Technical Specifications

Deep Tube Well (DTW)

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Scope of works

The scope of works is the drilling of 4 deep tube wells (DTW).

The work consists of drilling 4 boreholes (8 wells in two lots) to the required depth for finding water of sufficient quantity and quality, the installation of a Tara hand pump and the construction of a platform and drainage as detailed in the BoQ.

The work includes drilling boreholes, delivery and installation of casings and screens; development of the boreholes and test pumping as specified hereinafter and as directed by the Supervisor.

Drilling sites

The Contractor shall drill the boreholes at the exact locations designated by the Client or the Supervisor. Tracks required for access of drilling plant, gear, camp and accessories to the borehole site shall be made by the Contractor, and should as little as necessary interfere with existing structures. Any modification necessary for the work done on the drilling site, e.g. dug ponds or trenches, must be backfilled and rehabilitated after the completion of the works.

Environmental protection of the site

Care must be taken in the handling and storage of all drilling fluids, oils, greases and fuel on site, to avoid any environmental degradation. The Contractor shall dispose of any toxic materials, drilling fluids and other additives, cuttings and discharged water in a manner approved by the Supervisor so as not to create damage to public and private property.

Professional standards

The Contractor is expected to carry out all works as instructed by the Supervisor in a thorough and workman-like manner and conducted in accordance with professional standards. The Contractor shall carry out operations with due efficiency in accordance with the terms of the contract and to the satisfaction of the Supervisor. For this purpose, the Contractor shall use suitable equipment, and supply efficient and experienced staff.

The Contractor shall appoint a coordinator with an excellent command of English (spoken, read and written). This person shall be fully in charge of all of the drilling works and related activities, and will be on site during all of the drilling works and related activities (casing installation, pumping test, etc.).

Equipment and materials

All necessary machinery, equipment and materials to carry out the drilling, test pumping, headwork construction, etc as specified in the Bill of Quantities (BoQ) are to be mobilised for the Works by the Contractor. This specifically includes water and electricity needs which must not be requested from nearby households without informing the Supervisor.

Supervision of the works

The execution of the Works is to be supervised by the Contractor’s site coordinator in close coordination with the Clients appointed Supervisor (Engineer in Charge).

Borehole depth and diameter

The Contractor shall drill to the total appropriate depth depending on the geological formations and to a diameter of 7 inch that shall allow nominal diameter casing of 4 inches to a depth of 150 feet and a diameter of 5 inches that shall allow nominal diameter casing of 2 inches between 150-750 feet maximum. All casing will be threaded, and will be screwed together. The minimum depth of the borehole shall be 500 feet and the estimated maximum depth shall be 750 feet. If the Supervisor finds it necessary to decrease or increase the depth of the borehole the Contractor shall do so after having sought confirmation with the Client's Engineer in Charge. Payment will be based on actual depth of the borehole according to the BoQ per foot (as built).

Drilling method

The Contractor shall utilize machinery such as a drilling rig with rotary jetting only. The use of bentonite mud, lost circulation agents or any form of plugging material that may ultimately affect the production capacity of the water bearing strata intersected may be used in exceptional cases. If drilling mud is used, the Contractor will flush the borehole with Telbon or an equivalent product after completion of the borehole.

Any drilling fluid additives must be approved by the Supervisor, and must be of a low solid, non-toxic degradable type. Animal faecal matter must not be used under any circumstances.

The depth of the borehole is estimated to be between 500 and 750 feet and will be dependent on the depth where the aquifer is found with the sufficient layer of coarse sand, so that the yield will be enough for production of minimum 10 m^3 of water per day.

The Client will not be held responsible for boreholes lost due to insufficient method. Payment will be done based on the depth of the successful borehole handed over to the Client that fulfils the specification according to the BoQ (as built).

In case no water of sufficient quantity or quality is found at the specified sites, the Contractor will prove the appropriate drilling method and machinery. If completed, the drilling costs (labour & materials) will be equally shared between the Client and the Contractor. The Contractor will make a maximum of 1 additional attempt per drilling site upon having sought confirmation with the Client's Engineer in Charge.

Temporary casing

Installation and diameter of any temporary casing required for the successful construction of the boreholes will be at the discretion of the Contractor provided that the completed borehole meets the specifications and design required under this Contract and is approved by the Supervisor. The cost for supply, installation and removal of temporary casing shall be entirely for the Contractor. The Contractor cannot claim any casing left in the borehole that is not retrievable, from the Client.

Water and electricity supply for drilling

The Contractor shall make own arrangements for obtaining, storing, transporting and pumping of water, and electricity needs required for drilling purposes, for the machinery used for test pumping and flushing, and for use by the drilling crew at their campsite. No water and electricity shall be requested from nearby household without informing the Supervisor.

