box for ultrasonic level sensor shall be provided.

Provision for the nitrogen purging facility in the ultrasonic sensor shall be provided for cleaning the buildup of the material.

Pipe insert of min. dia 200mm shall be available for mounting the level transmitter on top of the tanks. Necessary mounting brackets for mounting the level transmitter in the tank shall be provided.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0 to 15 meters</td>
</tr>
<tr>
<td>Temperature</td>
<td>-20 to +60° C</td>
</tr>
<tr>
<td>Temperature compensation</td>
<td>Built-in -20 to +60° C</td>
</tr>
<tr>
<td>Spread</td>
<td>3°, 6°</td>
</tr>
<tr>
<td>Enclosure</td>
<td>IP 68 / NEMA 6P (submersible to 10 m / 30 ft.)</td>
</tr>
<tr>
<td>Measuring accuracy</td>
<td>Better than 0.2%</td>
</tr>
</tbody>
</table>
Analog output: Active 4-20mA galvanically isolated, max. loop resistance 500 Ohms

Digital output: Two SPDT electromechanical relays. (max 50V DC / 1 A)

Transmitter Enclosure rating: IP 65 / NEMA 4X

6.10.3.10 Electromagnetic flow meter:

Selection of Electromagnetic flow meters shall be decided based on the following:

All magnetic flow meters shall be SMART type. Magnetic flow meters, which are to be installed in the control, alarm & interlocking circuits, shall have 4-20mA DC output (24V DC loop powered) / profibus compatibility along with Data loggers and battery back up.

Liner material shall be selected based on service. Generally, for liner material PTFE shall be used.

If gases are entrained in the liquid, meter shall be installed in vertical process line.

While installation it shall be ensured that flow tube is always completely filled with liquid.

Straight length requirement of minimum 5D to 10D in the upstream and 2D to 3D in the downstream shall be provided for water services. However, for other services it shall be designed as per manufacturer’s recommendation.

The tube material shall be SS 316, with PTFE inner and SS-316 Electrode. The coil housing should also be of SS-316.

Installation of electromagnetic flow meters shall be avoided near large conducting surface e.g. metal surfaces. (Large surface may interfere with magnetic field of instrument thus affecting accuracy).

Pulsed DC excitation shall be provided for field excitation of Electro Magnetic Flow Meter. Power & signal circuits of magnetic flow meter shall be completely isolated from each other.

Minimum one no. of grounding ring for metallic pipelines and minimum two nos. of grounding rings for non-metallic pipelines shall be used for installing the magnetic flow meter.

Selection and sizing of electro-magnetic flow meters flow characteristics published by the manufacturers shall be followed. Allowable flow velocity shall be considered based on the specific merit of the service, allowable pressure drop, and cost effectiveness and as per manufacturers recommendation, however the size of flow meter shall not be less than the size of conduit where it is proposed.

Accuracy of magnetic flow meter shall be ± 0.3% or better. Local display shall be calibrated in engineering unit.
A bypass line with isolation valves shall be provided for the magnetic flow meters so that magnetic flow meters can be cleaned on line.

Sensor & transmitter of magnetic flow meters shall be mounted separately.

Magnetic flow meter shall be provided with built-in auto zero facility for ensuring stable zero point.

Separate earth pit shall be provided exclusively for earthing of magnetic flow meters. Preparation of such earth pits shall be governed by the general methodology as described in IS 3043, 1991 or relevant international standards.

Necessary calibration unit for checking the electronic unit of magnetic flow meter shall be provided.

Enclosure class of magnetic flow meters shall be IP 68.

Pulsed DC excitation for better accuracy and measurement signal stability shall be used. Power & signal circuits of magnetic flow meters shall be completely isolated from each other.

While installation, it shall be ensured that flow tube is always completely filled with liquid and at no time the flow meter shall be empty.

Flow meter shall be provided with necessary ground ring, fasteners, gaskets, reducer / expander, matching flange including straight line pipes (Inlet run: 5D min & Outlet run: 3D min / as per manufacturer recommendation). Also spool pieces of length flange to flange for replacing the flow meters during maintenance shall be provided.

Pressure data logger capable of transferring data via GPRS/SMS communication. Input pressure range of 0 - 20 bars, accuracy ± 0.5%, and repeatability ± 0.1%, with re-zero function for offsetting. Memory must be not less than 50,000 readings, and can be set in cyclic or start-stop (block). Logging interval can be set 1 second, 1 min, 15mins, 30mins, hourly etc. Capable to export data to comma-separated values (csv) file format or Excel spreadsheets. Software Supports statistical data (average, maximum, mean and standard deviations). Ingress Protection rating of IP68, with minimum battery life of 5 years.

Data loggers must be compatible with the Employer’s telemetry software

**Mounting:** Flange

**Materials:** Housing: Painted carbon or stainless steel  
Liner: Hard rubber, soft rubber or PTFE  
Electrode: Stainless steel 1.4571

**Built-in grounding electrode:** required

**Accuracy:** Better than ± 0.25%

**Temperature:** 0 to 50° C

**Enclosure:** IP 67 (with gel potting IP 68)
**Analog output**: One active 4 - 20 mA, galvanic isolated (max. 800 Ω)

**Digital output**: One voltage-free, electromechanical relay (max. 50 V DC / 1 A)

One optically isolated (max. 50 V AC / V DC / 120 mA)

**Transmitter Enclosure rating**: IP 67

**Power supply**: 24 V AC

**Data logger**: Display 160,000 logs with date, time, value and daily totals

vi. **Communication and Data Presentation/ Display**

The controller should be interfaced with a GSM/GPRS communication modem to seamlessly transmit the data from remote plants to a central location over a pre-defined interval.

The communication to the system should be two way for ability to view settings and make changes to the configuration over the air, as and when required.

The data should be received at a central location and should be displayed there in real-time in graphical and tabular format. The software as a minimum should have ability to print reports, archive data and make it available for export as a CSV file. The system should also have facility to generate alarm when set points are exceeded.

### 6.11 PARTICULAR TECHNICAL REQUIREMENTS - PIPE LINE WORKS

#### 6.11.1 High Density Polyethylene Pipes (HDPE Pipes) Scope

This specification covers the requirements for successfully designing, manufacturing, supplying, laying, jointing and testing at works and site of High Density Polyethylene Pipes used for water supply.

#### 6.11.2 Applicable Codes

The manufacturing, testing, supplying, laying, jointing and testing at work sites of HDPE pipes shall comply with all currently applicable statutes, regulations, standards and Codes. In Particular, the following standards, unless otherwise specified herein, shall be referred. In all cases the latest revision of the Codes shall be referred to. If requirements of this Specification conflict with the requirements of the standards / Codes, this Specification shall govern.

Others Codes not specifically mentioned here but pertaining to the use of HDPE pipes form part of these Specifications.

- **IS: 4984** High Density Polyethylene Pipes for Water Supply
- **IS: 2530** Methods of test for polyethylene moulding materials and polyethylene compounds
- **IS: 5382** Rubber sealing rings for gas mains, water mains and sewers. Methods for random sampling
- **IS: 7328** High density polyethylene materials for moulding and extrusion
IS: 7634  Laying & Jointing of Polyethylene (HDPE) Pipes
IS: 9845  Method of analysis for the determination of specific and/or overall migration of constituents of plastics material and articles intended to come into contact with foodstuffs
IS: 10141 Positive lists of constituents of polyethylene in contact with foodstuffs, pharmaceuticals and drinking water.
IS: 10146 Polyethylene for its safe use in contact with foodstuff, Pharmaceuticals and drinking water.
IS 4905 1968 Methods for random sampling
IS 8360 (part- II) :1977 “Specification for Fabricated High Density Polyethylene Fittings for Potable Water Supplies – Specific Requirements for 90 Deg. Tee”
IS 8360 (part- III) :1977 “Specification for Fabricated High Density Polyethylene Fittings for Potable Water Supplies – Specific Requirements for 90 Deg. Bends”

6.11.3 Designation

Pipes shall be designated as per IS 4984, according to the grade of material, followed by pressure rating and nominal diameter, for example, PE 100 PN 10 DN 200 indicates a pipe pertaining to material grade 100 having a pressure rating 1.0 MPa and outside nominal diameter 200 mm.

6.11.4 Colour

• For the purpose of identification of the pipes, each pipe shall contain minimum three equi-spaced longitudinal strips of width 3mm (min) in blue colour, these strips shall be coextruded during pipe manufacturing and shall not be more than 0.2 mm in depth. The material of the strip shall be of the same type of resin.

• All HDPE Pipes of the same size, same pressure rating and same grade and also manufacture essentially under similar conditions of manufacture, shall constitute a lot.

6.11.5 Materials

The material used for the manufacturer of pipes should not constitute toxicity hazard, should not support microbial growth, should not give rise to unpleasant taste or odor, cloudiness or discoloration of water. Pipe manufacturers shall obtain a certificate to this
effect from the manufacturers of raw material by any internationally reputed organization as per the satisfaction of the Employer’s Representative.

6.11.6 **Raw Material**

Raw material used to manufacture the HDPE pipes shall be 100% virgin PE compound or Natural black PE resin confirming to IS: 4984, IS: 7328 and ISO: 4427 for this a certification has to be given by the resin manufacturer as per clause 3.2.3 of IS: 4984. The resin proposed to be used for manufacturing of the pipes should also comply with the following norms as per ISO 9080

(a) The resin should have been certified by an independent laboratory of international repute for having passed 10,000 hour long term hydrostatic strength (LTHS) test extrapolated to 50 years to show that the resin has a minimum MRS of over 10MPa. Internal certificate of any resin manufacturer will not be acceptable.

(b) Certificate for having passed the full scale rapid crack propagation test as per ISO 13478. High density Polyethylene (HDPE) used for the manufacture of pipes shall conform to designation PEEWA-45-T-006 of IS 7328. HDPE conforming to designation PEEWA-45- T-012 of IS 7328 may also be used with the exception that melt flow rate (MFR) shall not exceed 1.10 g/10 min. In addition the material shall also conform to clause 5.6.2 of IS 7328.

(c) The specified base density shall be between 941.0kg/ m³ and 946.0kg/ m³ (both inclusive) when determined at 27°C according to procedure prescribed in IS7328. The value of the density shall also not differ from the nominal value by more than 3 kg/ m³ as per 5.2.1.1 of IS 7328. The MFR of the material shall be between 0.41 and 1.10 (both inclusive) when tested at 190°C with nominal load of 5 kgf as determined by method prescribed in IS 2530. The MFR of the material shall also be within ± 20 percent of the value declared by the manufacturer.

(d) The resin shall be compounded with carbon black. The carbon black content in the material shall be within 2.5 ±0.5% and the dispersion of carbon black shall be satisfactory when tested as per IS 2530.

6.11.7 **Anti-oxidant**

The percentage of anti-oxidant used shall not be more than 0.3 percent by mass of finished resin. The anti-oxidant used shall be physiologically harmless and shall be selected from the list given in IS 10141

6.11.8 **Reworked Material**

No addition of Reworked/ Recycled Material from the manufacturer’s own rework material resulting from the manufacture of pipes is permissible and the vendor is required to use only 100% virgin resin compound.

6.11.9 **Effect of nature of soil on pipe performance**

The bidder shall provide certified information, as per IS code of practice about the performance of HDPE pipes, if laid in corrosive soils, below water table or under saturated conditions or rocky strata, etc. The necessary precautions, as per IS code of practice, to be taken like painting or bitumen coating or providing special bedding or
crossing any feature under hanging, etc to encounter such conditions shall be mentioned and accounted for in the bid cost by the bidder

6.11.10 Maximum Ovality of Pipe

The outside diameter of pipes, tolerance on the same and ovality of pipe shall be as given in table 2 of IS 4984. Ovality shall be measured as the difference between maximum outside diameter and minimum outside diameter measured at the same cross section of the pipe, at 300 mm away from the cut end. For pipes to be coiled the ovality shall be measured prior to coiling. For coiled pipes, however, re-rounding of pipes shall be carried out prior to the measurement of ovality.

6.11.11 Wall Thickness

The minimum & maximum wall thickness of pipe for the three grades of materials, namely PE63, PE80, and PE100 shall be as given in table 3, 4, & 5 respectively in IS:4984.

6.11.12 Length of Straight Pipe

The length of straight pipe used shall be more than 6 m or as agreed by Employer’s Representative. Short lengths of 3 meter (minimum) up to a maximum of 10% of the total supply may be permitted.

6.11.13 Coiling

The pipes supplied in coils shall be coiled on drums of minimum diameter of 25 times the nominal diameter of the pipe ensuring that kinking of pipe is prevented. Pipe beyond 110mm dia shall be supplied in straight length not less than 6m.

6.11.14 Workmanship / Appearance

Pipes shall be free from all defect including indentations, delaminating, bubbles, pinholes, cracks, pits, blisters, foreign inclusions that due to their nature degree or extent detrimentally affect the strength and serviceability of the pipe. The pipe shall be as uniform as commercially practicable in colour opacity, density and other physical properties as per relevant IS Code or equivalent International Code. The inside surface of each pipe shall be free of scouring, cavities, bulges, dents, ridges and other defects that result in a variation of inside diameter from that obtained on adjacent unaffected portions of the surface. The pipe ends shall be cut clearly and square to the axis of the pipe.

6.11.15 Marking of Pipes

The internal and outer diameter, length, wall thickness, tolerances and other dimensions of pipes shall be as per relevant clauses of IS 4984:1995 (inc. all amendments) and any amendments made to till date. Each straight length of pipe shall be clearly marked and should cover the following:

a. The manufacturers name and trade mark,

b. Outside diameter,

c. IS classification,
d. Stiffness class
e. Lot number / Batch number

6.11.16 Handling, Transportation Storage and Lowering of pipes

During handling, transportation, storage and lowering, all sections shall be handled by such means and in such a manner that no distortion or damage is done to the section or to the pipes as a whole.

The following procedures should be followed so as to eliminate potential damage to pipes and fittings and to maintain maximum safety during unloading, lifting and lowering.

- Pipes must not be stored or transported where they are exposed to heat sources likely to exceed 60°C.
- Pipes shall be stored such that they are not in contact with direct sunlight, lubricating or hydraulic oils, petrol, solvents and other aggressive materials.
- Scores or scratches to a depth of greater than 10% or more of wall thickness are not permissible; any pipes having such defects should be strictly rejected.
- PE pipes should not be subjected to rough handling during loading and unloading operations. Rollers shall be used to move, drag the pipes across any surface.
- Only polyester webbing slings should be used to lift heavy PE (>315mm) pipes by crane. Under no circumstances, chains, wire ropes and hooks be used on PE pipes.
- Pipes shall not be dropped to avoid impact or bump. If any time during handling or during installation, any damage, such as gouge, crack or fracture occurs, the pipe shall be repaired if so permitted by the competent authority before installation.
- During coiling care should be taken to maintain the coil diameter at or above the specified minimum to prevent kinks. Coiling shall be done when the pipe attains the ambient temperature from the extruder. In uncoiling or recoiling care should be taken that sharp objects do not scour the pipe.
- When releasing coils, it must be remembered that the coil is under tension and must be released in a controlled manner. The end of the coil should be retained at all times, then the straps released steadily, one at a time. If the coil has bands at different layers of the coil, then they should be released sequentially starting from the outer layers. The amount of the energy locked up in the coil will depend on the size of the pipe, the SDR of the pipe, and the size of the coil.
- Straight lengths should be stored on horizontal racks giving continuous support to prevent the pipe taking on a permanent set
- Bare coils shall be wrapped with hessian cloth for long distance (> 300Kms) transportation. The truck used for transportation of the PE pipes shall be exclusively used of PE pipes only with no other material loaded – especially no
metallic, glass and wooden items. The truck shall not have sharp edges that can damage the Pipe.

- Pipes manufactured at factory are to be carried to the site of work directly or stacked suitably and neatly along the alignment/road side/elsewhere near by the work site or as directed by the Engineer.

- Damages during transit, handling, storage will be to the Contractor’s account and replacement for such pipes has to be made by the Contractor without any extra cost as directed by the Engineer.

6.11.17 Lowering, Laying of Pipes

Each pipe shall be thoroughly checked for any damages before laying and only the pipes which are approved by the Engineer shall be laid. While installing the pipes in trenches, the bed of the trench should be level and free from sharp edged stones. In most cases, the bedding is not required, as long as the sharp and protruding stones are removed, by sieving the dug earth, before using the same a backfill material. While laying in rocky areas suitable bed of sand or gravel should be provided. The fill to about 10 to 15 cm above the pipe should be fine sand or screened excavated material. Where hard rock is met with, bed concrete M15, 15 cm or 20cm thick sand bed as approved by the engineer may be provided.

As PE pipes are flexible, long lengths of fusion-jointed pipes having joints made above ground can be rolled or snaked into narrow trenches. Such trenches can be excavated by narrow buckets. During the pipe laying of continuous fusion jointed systems, due care and allowance should be made for the movements likely to occur due to the thermal expansion/contraction of the material. This effect is most pronounced at end connections to fixed positions (such as valves etc) and at branch connections.

Care should be taken in fixing by finishing the connections at a time the length of the pipe is minimal (lower temperature times of the day). For summer time installations with two fixed connection points, a slightly longer length of PE pipe may be required to compensate for contraction of the pipe in the cooler trench bottom. The final tie-in connections should be deferred until the thermal stability of the pipeline is achieved.

The flexibility of polyethylene pipes allows the pipe to be cold bend. The fusion jointed PE pipe is also flexible as the plain Pipe. Thus the total system enables directional changes within the trench without recourse to the provision of special bends or anchor blocks. However, the pipe should not be cold bend to a radius less than 25 times the OD of the pipe.

The Installation of flanged fittings such as connections to sluice/air/gate valves and hydrant tees etc., requires the use of stub ends (collars/flange adaptors complete with backing rings and gaskets. Care should be taken when tightening these flanges to provide even and balance torque.

Provision should be made at all heavy fittings installation points for supports (such as anchoring of the flange in the soil) for the flange joint to avoid the transfer of valve wheel turning torque on to the PE flange joint.
PE pipe is lighter than water. Hence care should be taken for normal installations where there could be a possibility of flooding of the trench thus the trench shall be kept free of water till the jointing has been properly done. When flooded, some soils may lose cohesiveness, which may allow the PE pipe to float out of the ground. Several design checks are necessary to see if groundwater flotation may be a concern. Obviously, if the pipeline typically runs full or nearly full of liquid, or if groundwater is always below the pipe, flotation may not be a significant concern.

However, weights by way of concrete blocks (anchors) are to be provided so that the PE pipe does not float when suddenly the trench is flooded and the soil surrounding the pipe is washed away. Thus site conditions study is necessary to ensure the avoidance of flotation.

Pipe embedment backfill shall be stone-free excavated material placed and compacted to the 95% maximum dry density.

6.11.18 Jointing of Pipes

The pipe shall have a jointing system that shall provide for fluid tightness for the intended service conditions. Appropriate jointing for HDPE pipe as per IS 4984 shall be selected considering site and working condition, pressure and flow of liquids.

i. All joints shall be made as per relevant IS code, in practice, and manufacturer’s installation manual or instructions. All joints shall be tested for their performance as per provisions made in relevant IS codes. Joints that show leakage will not be accepted. After backfilling and inspection, if groundwater infiltration is observed through joints into the laid water line, then such joints shall be sealed by the bidder at no extra cost to the Employer.

ii. Pipe surfaces to be joined must be free of dust, dirt, oil, moisture and other foreign material. If required, use of chemical such as dichloro-methane, methyl ethyl-ketone or mechanical cleaner may be carried out.


iv. However to join HDPE with other pipe/valves flanges/ mechanical joint compression fittings shall be used confirming to ISO 14236:2000 Plastics pipes and fittings - Mechanical-joint compression fittings for use with polyethylene pressure pipes in water supply systems

6.11.19 Bedding, Backfilling and Compaction

6.11.19.1 Bedding

In case of sandy strata no separate bedding is required. However the bottom face / trench bed where pipe shall be placed shall be compacted to provide a minimum compaction corresponding to 95% of maximum dry density. The pipe bedding should be placed so as to give complete contact between the bottom of the trench and the pipe.
6.11.19.2 Back Filling

Backfilling should be placed in layers not exceeding 15cm thickness per layer, and should be compacted to a minimum of 95% maximum dry density. The refilling should be done on both sides of pipe together & height difference in earth fill on each side should not be more to cause lateral movement of pipe.

Most coarse grained soil are acceptable. This may comprise of gravel or sand. However silty sand, clayey sand, silty and clayey gravel shall not be used unless proposed to be used in conjunction with gravel or clean sand.

It is very important that the pipe zone backfill material does not wash away or migrate into the native soil. Likewise, potential migration of the native soil in to the pipe zone backfill must also be prevented.

Heavy earth moving equipment used for backfilling should not be brought until the minimum cover over the pipe is 90 cm in the case of wide tracked bulldozers or 120 cm in the case of wheeled roaders or roller compactors.

6.11.19.3 Compaction

Vibratory methods should be used for compaction. Compaction within distances of 15 cm to 45 cm from the pipe should be usually done with hand tempers. The backfill material should be compacted not less than 95% of maximum dry density.

6.11.20 Fittings & Specials

Injection moulded HDPE fittings shall be as per IS: 8008 (Part I to IX). All fittings/specials shall be injection moulded at factory only. General requirement of Injection moulded HDPE fittings conforming to IS: 8008 Part I.

Bends

HDPE bends shall be conforming to IS: 8008 Part II Specifications.

Tees

HDPE Tees shall be conforming to IS: 8008 Part III Specifications.

