



Republic of the Philippines

ZAMBOANGA CITY WATER DISTRICT

Pilar Street, Zamboanga City

TECHNICAL SPECIFICATIONS

FOR THE

**PROPOSED DEEP WELL
EXPLORATION, TESTING, AND
DEVELOPMENT AT MERCEDES**

**TECHNICAL SERVICES GROUP
ENGINEERING & CONSTRUCTION DEPARTMENT
DESIGN DIVISION**

APRIL 2024



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1 INTRODUCTION

1.1 BACKGROUND

As of April 2024, the El Niño has already persisted in Zamboanga City which affects the water supply level and resulted to water rationing throughout the ZCWD service area. Although water conservation and water rationing are one of the actions needed to be taken to mitigate the effects of the El Nino, however, it is still imperative to develop an additional water source as water security that can withstand even during the worst effect of El Niño.

The Technical Services Group through the management conceptualizes the project of development of deep well at ZCWD lot located at Brgy. Mercedes which can serve the barangay Mercedes (should they opt to transfer to ZCWD in the future) and barangay Zambwood. Hence, a board resolution number 45 Series of 2024, was approved on March 27, 2024, a resolution approving a supplemental budget appropriation amounting to Php3,963,742.44 for the well development at barangay Mercedes and Tetuan.

This project to bid is comprising of the exploration, testing and development of one deep well at Barangay Mercedes. Barangay Mercedes is located on the east coast with 13.8 kilometers away from the Zamboanga City Hall. Its population as determined by the 2020 Census was 22,321. This represented 2.28% of the total population of Zamboanga City. It is expected that this barangay will further develop due to the proposed Zamboanga City International Airport thereat. Hence, water demand is expected to increase in the area. With this, the proposed deep well development will serve those water demand in the future and this will also augment the existing water supply at Barangay Zambwood that is presently insufficient in water supply.

The viability of the project was determined with the geo-resistivity survey data that the water-bearing zone or the aquifer development of groundwater source is likely recommended from 77.4 meters up to 90 meters at Barangay. A preliminary well design was prepared with the expectation of tapping the most productive zones in the area.



2 GENERAL BIDDING REQUIREMENTS

- 2.1 All eligibility documents shall conform to the requirements stipulated in the Updated Revised Implementing Rules and Regulation of Republic Act 9184.
- 2.2 Statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid shall refer to deep well exploration, testing and development regardless of depth and borehole size as long as the SLCC is not less than 50% of the ABC.
- 2.3 For single contractor, PCAB LICENSE shall be in compliance with the DTI PCAB Categorization Table, Board Resolution No. 201 Series of 2017. For this project, the PCAB License shall be SP-WD (Well-Drilling Work) Classification with Size Range Small B.
- 2.5 The Bidder shall not be allowed to subcontract any portions of the Project.
- 2.6 The contractor cannot proceed with the next work item unless they can present that the materials to be used indeed passed the requirements/specifications, in which case, the project engineer has the right to demand from the contractor, otherwise, the project engineer may order the stoppage of the work portion where the construction materials did not pass the specifications while the period to complete the project shall continue to run.
- 2.7 All Items of Works as enumerated in the Bill of Quantities shall include all the necessary equipment, manpower and materials to complete the said items of works; and this shall be considered and anticipated by the Contractor in their financial bid offer. Hence, any additional equipment, manpower and/or materials which will be needed during the implementation, in order to complete the Items of Works, shall be at the expenses of the contractor.
- 2.8 The Bill of Quantities (BOQ) prevails in all issues relating to pay items of work. The contractor shall supply the needed materials, equipment/tools & manpower to complete the quantity stated in the BOQ with specifications as stated herein. For deficiency in the contractor's detailed estimate, the contractor shall bear the expenses for the deficiency made in the detailed estimates (materials, manpower or equipment) to complete the quantity stated in the BOQ.
- 2.9 The Minimum Manpower and Equipment Requirement for this project shall refer to the Philippine Bidding Documents.