On-site pollution

The Contractor will take all necessary measures to prevent soil or surface water pollution of the drilling sites by means of hydraulic oil, motor oil, fuel, etc. Any accidentally polluted soil will be removed by the Contractor at his costs. Final payments will depend on rehabilitated drilling sites.

Verticality

All boreholes shall be vertical, shall be drilled and cased straight, and all casings/screens shall be set round, plumb and true to line. If required by the Supervisor, the Contractor will make a verticality test during and after drilling by approved methods and at his own expense to demonstrate that the departure from the vertical does not exceed 3 mm per 1 m between ground level and the bottom of the borehole. If this departure is exceeded, the Contractor shall make the necessary corrections to the approval of the Supervisor, without additional payment. If the error cannot be corrected, then drilling shall cease, and a new borehole shall be drilled at a position nearby, indicated by the Supervisor. The abandoned borehole shall be backfilled and/or capped by methods approved by the Supervisor. No payment will be made for the re-drilling, the sealing/backfilling of the abandoned borehole, or for moving to the new site. Any materials (i.e. casing, screens, gravel pack, cement, etc.) lost in the abandoned borehole will be to the Contractors cost.

Sanitary seal

On top of the sand pack a clay seal (preferably using clay pellets) of approximately 30 feet length shall be installed to prevent contaminants from above to enter the well and the screened section.

To provide an effective seal against the entry of contaminants, the upper 10 feet of the annular space between the casing and the borehole wall shall be grouted using a cement slurry of 1.85-2.15 kg cement/litre. Grout shall be injected into the annulus in a single operation so that a complete and continuous seal is achieved, by a method approved by the Supervisor. However, the top 1.2 feet of the annulus shall be left ungrouted but temporarily back-filled with inert drill cuttings.

Collection of soil samples

The Contractor shall take at least one sample every 10 feet of drilling and at every change in rock formation. The sampling technique will be indicated by the Supervisor, and is to be strictly followed by the Contractor. Each sample should weigh a minimum of 500 grams. All results shall be presented in the final documentation handed over to IFRC/BDRCS.

Completion, development and cleaning of boreholes

Prior to drilling the Contractor shall hand over to the Supervisor the full technical specifications of all materials used for the completion of the borehole. This includes the technical specifications of plain and screened casings, gravel pack, clay seal, etc. If these specifications are unsatisfactory to the Supervisor, the Contractor shall use other materials, to the satisfaction of the Supervisor. The Contractor shall execute the completion of the borehole exactly according to the design of the Supervisor.

The Contractor shall develop and clean the boreholes upon installation of casing, screens, and filter pack, in order to remove native silts, clays, loose rock particles and drilling fluid residues deposited on the borehole wall during the drilling process. If organic drilling fluids are used, they shall be broken down chemically according to manufacturer’s recommendations before or during development. Cleaning will be carried out by airlift, if necessary pumping, surging, backwashing or jetting may also

be used, to the approval of the Supervisor. Clay desegregation by means of Sodium Hexametaphosphate ("Calgon") treatment may, in some cases, also be called for by the Supervisor.

The minimum requirement is the "air-lift" method which will be applied by a compressor of sufficient capacity and discharge until the well provides clean and turbidity free water, to the opinion of the Supervisor. Before start of the operations, the Contractor shall hand over the technical specifications of the compressor to be used to the Supervisor for approval. If clean water is not produced after 6 hours, air-lift will be carried-out until the water becomes clear. Upon completion of development, any accumulation of material shall be removed from the bottom of the borehole by airlifting.

The Contractor will make arrangements so as to estimate the well yield during well development.

Test pumping

The Contractor shall perform test pumping to establish the performance and yield of the borehole, and shall provide a suitable, self-contained, mobile test pumping unit, approved by the Supervisor, for this purpose. The method for varying the discharge rate of the pumps will depend on the type of pump used, but the Contractor shall ensure the provision of a suitable means of achieving the range of constant flow rates specified by the Supervisor.

Test pumping will be undertaken in the borehole as assessed by the Supervisor from the yields indicated during drilling and development.

The borehole will be tested by means of a step-test, with the initial step being at about 0,25 x Q_{MAX}, and the subsequent steps 0,5 x Q_{MAX}, 0,75 x Q_{MAX} and Q_{MAX}. The duration of each step shall be 120 minutes (or until steady-state is achieved), and the test will comprise a minimum of four steps of increasing discharge. The final step should lower the dynamic water level to approximately three metres above the level of the pump. Discharge for each step should be kept constant. On completion of the final step, the recovery of water level should be monitored by the Contractor until 95 % recovery has been achieved, or until advised by the Supervisor. The pumping test will be for 72 hours or as agreed with the Supervisor.

Discharge shall be measured by volumetric methods, or by means of some other approved calibrated measuring device.