Reducers

HDPE Reducers shall be conforming to IS: 8008 Part IV Specifications.

Flanged HDPE Pipe Ends

HDPE Stub ends shall be square ended conforming to IS: 8008 Part I & VI Specifications. Stub ends will be welded on the pipe. Flange will be of slip on flange type as described below:

Slip-On Flanges

Slip-on flanges shall be metallic flanges covered by epoxy coating or plastic powder coating. Slip-on-flanges shall be conforming to standard mating relevant flange of valves, pipes etc. Nominal pressure rating of flanges will be PN10.
6.11.21  **Welding Procedure**

Jointing between HDPE pipes and specials shall be done as per the latest IS: 7634 part II. Method of jointing between the pipes to pipes and pipes to specials shall be with fusion welding using automatic or semi automatic, hydraulically operated, superior quality fusion machines which will ensure good quality fusion welding of HDPE pipes. If approved by the concerned Engineer, jointing with PP compression fittings may be carried out for smaller diameters of PE pipes (up to 110mm).

6.11.22  **Tests to Establish Portability of Work**

Pipe specimen shall be subjected to tests specified below in order to establish the suitability of these pipes for use in carrying potable water:

I. Smell of the extract
II. Clarity of the colour of the extract
III. Acidity and alkality
IV. Global migration UV absorbing material Heavy metals
V. Un-reacted monomers (styrens) and Biological tests

6.11.23  **Hydraulic Testing**

Pipes shall be given different hydraulic tests for ensuring quality of manufacture as per relevant IS and specification mentioned elsewhere in the bid documents. Hydro pressure testing shall be done on the completed pipe length for a minimum pressure of 1.5 times the designed pressure for retaining period of 4 hours, and as mentioned in IS 4984 –1995 including its latest amendments. The acceptance criteria for hydrostatic test are no permanent deformation of any part of the pipeline fitting or equipment’s and there shall not be any leakage through any of the joints

6.11.24  **Measurement**

The net length of pipes as laid or fixed shall be measured in running meters correct to a cm. Specials shall be excluded and measured and paid separately under the relevant item. The portion of the pipe at the joints (inside the joints) shall not be included in the length of pipe work. Excavation, refilling, masonry and concrete work wherever required shall be measured and paid for separately under relevant items of work.

Payment shall be made as per relevant items in BOQ

6.11.25  **Rate**

The rate shall include the cost of materials and labour involved in all the operations described above except for the items measured/enumerated separately under clause Measurements’, which shall be paid for separately.

6.11.26  **JOINTING MATERIAL: Detachable Joints**

**PUSH-ON JOINTS**

For Push-on joints the rubber ring will be inserted through the chamfered spigot end of the pipe. The two pipes shall be aligned properly in the trench and the spigot end shall be pushed axially into the socket either manually or with a suitable tool specially
designed for the assembly of pipes and as recommended by the manufacturer. The spigot has to be inserted up to the insertion mark on the pipe spigot.

After insertion, the correct position of the socket has to be tested with a feeler blade. A penetration gauge shall be used to check each joint after assembly, to ensure that the rubber ring is properly seated.

When it is desired to deflect push-on joint pipe in order to form a long-radius curve, the amount of deflection shall be as per the instructions of the manufacturer and approved by the Engineer. It is important that in making the joint the pipes are maintained in a straight line and the deflection introduced after the joint has been assembled. However, it is preferable that such deflection will not exceed 75% of the permissible deflection at a single joint as stipulated by the manufacturer of the pipe.

6.11.27 MECHANICAL JOINTS

Bolts shall be tightened alternately on opposite ends of joint diameter and in rotation around the pipe. When properly assembled the gland shall be equidistant from the socket face at all joints. Under no conditions shall extension wrenches or pipe-over-handle or ordinary ratchet wrenches be used to secure greater leverage.

6.11.28 FLANGED JOINTS

Flanged joint pipes and fittings shall be firmly and fully bolted with machine bolts provided by the manufacturer. Standard flange drilling of flanged pipes and fittings shall be in accordance with IS: 1538. The nuts and bolts to be used for jointing shall be made of MS for size up to 27 x 120 mm and high tensile steel of approved make for higher sizes. Gaskets used between flanges of pipes shall be compressed fibre board or natural/synthetic rubber of thickness between 2.5 mm to 3 mm in conformity with IS:3114. The fiber board shall be impregnated with chemically neutral mineral oil and shall have a smooth and hard surface. Its weight per sqm shall not be less than 12 gram/mm thickness.

Slip-on flanges shall be double welded to the pipe with a strength weld jointing the flange hub to the pipe and seal fillet weld inside the flanges at the pipe end. All flanges of the same diameter shall be compatible.

6.11.29 MILD STEEL PIPELINE WORK

6.11.30 General

This part of the specification covers the manufacturing, supply, delivery, lowering, laying, jointing, internal coating, outer coating, testing and commissioning mild steel pipes.

6.11.31 Applicable standards:

The following specifications, standards and codes are applicable for the fabrication of the pipe stock and fittings. All standards referred to shall be the latest editions, including all applicable amendments and revisions. Other authoritative standards that ensure substantial equivalence to the codes listed below will be acceptable. MS pipes shall be designed to withstand internal pressures, surge pressures and external loads and
shall withstand collapsible pressure. Provision for anti vacuum valves has to be made where required.

IS 10221 Code of practice for coating and Wrapping of Underground Mild steel pipes
IS 4533 – Submerged Arc welding of mild steel and low alloy steels
IS 3613 – Acceptance tests for wire flux combinations for submerged arc welding.
AWS A 5-17 – Specification for bare mild steel electrodes and fluxes for submerged arc welding.
IS 816 – Code of practice for use of metal arc welding for general construction in mild steel
IS 4353 – Submerged arc welding of mild steel and low alloy steels recommendations.
IS 817 – Code of practice for training and testing of metal arc welders.
IS 1182 – Recommend practice for Radiographic examination of fusion weld Butt joints in steel plant.
IS 3658 – Code of practice for liquid penetration flaw detection.
ASTM E 165 – Test method for Liquid Penetrate Examination.
IS 3600 – Method of testing fusion welded joints and weld metal in steel (Parts 1 to 9)
IS 4853 – Recommended practice for Radiographic inspection of fusion welded butt joints in steel pipes.
IS 3589 – Seamless or electrically welded steel pipes for water, gas and sewage (168-3 to 2032 outside diameter)
IS 2062 – Steel for general structural purposes grade FE 410
IS 814, IS 3613, SI 6419 and IS 7280 – Welding consumables – such as electrodes, filler rods and wires.
IS 1785, IS 432 – Steel for Reinforcement (Parts I & II)
IS 2825 – Code for unfired pressure vessels.

6.11.32  Technical Specification:

The MS pipes shall be of spirally welded, manufactured conforming to IS 5504 -1997 with 12 mm thick mild steel HR coils conforming to IS 10748 grade 3

6.11.33  Internal coating

The Cement mortar and Cement concrete used for pipes and specials, shall confirm to
the specifications mentioned in the IS 11906 latest amendments. The maximum size of
the aggregate shall be 1/3rd the thickness of concrete cover. The concrete mix shall
have a minimum Cement content of 450 Kg/m3 and minimum characteristic
compressive strength of 25 N/mm2 at 28 days. The mortar shall be thoroughly mixed
and shall have a consistency which results in a dense and homogeneous lining. The
cement mortar shall have a minimum cement content of 600 Kgs/m3 characteristic
compressive strength of 25 N/mm2 at 28 days.

6.11.33.1 Method of Application

All lining work shall be done by machine in factory through centrifugal process.
However, for joints In Situ smooth lining shall be acceptable.

6.11.33.2 Materials of Construction

Material of construction shall be as specified in IS 11906. To improve workability,
density and strength of the mortar, admixtures as approved by the Employer or his
Representative may be used by the Contractor at his own cost. No admixtures shall be
used that would have a deleterious effect on water flowing in the pipe, which is
required for drinking purposes. Bidder should indicate in his bid the details of
admixture he proposes to use.

6.11.33.3 Thickness of Lining

Cement mortar lining shall be uniform in thickness, except of joints or other
discontinuities in the pipe wall. Lining thickness shall be as per ISS 11906 or as
specified by the purchaser. Ends of lining shall be left square and uniform with regard
to the longitudinal axis of the pipe, and the lining holdback shall be as specified by the
purchaser for the type of joints required.

6.11.33.4 Curing

Curing shall commence immediately after completion of the mortar lining and hand
finishing of a section of pipeline. This shall, however, not be later than 8-hours after
mixing of mortar. The lining shall be kept continuously in moist condition for a period
of 14 days. During the operation of lining, finishing and curing, exterior surface of the
pipe exposed to sunlight shall be sprinkled with enough water to keep the pipe cool.
Open ends of pipes shall be suitably closed so as to maintain a moist atmosphere and
prevent draught. Curing of mortar lining and simultaneous cooling of the pipeline
exterior shall be continued even beyond the period of 14 days if so directed by the
Engineer. Defective Lining: Defects in the cement mortar lining include, but are not
limited to, sand pockets, voids, over sanded areas, excessively cracked and dummy
areas and areas of unsatisfactorily surface finish. Repair of Defective Lining: Defective
or damaged areas of linings may be patched by cutting out the defective or damaged
lining to the metal so that edges of the lining not removed are perpendicular or slightly
undercut. A stiff mortar shall be prepared. The cut-out area and the adjoining lining
shall be thoroughly wetted and the mortar shall be applied and trowel led smooth with
the adjoining lining. After any surface water has evaporated, but while the patch is still
moist, it shall be cured as specified. Protection of Lining: The lined pipe and fittings
shall be protected from extreme heat due to direct rays of the sun, from impact of
rainfall and from freezing temperatures until the linings have cured sufficiently to
withstand these conditions. Every precaution shall be taken to prevent any damage to
the lining. If lining is damaged through the fault of the Contractor, such damages shall be repaired conforming to the specifications at the Contractor’s expenses.

6.11.33.5 Tests

Test blocks of the same material as used for the lining shall be made in 100 mm cube moulds and subjected to cube crushing tests. Each block shall be removed from its mould as soon as practicable and cured under the conditions of temperature and humidity identical with those in which the lining of the pipe is cured. The number of tests shall be at least 4 cubes for each age and each water cement ratio for each days work. The works cube strength of the test cube shall not be less than 170 kg/cm² after 7 days of curing or 300 kg/cm² after 28 days of curing. The density of the test cube shall not be less than 2300 kg/m³. Lining Quality: The surface of the lining shall be uniformly smooth and shall be free from voids. The lining shall not have any flaky areas. It shall not be crumbly and do not have any waves or grooves.

The following field tests shall be carried out by the contractor at his cost for determining the quality of mortar: a) Slump Test b) Cube Test c) Testing the thickness of lining.

6.11.34 External Coating

External Coating The cement mortar coating is applied on MS pipe using either by wire brush/rubber brush coating method. The pipe is rotated in a lathe type machine which turns and traverses the pipe. The weld mesh of 50x50mm13mm gauge is wrapped on MS pipe with spacing between pipe weld mesh. Prior to coating cement slurry is applied over the pipe to create alkaline surroundings around the pipe. A stream of premixed cement mortar 1:3 is then shot on to the pipe ejection between high speed counter rotating wheels in contact. Compaction is by impact. Turning and traverse speeds of the pipe make a coat of the minimum thickness 25mm. The ends of the mortar are trimmed to shape. The coated pipe is then cured either by immersion in water or by spraying or by stream or a combination. By this coating process, MS pipe is adequately protected against corrosion. The permeability results shall be as per revised IS 3589/2001 with latest amendments.

6.11.35 Pipe fittings:

Pipe fittings shall be manufactured in accordance with IS 7322, and lined internally.

6.11.36 Welding Procedure:

The welding procedure shall be as follows:

Submerged arc welding in accordance with IS 4353 (SAW). For submerged arc welding, alloying is not permitted via the flux.

6.11.37 Welding Electrodes and Consumables:

All welding electrodes/consumables shall comply with IS 814, IS 3613, IS 6419 and IS 7280. The electrode/consumable chemistry shall meet the requirements of the base material and shall be selected such that the deposited weld metal exhibits mechanical properties equal to or in excess of the base material.

All welding electrodes/consumables shall, as a minimum, be stored and used in accordance with the manufacturer’s recommendations.
6.11.38 Non-destructive Examination (NDE):

All NDE shall be performed by a qualified personnel to recognized National or International Standard (E.g. PCN, ASNI Level 11 etc.)

A document listing the relevant NDE procedures, methods and technique for the item, shall be submitted to Employer for review. Any subsequent revision to the document shall be approved by the Employer.

For the mild steel pipes manufactured in site Factory/Workshop fabricated from mild steel coils, 15% of weld length of each pipe shall be subjected to Radiography Test by Digital Image/ X-Ray Film Method. (As per API 1104 or IS:10234)

Employer have right to review certification of NDE personnel at manufacturer works.

6.11.39 Pipe Marking:

All pipes shall be marked with unique serial number. The number shall be hard stamped in letters or numbers not less than 15 mm high on the external face 200 mm from the pipe end and clearly stenciled in Red or White paint in letters or numbers not less than 200 mm high on the internal and external face of the pipe close to the pipe end.

1. Diameter and length of pipe
2. Date of Manufacture
3. Manufacture’s name

6.11.40 Test Procedures:

1. Testing of Raw Materials as per applicable standards
2. Testing of consumables as per applicable standards
3. Testing of final product such as DP test, radiographic, hydro test, etc. as per applicable standards.

6.11.41 Materials:

Material test reports certifying compliance with relevant standards for each batch/delivery for the following items:

1. HR coils
2. Welding consumables

6.11.42 Final Product:

Following testing will be carried out in the presence of Employer’s Representative, who will have right to select samples for testing where 100% testing is not involved.

1. Hydraulic pressure tests on each pipe as per IS 3589 Clause 13.
2. Dye penetration test on 10% random, selection of weld length of each pipe.
3. Radiographic examination on 1% random, selection of weld length of each pipe.
The pipes failing in above tests shall be rejected.

In the event of rejections or while inspecting re-worked pipes, Employer’s Representative will have right to demand higher sample sizes in point (2) and (3) mentioned above.

Record of inspection and testing shall be permanently available with contractor for any future reference.

6.11.43 **Inspection and Testing at site:**

**Inspection on Delivery:**

All pipes together with their associated documentation will be inspected by employer at the point of delivery at site for transit damages and physical measurements.

6.11.44 **Inspection and Testing during execution:**

The pipeline will be tested for the test pressures as per IS 3589. Any manufacturing defects observed during this pressure test, should be rectified within 7 days either by repairs or replacement.

The minimum thickness in different sections shall be as designed thickness approved by Employer’s Representative or the preferred thickness mentioned in IS: 3589-2001, whichever is more.

All the pipes, valves, MS specials and other pipe appurtenances shall be designed to withstand the maximum design pressures to which it may be subjected to under operation of the project.

Minimum earth cover over pipeline shall be 1.2 m except where the pipeline crosses the CD works above ground. In case natural ground level is below the pipe bottom, concrete pedestal supports shall be provided. The pipe thickness shall be designed to withstand

a). Maximum working pressure plus the surge pressure.

b). Field test pressure i.e. 1.5 times the working pressure

6.11.45 **Quality Assurance**

During the whole process of manufacturing, Employer’s Representative / IVA or Representative appointed by Employer along with contractor’s staff shall be present to supervise the Quality Assurance process and witness the test performed.

6.11.46 **Fabrication of MS Specials & Fittings**

6.11.46.1 **General**

The dimensions of all MS specials and fittings (bends, tees, scour tee, reducers, enlargers, etc.) shall in general confirm to the principals of IS: 7322, using MS plate/sheet conforming to IS:2062. The thickness shall be adequate to sustain field test pressure but shall not be less than the thickness of the pipe at that point.

Tolerance for steel fittings shall confirm to the requirements of IS: 7322
6.11.46.2 Flanged Branches

Flanged branches shall be fabricated in accordance with the general specification and to the Engineering-Charge’s requirement.

Flanged branches for air and scour valves shall be welded into pipe in the required position. The branch for an air valve shall be vertical and at right angle to the longitudinal axis of pipe. The invert of the branch for a scour valve shall be horizontal and at right angles to the axis of pipe and shall align with the invert of the barrel of the main pipe.

All the flanges shall be machined to standard thickness, square to the axis of the pipe.

Dimension of the flanges, welding details and welding procedure shall be as specified below.

6.11.46.3 Bends

Bends to provide change of alignment in pipe laying shall be manufactured to suit the site conditions. Bends of more than 45° shall not be provided. Bends shall be manufactured from tested pipes by angle cutting of the barrel or by such other standard procedure and re-welding. Bends shall be lined internally and coated externally as specified for the pipes.

a) Bends shall be fabricated taking into account the vertical and horizontal angles for each case.

b) The bends shall have welded joints and the upstream and downstream ends of each bend shall have a straight piece of variable lengths as required.

c) Bends shall be designed with deflection angle between two segments as per provisions of IS: 7322 (amended up to date).

d) When the point of intersection of a horizontal angle coincides with that of a vertical angle, or when these points can be made to coincide, a single combined or compound bend shall be used.

e) Details of thrust collars anchor bolts, holding down straps, saddle plates should be furnished together with full specifications in Contractor’s fabrication drawing.

6.11.46.4 Tapers

Tapers shall be manufactured out of steel plates and lined internally and coated externally. The tapers shall be suitable for connections to the sluice valves or flanged tailpiece on one side and to MS pipe on the other side. Stiffener rings shall be provided if required to afford rigidity to pipe. They shall be manufactured generally in accordance with IS: 7322.
6.11.46.5 MS flanges

Welding neck flanges confirming to BS 6392 for nominal pressure rating 1.6 N/mm² must be used in accordance to the design pressure at the place of installations. Nominal Size of flange shall be in conformity to the equipment or pipe appurtenance with which they are to be used. The flange drilling shall conform to IS 1538 for flanges up to 1500 mm ID.

Flanges shall be provided at the end of pipes or special where sluice valves, blank flanges, tapers, etc. have to be introduced. The Contractor shall assemble the flanges in the exact position by marginal cutting, if necessary, so as to get the desired position of the sluice valves, etc. either vertical or horizontal and shall then fully weld the flanges from both sides in such a way that no part of the welding protrudes beyond the face of the flanges. In case the welding protrudes beyond the flanges and if the Engineer-in-Charge orders that such protrusions shall be removed, the Contractor shall file or chip them off. If required and when ordered by the Engineer-in-Charge, the Contractor shall provide and weld gusset stiffeners, as directed on site.

6.11.46.6 Blind Flanges

Blank flanges shall be provided at all ends left unattended for the temporary closure of work and also for commissioning a section of the pipeline or for testing the pipeline laid. For temporary closures, non-pressure blank flanges consisting of mild steel plates, tack welded at the pipe ends may be used. For pipes subjected to pressures, the blank flanges or domes suitably designed as per Engineer-in-Charge’s requirements shall be provided. The thickness of the blank flanges shall be as defined in IS 6392 for the nominal size and design pressure at the place of installation, the flange drilling for all flanges up to 1500 mm ID shall conform to the provisions of IS 1538.

6.11.47 Stiffener Rings

The Contractor shall provide stiffener rings wherever required as per approved design calculations. The Contractor shall weld the same to the pipes with one circumferential run on each side.

6.11.48 Straps

In general the use of straps shall not be made. Whenever, it's uses is unavoidable, approval of Engineer-in-Charge shall be taken. Wherever pipe laying work is done from two faces and/or has to be done in broken stretches due to any difficulty met with at site, the final connection has to be made by introducing straps to cover gaps upto 30 cm length. Straps shall also be provided as per the procedure of fixing expansion joints by the method described. Such straps shall be fabricated in the field by cutting pipes, slitting them longitudinally and slipping them over the ends to be connected in the form of a collar. The collar shall be in two halves and shall have its inside diameter equal to the outside diameter of the pipe to be connected. A minimum lap of 8 cm on either ends of the pipe shall be kept and fillet welds shall be run both internally and externally for circumferential joint. The longitudinal joints of the collar shall be butt-welded.

All fillet welds shall have a throat thickness of not less than 0.7 times the width of welding.
6.11.49 Dismantling Joint:

All valves, Bulk water meters or any other online valves etc. shall be installed between flanges with a flexible MS dismantling joint at one side. The joint must allow dismantling of the valve, meters etc. without causing stress to the joints of the attached pipes. The minimum clearance of the dismantling joint shall be five (5) cm. The pressure class of the dismantling joint shall be the same as that of the pipe. Drawings of the dismantling joint shall be submitted to the Engineer-in-Charge for approval. The Nuts and Bolts of the joint shall be galvanized. The joints shall be painted/coated as per specification given for exposed pipes.

6.11.50 Inspection and Tests on Pipe and Fittings/Specials

The pipe shall be tested as per provision of Clause in specification.

Each special or fittings shall be subjected to tests as per IS: 7322 before inner and outer coating. Dye penetration test as prescribed in IS:7322 is acceptable in lieu of hydraulic test for all specials.

The workmanship and marking on pipes must be conforming to clause in specification. All works and material under specification will be rigidly inspected during all phases of manufacture and testing and such inspection shall not relieve the Contractor of his responsibility to furnish material and perform work in accordance with these specifications.

The Engineer-in-Charge or the authorized inspection agency shall have free access to those parts of the plants that are concerned with the furnishing of materials of the performance of work under this specification. The tenderer shall furnish the Engineer-in-Charge reasonable facilities and space without charge for inspection, testing and obtaining of any information he desires in respect of the quality of material used and the progress and manner of the work.

Sampling of pipes shall be taken as per IS 4711-1974.