3 GENERAL SPECIFICATIONS

- 3.1 The ZCWD Technical Services Group will locate the final location of borehole.
- 3.2 Any equipment breakdown or damaged during the implementation of the project shall subject to immediate replacement at the cost of the contractor as this will not toll the running of the period to complete the works called for under this Technical Specifications. Delays will be subjected to liquidated damages provided in Section 68 and Annex E of the Updated Revised IRR of RA 9184.
- 3.3 The Procuring Entity has the authority to suspend the work wholly or partly by written order for such period as may be deemed necessary due to the following:
 - 3.3.1 Force majeure or any fortuitous event;
 - 3.3.2 Failed on the part of the contractor to:
 - a. Correct bad conditions which are unsafe for worker or for the general public;
 - b. Carry out valid orders given by the Procuring Entity;
 - c. Perform any provisions of the contract; or
 - d. Adjustment of plans to suit field conditions as found necessary during construction.
- 3.4 The contractor shall furnish As-Built Plan as part of the requirement for issuance of Completion Certificate and Final Billing payment. Submission of the project as built layout is likewise a requirement for project that has stopped implementation due to arbitration or court litigation or the contract for the project has been terminated.
- 3.5 The project duration of the project is 48 calendar days excluding the acquisition of the permits and clearances. Permits and clearances are not a pay item but this shall be chargeable to the OCM and this shall be pre-requisite in the project implementation.
- 3.6 The contractor's site engineer shall prepare and submit a daily report reflecting the following information with concurrence of this Office Project In-Charge:
 - Weather condition
 - Activities for the day reflecting all the detail of the actual works performed. (It shall show the plan vs. actual)
 - Breakdown of utilized equipment
 - Breakdown of manpower
 - Materials utilized and delivered on site
 - Any other details relevant to the executed activities.
- 3.7 In cases where the delay reaches 5% of the planned activities, the contractor shall submit a CATCH-UP PLAN the following day reckoned from the date of the



- delay incurred. The “catch-up plan” shall cover the left-behind activities of the preceding week and the remaining works.
- 3.8 The procurement and payment of permits and licenses necessary for the project implementation shall be the responsibility of the Contractor. ZCWD shall provide assistance whenever necessary. The expense for the permits and ECC shall be included & chargeable to in the OCM, hence shall not be a separate pay item.
 - 3.9 The processing for the prompt of the Permit to Drill from the National Water Resources Board shall be the responsibility of the Contractor. The Contractor shall ensure that before any drilling activity will commence, it shall exhaust all the obligatory effort to expedite the release of the Permit to Drill.
 - 3.10 The Contractor must have a duly registered well driller with updated Well Driller Certificate of Registration issued by National Water Resource Board (NWRB) who will undertake the drilling as it is a requirement in the processing of the necessary permit/s to drill issued by the NWRB. For Well Drilling, all applications involving extraction of groundwater shall include the name of a duly registered well driller who will undertake the drilling.
 - 3.11 Deployment of labor and equipment shall only be done upon issuance of the Permit to Drill. Works and activities that do not need permits can commence simultaneously.
 - 3.12 The affected barangays and stakeholders must all be well-informed and documented through writing as to the definite date of TAKE-OFF.
 - 3.13 Temporary facilities include the construction of site facilities and other necessary components to complete the job. The detail for temporary facilities is reflected in the detailed engineering plan. However, the contractor may construct larger temporary facilities than what is reflected in the plan should deemed necessary without additional cost to the ZCWD.
 - 3.14 The contractor shall process and seek the approval from the Department of Labor and Employment (DOLE) for the Construction Safety and Health Program for this project and shall implement the Construction Safety and Health Program in compliance with DOLE D.O. No. 13, Series of 1998. This item shall include the provision of the Safety Officers, the provision of warning devices, safety and warning signage, barricades, first aid kit and personal protective equipment (PPE) for the workers.
 - 3.15 Regardless of project suspension and any impediments, the contractor shall maintain the safety measures and cleanliness at any of the working areas of the project.
 - 3.16 This item of work includes the construction of one (1) set project signage/ billboards by the contractor, placed on-site in accordance with the guidelines as specified in COA Circular No. 2013-044 dated Jan. 30, 2013. The frame for bill boards may be made from coco lumber or any lumber as long as the same