During all testing operations, once the flow rate has been determined and preliminary adjustments made, the measured discharge rate shall be maintained within 5 % of the required rate for the duration of the test or test stage. Persistent fluctuations beyond this tolerance will require abortion of the test.

When continuous pumping at a uniform rate is specified, failure of the pump operation for a period greater than one percent of the elapsed pumping time shall also require abortion of the test.

Any test which is aborted due to the reasons above shall be repeated, after full recovery of the water level. No payment shall be made to the Contractor for aborted tests, nor for standing time during water level recovery after aborted tests.

Water level observations

The Contractor shall facilitate appropriate electric contact water level gauges for measuring water levels in the boreholes. Water levels shall be measured during test pumping at pre-determined intervals, provided to the Contractor by the Supervisor, depending on the nature of the test. The frequency of measurement shall be specified in an agreed test pumping data form or as otherwise determined by the Supervisor. Well head arrangements shall permit these gauges to be inserted and

passed freely. Any other method of measuring water levels will be subject to approval by the Supervisor.

Records and reporting

The Contractor shall keep daily activity records for each borehole. The records shall contain the information as specified below.

Daily Record

Site name

Reference number of borehole

GPS Co-ordinates of borehole (latitude / longitude)

Date of reporting

Names of foreman and drillers

Method of drilling

Diameter of hole, and depth of changes in diameter

Depth of hole at start and end of shift or working day

Depth and size of casing at start and end of shift or working day

Depth at which water is struck

Time log showing rate of penetration in minutes per foot, type of bit, standby time due to breakdown.

Depth intervals at which formation samples are taken

Records of components and quantities used or added to the drilling fluid or air.

Water level at the start of each working day

Problems encountered during drilling

Details of installations in the borehole

Depth, size and description of well casing

Depth, size and description of well screens

Aquifer depth and static water level after completion of well

A copy of the Daily Record shall be made available daily to the Supervisor, and should include any other pertinent data as may be requested by the Supervisor.

ii) Borehole Completion Record

As per standard Borehole Completion Form.
Detailed drillers geological log.
Borehole design and installation details (as-built drawing)

iii) End of Contract Report.

The Contractor shall prepare together with the Engineer in Charge an end of Contract report, which should address at the minimum the following issues;

1. The drilling/test pumping methodologies

   (Type of drilling, designs used, test-pumping methods)

2. Borehole Completion Record

   (Original Drilling and test pumping logs bound separately from the report)

   Final payment will be released upon completion of the final drilling report.

Capping of borehole

During borehole construction, installation, development and test pumping, the Contractor shall use all reasonable measures to prevent entry of foreign matter into the borehole. The Contractor shall be responsible for any objectionable materials that may fall into the borehole and any effect it may have on the water quality or quantity until completion of the Works and acceptance by the Supervisor.

Acceptance of boreholes

The borehole shall only be acceptable by the Supervisor upon satisfactory completion of all drilling operations, installation of casing and screens, development works, and test pumping.

Loss of equipment

Any equipment lost down a borehole must be removed by the Contractor or the borehole will be considered a lost bore. A replacement borehole will have to be constructed and test pumped at the Contractors expense. The Contractor shall be entitled to NO payment for such tools or equipment.

Lost bore

In the event of a lost bore, the Contractor shall construct a borehole at a site indicated by the Supervisor. The option of declaring any bore lost shall rest with the Contractor, subject to the approval of the Supervisor.

In case of a lost bore, the drilling attempt costs will be equally shared and the Contractor will be paid 50 % for the drilling. Boreholes that cannot be developed further due to mistakes from the Contractor (e.g. dropped equipment or foreign materials) or inappropriate drilling techniques such as manual drilling cannot be considered as a lost bore and do not qualify for cost sharing. Only approper drilling attempts to the required depth with appropriate methods according to the required specifications which yield in insufficient water quality or quantity qualify.

A lost bore shall be treated as follows:

a. The Contractor may salvage as much casing and screen from the lost borehole as possible, and may use it if not damaged in a replacement borehole, with the approval of the Supervisor.

b. The lost bore shall be backfilled with native soil from the bottom upward and 2 of the last 3 meters shall be sealed by concrete, cement grout, or neat cement, which shall be placed by a method approved by the Supervisor that will avoid segregation or dilution of material.

c. The upper 1 meter of the lost bore shall be backfilled with native top soil. Sealing of such abandoned boreholes shall be done in such a manner as to avoid accidents or subsidence, and to prevent it from acting as a vertical conduit for transmitting contaminated surface or subsurface waters into the water bearing formations.

Clearing the site

On completion of each borehole the site shall be left clean and free from all debris, hydrocarbons and waste, and all pits and trenches filled to the satisfaction of the Supervisor. A site not delivered clean may render the borehole unacceptable and not eligible for payment.