Contractor shall provide and operate suitable equipment capable of conducting the specified hydraulic test pressure to the inside surfaces of the pipe and of sustaining the pressure for the required period.

6.11.51 Laying & Jointing Work of Mild Steel Pipeline & Fittings/ Specials

6.11.51.1 Standard

The Laying, jointing and testing of MS pipeline shall confirm to IS: 5822.

6.11.51.2 General

Unless specified otherwise, the pipeline shall be buried with minimum cover of 1.2 meters at top. No material shall be erected unless it has been previously passed by the Engineer.
6.11.51.3  **Welding**

Except for routine welding of joints, no other work shall be done in the absence of Contractor's engineer, either during the day time or at night. Chipping shall not be kept in arrears for more than 15 joints.

Saddle pieces shall be fixed in position after checking bolts holes, by means of templates. These works shall be done together with the pipe laying work, if pipeline is to be laid above ground in unavoidable circumstances.

6.11.51.4  **Temperature**

The components of the pipeline such as base plates, top plates and pedestals have been so designed that the centers of the plates and pedestals shall coincide at the Mean Temperature (30°).

For this reason, all works such as fixing flanges, base plate etc. in true alignment and in correct position and track welding pipes shall be done at the mean temperature.

For ascertaining the temperature, the Contractor shall provide mercury cups and fix them to the pipe shell from outside and shall also provide thermometers of the required type and range.

6.11.52  **Earth Work**

(a)  **General**

The Contractor shall furnish all tools, plant, instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein for completion of the work in accordance with the Employer’s Requirements.

The Contractor shall survey the site before excavation and set out all lines and establish levels for various works such as grading, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established reference/grid lines at 8m intervals or nearer, if necessary, based on ground profile and thereafter properly recorded.

The excavation shall be carried out to correct lines and levels. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and maintaining of substantial barricades around excavated areas and warning lamps at night.

Excavated material shall be dumped in regular heaps, bunds, riprap with regular slopes within the lead specified and leveling the same so as to provide natural drainage. Rock/soil excavated shall be stacked properly as approved by the Employer's Representative. As a rule, all softer material shall be laid along the center of heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Rock shall be stacked separately.

Topsoil shall be stock piled separately for later re-use.

(b)  **Clearing**
The area to be excavated/filled shall be cleared of fences, trees, plants, logs, stumps, bush, vegetation, rubbish, slush, etc. and other objectionable matter. If any roots or stumps of trees are encountered during excavation, they shall also be removed. The material so removed shall be disposed off as approved by the Employer’s Representative. Where earth-fill is intended, the area shall be stripped of all loose/soft patches, top soil containing objectionable matter/ materials before fill commences.

(c) Excavation

Excavation shall be taken out to such widths, lengths, depths and profiles as are shown on the approved L-section or such other lines and grades as may be agreed with the Employer’s Representative. Rough excavation shall be carried out to a depth of 150mm above the final level. The balance shall be excavated with special care.

Soft pockets shall be removed below the final level and extra excavation filled up with lean concrete as approved by the Employer’s Representative. The final excavation should be carried out just prior to laying the blinding course. To facilitate the permanent works the Contractor may excavate, and also backfill later, outside the lines shown on the drawings provided by the Contractor as agreed with the Employer’s Representative.

All excavations shall be to the minimum dimensions required for safety and ease of working. Prior approval of the Employer’s Representative shall be obtained by the Contractor in each individual case, for the method proposed for the excavation, including dimensions, side slopes, dewatering, disposal, etc. This approval, shall not in any way relieve the Contractor of his responsibility for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. Side slopes shall be as steep as will stand safely for the actual soil conditions encountered. Every precaution shall be taken to prevent slips. Should slips occur, the slipped material shall be removed and the slope dressed to a modified stable slope.

(d) Excavation for laying pipe along the road

While laying the pipeline below ground along the road side, the contractor shall observe the following:

(i) The contractor shall not be allowed to take earth from the burrow pits if excavation required to take additional earth results in side slopes steeper than 1:1 in clay dominating soil and 1:1.5 in case of silty sand or sandy soils.

(ii) If invert of pipe is kept above the existing burrow pit level or part of pipe is above it, the minimum side slopes of 1:1 in clay dominating soil and 1:1.5 in case of silty sand or sandy soils shall be provided on the side towards the burrow pit area so as to provide required cover. The side slopes shall be properly compacted upto 95% of Procter density.

(iii) If earth is taken for providing required cover to pipe from the burrow pits, the burrow pits shall be so graded upto the nearest drain, that no impounding of water is possible in burrow pit area.

(iv) If the pipeline is laid just near the road section, as far as practical minimum cover of 0.9 meter shall be ensured. Whenever this requirement of cover cannot
be ensured, concrete casing of designed thickness as per considerations given for design in this chapter shall be provided.

(e) Dewatering

The Contractor shall ensure that the excavation and the structures are free from water during construction and shall take all necessary precautions and measures to exclude ground/rain water so as to enable the works to be carried out in reasonably dry conditions in accordance with the construction program. Sumps made for dewatering must be kept clear of the excavations/trenches required for further work. The method of pumping shall be approved by Employer’s Representative, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. The dewatering shall be continued for at least (7) seven days after the last pour of the concrete. The Contractor shall, however, ensure that no damage to the structure results on stopping of dewatering.

The Contractor shall study the sub-soil conditions carefully and shall conduct any tests necessary at the site with the approval of the Employer’s Representative to test the permeability and drainage conditions of the sub-soil for excavation, concreting etc., below ground level.

6.11.53 Handling of pipes and specials

a). Carting & Handling

Pipes and fittings/specials shall be transported from the factory to the work sites and stacked at places along the alignment of the pipeline as directed by Engineer-in-Charge. Contractor shall be responsible for the safety of pipes and fittings/specials in transit, loading/unloading. Every care shall be exercised in handling pipes and fittings/specials to avoid damage. While unloading, the pipes and fittings/specials shall not be thrown down from the truck on to hard surfaces. They should be unloaded on timber skids with steadying ropes or by any other means. Padding shall be provided between coated pipes, fittings/specials and timber skids to avoid damage to the coating. As far as possible pipes shall be unloaded on one side of the trench only. The pipe shall be checked for any visible damage (such as broken edges, cracking or spelling of pipe) while unloading and shall be sorted out for reclamation.

Any pipe which shows sufficient damage to preclude it from being used shall be discarded. Dragging of pipes and fittings/specials along concrete and similar pavement with hard surfaces shall be prohibited.

(b) Storage

Coated pipes and specials that are to be stored on supports shall bear on the uncoated ends only. If bearing on coating is employed the supports shall be not less than 20cm (8 inches) wide and so arranged to prevent damage to the coating.

Storage if required shall be done on firm level and clean ground and wedges shall be provided at the bottom layer to keep the stack stable. The stack shall be in pyramid shape or the pipes laid lengthwise or crosswise in alternate layers. Fittings/specials shall be stacked under cover and separated from pipes.
(c) Benchmark

Permanent benchmarks, at least four in every Kilometer shall be fixed before any work is started by the Contractor in any section. These benchmarks shall be fixed away from the field of work so as not to be disturbed during the execution and shall be securely fixed in concrete.

(d) Fencing, Watching and Lightening

The posts of the fencing shall be of timber, securely fixed in the ground not more than 2.5 m apart. They shall not be less than 10 cm in dia. or not less than 1.25 m above the surface of ground. There shall be two rails, one near the top of the posts and the other about 0.5 m above the ground and each shall be of 5 cm to 10 cm in dia. and sufficiently long to run from post to post which they shall be bound with strong ropes. The method, of projecting rails beyond the posts and tying together where they meet will not be allowed on any account. All along the edges of the excavated trenches, a bund of earth about one meter high shall be formed where so required by the Engineer-in-Charge for further protection. Proper provision shall be made for lighting at night and watchman shall be kept to see that this is properly done and maintained. In addition to the normal lighting arrangements, the contractors shall provide wherever such work is in progress, battery operated blinking light (6 volts) in the beginning and end of a trench with a view to provide suitable indication to the vehicular traffic. The contractor shall provide and display special boards printed with fluorescent paints indicating the progress of the work along the road. The contractor shall be held responsible for payment of all claims for compensation as a result of accident or injury to any person or property due to improper fencing, inadequate lighting or non-provision of red flags. The contractors shall provide all notice boards before opening of roads as directed by the Engineer-in-Charge. Arrangements shall be made by the contractors to direct traffic whenever work in through fare is in progress.

6.11.54 Pipe Laying above ground

Before commencing the work the contractor shall submit the working drawing of every km of pipeline laying as per the approved L-section of the pipeline for the section concerned. He shall also study the details of the type of saddles/ concrete pedestals to be provided before the actual work of casting is taken in hand.

Before execution the contractor shall submit detailed designs and drawings and all supports such as portal frames, saddles, ring girders etc., for approval of the department.

Pipe laying above ground shall generally start from the fixidity points on either side, the expansion joints being provided in the last. Fixing points are at all anchor blocks. Where such blocks are not required for long lengths, fixidity shall be achieved by fixing the pipeline to the special type of R.C.C. or steel saddles/ concrete pedestals as specified above. The distance between successive fixidity points shall not exceed 300 m.

Anchor blocks shall be constructed before commencing the pipe laying work in any section. The construction of the blocks shall be carried out in 3 stages in the first stage the lower part upto 150 mm below the invert of the pipeline including concrete chairs to support it shall be constructed; in the second stage the pipeline on this part of the block
shall be laid; and lastly, the remaining block around and over the pipeline shall be constructed.

The fixidity saddles/ concrete pedestals and ordinary saddles/ concrete pedestals shall be cast at least 3 weeks before the pipeline is laid on them. After all saddles/ concrete pedestals between successive fixity points have been cast, a line plan showing the actual position thereof shall be prepared, after taking levels and measuring distances. In case of any errors in casting the pedestals, corrections shall be applied. The pipe laying work shall then start from the fixidity points and shall proceed towards the expansion joints. The method of jointing the pipes and erecting them on previously cast R.C.C. saddles/ concrete pedestals shall be determined by the Contractor depending upon the type of plant equipment and personnel available with them.

The pipe strakes shall be assembled in position on the saddles/ concrete pedestals either by the cranes, portable gantries, shear legs or any other equipment approved by the Engineer-in-Charge. Normally, not more than two pipes shall be aligned, tacked and kept in position on temporary supports. The Contractor shall not proceed with further work, until the circumferential joints of these pipes are fully welded. During assembly, the pipeline shall be supported on wooden sleepers and wedges, with the free end of the pipeline held in position by slings to avoid deflection due to temperature variations during the day. In general, the assembly of pipe stretches and one run of welding shall be done during the day time while full welding including the external gouging and sealing runs shall be done after 5 p.m. or so. The Contractor shall maintain the continuity of the work by adding at least two more pipes on the second day in a similar manner, after full welding of the previous joints is completed during the night. While this new work is being done, the Contractor shall proceed with the work of providing permanent supports for the pipeline assembled and welded previously.

6.11.55 Fixing Expansion Joint

The work of laying pipeline in aboveground, laying starts from the fixity points and proceeds towards the expansion joints. It shall be continued until the gap between the pipe ends is less than the lengths of the expansion joint plus pipe strake length. At mean temperature the exact gap between pipes shall be measured. Free ends of pipes shall be brought in a correct line and level; lateral movement, if any, shall be corrected. Then the gap between the free ends shall be made equal to the exact length of the expansion joint by cutting one of the pipe ends. Choice of the end to be cut must be made from the point of view of bringing the expansion joint to a central position.

At mean temperature this expansion joint shall be inserted inside the gap and both ends shall be tack welded to the pipe ends, after pulling the expansion joint.

Welding of these two joints of the expansion joints shall be started only after it is ascertained by taking observations that the expansion joint is functioning properly.

6.11.56 Protection against scouring of foundation:

a) Providing pitching:
Wherever the pipeline pedestal or portal foundation are located near a nallaha or are across a nallaha, the tenderer shall provide a cut-off wall upto the scour depth all around the footing/ foundation at a distance of 2 times the depth of foundations below the existing ground level. The portion between the cut-off wall and the foundation shall be filled with compacted soil and 30cm thick stone pitching shall be done with weight of stone not less than 40kg. The minimum section of cut-off wall shall be of 0.3m in width and minimum 2m in depth. The cut-off wall shall be of RR masonry in cement mortar 1:4 laid on 1:3:6 Cement concrete mix minimum 15cm thickness.

b) Providing longitudinal walls and cross walls:

Wherever pipe is laid on pedestal across a nallah/drain or in revines with drain flowing across the pipe alignment, longitudinal check wall or curtain wall shall be provided on both side of the pipe foundations. The cut-off wall on the upstream side of nallah/drain shall be taken at least upto 2m depth from the general ground level or up to the scour depth which ever is more. The downstream side of cut off wall shall be taken 2.5 m in depth. The area between two wall shall be filled with compacted soil and a gentle slope shall be provided for drainage of water in case of minor drain, but a flexible apron shall be provided for bigger nallah. The minimum width of cut off walls shall be 0.3m. The wall shall be of RR stone masonry in cement mortar 1:4 and the exposed top face shall be provided 25mm cement coping in M-15 grade or grade as per IS 456 concrete. The base course shall be of 1:3:6 mix concrete of minimum 15cm thickness.

6.11.57 Pipe Laying Below Ground With Soil Cover

The earth work shall be carried out as specified here in.

Before excavating the trench the alignment of pipeline and L-section shall be approved by Engineer-in- Charge. The work of trench excavation should be commensurate with laying and jointing of the pipeline. It should not be dug in advance for a length greater than 3 days ahead of work of laying and jointing of pipeline unless otherwise directed by the Engineer-in-Charge. It is proposed to ensure the following:

- Safety precautions have to be incorporated in the work process
- Hindrances to the public have to be minimized
- The trench shall not be allowed to erode
- The trench must not be filled with water
- The trench must not be refilled before laying of the pipes
- The bed for the laying of the pipes has to be prepared according to the L-Section immediately before laying of the pipes.

6.11.58 Bedding for pipe line

i) Bedding

The MS pipeline shall generally be laid in ordinary sandy soil for which no extra bedding shall be provided. In such case, while doing the excavation, the bottom of the trench shall be prepared in a manner so as to match the curvature of the pipe as far as
possible subtending an angle of about 120° at the centre of pipe. Wherever the bottom of the trench is of such a nature (i.e. decomposed rock/ hard soil/ boulder) which is likely in the opinion of the Engineer-in-Charge to cause damage to the pipe or coating or an unsuitable material is encountered which cannot support the pipe, the contractor shall excavate the trench to an additional depth below the required depth and shall refill to required level with suitable material such as loose soil/excavated earth, to be approved by the Engineer-in-Charge. The bedding thickness shall be not less than 20 cm under the barrel of the pipes. The complete pipe has to be covered and surrounded by the same material as used for bedding so that a total cover of 30 cm above the barrel can be achieved. The excavated hard/dense soil can be refilled after bedding and covering of the pipe with the loose soil/ excavated earth. The bedding shall be compacted with a light hand rammer. Any reduction in thickness due to compaction shall be made up by adding earth during ramming. For the purpose of the bedding under this item only screened fine earth of grain size not larger than 2 mm shall be used. The bedding material shall be clean, uncoated and free from clay lumps, injurious amounts of dust, soft particles, organic matter, loam or other deleterious substances.

During the work of providing bedding and laying the pipeline over it, loose material from the sides or edges of the trench shall be prevented from falling inside the trench, by providing shoring and taking other measures. Also where necessary, trench shall be kept dry by pumping out seepage water continuously.

ii) Concrete Bedding:

This type of bedding is as per the drawing appended with the tender document and is to be provided at locations shown in the drawings or as specified by the Engineer. A concrete bedding using M15 grade is to be adopted. The concrete work related to this specification is detailed in the specifications of concrete and allied works.

6.11.59 Lowering and Jointing

The pipe shall be lowered into the trenches by removing only one or two struts at a time. It shall be seen that no part of the shoring is disturbed or damaged and, if necessary, additional temporary struts may be fixed during the lowering operations. It shall also be necessary to see that the gunite coating of pipe is not damaged in any way during the lowering and assembling. After the pipe is lowered into the trench, it shall be laid in correct line and level by using the levelling instruments, sight rails, theodolite, etc. Care shall be taken to see that the longitudinal joints of two consecutive pipes at each circumferential joints are staggered by 90°. While assembling the pipes, the ends shall have to be brought close enough to leave a uniform gap not exceeding 4 mm. If necessary, a marginal cut may be taken to ensure a close fit of the pipe faces. For this purpose, only experienced cutters who can make uniform and straight cuts, shall be permitted to cut the faces of the pipes. There shall be no lateral displacement between the pipe faces to be joined. If necessary, spiders from inside and tightening rings from outside shall be used to bring the two ends in perfect contact and alignment. It may also be necessary to use jacks for this purpose. In no case shall hammering or longitudinal slitting be permitted. When the pipe is properly assembled and checked for correct line and level, it shall be firmly supported on wooden beams and wedges and tack welded. Some portion of the trench may be refilled at this stage so as to prevent the pipeline from losing its alignment. The tack welded circumferential joints shall then be welded.
fully. Only experienced welders, who shall be tested from time to time shall be permitted to carry out the welding work.

On completion of the pipe jointing and external protection, the trench and the welding pits shall be cleaned. The welding pits shall be filled and compacted in 150mm layers with the bedding material.

Backfilling shall be carried out as detailed here under.

(a) Precautions against Floatation

When the pipeline laid underground or above ground in a long narrow cutting gets submerged in water collected in the trench of cutting it is subjected to an uplift pressure due to buoyancy and is likely to float if completely or partly empty. In the design of pipelines, provision is to be made to safeguard against floatation providing sufficient overburden or by providing sufficient dead weight by means of blocks, etc. Pipe shall be provided against floatation by providing anchor blocks as indicated in Drawing in volume IV. Factor of safety for calculations for check against floating shall be taken as 1.5.

In the case of works extending over one or more monsoon seasons, however, special care and precautions are necessary during the progress of work on this account. The Contractor shall close down pipe laying operations well in time for the monsoon. The work of providing blocks, refilling the earth to the required level, compacting the same, etc. shall always be done as soon as the pipeline in the cutting has been laid.

The Contractor shall see that the water shall not be allowed to accumulate in open trenches. Where work is in an incomplete stage, precautionary work, such as blank-flanging in the open ends of the pipeline and filling the pipeline with water etc. shall be taken up as directed by the Engineer.

(b) Expansion Bellows:

Expansion bellows shall be provided to take care for variation of temperature range from 2.8o C to 45.6o C for all pipe lengths laid above ground level and left uncovered. Each expansion bellow must be placed between two anchor blocks providing fixidity at two ends.

Expansion bellows burrow type shall be used confirming to EJMA / ASME specifications.

Expansion bellows adopted shall accommodate expansion and contraction movement of pipe by suitable displacement. Expansion bellows shall be provided at appropriate locations as per provision in IS: 5822-1994 and as shown in the approved L-section. The maximum distance between the expansion bellows shall be limited to 300 metres. These joints shall be equal to the internal diameter of the pipeline and shall be tested at 1.5 times the designed working pressure. Maximum movement of 15 cm’s must be possible at each expansion bellow without any damages to pipe. Whenever the expansion bellows are provided in pipeline alignment, the same shall have a protective MS cover over the joint portion to avoid damage to pipe by any external blow.
The Hydraulic testing of the MS pipe line should be greater of the (i) 1.5 times of the max Working head & (ii) 1.5 times of static head in case of Gravity mains and max Working head including surge in case of Pumping main

6.11.60 Civil Works

All the civil works associated with the MS pipeline laying & Jointing work e.g. excavation, Embankments construction, construction of thrust/ anchor blocks, butterfly/ Air/ Scour valves chambers, RCC support structures etc. shall be carried out in accordance with provisions. Specification of material used, workmanship, testing and sampling of materials shall be in accordance to respective provisions laid down in the chapter on “Specifications for Civil Works” of tender document.

6.11.61 Testing At Work Site

6.11.61.1 Field Testing of Joints

- Ten percent of the field joints shall be tested radio graphically (Samples at random) as per IS: 4853, in case of failure 20% field joints shall be selected. In case of second failure, 100% field joints shall be radio graphically tested.
- Five percent of the field joints shall be tested ultrasonic test as per IS: 4260.

The welding of pipes in the field should comply with IS 816-1965 and electrode used should comply with IS 814-1967. Welded joints shall be tested in accordance with procedures laid down in IS 3600- 1966 and one test specimen shall be taken from at least one field joint out of 10.

6.11.62 Field Hydraulic Test

After erection at site and after the concrete anchor/ thrust blocks have been constructed. The entire pipeline including valves shall be subjected to a hydraulic test as follows, to the required test pressure as per Clause 11 of IS: 5822.

If a drop in pressure occurs, the quantity of water added in order to re-establish the test pressure should be carefully measured. This should not exceed 0.1 liter/ mm of pipe diameter per km of pipeline per day for each 30 m head of pressure applied.

The contractor shall provide and maintain all requisite facilities, instruments, for the field testing of the material. All pipes, Specials, valves and civil works shall be replaced by the contractor if damaged during testing.

6.11.63 Flushing and Disinfection of Mains

The pipeline shall be disinfected before commissioning for use. After testing the main, it shall be flushed with water of sufficient velocity to remove all dirt and other foreign materials. When this process has been completed, disinfection (using liquid chlorine, sodium or calcium hypochlorite) shall be done as per of IS: 5822.
6.11.64 Fill, Backfilling and Site Grading

Trenches shall be backfilled with approved selected excavated material only after the successful testing of the pipeline. The tamping around the pipe shall be done by hand or other hand operated mechanical means. The water content of the soil shall be as near the optimum moisture content as possible. Filling of the trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressure does not occur. Each layer shall be consolidated by watering, ramming, care being taken to avoid damage to the pipeline.