shall stand for the entire duration of project implementation. The exact location for the installation shall be determined by ZCWD engineer project in-charge. For infrastructure projects, a tarpaulin project signboard must be suitably framed for outdoor display at the project location, and shall be posted as soon as the award has been made. The design and format of the project signboard tarpaulin, as shown in Annex "A" of the said COA Circular shall have the following specifications:

Annex "A"

Name of Agency
Business Address

Project: _____ Cost: _____
 Location: _____ Fund Source/s: _____

Implementing Agency/ies: _____
 Development Partner/s: _____
 Contractor/Supplier: _____
 Brief Description of Project: _____

Project Details:

Duration	Project Date		Percentage of Completion	Project Status			Remarks
	Started	Target Date of Completion		As of (Date)	Cost Incurred to Date	Date Completed	

For particulars or complaints about this project, please contact the Regional Office or Cluster which has audit jurisdiction on this project:

COA Regional Office No./Cluster: _____
 Address : _____
 Contact No. : _____ or Text COA Citizen's Desk at 0915-5391957

Tarpaulin, white, 8ft x 8ft;
 Resolution: 70dpi
 Font: Helvetica;
 Font Size: Main Information – 3"
 Sub-Information- 1"
 Font Color: Black



4 TECHNICAL SPECIFICATIONS

4.1 GENERAL

4.1.1 Technical Definition

The following definitions shall apply:

- a. Borehole means any drilled section of boring before completion as defined in well below.
- b. Casing means unslotted or non-perforated lining tubes.
- c. Development Equipment means high velocity jetting tool, surge plunger and all other equipment needed to develop the well.
- d. Diameters mean nominal diameters unless otherwise stated.
- e. Drilling Rig means drilling equipment and the auxiliary equipment for its operation.
- f. Drilling Unit as defined as Equipment.
- g. Final Well Design means the drawing and description prepared by the Contractor's Engineer upon completion of the drilling of the pilot hole and geophysical borehole logging specifying the final well construction.
- h. Lining Materials means any casing, screen, slotted lining or perforated lining tube whether permanently or temporarily installed in the borehole.
- i. Pumping Unit is the equipment used in the operation of the drilling activities, used in control of discharge rate, water level sounding pipe and discharge rate monitoring.
- j. Screens mean continuous wire wound stainless or low carbon steel screens, or slotted or perforated lining tube.
- k. Tentative Well Design means the contract drawing showing the estimated quantities of the work.
- l. Well - means any completed hole in which all lining material has been set, all grouting completed and all temporary lining removed.



4.1.2 Technical Standards

All materials or workmanship shall comply with the specifications. Other standards equal or superior to those enumerated in this specification, shall be acceptable, subject to the approval of the ZCWD.

4.1.3 Water Supply and Illumination

In the absence of adequate quantities of water or illumination required for drilling at the drilling site, the Contractor shall make such arrangements including the provision for mobile tanks or fixed as may be necessary to ensure a supply of water and illumination sufficient for drilling operations.

4.1.4 Electrical Power Supply

- a. The Contractor will make arrangements as may be necessary for the connection of or supply of power to site.
- b. Payment for the provision of electrical power supplies shall be deemed to be included in the rates entered in the tendered price for setting up equipment at the site, drilling rates and rates entered for operation of pumping unit.

4.1.5 Storage of Inflammables

The Contractor shall comply with all local authority regulations applicable to the use and storage of diesel oils, petrol, paraffin and other inflammable fuels used on the site, and shall ensure that adequate precautions are taken against fire.

