

General Technical Specifications

I. GENERAL

1.1 Technical Definitions

The following definitions shall apply:

1. Borehole - means any drilled section of boring before completion as defined in well below.
2. Casing - means unslotted or non-perforated lining tubes.
3. Development Equipment - means high velocity jetting tool, airlift equipment, surge plunger and all other equipment needed to develop the well.
4. Diameters - means nominal diameters unless otherwise stated.
5. Drilling Rig - means the drilling equipment and the auxiliary equipment for its operation.
6. Drilling Unit - as defined in Section 2.2 of the General Technical Specifications.
7. Final Well Design - means the drawing and description prepared by the Engineer upon completion of drilling specifying the final well construction.
8. Lining Materials - means any casing, screen, slotted lining or perforated lining tube whether permanently or temporarily installed in the borehole.
9. Pumping Unit - as defined in Section 8.7 of the General Technical Specifications.
10. Screens - means slotted or perforated lining tube.
11. Well - means any completed hole in which all lining material has been set, all grouting completed and all temporary lining removed.

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 Engineer. The opinion of the Engineer must be obtained prior to utilizing such materials or workmanship on or off the site.

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 tanks as may be necessary to ensure a supply of water and illumination sufficient for drilling operations.

1.4 Electrical Power Supply

1. The Contractor will make arrangements as may be necessary for the connection of or supply of power to the site.

2. Payment for the provision of electrical power supplies as specified in Section 1.4.1 of General Technical Specifications shall be deemed to be included in the rates entered in the Bid Form for setting up equipment at the site, drilling rates and rates entered for operation of pumping unit.

1.5 Boundaries of Work

The Owner shall provide land or 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 Owner without the written consent of the Owner of such property. Other Contractors and employees or agents of Tubod-Baroy Water District and/or the Owner may, for all necessary purposes, enter upon the work and premises used by the Contractor, and the Contractor shall conduct his/her work so as not to impede unnecessarily any work being done by others on or adjacent to the site.

1.6 Access Roads

Construction or improvement of access roads to the wells shall, unless otherwise agreed, be done by the Contractor at his/her own cost, which is deemed to be included in the contract sum. The access road shall be kept in proper condition during the entire construction period.

1.7 Protection of Site

1. Except as otherwise provided herein, the Contractor shall protect all structures, walks, pipelines, trees, shrubberies, lawns, etc., during the progress of his/her 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 Engineer.
2. Water pumped from the well shall be conducted to a place approved by the Engineer where it will be possible to dispose the water without damage to property or creation of a nuisance.

1.8 Site to be kept Tidy

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

1.9 Site Preparation and Reinstatement

1. 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 Engineer.
2. Payment shall be deemed to be included in the items entered in the Bid Form for erection and dismantling of drilling rigs.

2. WELL DRILLING

Scope

2.1

1. The Contractor shall provide and operate mobile Rotary Drilling Units required to complete the works within the contract period.
2. The Contractor shall provide all auxiliary equipment, lubricants, fuels and spares necessary to keep the drilling rig(s) in continuous operation.

2.2 Equipment

1. The drilling rig(s) together with all auxiliary equipment and personnel shall be defined as the Drilling Unit(s).
2. 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 min. 25% higher than indicated in the Contract Drawings.
3. Payment for drilling will be by the linear meter of borehole as measured after removal of drill string. The rates set against drilling items in the Bid Form shall be deemed to include all equipment, personnel, fuels and lubricants and the accessories required for operation of the Drilling Unit.
4. When the Drilling Unit is being used for a purpose other than drilling, then the rates for that purpose entered in the Bid Form shall be deemed to include the running costs of the Drilling Unit.

2.3 Drilling Method

1. All drilling shall, unless otherwise specified in the Special Technical Conditions, be performed with the rotary drilling method.
2. The Contractor shall drill the hole to such depth and with such a 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.

2.4 Strata Sampling

1. Strata samples shall be taken at 1 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.
2. The sampling procedure must provide that all the fractions of the penetrated strata are present in the sample.
3. 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.
4. A record of samples taken with the details described above, shall be submitted to the Engineer everyday.

2.5 Drilling Mud

1. Biodegradable mud (Revert® or similar) should be used and shall be the basis for the priced offer. The Contractor is to specify the kind and make of the additive and its properties in Section 6 of the Tender Documents.
2. 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 lb/US gal.).
3. 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.

3. GEOPHYSICAL LOGGING

3.1 Scope

The Contractor shall, if specified in the Special Technical Conditions, perform geophysical logging as specified in the Special Technical Conditions.

3.2 Equipment

1. 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.
2. The recorded logs shall be submitted to the Engineer immediately upon completion of logging as plots of recorded characteristics versus depth for his/her approval. In case of disapproval by the Engineer, the logs shall be repeated immediately.