6.11.64.1 Fill Backfilling

(a) General

All fill material shall be subject to the Employer’s Representative’s approval. If any material is rejected by Employer’s Representative, the Contractor shall remove the same forthwith from the site. Surplus fill material shall be deposited/disposed off as directed by Employer’s Representative after the fill work is completed.

No earth fill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with to the approval of the Employer’s Representative.

(b) Material

Where the extent available, selected surplus spoil from excavations shall be used as backfill. Backfill material shall be free from lumps, organic or other foreign material. All lumps of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of Murom or earth to fill the voids and the mixture used for filling.

If fill material is required to be imported, the Contractor shall make arrangements to bring such material from outside borrow pits. The material and source shall be subject to the prior approval of the Employer’s Representative. The approved borrow pit areas shall be cleared of all bushes, roots of trees, plants, rubbish, etc. Top soil containing foreign material shall be removed. The materials so removed shall be disposed of as directed by Employer’s Representative. The Contractor shall provide the necessary access roads to borrow areas and maintain the same if such roads do not exist.

(c) Backfilling

Where backfilling is required to be carried out with good local earth and it shall be clean, medium grained and free from impurities. The filled-in-earth shall be kept flooded with water for 24 hours to ensure maximum consolidation. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Employer’s Representative has inspected and approved the fill.

(d) Refilling of trenches

On completion of the pipe laying operations in any section, for a length of about 100m and while further work is still in progress, refilling of trenches shall be started by the
Contractor with a view of restricting the length of open trenches. Pipe laying shall closely follow the progress of Trench Excavation and the Contractor shall not permit unreasonably excessive lengths of trench excavation to remain open while awaiting testing of the pipeline. If the Engineer considers that the Contractor is not complying with any of the foregoing requirements, he may prohibit further trench excavation until he is satisfied with the progress of laying and testing of pipes and refilling of trenches. Only soft earth and murum of good quality free from stones boulders, roots, vegetation etc., shall be utilized after the lumps are broken for filling in around the pipes for at least 30 cm all around for pipes. Filling shall be done in layers not exceeding 150mm and compacted to 70 to 80% of max. dry density percent of the maximum dry density as per part VII of IS:2720. The excavated material nearest to the trench shall be used first. Care shall be taken during backfilling, not to injure or disturb the pipes, joints or coating. Filling shall be carried out simultaneously on both sides of the pipes so that unequal pressure does not occur. Walking or working on the completed pipeline unless the trench has been filled to height of at least 30cm over the top of the pipe except as may be necessary for tamping etc., during backfilling work. The remaining portion of the trench may be filled in with a mixture of hard and soft material free from boulders and clods of earth larger than 150mm in size if sufficient quantity of good earth and murum are not available. Filling in shall be done in layers not exceeding 225mm in thickness accompanied by adequate, ramming etc., so as to be compacted to 70 to 80% of the maximum dry density as per part VII of IS:2720. Water contents of the soil shall be as near the optimum moisture content as possible. The trench shall be refilled so as to build up to the original ground level, keeping due allowance for subsequent settlement likely to take place.

To prevent buckling of pipe shell of diameters 1200mm and above, pipes shall be strutted from inside while the work of refilling is in progress.

Subsidence in filling: Should any subsidence take place either in the filling of the trenches or near about it during the maintenance period.

6.11.64.2 General Site Grading

Site grading shall be carried out as approved by the Employer’s Representative. Excavation shall be carried out as specified in the Employer’s Requirements. Filling and compaction shall be carried out as specified elsewhere.

If no compaction is called for, the fill may be deposited to the full height in one operation and leveled. If the fill has to be compacted, it shall be placed in layers not exceeding 225 mm and leveled uniformly and compacted before the next layer is deposited.

To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the Contractor.

Field compaction tests shall be carried out in each layer of filling until the fill to the entire height has been completed. This shall hold good for embankments as well. The fill will be considered as incomplete if the desired compaction has not been obtained.

The Contractor shall protect the earth fill from being washed away by rain or damaged in any other way. Should any slip occur, the Contractor shall remove the affected material and make good the slip.
If so specified, the rock as obtained from excavation may be used for filling and leveling to indicate grades without further breaking. In such an event, filling shall be done in layers not exceeding 50 cm approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth, broken stone, etc. and the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 12 ton roller. No less than twelve passes of the roller shall be accepted before subsequent similar operations are taken up.

6.11.65 Clearing the Site

All surplus materials, and all tools and temporary structures shall be removed from the site as directed by Engineer-in-Charge and the construction site left clean to the satisfaction of Engineer-in-Charge.

6.11.66 Crossings

6.11.66.1 Road, Railway and Irrigation Canal Crossings:

At road, canal and railway crossings the work shall be performed to the specifications of local authorities or such public bodies as per the approval of Employer’s Representative(s) of roads, railways and canals to be crossed. The department shall apply for the required road crossing permissions and the contractor shall pursue the case with the authority for an early sanction. For maintaining the continuity of the laying, the contractor shall keep close liaison with the railway authorities for any early execution of crossing works. In the conduit/box-culvert constructed, the contractor shall lay the pipes and make necessary connections at the two ends of the pipe.

In case, however the minimum requirements of the governing agencies are less than those set out in the specifications given herein, then the requirements given in the specifications given for encased line shall be followed.

a) At locations wherein the open cut methods are permitted, the Contractor shall pass the carrier pipe through the casing located in the trench after the approval of the engineer-in-charge in writing and care shall be exercised to avoid damage to pipe coating and wrapping during this operation. The contractor shall adopt the methods such as tunneling or pipe pushing of culverts as required by National Highway authorities/ railways.

b) At all crossings the carrier pipe shall be laid straight without bends so that if necessary the pipe at a later date may be replaced without damaging the box culvert. The carrier pipe shall extend at least 2 meters beyond the end of box culvert at either end.

c) At railway crossings the Contractor shall eliminate unnecessary bending of pipe to conform to the contour of ground by gradually deepening the ditch at such approaches as directed by the engineer-in-charge. Where the installation of the casing has been made by open cut Contractor shall install suitable temporary bridge work ensuring the safety of the traffic aids and safeguards for protection of the public safety, or he shall provide suitable diversions as desired by the engineer-in-charge.
d) The method of carrying out a cased crossing by boring for various crossings on this pipeline route shall be jointly inspected by the representative of the Department, NHAI and Contractor for each category of work prior to commencement of actual work.

e) Pipeline under railway track and irrigation canal an applicable portion of the right-of-way shall be encased in accordance with the specification. This item of work shall include, necessary clearing and grading required therefore, trenching to the depths and widths required, welding of casing and carrier pipes, testing, lowering in, installation of vent assembles, end seals, insulator and all other fittings that may be required, backfilling, clean up, complete restoration to the original condition and further strengthening and protective works as may be required. The work shall be carried out in accordance with the drawings and as directed by the engineer-in-charge. For various operations mentioned above, the specifications pertaining to these operations shall apply in addition to the specifications given herein.

The Contractor shall be permitted to use William Sons type Neoprene seals in place of concrete end seals for the crossings. The representative of the Contractor may also be associated to determine the quality of the material and its delivery schedule from the open market. However, the particular work shall not be delayed on account of non-availability of Neoprene end seals. In such case, concrete seals may be provided.
6.11.67 DUCTILE IRON PIPES FOR WATER SUPPLY

6.11.68 Scope

This specification covers the requirements for manufacturing, testing, supplying, jointing and testing at work site Ductile iron pipes and fittings used for water conveyance.

6.11.69 Applicable Codes

The manufacturing testing, supplying, jointing and testing at work sites of Ductile Iron pipes and fittings shall comply with all currently applicable statutes, regulations, standards and codes. In particular, the standards in section below, unless specified herein shall be referred. In all cases, the latest revision of the codes shall be referred to. If requirements of specifications conflict with the requirements of the codes and standards, this specification shall govern.

6.11.70 Materials

The pipe shall confirm to IS: 8329 Specification for Centrifugally Cast (spun) Ductile Iron pressure pipes for water, gas and sewage specification and shall be provided with ISI mark

- IS: 638 Sheet rubber jointing and rubber insertion jointing.
- IS: 1387 General requirements for supply of metallurgical materials.
- IS: 1500 Methods for Brinell hardness test for metallic materials.

The D.I specials shall confirm to IS:9523 Ductile Iron fittings for pressure pipes for water, gas and sewage and shall be provided with ISI mark.

IS: 12820 Dimensional requirement., of rubber gaskets for mechanical Joints and push on joints for use with cast Iron pipes and fittings for carrying water, gas and sewage.

ISO: 4179 Ductile iron pipes for pressure and non-pressure-Centrifugal cement mortar lining – General requirements. ISO: 2531 Ductile iron pipes, fitting and accessories for pressure pipe lines. Code of Practice


6.11.71 Manufacturing

6.11.71.1 General

DI pipes and DI fittings shall be systematically checked for any manufacturing defects by experienced supervisors and a very high standard quality shall be maintained. Employer / Engineer shall at all reasonable times have free access to the place where the pipes and fittings are manufactured for the purpose of examining and testing the pipes and fittings and for witnessing the test and manufacturing.

6.11.71.2 Materials

The general requirements relating to the supply of material shall be as per IS:1387. The material for DI fittings shall conform to IS:9523.
6.11.71.3 Dimensions

The internal diameter, thickness and length of barrel, dimensions of pipes and fittings shall be as per the relevant tables of IS.8329/IS:9523 for different class of pipes and fittings. The tolerances for pipes and fittings regarding dimensions and deviations from straight line in case of pipes shall be as per relevant IS codes. The standard weight of uncoated pipes and fittings and the permissible tolerances shall be per relevant IS codes.

6.11.71.4 Workmanship and Finish

The pipes and fittings shall be stripped, with all precautions necessary to avoid warping or shrinking defects. The pipes and fittings shall be free from defects, other than any unavoidable surface imperfections which result from the method of manufacture and which do not affect the use of the pipes in the opinion of Engineer. The pipes and fittings shall be such that they could be cut, drilled or machined. The hardness of the external un-machined surface shall not exceed 230 HBS. In the case of spigot and socket pipes and fittings for lead joints, the socket shall be without the centering ring. In the case of flanged pipes the flanges shall be at the right angles to the axis of the pipe and machined on face. The bolt holes shall be drilled and located symmetrically off the center line. The bolt hole circle shall be eccentric with the bore and bolt holes equally spaced. The flanges shall be integrally cast with the pipes and fittings and the two flanges of the pipes shall be correctly aligned.

6.11.72 Testing

6.11.72.1 Mechanical Tests

Mechanical tests shall be carried out during manufacture of pipes and fittings as specified in relevant IS codes. The results so obtained shall be considered to represent all the pipes and fittings of different sizes manufactured during that period and the same shall be submitted to Employer/Engineer. The method for tensile tests and the minimum tensile strength requirement for pipes and fittings shall be as per relevant IS codes.

6.11.72.2 Brinell Hardness Test

For checking the Brinell hardness, the test shall be carried out on the test ring or bars cut from the pipes used for the ring test and tensile test in accordance with IS 1500.

6.11.72.3 Retests

If any test piece representing a lot fails in the first instance, two additional tests shall be made on test pieces selected from two other pipes from the same lot. If both the test results satisfy the specified requirements, the lot shall be accepted. Should either of these additional test pieces fail to pass the test, the lot shall be liable for rejection.

6.11.72.4 Hydrostatic Test

For hydrostatic test at works, the pipes and fittings shall be kept under test pressure as specified in relevant IS codes for 15 seconds, shall be struck moderately with a 700
gram hammer for conformation of satisfactory sound. They shall withstand the pressure test without showing any leakage sweating, or other defect of any kind. The hydrostatic test shall be conducted before coating the pipes and fittings.

6.11.73 Coating

Coating shall not be applied to any pipe and fittings unless its surface is clean dry and free from rust. All DI pipes and DI fittings shall be mortar lined on internal surface as specified in IS: 4179.

6.11.74 Marking

Each pipe and fitting shall have cast stamped or indelibly painted on it with the following appropriate marks:

a) The nominal diameter.
b) Class reference.
c) Mass of pipe.
d) Date of manufacture and
e) Manufacturer's name, initials or identification mark. Marking shall be done as per relevant IS Code.

6.11.75 Fittings

Dimensional and other requirement for fittings for specified Diameter shall conform to the details given in the IS specification code IS: 9523 (latest edition).

The Hydrostatic Test Pressure, Tolerances, and sizes of different type of fittings shall conform to IS specification code IS: 9523 (latest edition)

Each fitting shall have as cast, stamped or indelibly painted on it, the following appropriate marks.

(a) Indication of the source of manufacture.
(b) The nominal diameter
(c) The last two digits of the year of manufacture.
(d) PN rating of flanges when applicable, and
(e) Any other mark required by the purchaser.

Marking may be done on the barrel of castings or on the outside of the sockets. BIS Certification marking. The fittings may also be marked with the Standard Mark.

The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made there under. The details of conditions under which the license for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.
6.11.76 Jointing

6.11.76.1 General

Jointing of DI pipes and fittings shall be done as per the requirements of specifications and as per the relevant IS code. After jointing, extraneous material, if any, shall be removed from the inside of the pipe. In case, rubber sealing rings/gaskets are used for jointing these shall conform relevant IS codes.

6.11.76.2 Spigot And Socket Pipes

The Spigot and socket pipes and DI fittings shall have push on joints as specified in IS code/ as recommended by manufacturer. The gaskets/sealant used for push on joints/flanged joints shall be suitable for water conveyance. In jointing Ductile iron spigot and socket pipes and fittings with tyton flexible joints the contractor shall take into account the manufacturer's recommendations as to the methods and equipment to be used in assembling the joints. In particular the Contractor shall ensure that the spigot end of the pipe to be jointed is smooth and has been properly chamfered, that the rubber ring as per relevant IS code is correctly positioned in line, before the joint is made. The rubber rings and any recommended lubricant shall be obtained only through the pipe supplier or as otherwise directed by engineer.

6.11.76.3 Flanged Pipes

The gaskets used between flanges of pipes shall be compressed fibre board or natural/synthetic rubber conforming to IS:638-1955 of thickness between 1.5 to 3 mm suitable for water conveyance and as specified by manufacturer. The fibre board shall be impregnated with chemically neutral mineral oil and shall have a smooth and hard surface. Its weight per square metre shall be not less than 112 g/mm thickness. Each bolt should be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively. The practice of fully tightening the bolts one after another is highly undesirable. The bolts shall be of mild steel unless otherwise specified. They shall be coated with coal tar epoxy coating after tightening. The Bolts and Nuts to be used for jointing the D.I. double flanged pipes shall conform to I.S. 1363-1967.

6.11.77 Cleaning of Pipes and Fittings

Contractor shall ascertain that each stretch of pipeline is absolutely clear and without any obstruction by means of visual examination of the interior of pipeline suitably lighted by projected sunlight or otherwise. The open end of an incomplete stretch of pipeline shall be securely closed as may be directed by Employer/Engineer to prevent entry of mud or silt etc. If as a result of the removal of any obstructions Employer/Engineer considers that damages may have been caused to the pipeline, he shall be entitled to order the stretch to be tested immediately. Should such test prove unsatisfactory, contractor shall amend the work and carry out such further tests as are required by Employer / Engineer.

6.11.78 Testing at Work Site

After the pipes and fittings are laid, jointed and the trench partially backfilled except at the joints the stretch of pipe line as directed by Engineer shall be subjected to pressure test and leakage test as required in BOQ. Where any section of the pipeline is provided
with concrete thrust blocks or anchorages, the pressure test shall not be made until at least five days have elapsed after the concrete was cast. If rapid hardening cement has been used in these blocks or anchorages, the tests shall not be made until at least two days have elapsed. Each section of the pipe line shall be slowly filled with water and all air shall be expelled from the pipe by tapping at points of highest elevation before the test is made. Plugs inserted after the tests have been completed.

The Hydraulic testing of the DI pipe line should be greater of the (i) 1.5 times of the max Working head & (ii) 1.5 times of static head in case of Gravity mains and max Working head including surge in case of Pumping main

Should any test of pipe laid indicate leakage greater than that specified above,

The defective joints shall be repaired by Contractor until the leakage is within the specified allowance. Necessary equipment and water used for testing shall be arranged by Contractor. Damage during testing shall be Contractor's responsibility and shall be rectified. After the tests mentioned above are completed to the satisfaction of Employer/Engineer, the backfilling of trenches shall be done as per specifications in layers.

6.11.79 Measurement

All pipes shall be measured according to the work actually done and no allowance will be made for any waste in cutting to the exact length required. Pipes and fittings shall be described by their internal diameter and length measured in running meters. The measurement shall be taken along the centre line of pipe excluding fittings which shall be measured separately. The lengths of pipes shall not include the portion of spigots within the sockets of fittings and pipes.

Notes

If any damage is caused to the pipeline during the execution of work or while cleaning/testing the pipeline as specified, Contractor shall be held responsible for the same and shall replace the damaged pipeline and retest the same.

6.11.80 Laying and Jointing of pipes

6.11.80.1 Pipes

The contract envisages civil works namely excavation of earth, laying, jointing and testing of pipelines and construction of valve chambers including fixing of valves such as sluice valves, scour valves, double air valves and auxiliary specials required for D.I. spun pipes with socket and spigot ends or flanged ends of different diameters.

6.11.80.2 Materials

The surplus materials if any, left over due to additional purchase against possible breakages etc. will not be takeover by the department.

6.11.80.3 Trench Work

The trenches shall be so dug that the pipes may be laid to the required alignment gradient and depth. The width of trench above pipeline level shall be as small as
possible but provide sufficient space necessary for jointing pipes. The walls of trenches shall be cut according to the slopes mentioned in relevant I.S. specifications. The trenches shall be kept free from water while laying and jointing the pipes and specials.

The relevant clauses of IS 12288:1987 govern the trench work and preparation of base for laying of DI pipes.

6.11.80.4 Handling and Laying of Pipes

Reasonable care shall be exercised in Loading, Transporting and Unloading of pipes and specials. The pipes shall be lowered into the trench carefully and shall be laid true to alignment and gradient as specified and as per instructions of the Engineer-in-Charge.

The sections of the pipe shall be jointed together in such a manner that there shall be as little unevenness as possible along inside of the pipes. Necessary precautions shall be taken while laying as per the relevant I.S. specifications.

6.11.80.5 Jointing

Before commencing jointing, the pipes shall be cleaned, the joints and the ends of the pipes shall be cleaned, preferably with a hard wire brush to remove loose particles. Where jointing is done using rubber ring, care should be taken to see that the rubber ring does not get twisted or deformed while pushing the ring into position. The jointing of pipes shall conform to the requirements of the relevant I.S. specifications.

6.11.80.6 Anchor and Thrust Blocks

Thrust blocks, shall be provided as per drawings and BOQ to transmit hydraulic pressure as laid down in the relevant I.S. specification. Where the hydraulic thrust is in an upward direction, anchor blocks of sufficient weight shall be provided, to which the pipes shall be secured with steel strips.

6.11.80.7 Refilling

After the pipelines are laid, jointed and tested in conformity to the relevant I.S. specifications and to the satisfaction of Engineer-in-Charge the pipeline trenches should be refilled with excavated earth in layers of 6 inches. The clods should be broken, sufficiently watered and consolidated. The surface should be brought to the original condition by using the excavated material to the extent possible and using additional quantities of gravel and metal as the case may be. The extra earth after bringing back to the original condition should be disposed of as in spoil dumps as directed by the Engineer-in-Charge.
6.12 PARTICULAR TECHNICAL REQUIREMENTS – SURVEY & INVESTIGATIONS

6.12.1 GPR Survey

Before start of utilities detection survey contractor will have to submit the Execution Plan to Employer’s representative. The survey shall be carried out for collection of information of utilities up to minimum 5m depth on suitable wide corridor of transmission main. The utility corridor will be based on field survey input. All utilities (both metallic and non-metallic) in the corridor to be surveyed and scanned. The survey should be conducted with adequate advanced equipment in such a manner that all types of utilities, sewer line, cable/duct etc. are identified.

Wherever bands of utilities are identified, the upper and lower utility shall be placed in such a way that it provides a cross section of the utility bands. At any significant change (more than 0.3m) change of depth below the ground, an annotation shall be provided. This annotation shall be placed at the same z-value (depth level) as recorded at that very point. Each service shall be annotated with the type of utility, depth and diameter of pipe at appropriate intervals. To get accurate depth information, the data shall be calibrated for soil conditions on the day(s) of survey if required.

The applicant will be responsible for co-ordination with various city agencies and State Government Departments & utilities whenever and wherever necessary on the behalf of corporation for the purpose of survey. In case of major problems, Corporation will assist. This includes taking permission, clearance after restoring back the works & handing over. Applicant will have to incur all cost/charges related to Right of Way and Reinstatement.

Tolerance: Accuracy of utility detected for vertical and horizontal should within 50 cm. The validation of the report shall be carried out in presence of Employer’s representative at one or more location in each line. The locations shall be provided by Employer’s representative randomly and joint report shall be prepared. For such locations, any work such as digging of earth as required shall be done by contractor without any extra cost. In case during validation of the location of cable it is found that position of cable is at distances more than given tolerance band, entire survey shall be carried out again by the contractor until desired accuracy is achieved.