4.1.6 Boundaries of Work

The ZCWD shall provide rights-of-way for the work specified in this Contract and make suitable provisions for ingress and egress, and the Contractor shall not enter or occupy with men, tools, equipment or material, any ground outside the property of the ZCWD without the written consent of the ZCWD of such property. Other employees of the ZCWD may, for all necessary purposes, enter upon the work premises used by the Contractor, and the Contractor shall conduct his work so as not to impede unnecessarily any work being done by others on or adjacent to the site.



4.1.7 Access Roads

The project site at barangay Mercedes has already an access road. Further improvement of the access road to the well, may be done by the Contractor at his own cost. The access road shall be kept in proper condition during the entire construction period.

4.1.8 Protection of Site

- a. Except as otherwise provided herein, the Contractor shall protect all structures, walks, pipelines, trees, shrubberies, lawns, etc., during the progress of their work; shall remove from the site all drill cuttings, debris, and unused materials, and shall upon the completion of the work restore the site as nearly as possible to its original condition, including removal of access tracks and the replacement, at the Contractor's sole expense of any facility or landscaping which has been damaged beyond restoration to its original condition all to the satisfaction of the Zamboanga City Water District.
- b. Water pumped from the well shall be disposed to a place approved by the ZCWD where it will be possible to dispose the water without damage to property or creation of a nuisance.

4.1.9 Site to be Kept Tidy

The Contractor shall at all time keep the site and all working areas in a tidy and workmanship condition and free from rubbish and waste materials.

4.1.10 Shop Drawings

- a. The Contractor shall, if requested by the ZCWD prior to start of each operation, produce for the ZCWD's approval shop drawings showing details of technical operations such as test of plumbness and alignment, the method of the slotted casing production, if so required, the methods of placement of formation stabilizer and/or cement grout, the arrangement for well testing, the method for well development and all other drawings pertinent to the well drilling, well construction operations and well development as requested by the ZCWD.
- b. Requested shop drawings shall be completed with respect to dimensions, design criteria, materials, methods of construction and the like to enable the ZCWD to review the information as required.



4.1.11 Well Head Protection

- a. At all times during the progress of the work, the Contractor shall protect the well in such manner as to effectively prevent either tampering with the well or the entrance of foreign matter into it, and upon its completion they shall provide and install a well head cap satisfactory to the ZCWD.
- b. In the event that the well becomes contaminated or that water having undesirable physical or chemical characteristics has entered the well due to the negligence of the contractor, the contractor shall at its own expense perform such work or supply casings, seals, sterilizing agents or other materials as may be necessary to eliminate the contamination or to exclude any undesirable water in the well.

4.1.12 Water Level Sounding

The Contractor shall provide a functioning and accurate water sounding instrument acceptable to the ZCWD to measure the water level during the drilling, development and testing of the well. Failure to provide such will subject the Contractor to a penalty of PhP1,000.00 per day from the date of the notice issued by the ZCWD until said instrument has been completed and shall be deducted from the monthly billing.

4.1.13 Transport Personnel and Equipment

- a. The contractor shall supply and operate all transport required for transporting his employees, materials and equipment.
- b. The cost of movement of personnel, materials and equipment shall be included in the rates given for drilling development and pump operation.

4.1.14 Site Preparation and Reinstatement

- a. The contractor shall prepare the site, provide all necessary tanks and pits and make all necessary arrangements for erecting and dismantling the drilling unit and shall reinstate the site on completion of such phase of work to the satisfaction of the ZCWD.
- b. Payment shall be deemed to be included in the items entered in the tendered price for erection and dismantling of drilling rigs.



4.2 WELL DRILLING

4.2.1 Scope

- a. The Contractor shall provide and operate one or more mobile Drilling Units required in completing the works within the contract period.
- b. The Contractor shall provide all auxiliary equipment, lubricants, fuels and spares necessary to keep the drilling rig(s) in continuous operation.