4. WELL CASING

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, unless otherwise specified in the Special Technical Conditions.

4.2 Casing Material

1. The Contractor shall, before commencement of work, submit for the approval of the Engineer the following details of all casing:
 - a. Type of material
 - b. Internal and external diameters
 - c. Wall thickness
 - d. Method of jointing

4.3 Testing for Plumbness and Alignment

1. All boreholes shall be constructed, plumb and true to line as defined herein. To demonstrate the compliance of his/her 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 Engineer.
2. Tests for plumbness and alignment must be made after the complete construction of the well and before its acceptance. Additional tests, however, may be made by the Contractor during the performance of the work. No specific payments shall be made for making these tests.
3. Should the results of the tests for plumbness and alignment show that the plumb bob or 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/her own expense. Should the Contractor fail to correct such faulty alignment or plumbness, the Engineer may refuse to accept the well and the Contractor shall drill a new well without charge to Tubod-Baroy Water District and/or the Owner.

5. WELL SCREENS

5.1 Scope

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

5.2 Type of Screens

1. The type of screens shall be as specified in the tentative well design and the Special Technical Conditions.

6. FORMATION STABILIZER/GRAVEL PACK

6.1 Scope

The Contractor shall provide and install formation stabilizer, or gravel pack if specified in the Contract Drawings and the Special Technical Conditions.

6.2 Material

1. The formation stabilizer/gravel pack material shall consist of well rounded, water-worn siliceous grains. Angular chipping or road stone must under no circumstances be used as formation stabilizer/gravel pack material.
2. The Contractor shall, during the mobilization period, submit to the Engineer for his/her approval, samples of the formation stabilizer he/she proposes to use, stating the source of the formation stabilizer, quantities available, rate of delivery and any other information requested by the Engineer.

7. WELL DEVELOPMENT

7.1 Scope

1. 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 Engineer.
2. Development shall, if the percussion drilling method is applied, comprise surging with plunger and development by airlifting unless otherwise specified in the Special Technical Conditions.
3. Development shall, if the rotary method is applied, comprise deflocculation, high velocity jetting in continuous slot screens, surging with plunger in slotted screens and development by airlifting, unless otherwise specified in the Special Technical Conditions.

7.2 Expected Yield

The Contractor shall develop the well to its maximum expected yield, as specified in the Special Technical Conditions, by the methods specified in Section 7.2 of the Special Technical Conditions.

7.3 Surging with Plunger

1. 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 Engineer.
2. Before start of surging and with 1 hour intervals during the surging operation, the depth to the well bottom and to top of gravel pack shall be recorded.
3. Surging shall be continued until accumulation of sediments in the sump pipe, during a 1 hour period surging operation, is negligible.

7.4 Development by Airlifting

1. Upon completion of high-velocity jetting, and/or surging with plunger, the well shall be discharged by the airlifting method.
2. The compressor used for pumping by airlifting shall be capable of developing a minimum pressure of not less than 250 psi. The delivery shall be no less than 21.25 cum air per minute.
3. The quantity of water discharged from the well and the drawdown in the well at the commencement of the development shall be limited and shall be gradually increased only as the water clears. From time to time the air flow shall be stopped to facilitate loosening of trapped sand grains. The well may also be backwashed by pumping clean water into the well.
4. During the airlifting operation, position of air pipe and conductor pipe, drawdown in well, approximate yield and time for each change in position shall be recorded by the Contractor.
5. The development shall be completed with a conductor pipe not more than 0.5 m above the bottom of the well to ensure that all sand has been cleaned out of the sump pipe.

7.5 Well Cleaning

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

7.6 Freedom from Sand

1. 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 Standard Methods of Water Analysis (latest edition as published by AWWA, APHA and WPCT).
2. 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 equipment for measurement of the sand content shall be furnished by the Contractor.

7.7 Acceptance of Development

1. The development by the specified methods shall be repeated and continued until the well is thoroughly developed in accordance with the criteria specified in Section 7.8 of the General Technical Specifications.
2. 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 Engineer may instruct the Contractor to perform further development.

8.0 WELL TESTING

8.1 Scope

The Contractor shall, unless otherwise specified in the Special Technical Conditions, provide and operate a Pumping Unit for the following purposes:

1. Step-drawdown pumping tests on the completed well
2. Continuous constant discharge pumping test on the completed well.