6.12.2 Structural Stability of OHSR

The contractor shall be responsible for:

- Carrying out all testing and reporting works as per relevant IS codes, British Codes, ASTM codes, CPWD handbook on repairs & Rehabilitation of RCC buildings and any other reference applicable in the industry.
- Contractor shall obtain approval on methodology of the test to be conducted and plan
- Accuracy of the data collected at all stages of work,
- Testing procedure followed and safety of the structures during testing,
- Analyze the information gathered, interpret the test data and based on it establish the problem, the probable causes and factors influencing the deterioration of the structure.
- The contractor shall tabulate the information gathered at the investigation stage on a
specific performa along with examination of available facts, conclusion and recommendations for remedial measures, specifications for structural repairs and rehabilitation, materials etc. The Performa shall be prepared by the contractor for approval by the Employer’s representative and IVA.

Structural stability and condition assessment of OHSRs can be conducted using Non Destructive Evaluation Tests and physical assessment. These tests have been put under following categories depending on the purpose of test. These tests shall be conducted as per relevant IS codes and Manuals. The number of test on each element of OHSR shall be representative to establish the condition of OHSR.

1. In-situ Concrete Strength
   a. Rebound test- to evaluate the surface hardness of concrete
   b. Ultrasonic Pulse Velocity (UPV) test -
   c. Core sampling and testing
   d. Cut and Pull Out (CAPO) Test as ASTM C-900 or any other relevant code

2. Chemical attack
   e. Depth of carbonation
   f. Half-Cell Potential Survey

3. Physical condition assessment

6.13 PARTICULAR TECHNICAL REQUIREMENTS – MISCELLANEOUS

6.13.1 Contractor's Offices, Stores and Services

The Contractor shall provide, erect, construct, maintain and subsequently remove proper offices, stores, workshops, laboratories, storage and parking areas for his own use. Such facilities shall be sufficiently sized and equipped to enable him to manage his operations and those of his Subcontractors in a professional manner and to enable him to carry out all his obligations under the Contract. Sheds for storage of materials that may deteriorate or corrode if exposed to the weather shall be weatherproof, adequately ventilated and provided with raised floors. No material shall be placed directly on the ground. Within his offices a meeting room shall be available for site meetings with the Engineer and the Employer.

6.13.2 First Aid at Office and work site

The Contractor shall make his own arrangements for treatment of casualties on the Site in such first-aid units as may be thought necessary. The Contractor shall be responsible for the construction of such first-aid units and their management and operation and the removal by ambulance of injured or sick employees to nearby hospitals. The first-aid service shall cover the Contractor's own personnel as well as that of the Employer, the Employer’s representative and all Subcontractors.

6.13.3 Testing Facilities, Laboratory

Within 21 days of issue of Notice to Proceed, the Contractor shall establish, in the campus of site office, an on-site fully furnished and adequately equipped field laboratory staffed by qualified personnel suitable for construction material testing except cement and steel etc. He will make the facility to test other material in the approved independent material testing laboratory. The name and qualifications of
independent testing laboratories shall be submitted to Engineer for approval no less than thirty calendar days prior to the date the laboratories are to be used. Once approved, dismissal and replacement of the approved independent testing laboratory shall require written authorization by the Engineer. The site laboratory shall be functional till the design build work is completed. Laboratory and equipment shall become the property of the Contractor upon completion of the Contract.

The calibration of the laboratory equipment and instruments shall at the initial stage to be certified by agencies approved by the Engineer. Laboratory equipment shall be properly maintained and calibrated throughout the period of the Contract by the Contractor at his own expense. The Contractor shall notify the Engineer in sufficient advance prior to conducting any tests for the materials and work. The Engineer will also inspect the laboratory and the contractor shall provide adequate facilities to the Engineer for his independent verification of the accuracy and adequacy of the facilities.

The Contractor shall be responsible for the sampling, curing, and transport to the laboratories of all materials for testing, and all testing costs including laboratory fees, and/or all costs in running the on-site laboratory, i.e., chemicals, reagents, and other test consumables, staff, and utilities.

6.13.4 Site Safety

The Contractor shall at all time in the conduct of his work and that of his Subcontractors adhere to the established rules and regulations concerning all safety matters at Site as per applicable laws.

The Contractor shall provide the public with adequate information on all risks with respect to the construction works. If the general public sustains any kind of bodily injury or death, the Contractor shall be responsible for providing all necessary medical care and compensation.

During construction the Contractor shall erect, maintain and subsequently remove sufficient barricades, guards, lighting, sheeting, shoring, temporary sidewalks and bridges, danger signals as well as temporary covering of potential accident areas, as approved by the Engineer.

All open excavations along pipe lines shall be protected sufficiently to keep out livestock, and ensure the safety of workmen and members of the public and be in accordance with the directives of the police and the other local regulations.

The Contractor shall be responsible for ensuring that all persons working in the vicinity of powerlines are aware of the relatively large distance that high voltage electricity can "short" to earth when cranes or other large masses of steel are in the vicinity of power lines.

Where work is to be carried out in the proximity of buildings, bridges, tanks or other structures, the Contractor shall take all necessary precautions, including shoring and strutting, where necessary, to ensure the safety of the structures that are at risk.

The Contractor shall be responsible for all damages or injury which may be caused on any property by trespass by the Contractor's or his Subcontractor's employees in the
course of their employment, whether the said trespass was committed with or without the consent or knowledge of the Contractor.

6.13.5 Protection of Overhead and Underground Services

The Contractor will be held responsible for any damage to known services (i.e. overhead services that are visible within the Site and underground services shown on the drawings or marked through survey & investigations) and he shall take all necessary measures to protect them. All work or protective measures shall be subject to approval of the Engineer. In the event of a service being damaged he shall inform the Engineer and the authority concerned, the Contractor shall not repair any such service unless instructed to do so.

Contractor will map the underground utilities. Where no underground services are shown on the drawings or scheduled but the possibility of their presence can reasonably be inferred, the Contractor shall, in collaboration with the Engineer, ascertain whether any such services exist within the relevant section of the Site. The Contractor shall complete such an investigation well in advance of the start of construction work in the said section and he shall submit a report in good time to enable the Engineer to make whatever arrangements are necessary for the protection, removal or diversion of the services before any construction activities commence.

As soon as any underground service not shown on the drawings is discovered, it shall be deemed to be a known service and the Contractor will be held responsible for any subsequent damage to it. If such a service is damaged during the course of its discovery, the cost of making good such damage will be met by the Employer unless he establishes that the Contractor did not exercise reasonable diligence and that the damage was avoidable.

Where the authority concerned elects to carry out on its own account any alterations or protective measures, the Contractor shall co-operate with and allow such authority reasonable access and sufficient space and time to carry out the required work.

6.13.6 Signboards

Signboards shall be placed at the project offices, at important locations and at each DMA zone, in English & Punjabi, information about the project and Employer, and the names of the Engineer and Contractor in a form and size to be agreed by the Engineer. They shall be of durable construction capable of withstanding the effects of the climate until the end of the design build Period.

The Contractor shall keep the signboards in good repair for the duration of the contract and shall remove them on completion of the Contract.

Besides these signboards the Contractor shall not, except with the written authority of the Engineer, exhibit or permit to be exhibited on the Site any other form of advertisement.

6.13.7 Site Drainage

The Contractor shall keep each Section of the Works well drained until the Engineer certifies that it is substantially complete and shall ensure that, so far as is practicable, all work is carried out in the dry. Site areas shall be kept well drained and free from
standing water except where this is impracticable having regard to methods of
Temporary Works properly adopted by the Contractor.

The Contractor shall provide, operate and maintain in sufficient quantity such pumping
equipment, well points, pipes and other equipment as may be necessary to minimize
damage, inconvenience and interference and shall construct, operate and maintain all
temporary coffer-dams, sumps, ditches, drains and other temporary works as may be
necessary to remove water from the Site while construction is in progress. Such
Temporary Works and construction equipment shall not be removed without the
approval of the Engineer.

Notwithstanding any approval by the Engineer of the Contractor's arrangements for the
removal of water, the Contractor shall be responsible for the sufficiency thereof and for
keeping the Works safe at all times and for making good at his own expense any
damage to the Works.

The Contractor shall be responsible to keep the Site clear of water at whatever pump
rate is found necessary.

The Contractor’s site drainage facilities shall not cause pollution in any local
watercourses, he shall be responsible for any legal action resulting from pollution
events.

6.13.8 Detours and Traffic Control

The Contractor shall program his work in such a way that, wherever the temporary
closure of street sections to public thoroughfare cannot be avoided, the duration of
traffic diversion can be kept as short as possible. No streets shall be closed and no
detours shall be introduced and no traffic diverted until the Contractor's proposals have
been approved by the Engineer and the appropriate Government authorities.

Where work is to be carried out in public roads, the Contractor shall give notice to the
Engineer sufficiently in advance of the date on which he wishes to commence such
work.

The Contractor shall be responsible for obtaining the permission of the Engineer, Road
Department and the Police for activities he intends to carry out in public roads. Two
copies of the Contractor's proposals to the relevant authorities shall be submitted to the
Engineer. One copy of all obtained approvals shall be submitted to the Engineer.

Detours shall be selected in such a way that the inconvenience to the affected traffic as
well as to the inhabitants of the affected areas is kept to a minimum.

The Contractor shall furnish, install and maintain at all times during the execution of
the Works all necessary traffic signs, barricades, lights, signals and other traffic control
devices, including flagging and other means of guiding traffic through the work zone.
Traffic control shall be managed in accordance with prevailing rules and regulations,
and with the approval and to the satisfaction of the Engineer.

All devices mentioned above shall be in conformity with the requirements of the Roads
Department. All traffic signs and control devices to be furnished and installed by the
Contractor shall be approved by the Engineer for their location, position, visibility,
adequacy and manner of use under specific job conditions.
All traffic control devices necessary for the initial stage of construction shall be properly placed and operational before any construction is allowed to start. When work of a progressive nature is involved, the necessary signs shall be moved concurrently where they are needed.

If the Engineer determines that proper provisions for safe traffic control are not being provided or maintained, he may restrict construction operations affected by such defective signs or devices until such provisions are established or maintained, or may altogether order suspension of the Work until a proper traffic control is achieved. In case of serious or willful disregard by the Contractor of the safety of the public or his employees, the Engineer may take necessary steps to rectify the situation and deduct the cost thereof from monies due or becoming due to the Contractor. The Contractor shall be responsible for all resulting delays.

The Contractor shall designate or otherwise employ personnel to furnish continuous surveillance of the traffic control operations. The designated personnel shall be available day and night to respond to calls involving damage due to traffic accidents.

At sections where traffic is in operation and when ordered by the Engineer, the movements of the Contractor's equipment from one place of work to another shall be subject to traffic control. Spillage resulting from hauling operations along or across the roadway shall be removed immediately at the Contractor's expense.

The cost of traffic control is deemed to be included in the rates for works.

6.13.9 Provision of Temporary Services

When the execution of the Works requires the temporary disconnection of existing public utilities, the Contractor shall provide the affected users with temporary services in at least the same standard as the original services.

For water supply he may install temporary lines or arrange for regular supply by tankers. The amount of water to be provided for the interruption period for a specific area shall be assessed by the Contractor. The Contractor shall submit to the Engineer, for its approval, the recommended volume of water to be provided.

When forced to disconnect existing sewers/drainage facility, the Contractor shall install temporary pipes of adequate size to carry off sewage/drainage. No sewage/drainage shall be allowed to flow upon the ground surface or into the trench excavation.

No valve or other controls in public service facilities shall be operated by the Contractor without approval of the Engineer and the relevant authorities. All users affected by such operation shall be notified by the Contractor at least two hours before the operation and advised of the probable time when service will be restored.

6.13.10 Protection of Adjoining Property and Reinstatement upon Completion

The Contractor shall be responsible and take all measures in order to protect adjoining property including buildings, electrical and telephone poles, bridges and culverts, retaining walls, compound walls and fences, and other structures. Prior to the commencement of the activities, the Contractor shall assess the probability and extent of unavoidable damages, if any, to the building and properties and submit his assessment to the Engineer. The Engineer may make his own opinion and if required
may order arrangements for protection or repair of such likely unavoidable damage in which event the Contractor shall complete the activities.

Temporary facilities shall be provided by the Contractor, only for as long as required after which he shall dismantle and remove the same from their place of use as speedily as possible. Re-usable components shall be safely stored by the Contractor in his yard. The place of use shall be cleared and reinstated immediately to at least the condition existing before the temporary facilities were provided, and to the satisfaction of the Engineer.

6.13.11 Coordination with Other Authorities

i. Statutory Services
   As far as possible the Contractor shall acquaint himself with the actual location of all existing public utilities such as sewers, water mains, drains, cables for electricity, telephone lines, lighting poles, masts, etc., before commencing any activities likely to affect the existing utilities. The Contractor shall with the assistance of the Employer obtain such information directly from the responsible authorities as early as possible.

ii. Notices, Permits
   Well in advance of the programmed start of any work which may affect traffic or any existing utilities the Contractor shall give advance information to the Employer/Engineer indicating the type, the exact location, the programmed starting time and the expected duration of the activities and shall provide whatever particulars may be required by the authorities to issue any required permits and make all necessary arrangements. The Employer will provide necessary permissions.

6.13.12 Submissions by the Contractor

i. Pre-Construction Surveys and Setting Out
   The Contractor shall verify all measurements and be responsible for their correctness. Site bench marks shall be accurately and safely established, maintained and removed upon completion of the Works, all to the satisfaction of the Engineer. The Contractor shall prepare a plan detailing the location of the bench marks and keep this up-to-date throughout the period of the Contract. Reproducible copies of the plan so prepared shall be supplied to the Engineer, as and when he may require.

   The Engineer reserves the right to order levels, considered necessary for the full and proper supervision and measurement of the works, to be taken at any time.

   Before the Works, or any part thereof, are commenced, the Contractor and the Engineer shall together make a complete survey, and take levels, of the Site and agree on the dimensions and elevations upon which setting out of the Works shall be based.

   These levels shall be related to the bench marks and shall be plotted and drawn up by the Contractor. After agreement of the drawings, which shall be signed by the Engineer and the Contractor, these levels shall form the basis of setting out of the Works.
The Contractor shall be responsible for the true and proper setting out of the Works in relation to reference data given on the Drawings and shall accurately set out the positions, levels and dimensions of all parts of the Works. Any delay or loss resulting from errors in the setting out of the Works shall be the responsibility of the Contractor.

Setting out shall be reviewed by the Engineer before commencing the Works, but any approval shall, in no way, relieve the Contractor of his responsibility for the correct execution of the Work.

ii. Working Drawings
The proposals shown on the tender drawings are based on information available prior to preparation of the Tender Documents. All levels indicated or proposed are based on survey information previously available but will need to be revised subject to the results of survey and site investigation carried out by the Contractor during SIP.

Working Drawings of the designs carried out by the Contractor shall be submitted by the Contractor to the Engineer. Working Drawings shall include, but not be restricted to, pipeline plans and profiles, reinforcement detail drawings and bending schedules, shop drawings for structural steel and miscellaneous metal work, and drawings for other work for which the Engineer's approval is required.

It shall be the Contractor's own responsibility to prepare such Working Drawings as he may require for the proper setting out and construction of all structures and facilities. Work shall not commence on an individual structure or facilities until the relevant Working Drawings have been approved by the Engineer.

All dimensions shall be in metric units and each drawing shall be properly identified by a drawing head and a numbering code in the form prescribed by the Engineer upon commencement of the Works.

The Contractor shall submit 3 (three) copies of all drawings for approval.

Any changes or modifications to the Working Drawings that the Engineer considers necessary shall be made by the Contractor promptly and the drawings resubmitted for approval.

Approval of Working Drawings will be given by the Engineer in the form of a stamp "RELEASED FOR CONSTRUCTION" together with the date and the authorized signature. Only those Working Drawings carrying the signed and dated stamp shall be used for execution.

Copies of all such approved Working Drawings together with one unreduced transparency shall be supplied to the Engineer by the Contractor immediately after approval. The cost of preparing and providing all Working Drawings shall be included in the Contract Rates.

Should it be found at any time after approval has been given by the Engineer to a Working Drawing submitted by the Contractor that the said Working Drawing does not comply with the terms and conditions of the Contract or that the details do not agree with the Working Drawings previously approved, such alterations and
additions as may be deemed necessary by the Engineer shall be made therein by the Contractor and the work carried out accordingly without entitling the Contractor to extra payment on account thereof, except where such alternations and additions are to be made in direct consequence of written order by the Engineer to vary the Works.

No examination by the Engineer of any document submitted by the Contractor or of the Contractor's Working Drawings, nor the approval expressed by the Engineer in regard thereto, either with or without modification, shall absolve the Contractor from any liability imposed upon him by any provision of the Contract. Notwithstanding the Engineer's approval of the Working Drawings the Contractor shall be responsible for any dimensional or other errors.

iii. As-Built Drawings and GIS Data Creation

Such approved Working Drawings as have been selected by the Engineer shall be correctly modified for inclusion in the As-Built Drawings incorporating such variations to the Works as have been ordered and executed. Such drawings shall show the actual arrangement of all structures and items of equipment installed under the Contract. The Contractor shall submit 1 (one) reproducible copy and 3 (three) prints of all As-Built Drawings clearly named as such to the Engineer for approval before applying for the Taking-Over Certificate for the respective Section of the Works. After approval of the As Built Drawing the Contractor shall supply an electronic copy of the drawing in together with a licensed copy of the drafting software.

During the course of the Works, the Contractor shall maintain a fully detailed record of all changes from the approval to facilitate easy and accurate preparation of the As-Built Drawing.

Irrespective of the other contractual prerequisites no Section of the Works will be considered substantially completed until the respective As-Built Drawings have been approved by the Engineer.

In parallel with the preparation of as-built drawings, the Contractor shall produce GIS data of the constructed works. The contractor conducts all necessary survey work, and shall ensure that vertical and horizontal measurements shall be captured at an accuracy of +/- 0.1m at a 95% confidence level, using the most suitable and cost-effective field data collection technology and methodology. All horizontal and vertical survey measurements will be referenced to the present Survey of India GIS geo reference.

The Contractor will survey the three-dimensional position (x,y,z) of all point and line assets constructed under this project, e.g., pipelines, bridge crossings, manhole chambers, chambers, valves, meters, hydrants, plugs, reducers, and tees. Nodes shall be created to clearly delineate different pipe sections in terms of material and/or diameter and to allow for future development of a hydraulic model in the GIS platform. Nodes shall also require a three-dimensional position, and through this, the position of the ends of a pipeline segment shall be defined. Point and line data (i.e., the pipeline) should be consistent with the attributes of the existing Survey of India GIS. However, the Engineer and the Employer may require the Contractor, at no additional cost, to create new attributes to include non-survey
data, e.g., valve model, name of the manufacturer, images or plans, etc. Prior to the field survey, the Contractor shall submit to the Engineer, for approval, the GIS design in terms of themes, feature types and attributes.

The Contractor shall develop a checklist of QC checks for each type of deliverable and will be responsible for ensuring that these QC checks are performed. The Contractor shall assign a GIS quality officer to manage the quality review process. This officer shall be independent of the capture and production teams.

The Contractor shall be required to integrate the GIS deliverables with the existing pipe network data, i.e., ensure that the GIS data connects with any existing GIS system. This may entail revising GIS data of existing pipes at connection points. GIS data for the project will be delivered in an ArcGIS compliant file geo-database.

6.13.13 Construction Program and Progress of Works

i. Construction Program
Contractor shall prepare Construction Program as part of SIP. Construction Program shall be in the form of a Critical Path Method (CPM) Diagram showing, sequences, dependencies, durations and dates for execution of all major items including sectional completion following the sub-divisions in the Bills of Quantities for the execution of the Works within the periods stated in the Contract. It shall be supported by:

a. Data of the construction methods
b. Equipment Utilization Schedule
c. Manpower Utilization Schedule
d. Subcontracting Schedule
e. Mobilization/Demobilization Schedule

The CPM diagram incorporating the above mentioned schedules shall be prepared using Microsoft Project, or similar approved project management software, and shall be presented in hard copy and electronic form to the Engineer as part of SIP.

In carrying out the Works due attention shall be paid to all measures which can reasonably be taken in order to diminish the inconvenience which the work may cause to services and access to property.

6.13.14 Updating, Monitoring and Reporting Progress

The Contractor shall monitor the progress of the Works including information provided by his Sub-contractors and suppliers, as necessary, for purpose of network planning, scheduling and updating and shall confirm the actual progress on each current activity shown on applicable CPM networks. The CPM networks shall form part of the Monthly Progress Report and shall indicate changes of schedule, if any in network activity duration and start/finish imposed dates. It shall also be provided in electronic form.

The Contractor shall prepare written explanatory notes on the particular activities which are overrunning or going to overrun against the schedule. If any such overrunning work
is on the critical path, the Contractor shall state what corrective actions will be taken by him to bring it back on the schedule.

i. **Detailed Fortnightly Program**
The contractor shall submit at the end of each working week a detailed bar chart program for the next fortnight. The program shall identify where further drawings or instructions are to be issued by the Engineer to avoid disruption to the progress of the Works.

ii. **Progress Reports**
The Contractor shall furnish the Engineer with 5 copies of Progress Reports at regular monthly intervals in a form determined by the Engineer, containing the following information:

- physical progress for the report month and estimated progress for the next month;
- CPM networks and explanatory notices;
- updated S-curves for physical progress at different sections of the Works;
- any report which may be specifically requested by the Employer and/or the Engineer.