4.2.2 Equipment

- a. The drilling rig(s) together with all auxiliary equipment and personnel shall be defined as the Drilling Unit(s).
- b. All rigs shall have sufficient capacity to drill the specified borehole(s) in the diameters specified in the tentative well design(s) to a depth which is, at the minimum, 25% higher than indicated in the Contract Drawings.
- c. Payment for drilling shall be in accordance with the Bill of Quantities, where payment for drilling is by linear meter of borehole as measured after removal of drill string. The rates set against drilling items in the tendered price shall be deemed to include all equipment, personnel, fuels, and lubricants and the accessories required for operation of the Drilling Unit.
- d. The Contractor shall provide and operate one (1) mud rotary drilling rig including all auxiliary equipment necessary to complete the work within the contract period.

4.2.3 Drilling Method

- a. All drilling shall, unless otherwise specified in the Special Provisions, be performed with the rotary drilling method.
- b. The Contractor shall drill the hole to such depth and with such diameter, which shall enable an easy installation of casing and screen and placement of gravel envelope with a uniform thickness as specified, if required. During drilling of the hole, the Contractor shall ensure that the natural permeability of the yielding strata near the well bore is not irreversibly reduced due to the drilling method employed.
- c. The drilling shall be performed with the mud rotary method.



4.2.4 Pilot Borehole Drilling

The Contractor shall first drill the 250mmØ pilot borehole as specified in the preliminary well design to a target depth of 77.40 linear meters. The Contractor shall take all measures necessary to protect the borehole from caving. **Drilling of pilot hole directly to 250mmØ is not allowed.** The second drilling step is to ream the pilot hole to its full diameter as specified in the preliminary well design and in the bill of quantities. If the Contractor will introduce a methodology other than specified herein, it shall seek approval from the ZCWD.

4.2.5 Strata Sampling / Material Testing

- a. Strata samples shall be taken at one-meter intervals or more frequent if the formation penetrated changes. Samples shall be placed in plastic or other appropriate bags on which or in which the sampling depth and the date of sampling is written in such a manner that it is permanently readable.
- b. The sampling procedure must provide that all the fraction of the penetrated strata is present in the sample.
- c. Each sample shall be placed in a wooden box with space for storage of one sample and the sampling depth shall be written on the box.
- d. A record of samples taken with the details described above shall be submitted to the ZCWD every day.
- e. Payment for sampling shall be deemed to be included in the rates entered for drilling in the tendered price.
- f. The failure on the part of the Contractor to obtain, preserve and deliver samples or records, satisfactory to the ZCWD, shall be considered as actual damage to the ZCWD. Such failure shall entitle the Zamboanga City Water District to retain from the Contractor the sum of One Thousand (P1,000.00) as liquidated damages for each sample that the Contractor shall fail to obtain, preserve or deliver, or for each length of pipe not properly measured and recorded in the order in which it was placed in the well. In the event that, in the opinion of the ZCWD, the failure of the Contractor to take and preserve the samples may affect the proper design of the well, the Contractor may be required to perform such work as the ZCWD deems necessary to remedy such failure at no cost to the ZCWD. It is understood that the liquidated damages herein provided are fixed, agreed and not by way of penalty; and that the



ZCWD shall not be required to prove that he has incurred actual damages.

4.2.6 Drilling Mud

- a. Bentonite, if used, shall be of premium quality in accordance with API Standard 13A with 150 kg/cum of make-up water yielding a mud with a viscosity of between 35 and 40 seconds using a Marsh funnel and a mud weight of less than 1.10 kg/l (9.2 lbs/US gal.).
- b. Make-up water shall be treated with caustic soda (soda ash) to maintain the pH between 8.0 and 9.0 prior to mixing mud.
- c. During drilling with mud, the Contractor shall perform hourly measurements of the following mud characteristics:
 - pH value
 - Mud Viscosity
 - Funnel Viscosity
 - Specific Gravity
 - Sand Content
 - Filtration loss
 - Filter cake thickness

The drilling contractor shall maintain a drilling fluid log showing the date, time, depth, Marsh Funnel viscosity, drilling fluid weight and PH, and shall record any drilling fluid additives used, including time introduction as well as other pertinent information.