8.2 Equipment Capacity

1. The Contractor shall provide and operate pumping machinery capable of carrying out the specified pumping and shall provide adequate controls to allow discharge rates to be kept constant at varying pumping water levels and to permit pumping with a variation of not more than 5% of the designated discharge rate during any period of yield or aquifer testing.
2. The Pumping Unit set shall be able to deliver a discharge rate, which is min. 50% higher than the expected yield of the well and a minimum discharge, which is maximum 15% of the expected yield of the well when suitably throttled by use of a gate valve.
3. Suitable pumping machinery will be deemed to be:

- i. Submersible electric pump unit together with generator and such accessories needed to run the pump.
- ii. Line-shaft pump and internal combustion prime mover together with all accessories needed to run the pump.

8.3 Equipment Operation

1. The Contractor shall supply and operate all equipment and accessories necessary for installation and removal of pumps.
2. The Contractor shall maintain on site sufficient fuels, lubricants, spares and other accessories needed to run the Pumping Unit for whatever period may be specified by the Engineer.
3. The Contractor shall provide sufficient competent personnel including a qualified fitter and electrician, as may be necessary to install and operate the Pumping Unit.

8.4 Control of Discharge Rate

The Contractor shall, during the pumping tests, provide a suitable gate valve on the discharge pipeline, to facilitate easy control of the discharge rate. Discharge shall be controlled with a valve fitted behind the elbow and measured with a water meter, fitted at a distance of not less than 1 m behind the valve. An additional measuring device (e.g. oil drum and stopwatch) shall be provided for back up and checking. Drawdown and recovery of the water level is to be monitored with a water level indicator through the piezometer pipe at intervals as specified by the Engineer on the site. The Engineer may demand water quality measurements. He will provide the monitoring forms.

8.5 Water Level Sounding Pipe

1. The Contractor shall, if instructed by the Engineer, provide and install a temporary tube of at least 1 inch diameter from the top of the well to 2 meters above the pump bowl assembly to facilitate easy measurements of water level. The tube shall be open only at the bottom and top.
2. Payment for providing, installing and removing the tube shall be deemed to be included in the rates given for pumping tests.

8.6 Discharge Rate Monitoring

Discharge rates up to 10 L/s (36 cum/hr) may be measured by drum filling. Discharge rates in excess of 10 lps shall be recorded with a water meter or by a V-notch weir or with orifice discharge pipe. All items are subject to the Engineer's approval before start of drilling.

8.7 Equipment Breakdown During Pumping

The pumping must be continuous and at a constant rate during the pumping tests. The Engineer will instruct the Contractor as to the expected maximum duration of each pumping test before start of each test.

1. If pumping is interrupted or the discharge rate fluctuates by more than 5% of the designated discharge rate, the test may be repeated after a period of recovery determined by the Engineer.
2. If any pumping test is interrupted because of equipment breakdown or inadequate supervision or discharge control, no payment will be made for any pumping period before commencing the test.

8.8 Duration of Tests

1. The step-drawdown pumping tests shall be performed on 5 steps with a duration of 1 hour each.
2. The continuous constant discharge pumping tests shall be performed for a period of 3-5 days, unless otherwise specified in the Special Technical Conditions or unless otherwise instructed by the Engineer.

9.0 CEMENT GROUTING

9.1 Scope

The Contractor shall, unless otherwise specified in the Special Technical Conditions, provide the cement and mixing equipment required for the mixing of the grouting indicated in the Tentative Well Design and shall place the cement grout as specified.

9.2 Grouting Material

1. Cement grout shall consist of a mixture of 95% Portland Cement, 5% bentonite and clean water, mixed in the proportion of 52.5 kg of Portland Cement/bentonite to max. 30 liters of water.
2. All cement shall, unless otherwise specified in the Contract Documents, conform to the "Specifications for Portland Cement" (ASTM C150-latest revision).

10.0 WELL DISINFECTION AND CLEANING

10.1 Scope

1. The Contractor shall upon completion of well construction and well testing thoroughly clean the well of all foreign substances including tools, timbers, rope, debris of any kind, cement, oil, grease and scum.
2. The casing pipe shall be thoroughly swabbed using alkalis, if necessary, to remove oil and grease of joint dope.

10.2 Cleaning of Test Pump

In the event that the test pump is to be installed after the well has been disinfected, all exterior parts of the test pump coming in contact with the water shall be dubbed with a chlorine solution as directed by the Engineer.

11.0 WELL COMPLETION

11.1 Scope

The Contractor shall provide and operate all equipment necessary to restore the site as near as possible to its condition before commencement of drilling and shall furnish and install a well head cap as specified in the Contract Drawings.

11.2 Site Restoration

The site shall be restored to a condition as nearly possible to that which existed before the well drilling and testing activities commenced. This work shall include, but not be limited to, restoration of fences and structures, removal of drill cuttings, leveling of the disturbed ground surfaces and replacement or compensation for the destroyed plants and landscaping.

11.3 Well Head Capping

The well head shall be completed with a well head assembly fully welded to the upper casing as well as a water level sounding tube with screw cap in order to prevent any unauthorized tampering of the well.