These monthly progress reports shall be submitted not later than 7 days after the end of the report month.

iii. **Operation and Maintenance Manual**
The contractor will submit an operation and maintenance manual, providing details of all the plant/mechanical facilities (valves, meters, etc.) he supplies and give details of recommended maintenance intervals and procedures.

iv. **Record/Progress Photographs**
The Contractor shall arrange each month sufficient number of photographs as Record Photographs of progress of works and shall provide the electronic files. Contractor will include progress photos in the progress reports.

6.13.15 **Quality Control**

i. **Quality Control Plan and Procedures**
The Contractor shall be responsible for establishing and maintaining procedures for quality control that will ensure that all aspects of the Works comply with the requirements of the Contract.

As soon as reasonably practicable prior to the commencement of Works the Contractor shall submit for approval a Quality Control Plan giving detailed proposals for control of quality of all aspects of work on the Site and at suppliers' workshops.

The Quality Control Plan shall include the following: a) a list of the Contractor's staff engaged in quality control b) a list of any outside testing agencies employed by the Contractor for work in connection with quality control c) where a testing laboratory is to be established on Site under the Contract, a list of major items of equipment and a layout of the laboratory, together details of the tests which will be
carried out there d) a list of manufactured items and materials, obtained by the Contractor for the Works, which require inspection at the suppliers' premises, and the proposed procedures for ensuring quality control e) a list of materials and operations to be inspected by the Contractor at the various stages of construction work on Site, together with inspection procedures, test types and frequencies f) sample of proposed quality control records, testing and reporting forms.

Unless the Engineer permits otherwise, the approved Quality Control Plan shall be followed throughout the construction of the Works. Any approval by the Engineer of the Contractor's plan and procedures shall not relieve the Contractor of his obligation to ensure that the Works comply with the requirements of the Contract.

The Contractor shall appoint a suitably qualified member of his staff to be responsible for all aspects of quality control and to maintain effective liaison with the Engineer.

ii. Sampling and Testing
The Contractor shall provide for the approval of the Engineer, samples of all construction materials and manufactured items required for the Permanent Works. All samples rejected by the Engineer shall be removed from Site. All approved samples shall be stored by the Contractor in a sample room, at a location approved by the Engineer, for the duration of the Contract, and any materials or manufactured items subsequently delivered to Site for incorporation in the Permanent Works shall be of a quality at least equal to the approved sample. The approved samples may only be disposed of with the Engineer's approval.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by the Engineer. Samples for testing will generally be selected by the Engineer from materials to be utilized in the project and all tests will be under the supervision of, and as directed by, and at such points as may be convenient to the Engineer.

Material requiring testing shall be furnished in sufficient time before intended use so as to allow for testing. No materials represented by tests may be used prior to receipt of written approval of said materials.

The Contractor shall give the Engineer 3 to 7 days’ notice in writing of the date on which any of the materials will be ready for testing or inspection at the suppliers' premises or at a laboratory approved by the Engineer and unless the Engineer shall attend at the appointed place and time the test may proceed in his absence. The Contractor shall in any case submit to the Engineer within 3 days after every test such number of certified copies of the test readings as the Engineer may require.

Approval by the Engineer as to the placing of orders for materials or as to samples or tests shall not prejudice any of the Engineer's powers under the Contract.

The provisions of this Clause shall also apply to materials supplied under any nominated subcontract.

After all construction at each Section is completed and before applying for taking-over, the Contractor shall perform field tests as called for in the Specifications. The Contractor shall demonstrate to the Engineer the proper operation of the facilities
and the satisfactory performance of the individual components. Any improper operation of the system or any improper, or faulty construction shall be repaired or corrected to the satisfaction of the Engineer. The Contractor shall make such changes, adjustments or replacement of equipment as may be required to make the same comply with the Specifications, or replace any defective parts or materials.

In addition to any special provision made herein as to sampling and testing materials by particular methods, samples of materials and workmanship proposed to be employed in the execution of the Works may be called for at any time by the Engineer and these shall be furnished without delay by the Contractor at his own cost. Approved samples will be retained. The Engineer will be at liberty to reject all materials and workmanship that are not equal or better in quality and character than such approved samples.

The tests required for quality control shall include but not be limited to:

a) tests conducted at the premises of the Contractor, Subcontractor, manufacturer or supplier which are normally or customarily carried out at such premises for the items or materials being supplied for the Works

b) tests which are normally or customarily conducted on the items or materials being supplied for the Works by the Contractor, Subcontractor, supplier or manufacturer but which have to be conducted at an approved laboratory because the necessary testing facilities are not available on the premises of the Contractor, Subcontractor, supplier and manufacturer

c) tests on locally obtained materials or items either on the Site or at an approved laboratory for the purpose of obtaining the approval of the Engineer to the classification, use and compliance with the Specifications of such items or materials

d) routine quality control tests conducted by the Contractor to ensure compliance with the Specifications e) regular testing of concrete and other materials as specified in the relevant Chapters of the Technical Specifications f) standard shop and Site acceptance tests, including trial assemblies, of Plant.

iii. Inspection and Acceptance

The Engineer will not inspect any item of fabricated or finished work until such time as the Contractor shall have forwarded to the Engineer the approved Working Drawings covering the items to be inspected, together with copies of the respective orders.

Manufactured items and materials delivered to the Site shall be inspected by the Contractor on arrival. Any defects shall be notified to the Engineer.

Minor defects to surface finishes and the like in manufactured items shall be made good in an approved manner to the satisfaction of the Engineer. Items with more serious defects shall be returned to the suppliers for correction or replacement as appropriate.

iv. Materials/ Plant Certificates and Inspections
Where certificates are required by the Specifications or relevant Reference Standard, the original and one copy of each such certificate shall be provided by the Contractor.

Certificates shall be clearly identified by serial or reference number and shall include information required by the relevant Reference Standard or Specification clause.

The timing for submittal of certificates shall be as follows:

a) manufacturer's and supplier's test certificates shall be submitted as soon as the tests have been completed and in any case not less than 7 calendar days prior to the time that the materials represented by such certificates are needed for incorporation into the Permanent Works

b) certificates of tests carried out during the construction or on completion of parts of the Permanent Works shall be submitted within 7 days of the completion of the test.

No materials, articles or items of fabricated or finished work to be supplied by the Contractor or Subcontractors which have been inspected and tested by the Engineer or the inspecting Engineer shall be dispatched unless a Passing Certificate has been requested by the Contractor from the Engineer and subsequently been issued by the Engineer to the effect that the same are approved. Neither the Contractor nor Sub-Contractors shall make use of any materials or articles ordered by them for the purpose of fabrication until a Passing Certificate covering the said materials and articles shall have been issued by the Engineer or inspecting Engineer.

6.13.16 Site Records

Daily records of on-site testing and inspection shall be kept on forms of approved format. Test results shall be certified by the responsible member of the Contractor's staff. All test certificates and inspection records (including any from suppliers or other outside testing agencies) shall be clearly identified with the appropriate part of the Works to which they refer, and they shall be submitted to the Engineer together with the respective Passing Certificate.

Once each month, or at such other intervals as the Engineer may require, the Contractor shall submit in an approved form a summary of all quality control inspections and tests performed at Site and elsewhere in the intervening period.

Test results shall be summarized in tabular form or graphically or both in a way that best illustrates the trends, specific results and specification requirements. Where the tests show that the specified requirements were not achieved, the report shall describe the action that was taken.

Each report shall also contain a forecast of quality control work likely to be carried out during the period to be covered by the succeeding report.

The Contractor shall keep detailed and up-to-date inventories in an approved form of goods and materials already approved by the Engineer for which Passing Certificates have been issued as well as of all other goods and materials subject to quality control.
which are on order, delivered, found faulty, lost during the work or found to be surplus to requirements. The Engineer shall have access to these records at all times.

6.13.17 Separation of Water and Sewer lines

The issue of relative placement of the water line and sewer in relation to possibilities of pollution should also be paid attention. The provisions of the Manual of Water Supply be followed in the matter. Accordingly broadly the following may be followed:

Horizontal Separation:
- Desirable 3 m separation
- In case of local compulsions, it may be laid in a separate trench on a shelf closer to the sewer but 0.5 m above the top of the sewer

Vertical Separation:
- In case of crossings, the water main should be 0.5 m above the sewer top or drain for 3 m on either sides and should have joints as far as possible.

6.13.18 Water Tightness Tests for the Reservoirs:

In addition to the structural test of structures, the newly constructed reservoirs shall also be tested for water tightness test at full supply level as described in latest revision of IS 3370 (Part I).

On completion of the Service Reservoir works and before its commissioning, the contractor shall carry out a water tightness test for the maximum water head condition i.e. with the water standing at Full Supply Level (FSL). This test shall be carried out preferably in dry season in accordance with the procedure given below:

The water tightness test shall be carried out when the construction of Service Reservoir is done and when it is possible to fill the reservoir and ensure that uniform settlement of the structure as a whole or as directed by the Engineer. Before starting of the filling operations, the reservoir shall be inspected by the Engineer and the Contractor's Representative and the condition of surfaces of walls, contraction joints shall be noted and it shall be ensured that the jointing material filled in the joint is in position and all openings are closed. The Contractor shall make necessary arrangement for ventilation and lighting of the reservoir by way of floodlights, circulators etc. for carrying out proper inspection of the surfaces and inner conditions if so desired by the Engineer. For this purpose, it shall be verified that sluice valves provided on the various pipes connected to the reservoir then shall be carried out gradually at the rate not exceeding 30 cm rise in water level per hour. Records of leakages starting at different levels of water in the reservoir, if any, shall be kept.

The reservoir once filled shall be allowed to remain so for a period of seven days before any readings of drop in water level are recorded. The level of the water shall be recorded against the subsequent intervals of 24 hours over a period of seven days. The total drop in surface level over a period of seven days shall be taken as an indication of the water tightness of the reservoir, which for all practical purposes shall not exceed 40 mm. Also there shall be no indications of the leakage around the puddle collars or on the walls and bottom of the reservoirs.
If the structure does not satisfy the condition of test and the daily drop in water level is decreasing, the period of test may be extended for a further period of seven days and if the specified limit is then reached the structure may be considered as satisfactory.

The external faces of structure shall not show any signs of leakage and shall remain apparently dry over the period of observation of seven days after allowing a seven day period for absorption after filling.

In case the drop in level exceeds the permissible level limit and signs of leakage with the stipulated period of test, the Contractor shall carry out such additional works and adopt such measures as may be directed by the Engineer to reduce the leakage within the permissible limits. The entire rectification work that shall be carried out in this connection shall be at the Contractor's cost. Contractor shall have to make arrangement for filling emptying the reservoir at his own cost.

If the test results are unsatisfactory, the Contractor shall ascertain the cause and make all necessary repairs and repeat the water retaining structures test procedures, at his own cost. Should the re-test results still be unsatisfactory after the repairs, the structure will be condemned and the Contractor will dismantle and reconstruct the structure, to the original specification, at his own cost. During testing and during defect liability period the impression marks created due to seepage shall be rectified and made good.

No separate payment shall be made for water tightness test and the cost thereof shall deem to be covered in the rates quoted of different items of work of Service Reservoir.

**Precautions to keep Service Reservoirs free from Contamination**

As soon as possible after completion of reservoir and after its pipes have been laid the Contractor shall remove all dirt, debris, materials, tools etc. from the reservoir and shall wash and brush down with water the whole of the interior. He shall also if required by the Engineer incorporate a mixture of chloride of lime in the water wash required.

The greatest care shall be taken to keep the entire reservoir free from any contamination. Strict supervision shall be maintained over the workmen entering after first washing down. Provision shall be made to enable workmen to wash their feet or footwear clean and sterilize them before entering.

**6.13.19 Testing, Disinfecting and Rinsing of Water Pipelines**

**6.13.19.1 General**

All pipelines and all works shall be subject to pressure and leakage tests after being laid and installed before commissioning.

Pressure and leakage tests shall be carried out simultaneously. Provisions of this clause shall be read in conjunction with the provisions for testing and disinfection of pipes under IS: 3114, IS:12288 and other Indian Standard Specifications as applicable.

The Contractor shall provide all equipment, material and labour necessary for carrying out testing and cleaning including pumps, gauges, pipe connections, stop ends and all other temporary works. Contractor shall remain entirely responsible for the care of the works during testing and cleaning of the pipelines.
Hydraulic tests for pipeline

After laying and jointing, the pipeline shall be tested for tightness of barrels and joints, and stability of thrust blocks in sections approved by the Engineer. The length of the sections depends on the topographical conditions. Preferably the pipeline stretches to be tested shall be between two chambers (air valve, scour valve, isolation valve, and other chamber). At the beginning, the contractor shall test stretches not exceeding 2 km.

After successful organization and execution of tests the length may be extended to more than 2 km after approval of the Engineer. The water required for testing shall be arranged by the contractor himself. The Contractor shall fill the pipe and compensate the leakage during testing. The Contractor shall provide and maintain all requisite facilities, instruments, etc. for the field testing of the pipelines. The testing of the pipelines generally consists in three phases: preparation, pre-test/saturation and test, immediately following the pre-test. Generally, the following steps are required which shall be monitored and recorded in a test protocol, if required:

- Complete setting of the thrust blocks
- Partial backfilling and compaction to hold the pipes in position while leaving the joints exposed for leakage control
- Opening of all intermediate valves (if any)
- Fixing the end pieces for tests and after temporarily anchoring of these against the soil (not against the preceding pipe stretch)
- At the lower end with a precision pressure gauge and the connection to the pump for establishing the test pressure
- At the higher end with a valve for air outlet
- If the pressure gauge cannot be installed at the lowest point of the pipeline, an allowance in the test pressure to be read at the position of the gauge has to be made accordingly
- Slowly filling the pipe from the lowest point(s)
- The water for this purpose shall be reasonably clear and free of solids and suspended matter
- Complete removal of air through air valves along the line
- Closing all air valves and scour valves
- Slowly rising the pressure to the test pressure while inspecting the thrust blocks and the temporary anchoring
- Keeping the pipeline under pressure for the duration of the pre-test/ saturation of the lining by adding make – up water to maintain the pressure at the desired test level. Make up water to be arranged by Contractor himself at his own cost.
• Start the test by maintaining the test pressure at the desired level by adding more make up water; record the water added and the pressure in intervals of 15 minutes at the beginning and 30 minutes at the end of the test period.

• Water used for testing should not be carelessly disposed off on land which would ultimately find its way to trenches.

• The testing conditions for the pipelines shall be as per the test pressures and condition laid out in IS: 8329 for DI pipes and IS: 7634 (Part II) for HDPE pipes.

• The pipeline stretch will pass the test if the water added during the test period is not exceeding the admissible limits. No section of the pipe work shall be accepted by the Engineer until all requirements of the test have been obtained.

• Pre test and saturation period with addition of make-up water
  
  Pressure: Test Pressure
  
  Duration: 3 hrs for pipes without cement mortar lining / 24 hrs for pipes with cement mortar lining

• **Test criteria for DI pipes:**
  
  Pressure: Test Pressure
  
  Duration: 3 hrs
  
  $$Q = 1 \text{ litre per km per length per 10mm diameter of pipe per 30m test pressure per 24 hrs.}$$

• **Test criteria for HDPE/ uPVC pipes :**
  
  $$Q = 1.125 \text{ litre per km per 10mm diameter of pipe per 30 m test pressure per 24 hrs.}$$

No pipe installation shall be accepted until the leakage is less than the amount ‘Q’, as determined by the above formula:

All pressure testing at site should be carried out hydrostatically. The pipes along with valves shall be accepted to have passed the pressure test satisfactorily, if the quantity of water required to restore the test pressure does not exceed the amount ‘Q’, calculated by the above formula. Where any test of pipe laid indicates leakage greater than that specified as per the above formula, the defective pipe(s) or joint(s) shall be repaired/replaced as per the satisfaction of Employer’s Representative until the leakage is within specified limits. The Contractor has to make his own arrangements for water of approved quality, required for testing pipeline.

The table, hereunder, gives recommended test pressure for HDPE/DI pipes.

**Table 9: Recommended Test Pressure for HDPE/DI Pipes**

<table>
<thead>
<tr>
<th>Class of pipe</th>
<th>Working Pressure</th>
<th>Recommended Site/ Field Test Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Continuous Working Pressures and Recommended Test Pressures</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kg/ sq cm</td>
<td>Kg/ sq cm</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>HDPE pipes</td>
<td>6.0</td>
<td>9.0</td>
</tr>
<tr>
<td>DI Class K-7/K- 9/MS</td>
<td>As per pipe size &amp; up to 45 kg/sqcm</td>
<td>2xmaximum design pressure (with minimum design pressure as 6.0 kg/sqcm)</td>
</tr>
</tbody>
</table>

If it is required to test a section of a pipe line with a free end, it is necessary to provide temporary support against the considerable end thrust developed by the application of the test pressure. The end support can be provided by inserting a wooden beam or similar strong material in a short trench excavated at right angle to the main trench and inserting suitable packing between the support and pipe end.

### 6.13.19.3 Failure to pass the test

All pipes or joints which are proved to be in any way defective shall be replaced or remade and re-tested as often as may be necessary until a satisfactory test shall have been obtained. Any work which fails or is proved by test to the unsatisfactory in any way shall be redone by the Contractor.

### 6.13.19.4 Cleaning Out After Testing

On completion of a satisfactory test any temporary anchor blocks shall be broken out and stop ends removed. Backfilling of the pipeline shall be completed. All pipes or joints which are proved to be in any way defective shall be replaced or remade and re-tested as often as may be necessary until a satisfactory test shall have been obtained. Any work which fails or is proved by test to be unsatisfactory in any way shall be redone by the contractor.

After the completed pipeline is tested, approved, backfilled and the Contractor has removed all temporary works and has reconnected any parts temporarily removed from the pipeline, the Contractor shall finally clean out the whole pipeline and flush it through with water.

### 6.13.19.5 Disinfection

After cleaning out, disinfection shall be performed in the following manner: after flushing the pipes the system shall be drained completely, all valves shall be closed carefully and the system filled with a strong chlorine solution of about 50 ppm free chlorine. This solution shall remain in the system for a period as directed but not exceeding 24 hours uninterruptedly. Chlorine residual tests shall be done at various points by an orthotolidine reagent with a colour scale. The disinfection process shall be repeated until the chlorine residual is not less than 10 ppm at all sampling points. After disinfection the entire pipeline shall be rinsed with potable water till the chlorine residual is less than 4 ppm at various points of testing.

After completion of disinfection and rinsing the results shall be reported by the Contractor in writing and signed by the Contractor and the Engineer.
The Contractor shall provide at his own expense such sampling points as the Engineer may direct if permanent points are not available or suitably located.

6.13.19.6 Water for Testing and Cleaning

The Contractor shall provide all water required for testing, cleaning and disinfection of the pipeline at his own cost and shall use only potable water. Contractor shall also bear the cost of chemical required for disinfection.

Disposal of water after testing, disinfection and cleaning shall be arranged by the Contractor with prior approval from the Engineer. The disposal shall be done in such a manner as will not cause any harm to any standing crop, cultivated land, damage to roads or structures, cause submergence and/or nuisance to any public or vehicular traffic.

6.13.19.7 Testing and Commissioning

After successful sectional tests after pipe laying and other pre-commissioning tests after physical completion, the pipeline shall be commissioned by the Contractor. Dynamic commissioning shall be made in conjunction with or after the commissioning of the respective system.

Complete supplying, laying, jointing, testing and commissioning of the pipeline works are included in the contract package and Contactor will make all necessary arrangement for complete commissioning of the transmission pipeline system when the pump sets feeding the pipelines are installed and yard piping works for respective service reservoir complexes are complete and ready. Such coordination with the other Contractors and ensuring availability of required personnel and necessary equipment for such commissioning will have to be provided by the Contractor in consultation with and to the full satisfaction of the Engineer.

During testing/commissioning, the Contractor shall supply all material and labour to supervise, adjust, test, repair and do all things necessary to maintain the testing/commissioning. This shall include labour on a 24 hour-a-day basis during the test period and for such other period of continuous operation as the Engineer may consider necessary to establish the efficient operation of the cluster distribution system.

If any test result shows noticeable variation from the specification requirements for the system the Contractor shall immediately take steps to rectify the deficiency without any extra cost to Engineer.

The Contractor shall test and commission the system for 7 days at a stretch, from the date of commissioning. On expiry of this period the system shall be taken over by the Engineer and a taking-over certificate shall be issued by the Engineer, provided all defects and/or deficiencies noticed are rectified to the satisfaction of the Engineer.