The recorded mud characteristics shall not exceed the following values, without prior approval of the ZCWD:

Specific Gravity	: 9.5 lb/gal
Sand Content	: 4%
Filtration Loss	: 10 ml
Filter Cake	: 1.5 mm

- d. It is the contractor's responsibility to assure that equipment for measuring fluid properties shall be at the drilling site.
- e. An Alternative to Bentonite: Polymer or other substitute may only be allowed, when it will be proven as more efficient, less cost, effective and not hazardous to the quality of water and no plugging effects to the aquifer, and as approved by the ZCWD.



4.2.7 Working Hours

All work from start of drilling of the borehole until completion of well development shall be on the round the clock basis (24 hours per day).

4.3 GEOPHYSICAL LOGGING

4.3.1 Scope

The Contractor shall perform geophysical logging as specified in this Technical Specifications

The work includes geophysical logging. Geophysical logging shall be done from ground surface down to 77.40 meters depth. The brief interpretation of the data obtained from the geophysical logging results and the recommended final well design should be signed and sealed by a Hydrogeologist (Photocopy of the License and Professional Tax Receipt of the signing professional should also be submitted).

In addition, the electronic file of the geophysical well logging results (Resistivity Log, Spontaneous Potential Log/Self-Potential Log (SP), Mud Viscosity Log and Penetration Rate) including the raw data shall be submitted to the Zamboanga City Water District together with the recommended final well design.

4.3.2 Equipment

- a. The geophysical logs may be recorded either by automatic recording on a chart strip or by manual reading of recorded values. In case the logs are recorded by the manual method, readings shall be taken per min. 0.33 m of borehole length.
- b. The recorded logs shall be submitted to the ZCWD immediately upon completion of logging as plots of recorded characteristics versus depth for his approval. In case of disapproval by the ZCWD, the logs shall be repeated immediately.

4.3.3 Logs

Geophysical logging shall comprise the following logs:

- Resistivity log (16" and 64")
- Self-potential log (SP)
- Mud Viscosity Log
- Penetration Rate



4.4 WELL CASING

4.4.1 Scope

The Contractor shall provide and install the well casing specified in the Contract Drawings and any temporary casing required during the work.

4.4.2 Casing Material

a. The Contractor shall, before commencement of the work, submit for the approval to the ZCWD the following details of all casing:

- Type of material
- Internal and external diameters
- Wall thickness
- Method of jointing

b. All permanent casing material shall be spiral welded steel pipe and of new stock unless otherwise specified in these documents.

c. All permanent casings to be installed shall be:

250mmØ UPVC casing with minimum thickness of 9.60mm and a maximum of 11mm as shown in the preliminary well design and should be of new stock.

d. The Contractor shall assume responsibility for any casing failure and shall correct, as approved by the ZCWD, any casing failure at no cost to the ZCWD. In the event that the Contractor cannot correct a casing failure, the Contractor shall replace the casing with material complying with the specifications, or if necessary, better casing as approved by the ZCWD at no extra cost.

e. The Contractor shall not be allowed to order casing materials prior the approval of the Final Well Design by the ZCWD. All casing materials shall be delivered based from the Approved Final Well Design, no payment shall be made for excess length of casing material that is not in accordance with the final well design.

4.4.3 Temporary Casing

The Contractor shall provide such temporary casing as may be necessary to prevent the collapse of any formation during the drilling operation to allow the well to be sunk to the specified depth and to allow



the insertion of permanent lining material as required. The Contractor shall remove the temporary casing before completing the well, unless otherwise specified in these documents.

4.4.4 Lining Installation

- a. Lining materials shall be assembled and located in the well at the required depth in a continuous operation. The lining material shall be set concentric within the borehole by centralizing bars unless otherwise agreed with the ZCWD.
- b. If the lining jams or is lost before it is set to the specified depth, the Contractor shall endeavor to remove the lining material from the well or, if unable to effect removal, shall re-drill the well and replace the lining material at their own expense.