12.0 SUBMITTAL OF REPORTS AND BOREHOLE DATA

12.1 Scope

1. The Contractor shall submit to the Engineer daily records in duplicate containing the following information:

Site:

Date:

Description of each stratum encountered:

Depth below ground of each change of stratum:

Depths and details of all disturbed samples:

2. The Contractor will be required to keep a record of penetration rate, mud losses and mud conditions.
3. At the end of the well construction and before final payment is made, the Contractor shall submit to the Engineer a report containing the following information:
 - a) The total depth of the well
 - b) Description of the strata encountered
 - c) The sizes and the lengths/specifications of the casing installed
 - d) The date of the start and the completion of the well construction
 - e) The locations and the description of the casing perforations or the well screen placement.
 - f) The locations of the gravel, the size of gravel, if applicable, and the amount of cement grout installed
 - g) Records of discharge rates and drawdown during well development together with description of the methods of the development
 - h) The well yield (expressed as discharge rate and drawdown), the dates and the duration of the test(s)
 - i) The methods of measuring the discharge rate and the drawdown
 - j) Pump test evaluation including drawdown graphs, other illustrations, calculation of hydraulic parameters (transmissivity, storage coefficient, well and aquifer efficiency, specific capacity, etc.)
4. The cost of records shall be deemed to be included in the contract rates.

Special Technical Conditions

1. GENERAL

1.1 Scope

The work includes the drilling of one (1) production wells in Brgy. Poblacion, Baroy, Lanao del Norte.

2. WELL DRILLING

2.1 Equipment

The Contractor shall provide and operate one (1) Rotary drilling rig including all auxiliary equipment necessary to complete the work within the contract period.

2.2 Drilling Method

All drilling shall be performed with the mud rotary method.

3. GEOPHYSICAL LOGGING

3.1 Scope

The work includes geophysical logging (refer to Section 3.3 of the General Technical Specifications).

The Engineer and the operator of the logging device will decide jointly on the logging velocity. The logging direction shall generally be from bottom to top. Processing of the measurements and printout of graphs must take place on the site. The Contractor shall assign the borehole logging to a person familiar with

the instrument and the data processing. "Learning-by-doing" will not be accepted. The borehole logging is remunerated per meter of borehole logged, but for complete loggings over the entire length of the hole, only.

4. WELL CASING

4.1 Well Dimension

Reaming from 250 mm diameter Pilot Hole to 450 mm diameter

4.2 Casing Material

All permanent casings to be installed shall be 250 mm diameter spiral welded steel casing with minimum wall thickness of 6 mm including 1 meter stick-up pipe and should be of new stock.

5. WELL SCREEN

5.1 Well Screen Materials

Well screens have to be designed to match with the casing supplied under this contract.

Furnishing of 250 mm nominal diameter stainless steel, continuous slot wedge wire wound screen slot 1.5 mm, 3m per length.

6. FORMATION STABILIZER/GRAVEL PACK

6.1 Scope

The Contractor shall provide formation of stabilizer and install graded gravel pack materials with grain size 4 to 7 mm. The final grain size of the gravel pack to be installed, if any, shall be determined based on the strata samples collected during drilling.

6.2 Materials

Furnishing and installation of 50 mm dia. G.I (Schedule 40) gravel fill-up pipe with screw cap

7. WELL DEVELOPMENT

7.1 Scope

Well development for the production wells shall consist of de-flocculation, surging with plunger including bailing out of sediments, high pressure water jetting, airlifting, discharge pump test, cement grouting.

7.2 Expected Yield

The production wells are expected to yield from 7 to 12 L/s.

8. WELL DISINFECTION AND CLEANING

The work does not include disinfection with a chlorine solution.

9. WELL COMPLETION AND SUBMISSION OF WELL REPORT

Demobilization (resource movement, site clean-up & restoration, water quality testing & report, final well report).

At the end of the well construction and before final payment is made, the Contractor shall submit to the Engineer a report containing the following information:

- a.) The total depth of the well
- b.) Description of the strata encountered
- c.) The sizes and the lengths/specifications of the casing installed
- d.) The date of the start and the completion of the well construction
- e.) The locations and the description of the casing perforations or the well screen placement.

- f.) The locations of the gravel, the size of gravel, if applicable, and the amount of cement grout installed
- g.) Records of discharge rates and drawdown during well development together with description of the methods of the development
- h.) The well yield (expressed as discharge rate and drawdown), the dates and the duration of the test(s)
- i.) The methods of measuring the discharge rate and the drawdown
- j.) Pump test evaluation including drawdown graphs, other illustrations, calculation of hydraulic parameters (transmissivity, storage coefficient, well and aquifer efficiency, specific capacity, etc.)