The main indicators for the successful commissioning are:

a) No leaks in pipes, joints, locations of specials and valves,

b) All valves are properly installed and operational,
c) Execution of the entire work including finishing according to the drawings and specifications,

d) Submission of “As built” drawings both in soft copies and hard copies.
### 6.14 List of Specified Makes

<table>
<thead>
<tr>
<th>SR.NO.</th>
<th>ITEM/EQUIPMENT</th>
<th>SPECIFIED MAKES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>PIPES</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>DI Pipes</td>
<td>JINDAL SAW/ TATA metaliks/ kubota/ Electrosteel</td>
</tr>
<tr>
<td>2.</td>
<td>DI Specials</td>
<td>Jindal/Bharat Industrial Corporation/ Oriental Castings / Electro Steel Castings/ Kejriwal Casting</td>
</tr>
<tr>
<td>3.</td>
<td>HDPE/MDPE Pipes</td>
<td>Jain Irrigation/ Kimplas/ Timeplast/Duraline</td>
</tr>
<tr>
<td>4.</td>
<td>HDPE Fittings</td>
<td>Kimplas/George Fischer/Aviva/Presto</td>
</tr>
<tr>
<td>5.</td>
<td>uPVC Pipes</td>
<td>Supreme/Prince/Finolex</td>
</tr>
<tr>
<td>6.</td>
<td>RCC Pipes</td>
<td>Indian Hume Pipes/ K K Spun/JSP Infra/Baba Farid</td>
</tr>
<tr>
<td></td>
<td><strong>PUMPS</strong></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Horizontal centrifugal split case double suction pumps</td>
<td>Kirloskar/ KSB/ M&amp;P (WILO) / Beacon Weir/Sulzer</td>
</tr>
<tr>
<td>9.</td>
<td>Horizontal centrifugal end suction top discharge pumps</td>
<td>Kirloskar/ KSB/ M&amp;P (WILO) / Flowserve/Sulzer</td>
</tr>
<tr>
<td>10.</td>
<td>Vertical turbine pumps single stage/multi-stage with radial flow/mixed flow/axial flow impeller</td>
<td>Kirloskar/M&amp;P(WILO)/Jyoti/Wpil/Flowmore</td>
</tr>
<tr>
<td>11.</td>
<td>Vertical Centrifugal Pumps (Pumps Wet Pit Installation &amp; Dry Motor Above Sump)</td>
<td>SU Motors/Kishore/KSB/Kirloskar/Sam Turbo</td>
</tr>
<tr>
<td>12.</td>
<td>Submersible Centrifugal Pump(Motor &amp; Pump Monoblock Unit Submerged) With Auto-coupling Unit, Integral Duck-foot Base Bend with Guide Pipe/Chain and PMU Complete/Portable Installation Types Submersible Pump (Motor &amp; Pump Monoblock Unit Submerged)</td>
<td>Kirloskar/M &amp; P (wilo)/aqua/darling/kishore</td>
</tr>
<tr>
<td>SR.NO.</td>
<td>ITEM/EQUIPMENT</td>
<td>SPECIFIED MAKES</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>13.</td>
<td>Centrifugal pumps for chemical application</td>
<td>AKAY/KHIMLINE/KSB/ANTICO/SAM TURBO</td>
</tr>
<tr>
<td>14.</td>
<td>Liquid ring vacuum pump</td>
<td>KIRLOSKAR / SLM MANEK LAL/GARUDA/PPi SYSTEMS/PARAG</td>
</tr>
<tr>
<td>15.</td>
<td>Progressive cavity screw type positive displacement pump</td>
<td>Tushaco / Netzsch / Roto Pumps/Alpha Helical</td>
</tr>
<tr>
<td>16.</td>
<td>Dose metering pumps</td>
<td>Asia LMI/Swellore/Shape Tools/Milton Roy/Positive Metering</td>
</tr>
<tr>
<td></td>
<td><strong>Valves &amp; gates</strong></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>Di resilient (soft) seated sluice valve</td>
<td>IVC/ Kirloskar/VAG/ /BDK (Weir)/AVK</td>
</tr>
<tr>
<td>18.</td>
<td>Butterfly valve</td>
<td>IVC/ Kirloskar/VAG/ /BDK (Weir)/AVK</td>
</tr>
<tr>
<td>19.</td>
<td>Non return valve</td>
<td>IVC/ Kirloskar/VAG/ /BDK (Weir)/AVK</td>
</tr>
<tr>
<td>20.</td>
<td>Air valve</td>
<td>Fouress/ IVC/ Kirloskar/VAG/ /B (Weir)</td>
</tr>
<tr>
<td>21.</td>
<td>Self- regulating pressure control valve</td>
<td>Keystone/TALIS/VAG /AVK / Kennedy</td>
</tr>
<tr>
<td>22.</td>
<td>Solenoid valve</td>
<td>ASCO/ AVCON/ ROTEX/ JUCOMATIC/ SCHRADER- SCHOVILL</td>
</tr>
</tbody>
</table>
| 23.    | Sluice gates                                             | Jash Engineering (P) LTD. / The Indian Valve CO. /Oriental /I/VAG/M/MECH/ST/ 

<p>|        | <strong>MOTOR &amp; ACTUATORS</strong>                                   |                                                      |
| 24.    | Squirrel cage induction motor                            | Kirloskar (KEC) /Jyoti / Siemens/ CGL/ ABB          |
| 25.    | Electrical actuators                                     | AUMA/ MARSH/ ROTORK/ Siemens/EMTORK                 |
|        | <strong>INSTRUMENTS</strong>                                          |                                                      |
| 26.    | Electromagnetic flow meter                               | /Endress &amp; Hauser/Forbes Marshal/ /ABB/ Yokogawa/Siemens |
| 27.    | Ultrasonic flow meter                                    | Endress &amp; Hauser/Forbes Marshal/ /ABB/ Yokogawa/Siemens |
| 28.    | Level (ultrasonic type) transmitter                     | ABB / Endress &amp; Hauser/ Krohne Marshall/ Siemens / Yokogawa |
| 29.    | Level switch                                             | Endress &amp; Hauser/ KrohneMarshall/ABB/ Yokogawa/Siemens |</p>
<table>
<thead>
<tr>
<th>SR.NO.</th>
<th>ITEM/EQUIPMENT</th>
<th>SPECIFIED MAKES</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.</td>
<td>Level sensors (capacitance type)</td>
<td>Levcon/Toshniwal/Pune Techrol/E&amp;H/Rlt</td>
</tr>
<tr>
<td>31.</td>
<td>Limit switches</td>
<td>Electronic &amp; Power Control Company/ Honeywell Automation (I) LTD/ L &amp; T/ Siemens AG/ Speed O Controls PVT Ltd</td>
</tr>
<tr>
<td>32.</td>
<td>Flow switch</td>
<td>Krohne-Marshall / Siemens AG/ Switzer/ Levcon/ABB</td>
</tr>
<tr>
<td>33.</td>
<td>ORP / pH / conductivity measurement</td>
<td>Endress &amp;Hauser/ /ABB/ Yokogawa/ HACH</td>
</tr>
<tr>
<td>34.</td>
<td>Turbidity measurement</td>
<td>Endress &amp;Hauser/ /ABB/ Yokogawa/ HACH</td>
</tr>
<tr>
<td>35.</td>
<td>Pressure / differential pressure gauge</td>
<td>General Instruments/ KSB / Manometer India/ Forbes Marshall / Baumer</td>
</tr>
<tr>
<td>36.</td>
<td>Pressure / differential pressure transmitter</td>
<td>Emerson (Rosemount)/ Honeywell/ Siemens / Yokogawa/ E&amp;H</td>
</tr>
<tr>
<td>37.</td>
<td>Pressure relief valve</td>
<td>Tyco sanmar/ ksb ag/ keystone valves ltd./ sebim valves</td>
</tr>
<tr>
<td>38.</td>
<td>Chlorine measurement</td>
<td>ABB/E&amp;H/ Yokogawa/Hach/Emerson</td>
</tr>
<tr>
<td></td>
<td><strong>Mechanical equipment</strong></td>
<td></td>
</tr>
<tr>
<td>39.</td>
<td>Crane &amp; hoist</td>
<td>Hercules/Electromech/Eddy Cranes/W H Brady/Century</td>
</tr>
<tr>
<td>40.</td>
<td>Air compressor</td>
<td>Kirloskar Pneumatics/ELGI/ Atlas Copco/ Ingersoll-Rand</td>
</tr>
<tr>
<td>41.</td>
<td>Chlorinators</td>
<td>Metito / Penwalt / Chlorocontrol/ Industrial Device</td>
</tr>
<tr>
<td>42.</td>
<td>Clarifier / clariflocculator / thickener</td>
<td>Hindustan Dorr-Oliver / Geo- Miller / EIMCO KCP / Triveni Engineering / Voltas</td>
</tr>
<tr>
<td>43.</td>
<td>PP nozzles</td>
<td>GUDDI PLASTCON / N.K INDUSTRIES / B K INDUSTRIES</td>
</tr>
<tr>
<td>44.</td>
<td>Centrifuge</td>
<td>Alfa Laval India ltd., / Pennwalt Ltd. / Humboldt Wedag / Hiller</td>
</tr>
<tr>
<td>45.</td>
<td>Agitators / mixers</td>
<td>REMI / FIBRE &amp; FIBRE / EMICO / Triveni/ Reliable Equipments</td>
</tr>
<tr>
<td>46.</td>
<td>Filter media sand / gravel / anthracite</td>
<td>Global Adsorbent / AP Industries / Aqua Zone / Central Agency</td>
</tr>
<tr>
<td>SR.NO.</td>
<td>ITEM/EQUIPMENT</td>
<td>SPECIFIED MAKES</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>47.</td>
<td>Positive displacement type twin lobe rotary air blower</td>
<td>Everest/Kay International/Usha/Ingersoll Rand/Swam</td>
</tr>
<tr>
<td>48.</td>
<td>Surge control devices (zero velocity valve)</td>
<td>Sureseal/Megha Engineering / Flownix / Mannemann Meer</td>
</tr>
<tr>
<td>49.</td>
<td>Transformer (oil)</td>
<td>ABB/ Bharat Bijlee/ Alstom/ Schneider /CGL</td>
</tr>
<tr>
<td>50.</td>
<td>Transformer (dry)</td>
<td>VOLTAMP/ABB / CGL / DANISH</td>
</tr>
<tr>
<td>51.</td>
<td>Current transformer and potential transformer</td>
<td>Automatic Electrical / KAPPA / BHEL / ABB/Jyoti</td>
</tr>
<tr>
<td>52.</td>
<td>Power capacitors</td>
<td>Crompton Greaves LTD. / L&amp;T, SCHNEIDER /EPCOS / /UNISTAR</td>
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<tr>
<td>53.</td>
<td>Insulators</td>
<td>BHEL / JAI SHREE / WSI</td>
</tr>
<tr>
<td>54.</td>
<td>Protective relays / relay control panel</td>
<td>ALSTOM / Siemens / ABB / Schneider / Larsen &amp;toubro</td>
</tr>
<tr>
<td>55.</td>
<td>Dc batteries / power pack</td>
<td>Exide / Standard Batteries Ltd. / AMCO batteries ltd. / Amarraja</td>
</tr>
<tr>
<td>56.</td>
<td>Battery chargers</td>
<td>EXIDE / AMCO/UPTRON / AE /HBL</td>
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<tr>
<td>57.</td>
<td>H.T., l.T. Cables</td>
<td>Cable Corporation Of India / UNISTAR/ RPG / KEI / POLYCAST</td>
</tr>
<tr>
<td>58.</td>
<td>Control cable</td>
<td>Cable Corporation Of India / Universal / RPG / KEI / POLYCAST</td>
</tr>
<tr>
<td>59.</td>
<td>Lighting cables</td>
<td>RPG /KEI / Finolex/Havells/Polydac</td>
</tr>
<tr>
<td>60.</td>
<td>Lighting fixtures</td>
<td>Phillips / Bajaj Electrical Ltd. / Crompton Greaves Ltd. / Wipro ltd. / Havells</td>
</tr>
<tr>
<td>61.</td>
<td>H.T. &amp;l.T. Termination kits</td>
<td>Raychem / CCI / M-SEAL</td>
</tr>
<tr>
<td>62.</td>
<td>Light poles</td>
<td>Bajaj / Valmont / Sumip</td>
</tr>
<tr>
<td>63.</td>
<td>Smart energy meters</td>
<td>ABB / Schneider / L&amp;T / Secure Meters</td>
</tr>
<tr>
<td>64.</td>
<td>Automatic power factor control (apfc) panel</td>
<td>Crompton / Larsen &amp; Toubro Ltd. / ABB / Siemens</td>
</tr>
<tr>
<td>65.</td>
<td>Hv and lv bushings</td>
<td>BHEL / JAYSHREE / WSI / CGL / SSB</td>
</tr>
<tr>
<td>SR.NO.</td>
<td>ITEM/EQUIPMENT</td>
<td>SPECIFIED MAKES</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>67.</td>
<td>Cable lugs</td>
<td>Dowells/ AMP (TYCO Electronics) / RAYCHEM RPG</td>
</tr>
<tr>
<td>68.</td>
<td>Annunicators</td>
<td>Minilec/Aplab/Letrotek/Masibus</td>
</tr>
<tr>
<td>69.</td>
<td>Semaphore</td>
<td>ALSTOM / ABB / SIEMENS / SCHNEIDER</td>
</tr>
<tr>
<td>70.</td>
<td>Modular type switches</td>
<td>ABB/ MK / Schneider / Legrand / Havells</td>
</tr>
<tr>
<td>71.</td>
<td>Indicating meters</td>
<td>AE/ Schneider/ABB</td>
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<tr>
<td>72.</td>
<td>Pushing button</td>
<td>L&amp;T / BCH / Siemens / C&amp;S / Schneider</td>
</tr>
<tr>
<td>73.</td>
<td>Selector &amp; control switches</td>
<td>Alstom / Siemens/ Hager/ Schneider</td>
</tr>
<tr>
<td>74.</td>
<td>MCCB / MCB</td>
<td>Siemens / ABB / Schneider / Legrand / L&amp;T</td>
</tr>
<tr>
<td>75.</td>
<td>Switch sockets &amp; modular type receptacles</td>
<td>Legrand / Siemens / Crompton / Schneider / Havells</td>
</tr>
<tr>
<td>76.</td>
<td>Mcb distribution board</td>
<td>Legrand / Siemens / Alstom / Schneider / ABB</td>
</tr>
<tr>
<td>77.</td>
<td>Lighting panels</td>
<td>Legrand / Siemens / L&amp;T / Schneider / ABB</td>
</tr>
<tr>
<td>78.</td>
<td>Indicating lamps</td>
<td>Siemens / BCH / TEKNIC / Schneider / GE</td>
</tr>
<tr>
<td>79.</td>
<td>Contactors</td>
<td>L&amp;T / Siemens / ALSTOM / Schneider</td>
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<tr>
<td>80.</td>
<td>Portable fire extinguishers</td>
<td>MINIMAX / MATHER PLATT / CEASFIRE</td>
</tr>
<tr>
<td>81.</td>
<td>Scada including communication equipment along with remote terminal unit / plc</td>
<td>ALSTOM / Schneider/ ABB / Siemens / L&amp;T</td>
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<tr>
<td>82.</td>
<td>Online ups, servo stabilizer, inverter</td>
<td>AEI/ L&amp;T/ Siemens / APC/ LUMINOUS</td>
</tr>
<tr>
<td>83.</td>
<td>Lightning arresters</td>
<td>ELPRO / ABB / BHEL/ OBLUM/IGE</td>
</tr>
<tr>
<td>84.</td>
<td>Vacuum circuit breaker (indoor &amp; outdoor) &amp; panels</td>
<td>ABB/ ALSTOM / AREVA/ Siemens / Schneider</td>
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<tr>
<td>85.</td>
<td>ACB</td>
<td>ABB/ Siemens / Schneider/LEGRAND / L&amp;T</td>
</tr>
<tr>
<td>SR.NO.</td>
<td>ITEM/EQUIPMENT</td>
<td>SPECIFIED MAKES</td>
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<tr>
<td>--------</td>
<td>---------------------------------------</td>
<td>------------------------------------------------------</td>
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<tr>
<td>86.</td>
<td>HRC FUSES</td>
<td>ABB/Crompton Greaves/GE / Siemens / Schneider</td>
</tr>
<tr>
<td>87.</td>
<td>Alternators</td>
<td>KEC/JYOTI/AVK/Crompton</td>
</tr>
<tr>
<td>88.</td>
<td>LT / HT SWITCHGEAR PANEL</td>
<td>Schneider/ L&amp;T/ Siemens / ABB /C&amp;S</td>
</tr>
<tr>
<td>89.</td>
<td>Measuring instruments, ammeter, voltmeter, etc.</td>
<td>SIMCO/ AE/ Conserve/ L&amp;T/ Siemens</td>
</tr>
<tr>
<td>90.</td>
<td>Selector switches, rotary switches</td>
<td>AE/ CONSERVE / L&amp;T/ Siemens / SCHNEIDER</td>
</tr>
<tr>
<td>91.</td>
<td>Exhaust fan/ ceiling fan/ air circulator/ pedestal fan/ bracket fan</td>
<td>CROMPTON GREAVES/ USHA/ ORIENT/ KHAITAN/ BAJAJ</td>
</tr>
<tr>
<td>92.</td>
<td>AC units / central acs</td>
<td>HITACHI / LG/ SAMSUNG/ CARRIER / LLOYED</td>
</tr>
<tr>
<td>93.</td>
<td>Soft starters</td>
<td>ABB/ CGL/ SCHNEIDER/ Siemens / L&amp;T</td>
</tr>
<tr>
<td>94.</td>
<td>Variable frequency (speed) drives</td>
<td>ABB/ LARSEN &amp; TOUBRO/ Siemens AG</td>
</tr>
<tr>
<td></td>
<td><strong>CONTROL &amp; INSTRUMENTATION</strong></td>
<td></td>
</tr>
<tr>
<td>95.</td>
<td>Auxiliary relays</td>
<td>OEN/ Siemens / ABB / SCHNEIDER</td>
</tr>
<tr>
<td>96.</td>
<td>Cable trays – FRP / GRP</td>
<td>DENSONS/ ERCON/ GENERAL COMPOSITES/ PREMIER/ SUMIP</td>
</tr>
<tr>
<td>97.</td>
<td>Control desk, I/O panels&amp; PLC panels / consoles</td>
<td>CHEMIN/ INSTRUMENTATION LIMITED/ Siemens / ABB/ SCHNEIDER</td>
</tr>
<tr>
<td>98.</td>
<td>DC Power Supply Unit</td>
<td>APLAB/ Siemens AG/ Schneider/ Phoenix</td>
</tr>
<tr>
<td>99.</td>
<td>Fiber optic cables</td>
<td>AMP/ KRONE/ MOLEX</td>
</tr>
<tr>
<td>100.</td>
<td>Instrument panels</td>
<td>Instrumentation Ltd/ Pyrotech/ Rittal</td>
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<tr>
<td>101.</td>
<td>Instrument tubing</td>
<td>Apex Tubes Pvt Ltd./ Choksy Tube Co Ltd./ Maharashtra Seamless LTD./ Ratnamani Metal &amp; TUBES LTD./ Swagelock</td>
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<tr>
<td></td>
<td><strong>OTHERS</strong></td>
<td></td>
</tr>
<tr>
<td>102.</td>
<td>DG SET (Alternator)</td>
<td>Crompton Greaves / Kirloskar Green/ STAMPFORD / KEC/ Leroy Somer</td>
</tr>
<tr>
<td>SR.NO.</td>
<td>ITEM/EQUIPMENT</td>
<td>SPECIFIED MAKES</td>
</tr>
<tr>
<td>--------</td>
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<td>-----------------</td>
</tr>
<tr>
<td>103.</td>
<td>DG SET (ENGINE)</td>
<td>Cummins/ Kirloskar Green/ Caterpillar/ Penta Volvo / Perkins</td>
</tr>
<tr>
<td>104.</td>
<td>Reinforcement steel</td>
<td>TATA STEEL/ SAIL/ RashtriyaIspat/ Jindal/ Vizag Steel</td>
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<tr>
<td>105.</td>
<td>Cement</td>
<td>ACC/ AMBUJA/ J K CEMENT/ ULTATECH / BIRLA CEMENT</td>
</tr>
<tr>
<td>106.</td>
<td>Structural steel</td>
<td>TATA STEEL/ SAIL/ RashtriyaIspat/ Jindal/ Vizag Steel.</td>
</tr>
<tr>
<td>107.</td>
<td>Cement concrete paver block (pedestrian areas, amenities, car parking areas)</td>
<td>SK Engineers, Patiala/ Samrat Tiles, Ludhiana / Mavi Tiles, Ludhiana/ Gulgul Tiles, Barnala/ Nitco/ Pavit/ Supertiles</td>
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<tr>
<td>108.</td>
<td>Cement concrete kerb</td>
<td>KK INDIA/ KJS CONCRETE/ PAVE ESPANIA</td>
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<tr>
<td>109.</td>
<td>Tactile paver for footpath</td>
<td>SK Engineers, Patiala/ Samrat Tiles, Ludhiana / Mavi Tiles, Ludhiana/ Gulgul Tiles, Barnala/ Nitco/ Pavit/ Supertiles</td>
</tr>
<tr>
<td>111.</td>
<td>Dual system litter bins</td>
<td>Saflow/ Jindal Steel/ Ozone/ Blue Stream</td>
</tr>
<tr>
<td>112.</td>
<td>Concrete bollards</td>
<td>KK India/ Surab Ferro Concrete Private Limited/ NTC TILES</td>
</tr>
<tr>
<td>113.</td>
<td>Bicycle stand hoops</td>
<td>Optitrect/ Chevron Enterprises/ Saflow/ Jindal ARC</td>
</tr>
<tr>
<td>114.</td>
<td>Bus shelter + toilet</td>
<td>Agasti / Fabloo/Eram Scientific</td>
</tr>
<tr>
<td>115.</td>
<td>Water atm</td>
<td>Apex/Aquasoft/Synergy Water</td>
</tr>
<tr>
<td>116.</td>
<td>Tree grate</td>
<td>Crescent Foundry/Govind Steel / Chevron Enterprises</td>
</tr>
<tr>
<td>117.</td>
<td>Road marking</td>
<td>3M All Weather Paint/, Asian Paints/ PPG Automark Technologies</td>
</tr>
<tr>
<td>118.</td>
<td>Bus stop marking</td>
<td>RIDE A WAY BY FLINT/ Kataline/ Plastitrak/Setwell Coatings</td>
</tr>
<tr>
<td>119.</td>
<td>Cycle track marking</td>
<td>RIDE A WAY BY FLINT/ Kataline/ Plastitrak.</td>
</tr>
<tr>
<td>120.</td>
<td>Raised pavement markers</td>
<td>3M/ Reliazen/ Nippon</td>
</tr>
<tr>
<td>121.</td>
<td>Traffic light/solar blinkers</td>
<td>Envoys/ Omnitech/ Star Automation</td>
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<tr>
<td>122.</td>
<td>Solar rpm/cat eyes</td>
<td>3M/ Reliazen/ Nippon</td>
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<tr>
<td>SR.NO.</td>
<td>ITEM/EQUIPMENT</td>
<td>SPECIFIED MAKES</td>
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<td>------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>123.</td>
<td>Rumble strips</td>
<td>3M/ Reliazen/ Nippon</td>
</tr>
<tr>
<td>124.</td>
<td>AMR Water Meters</td>
<td>ITRON/ ARAD / BAYLAN</td>
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</table>
## SITE PLANS / CONCEPT DRAWINGS

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Drawing name</th>
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<tbody>
<tr>
<td>1</td>
<td>Project Area</td>
</tr>
<tr>
<td>2</td>
<td>Location of WTP Land</td>
</tr>
<tr>
<td>3.</td>
<td>Location of Existing OHSRs</td>
</tr>
<tr>
<td>4.</td>
<td>Location of Proposed OHSRs</td>
</tr>
<tr>
<td>5</td>
<td>Transmission Main alignment</td>
</tr>
</tbody>
</table>
(i) **QUALITY ASSURANCE PLAN:**

The Contractor shall, within fourteen (14) days from the date of issuance of letter of acceptance, submit a Quality Assurance Plan for all major items. (Sample format of Q A P for some of the items is attached in excel sheet) The plan shall include testing schedules. List of materials sources, quality control procedures to ensure the provision of adequate materials and the execution of the works according to the technical specification, the Contractor’s internal ensuring good quality of constructions works, procedures for supplying of suitable materials, procedures for verification of drawings and other items as required by the Executive Engineer. The Contractor shall implement the quality control procedures in compliance with the approved Quality Assurance Plan. The contractor shall deploy ONE GRADUATE CIVIL for Quality control & assistants for Site Quality Laboratory as well as a Mechanical & electrical engineers on part time duration. During the contract

(ii) **CONSTRUCTION SUPERVISION:**

Supervision of construction work will be done by the Executive Engineer and his site staff on a day-to-day basis and periodically by the concerned Superintending Engineer and Chief Engineer in charge of the Project.