4.4.5 Lining Material Accessories

- a. The Contractor shall provide as necessary the following accessories to set the lining materials to the required depth:
 1. Centralizers to be affixed to the lining material at intervals of 20 meters to locate the lining material in the center of the drill hole;
 2. Supporting clamps, equipment and tools;
 3. Reducing cones and connecting pieces;
 4. Casing hangers;
 5. All other necessary equipment.
- b. Except where expressly provided, all accessories shall be deemed to be included in the Bid Form for the provision and insertion of lining material.

4.4.6 Testing for Plumbness and Alignment

- a. All boreholes shall be constructed, plumb and true to line as defined herein. To demonstrate the compliance of contractor's work with this requirement, the Contractor shall furnish all labor, tools and equipment and shall provide the detailed drawings and the description of the tests to the satisfaction of the ZCWD.
- b. Tests for plumbness and alignment must be made after the complete construction of the well and before its acceptance. The Contractor, however, may make additional tests, during the performance of the work. No specific payments shall be made for making these tests.



- c. Should the results of the test for plumbness and alignment show that the plumb bob of dummy fails to move freely throughout the length of the lining or borehole to a depth of the lowest anticipated pump setting and should the well vary from the vertical in excess of two thirds of the smallest inside diameter of that part of the well being tested or beyond the limitations of this test, the plumbness and alignment of the well shall be corrected by the Contractor at his own expense. Should the Contractor fail to correct such faulty alignment or plumbness, the ZCWD may refuse to accept the well and the Contractor shall drill a new well without charge to the ZCWD.

4.5 WELL SCREENS

4.5.1 Scope

The Contractor shall provide and install the well screens specified in the Contract Drawings, unless otherwise specified in the Special Provisions.

4.5.2 Type of Screens

- a. The type of screens shall be as specified in the tentative well design.
- b. Slotted screens, if specified for installation, shall be so fabricated as to ensure the maximum yield of the well and to prevent clogging and encrustation and shall be free from jagged edges and irregularities that may accelerate clogging or corrosion.
- c. The screens shall be UPVC screen in accordance with ISO 9002 standard or equivalent, 3 meters length per piece and of new stock. The screen specifications shall be subject to evaluation as to the quality, efficiency and must be cost effective. Photocopies of receipts of purchase duly certified shall be submitted to ZCWD as proof of purchase.

4.5.3 Responsibility for Malfunction

- a. The Contractor shall assume full responsibility for any malfunction of the screen caused by inadequate installation procedure and shall undertake any correction as approved by the ZCWD at no extra cost to ZCWD.



- b. The screen must have no change of alignment at any of its joints after installation. If requested by the ZCWD, the Contractor shall submit for approval by the ZCWD the design and method of construction and installation of the screen.
- c. In the event that the Contractor cannot correct a screen failure, the Contractor shall replace the screen with material complying with the specifications of this Contract at no extra cost to the ZCWD.

4.5.4 Screen Strength

The screens shall have adequate strength to resist the external forces that may be applied during and after installation.

4.5.5 Screen Accessories

All fittings, packers, couplings, joints, plugs and seals used during installation of well screen together with the installation procedure, shall be to the approval of the ZCWD.

4.6 FORMATION STABILIZER/GRAVEL PACK

4.6.1 Scope

The Contractor shall provide and install formation stabilizer, or gravel pack as specified in the Contract Drawings and the Special Provisions.

4.6.2 Material

- a. The formation stabilizer/gravel pack material shall be #5 & #10 and shall consist of well-rounded, water worn siliceous grains. Angular chippings or road stone must under no circumstances be used as formation stabilizer/gravel pack material.
- b. The Contractor during the mobilization period shall submit to the ZCWD for his approval, samples of the formation stabilizer it proposes to use, stating the source of the formation stabilizer, quantities available, rate of delivery and any other information requested by the ZCWD.



4.6.3 Method of Installation

The method of placing the formation stabilizer/gravel pack in the annulus shall be such that separation of the gravel and bridging is avoided.

4.7 WELL DEVELOPMENT

4.7.1 Scope

- a. The Contractor shall furnish compressors, surge plungers, jetting tools, electric generators, chemicals and any other equipment required for satisfactory well development and shall undertake the development as directed by the ZCWD.
- b. Development shall comprise deflocculation, high velocity jetting in continuous slot screens, surging with plunger in slotted screens, unless otherwise, specified in this Technical Specifications.
- c. Well development for each production well shall consist of deflocculation, surging with plunger and bailing, water jetting and airlifting.

4.7.2 Expected Yield

- a. The Contractor shall develop the well to its maximum expected yield, as specified in the Technical Specifications.
- b. The production well is expected to yield at 242.15 gallons per minute (15.27 liters per second).

4.7.3 Surging with Plunger

- a. Upon completion of installation of lining or formation stabilizer/gravel pack, the Contractor shall develop the well by mechanical surging with a valve-type surge plunger approved by the ZCWD.
- b. Before start of surging and with one-hour intervals during the surging operation, the depth to the well bottom and to the top of gravel pack shall be recorded.



- c. Surging shall be continued until accumulation of sediments in the sump pipe, during a one-hour period surging operation, is negligible.

4.7.4 Deflocculation

- a. Upon completion of installation of lining or formation stabilizer/gravel pack, the drilling mud shall immediately be displaced from the well by pumping clean water into the sump pipe
- b. Mud displacement shall immediately be followed by injection and/or jetting through the screened sections with polyphosphate solution to deflocculate the mud cake on the borehole wall. The concentration of the polyphosphate solution shall be 3.0 percent by weight of the quantity of water in the borehole. The well shall then be left for 12-24 hours before developing is continued, to allow the polyphosphate to react; however, if the drilling mud viscosity during drilling had been or had exceeded 40, the percentage of the polyphosphate solution shall be increased proportionately with the increase of viscosity.

4.7.5 High Velocity Jetting

- a. After the deflocculation material has been allowed to work for 12-24 hours, all sections screened with continuous slot screens shall be developed by high velocity jetting.
- b. The jetting tool shall be equipped with two or four nozzles. The nozzle design shall be such that it produces a concentrated jetting action. The tool shall be presented to the ZCWD for approval before the start of drilling operation.
- c. The jetting tool shall also be equipped with a circular brush or any approved equivalent to facilitate cleaning. The jetting tool with equipped brush shall be presented to the ZCWD for approval before the start of drilling operation.
- d. The jetting tool shall be supplied with water through a high-pressure pump capable of producing a nozzle velocity appropriate to develop a well in order to maximize well yield. The pump shall be equipped with suitable pressure gauge on the discharge side to facilitate monitoring of nozzle velocity.



- e. The development shall be carried out by slowly rotating the jetting tool and gradually lowering it in order to cover the entire surface of the screen.
- f. At the same time as the high velocity jetting is performed, the well shall be discharged with a discharge rate slightly higher than the discharge rate from the jetting tool.
- g. Each section of the screen shall be jetted until the return water is free from drilling mud, but no section shall be jetted less than 15 minutes per meter of screen.

4.7.6 Well Cleaning

Upon completion of the development operations, the Contractor shall demonstrate to the satisfaction of the ZCWD that the bottom of the well is clear of all sand, mud and other foreign materials.

4.7.7 Freedom from Sand

- a. The Contractor shall develop the well by the methods specified until the water pumped from the well is substantially free from sand and until the turbidity is less than 5 on the Silica Scale described in the Standard Methods of Water Analysis (latest edition as published by AWWA, APHA and WPCT).
- b. The water pumped from the well shall not contain an amount of fine material in excess of 1.0 mg per liter when the well is pumped at its maximum expected yield. The Contractor shall furnish the equipment for measurement of the sand content.

4.7.8 Acceptance and Development

- a. The development by the specified methods shall be repeated and continued until the well is thoroughly developed in accordance with the criteria specified.
- b. If the well yield after the well has been confirmed sand-free is still below the yield, which is considered acceptable for the penetrated aquifer, then the ZCWD may instruct the Contractor to perform further development.