(iii) **O.K. CARD System**

The Engineer shall introduce O.K. Card System to ensure methodical enforcement of specifications and execution of every activity of works through correct construction procedure in order to meet the quality control requirement and promote construction quality of works on a continuing basis till the completion of respective works. The printed O.K. Cards, work-wise, listing all activities in proper order in English & local language, shall be filled activity wise by the Contractor / his authorized representative with his dated signature and, there after, the same shall be put up to the field engineer and finally to the quality control engineer shall be promptly rectified by the Contractor. Senior Project Engineers shall also peruse O.K. Cards during their inspection of works and write their comments there-on. The o.k. Cards shall be properly maintained.
## O.K. Card for EMBANKMENT WORKS

<table>
<thead>
<tr>
<th>No.</th>
<th>Requirement Satisfied</th>
<th>Yes</th>
<th>No</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>General</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Embankment bench position correct &amp; approved?</td>
<td>![☐]</td>
<td>![☐]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Embankment bench width &amp; thickness as per drawing</td>
<td>![☐]</td>
<td>![☐]</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Materials</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Availability of materials from approved borrow areas</td>
<td>![☐]</td>
<td>![☐]</td>
<td></td>
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<td></td>
<td>Material moisture content checked &amp; approved?</td>
<td>![☐]</td>
<td>![☐]</td>
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<tr>
<td>3</td>
<td>Inspection</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compaction trial results and procedure approved?</td>
<td>![☐]</td>
<td>![☐]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Underlying layers approved?</td>
<td>![☐]</td>
<td>![☐]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Watering of previous layer done?</td>
<td>![☐]</td>
<td>![☐]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plant/equipment such as bulldozer, grader, water truck, adequate vibrating roller in good order and available for work?</td>
<td>![☐]</td>
<td>![☐]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Required testing equipment on site?</td>
<td>![☐]</td>
<td>![☐]</td>
<td></td>
</tr>
</tbody>
</table>
Name of Engineer's Representative | Signature | Name of Contractor's Representative | Signature
--- | --- | --- | ---

Date | Date

**O.K. CARD FOR REINFORCED CONCRETE WORKS**

Contractor: | Date: | Card No.
--- | --- | ---

Agreement: Number | Project Name: | Project No:
--- | --- | ---

Component: | Location: | Elevation:
--- | --- | ---

Grade of Mix: | W/C Ratio: | Slump:
--- | --- | ---

Quantity:

<table>
<thead>
<tr>
<th>No.</th>
<th>Requirement Satisfied</th>
<th>Yes</th>
<th>No</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Foundation: Excavated Surface</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Geological Mapping, Photos</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td></td>
<td>Adjacent concrete surfaces</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td></td>
<td>Dimensions</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td></td>
<td>Dowels and rock-bolts</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td></td>
<td>Water control</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>2</td>
<td>Formwork: Alignment &amp; Dimensions</td>
<td>☐</td>
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<td></td>
<td>Bracing and studding</td>
<td></td>
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<tr>
<td></td>
<td>Clean, oiled and grout-tightness</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>Embedded items</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Reinforcement</td>
<td>Quantity, Size</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Plates, bolts and sockets</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Pipework &amp; Water-stops</td>
<td></td>
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<td></td>
<td>Instruments</td>
<td></td>
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<td></td>
<td>Electrical conduits &amp; Earthing bar</td>
<td></td>
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<tr>
<td>4</td>
<td>Final Preparation</td>
<td>Access for inspection &amp; handling</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Placing equipment, batch plant, concrete pumps, crane &amp; buckets, chutes, vibrators</td>
<td></td>
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<tr>
<td>5</td>
<td>Material</td>
<td>Communication system</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Availability of Cement, Sand, Coarse aggregate, admixture and water</td>
<td></td>
<td></td>
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<td>6</td>
<td>Testing equipment</td>
<td>Required testing equipment on site?</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Name of Engineer’s Representative</th>
<th>Signature</th>
<th>Name of Contractor’s Representative</th>
<th>Signature</th>
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</thead>
<tbody>
<tr>
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<tr>
<td>Date</td>
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<td>Date</td>
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</table>
**O.K. CARD FOR**  
**DRILLING & GROUTING WORKS**

<table>
<thead>
<tr>
<th>No.</th>
<th>Requirement Satisfied</th>
<th>Yes</th>
<th>No</th>
<th>Remark</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Grout holes</td>
<td></td>
<td></td>
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<td></td>
<td>Grouting plan &amp; procedures submitted and approved?</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td></td>
<td>Layout and lengths of grout holes consistent with the drawing instruction &amp; approved?</td>
<td>☐</td>
<td>☐</td>
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<td></td>
<td>Location of holes marked on ground?</td>
<td>☐</td>
<td>☐</td>
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<td></td>
<td>Diameter of the holes approved?</td>
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<td>2</td>
<td>Drilling</td>
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<td>Drilling equipment approved?</td>
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<tr>
<td></td>
<td>Drilling procedure approved?</td>
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<tr>
<td>3</td>
<td>Grouting Equipment</td>
<td></td>
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<td></td>
<td>Grout pumps adequate and number approved?</td>
<td>☐</td>
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<td></td>
<td>Pressure gauges adequate and approved?</td>
<td>☐</td>
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<td></td>
<td>Grout delivery pipes/hoses adequate?</td>
<td>☐</td>
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<td>Grout valves adequate?</td>
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<td>Grout mixer adequate?</td>
<td>☐</td>
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<td></td>
<td>Grout agitator adequate?</td>
<td>☐</td>
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<tr>
<td>Packers adequate and approved?</td>
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<td>Water pump approved?</td>
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<td>Water Meter approved?</td>
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<tr>
<td>Illumination &amp; power supply adequate and approved?</td>
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<td>Arrangement of grouting equip. approved?</td>
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</tbody>
</table>

| 4 | Grouting Materials | Portland cement sufficient & approved? |   |   |
|   |                   | Water tested & approved? |   |   |
|   |                   | Additives approved? |   |   |
|   |                   | Bentonite tested & approved? |   |   |
|   |                   | Sand tested & approved? |   |   |
|   |                   | Special chemicals approved? |   |   |

| 5 | Grouting Operation | Grout mixes design approved? |   |   |

<table>
<thead>
<tr>
<th>Name of Engineer’s Representative</th>
<th>Signature</th>
<th>Name of Contractor’s Representative</th>
<th>Signature</th>
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<tr>
<th>Date</th>
<th>Date</th>
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</thead>
</table>
(iv) Quality Assurance and Inspection activities are covered in the brief procedures stated below:

- Submission and approval of field Test /manufacturing procedures
- Inspection call (Annex-2)
- Quality Assurance Plan (Q.P.) and Field Quality Plan (FQP) (Annex–3)
- Trade Test (Annex –4)
- Release of interim inspection report and identification of non-conformities (Annex 5)
- Material Dispatch Clearance Certificate (Annex –6)

3.1.0 Definitions:

- **Inspection Engineer**
  
  Inspection Engineer of PURCHASER/ Employer / Employer or Designated Third party Inspection Agency’s Engineer shall be called as “Inspection Engineer”.

- **Contractor or Supplier / sub-contractor** shall mean on whom Order has been placed for complete system or Hydro-Mechanical Equipment / civil construction/ erection & commissioning and who shall be responsible for complete execution for the scope of work covered in the purchase order /contract.

- **Customer Hold Point (CHP)**
  
  Inspection tests/ checks that are required to be witnessed by Inspection Engineer of EMPLOYER before proceeding for further action 358inimize from contractor’s works.

- **Trade Test:**
  
  Trade test specific to the work requirement, shall have to be passed by experience workman like high pressure welder, rigger/crane operator, gas welder, etc, before their deployment on specified job. (refer Anne -5)

3.2.0 Co-ordination and Communication
Contractor to nominate his Quality Engineer within seven days of Agreement.

Quality Engineer of contractor shall co-ordinate with Inspection Engineer of Employer / Employer / Purchaser for compliance of the Quality Plan.

All correspondence shall generally be in line with mutually agreed procedure.

3.3.0 Manufacturing Quality Plans.
- Contractor shall submit Quality Plan for items/equipment being manufactured, for Approval of Employer /Purchaser/ Employer, in the prescribed format – Anne -3.
- List of items/equipment requiring submission of Quality Plan in aforesaid manner along with their time schedule shall be submitted by contractor within 15 days of Agreement.
- Employer / Purchaser/ Employer shall identify “Customer Hold Points”, (CHP), on the quality plan submitted & accord its approval.
- Thereafter the manufacturing process will be carried out. As per approved plan & stages, the testing, inspection, conformities will be inspected, reported & then material approved for further processing / dispatch to site.

3.3.1 Field Quality Plans for Civil construction/Erection of Mechanical / Electrical works.
- Contractor shall furnish the Field Quality Plan for Civil works, erection of equipments and services to Employer / Purchaser/ Employer before commencement of construction & erection at site, in the prescribed format – Anne -3.
- Employer / Purchaser/ Employer / Site Inspection Engineer shall inspect / witness all the checks as per “Customer Hold Points” (CHP) indicated on the approved field quality plan.

- Field quality checks agreed by Contractor with Employer/ Employer / Purchaser shall be implemented by Contractor All the agreed stages of checks i.e., CHP check point shall be offered to Employer / Purchaser for witnessing & clearance to proceed with next activity.
- Contractor shall provide Employer / Employer / Purchaser with all necessary facilities, instruments, tools and tackles for carrying out quality checks at site.

3.4.0 Notice for Inspection.
- Contractor shall give Inspection Call Notice, as per Anne-2, in writing, 7 days in advance, to Purchaser for any material/ component/ equipment being ready at manufacturer’s works for testing at identified CHP stage along with an undertaking that material will be ready for inspection by scheduled date.
- Employer / Purchaser will ensure expeditious inspection and clearance of the job at Contractor’s and/or it’s Sub-contractor’s works.
- Contractor shall also submit to Employer / Purchaser, a tentative monthly look ahead inspection schedule by the last week of the every month indicating the tentative schedule of materials being offered for CHP witness for the next month.
- Similar schedule will be made on monthly basis, for Site Construction & Erection Activities for the Field Quality Plan.

3.4.1 Inspection at Supplier’s works.
- A formal inspection call to Employer / Purchaser for those identified CHP shall be forwarded to Inspection Engineer of Purchaser. Inspection call notice will be raised by contractor in the enclosed format at Anne-2.
- All the inspection shall be carried out as per the approved quality plans and related identified Approved documents, such as technical specifications, drawings, data sheets, national and international standards; manufacturer’s standard, as applicable.
- For the witnessed tests, at CHP stages of a Sub-assembly/ assembly/ equipment have been successfully completed as per contract at Contractor’s / Sub-supplier’s works, the Inspection Engineer of Employer/ Purchaser shall issue Inspection Report jointly with Contractor’s Quality Engr. To that effect, as per Anne-5. Along-with such signed test report, a M.D.C.C. will be issued by the Inspection Engineer of / Employer / Purchaser for release the material/ equipment for further processing / dispatch to site.
- Where witnessing of stage inspection is waived off/ not attended by Inspection Engineer of Employer /Purchaser, contractor shall proceed with the test and shall forward duly certified report to Employer / Purchaser for getting dispatch clearance certificate.
For those items for which quality plans are not required to be submitted (those items shall be decided and agreed mutually between Employer / Purchaser and contractor) for Employer’s/ Purchaser’s approval, the inspection and testing shall be carried out by Quality Engineer of Contractor in accordance with approved drawings/ technical specifications/ data sheets/ check list, etc., as applicable and compliance report with test certificates shall be submitted to Employer’s/ Purchaser’s Engineer for release of Dispatch clearance.

Contractor shall be associated in all of the inspection witness stages identified as CHP.

(v) 4.2 Disposition of Non-conformities.

If any deviation is observed during witnessing of any of the tests either at manufacturer’s place or at site during erection / construction, the Inspection Engineer of Employer/ Purchaser shall convey their comments & observation for clarification in the interim Inspection report. All such clarifications shall be appropriately addressed by contractor and shall be subjected to approval of Employer / Purchaser. Decision of Employer/ Purchaser shall be final and binding on contractor in this regard.

(vi) 5.0 Material Dispatch Clearance Certificate.

Upon satisfactory clearance of inspection of CHP, the Inspection Engineer of Employer/ Purchaser shall issue formal Dispatch Instructions in writing in MDCC, as per Anne-6.

For other items for which no inspection witness is envisaged or for which no quality plan approval from Employer / Purchaser is envisaged, as mutually agreed, dispatch instruction / further processing instructions shall be issued by Purchaser, based on contractor’s Q . A . Inspection / Test certificate / Compliance report.

3.6.0 Quality Assurance Documents.

Contractor shall submit to Purchaser, requisite number of Hard paper copies along with minimum two(2) soft copies of Quality Assurance Documents i.e. Inspection report, test certificates, performance results as identified in approved Quality Plans.

3.7.0 Review of Quality Assurance & Inspection activities:

Periodic meeting of QA Co-coordinator of contractor and Inspection Engineer of Employer/ Employer / Purchaser & others involved, shall be organized by
Engineer of Employer to review the progress of QA activities & issue required instructions.

3.8.0 Statutory Approvals:
- The compliance of all statutory requirements and approvals, as per applicable norms, with regard to the product(s) / system(s), being executed by contractor, shall be arranged by contractor in a professional manner in line with contract documents & project delivery schedule.

3.9.0 Audits by the Employer:

The contractor shall note that the employer shall be entitled, as its discretion, to conduct audits in respect to –

a) Quality Assurance & Quality Control activities
b) Costs incurred in the event of termination and
c) Any other costs that the contractor claims from the employer which are not specifically covered by the terms of the contract.

The contractor shall be obliged to keep accurate up to date accounts with records concerning the above items.
**PUNJAB W T P**

**INSPECTION CALL (FORMAT)**

Call Ref:-
Date: 
To

--------------------------------
From: ........................................................................
M/s .................................................................

Tel .................................................................

...

**Sub: Inspection Call for .........................**

The following component is ready for inspection. You are requested to kindly depute your Inspection Engineer / representative for the inspection of these items.

<table>
<thead>
<tr>
<th>Package Name</th>
<th>BBU Ref.</th>
<th>Item Description as per Client approved BBU.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Items being offered for inspection (with BBU Ref)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Quantity / Numbers</strong></td>
<td><strong>Total Qty.</strong></td>
<td><strong>Offered Qty.</strong></td>
</tr>
<tr>
<td>Approved QAP ref &amp; rev.</td>
<td></td>
<td></td>
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<tr>
<td>Approved datasheet and Drawings Ref. &amp; Rev.</td>
<td></td>
<td></td>
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<tr>
<td>Whether Contractor Hold point (Yes/No)</td>
<td></td>
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</tr>
<tr>
<td>Whether <strong>Employer’s</strong> Hold point (Yes/No)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tests being offered for inspection as per QAP</td>
<td></td>
<td></td>
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<tr>
<td>Proposed date of inspection and number of days required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address and place of inspection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact person at Vendor’s place with contact details Fax / E-MAIL/ MOB</td>
<td></td>
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</tr>
</tbody>
</table>

Kindly confirm by fax / e-mail on no. stated below:

Thanking you,
Yours faithfully,
M/s.................................................................

..........
Tel :

.................................................................

....
Fax

.................................................................

........
e-mail

.................................................................

.....

---

PUNJAB 01/03/2020 / W T P– QP – 1001 / REV – 0
Amritsar- W T P

MATERIAL DESPATCH CLEARANCE CERTIFICATE

PACKAGE NAME : 

CONTRACT NO. :

MDC C NO. :

CONTRACTOR :

MANUFACTURER :

ORIGINAL (Only signed hard copy is good for invoicing)

<table>
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<tr>
<th>Sl. No.</th>
<th>BILLING BREAK-UP NO.</th>
<th>MATERIAL DESCRIPTION</th>
<th>QUANTITY</th>
<th>INSPECTION REPORT NO./DT</th>
<th>REMARKS</th>
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</thead>
</table>

This certificate is issued for on account payment purposes only and does not absolve the contractor from their contractual obligations in any manner

SIGNATURE

(For and on behalf of E-I-C of Employer)

NAME DESIGNATION (Stamp)

PUNJAB

01/03/2020

W T P – QP – 1002

REV – 0
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Components &amp; Operation</th>
<th>Characteristics</th>
<th>Class</th>
<th>Type of Check</th>
<th>Quantity of Check</th>
<th>Reference Document</th>
<th>Acceptance of Norms</th>
<th>Format of Record</th>
<th>Agency</th>
<th>Remarks</th>
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**LEGEND:**
1. MANUFACTURER / VENDOR
2. SUB VENDOR OF THE VENDOR
3. 3rd PARTY INSPECTION AGENCY
4. AE/EE P: PERFORM V: VERIFY W: WITNESS

MANUFACTURER / SUB CONTRACTOR SEAL AND SIGN

CONTRACTOR SEAL AND SIGN

NAME AND SIGN OF APPROVING AUTHORITY & SEAL

Date: 01/03/2020
Place: W T P – QP – 1003
REV – 0

PUNJAB

**ANNEXURE – 4**
## TRADE TEST REPORT

Name of Contractor:  
Address of Contractor:  
Contact No. | TEL: | FAX: | E-Mail
--- | --- | --- | ---

### Description of Job:

WO/LOI/LOA/ PO NO:  
Date of WO:  
Date of Trade Test:

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<tr>
<th>Sl. No.</th>
<th>Name of Labour / Employee S/o</th>
<th>Trade</th>
<th>Age in years</th>
<th>Gender (M/ F)</th>
<th>Experience in years</th>
<th>Skilled (S) / Semi-Skilled (SS)</th>
<th>Physical Appearance (Visual)</th>
<th>Vision test report &amp; D.L. in case of crane operator / vehicle driver</th>
<th>Safety awareness / consciousness in his assigned job</th>
<th>Address</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
<td>G</td>
<td>H</td>
<td>J</td>
<td>K</td>
<td>M</td>
<td>N</td>
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</table>

### Committee Members

<table>
<thead>
<tr>
<th>Name of Committee Members</th>
<th>HR &amp; ADMIN.</th>
<th>E – in – C</th>
<th>Quality Control Inspection Engr.</th>
<th>External Resource</th>
</tr>
</thead>
</table>

The persons have been tested in their respective trade (skill) like Carpenter / Mason / Pressure Welder / Gas Cutter / Electrician / Scaffolder / Driver / Operator / Rigger / Fitter / Painter / Other (to be mentioned) and cleared.

PUNJAB W.T.P.  
01/03/2020  
PUNJAB – QP – 1004, REV – 0
### Customer Hold Point: CLEARANCE / INTERIM INSPECTION REPORT

**PUNJAB W T P**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description of Material / Test &amp; Reference of B.B.U.</th>
<th>Offered Qty.</th>
<th>Accepted Qty.</th>
<th>Hold/Reject Qty.</th>
<th>Unit</th>
<th>Disposal Code</th>
<th>MD CC No.</th>
<th>Reference Documents</th>
<th>Remarks</th>
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</table>

**For Contractor / Sub-contractor / Manufacturer**

**Disposal code details**

**For and on behalf of S E - W T P**

**SIGNATURE**

**NAME:**

**DATE:** 01/03/2020

---

**ANNEXURE – 5**

**PUNJAB W T P – QP – 1004**

**REV – 0**