

Annex: 1 A

A: New 1x8-inch Borehole Drilling Technical Specifications and Guidelines

1. Scope of work.

Background

The objective of the programme is to improve accessibility to sustainable, safe water for rural communities, with an emphasis on providing water to existing Communities in Southern Sudan and meeting the minimum standards for access to safe water. The work consists of drilling boreholes and installation with hand pumps for community and institutions water supply, installation of casings and screens; provision of gravel packing; development of the boreholes; test pumping; obtaining rock and water samples; water quality analysis; platform casting with a drainage System, and hand pump installation; as specified hereinafter and as directed by the Supervising Engineer.

2. Drilling site

The Contractor shall drill the borehole(s) at the exact location(s) designated by the Employer 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 fences and cultivated land. The contractor will deploy their equipment, labour and materials to ensure timely drilling of new boreholes in compliance with NCA and SS Water Policies, Standards, including appropriate hydro-geological surveys, water quality and quantity testing. Standard construction of aprons and hand pump installation will utilize India Mark II or India Mark II Extra deep well Hand pumps depending on water depth and previous agreement with NCA Writing prior to commencement of drilling, in consultation with NCA designated team, local civic and traditional authorities, and other concerned local committees in the respective area.

3. 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, and shall adhere to the set of "Environmental Guidelines for drilling and test pumping Operations" issued to him by the Employer. The Contractor's adherence to these guidelines will be closely monitored by the Supervisor, and any infringement by the Contractor may render unacceptable the particular portion of the Works to which it applies. The Contractor shall ensure that all its personnel are aware of these Environmental Guidelines and the consequences of not adhering to them.

4. Workmanship.

The Contractor is expected to carry out all works as instructed by the Supervisor in a thorough and workman-like manner, and up to today's professional standards. The Contractor shall carry out operations with due efficiency and dispatch 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.

5. Equipment and Materials.

All necessary machinery, equipment and materials to carry out the drilling, test pumping, headwork construction, etc. as specified are to be mobilised for the Works. Test pumping equipment should be independent from the drilling rig(s). Prior to mobilisation the Supervisor will verify the specifications and state of repair of all major items of plant and transport, and shall have the right to order the removal and/or replacement of any items which in his opinion is insufficient or in unsatisfactory condition. Acceptance by the Supervisor of the Contractor's proposed plant and transport does not, however, relieve the Contractor of his obligations under this Contract, in case such plant and transport accepted by the Supervisor fails to successfully complete the required Works.

All machinery, equipment and materials to carry out the said Works shall be handled, transported and stored in accordance with the manufacturers' recommendations to minimise deterioration.

6. Supervision of Works

The execution of the Works is to be supervised by the Employer's appointed Supervisor.

7. Borehole depth and Diameter

The completed boreholes must comply with minimum WASH standard on borehole Drilling. Boreholes must be developed after completion of drilling, after casing, screen and filter pack are installed. The Contractor will install plain 4 inch casing, DIN 4925 trapezoidal threads, flush joints; factory cut screen. Gravel pack (2-3mm) (not laterite) 50kgs X minimum 14 bags per borehole (covering 3 screens in case) Borehole development by airlifting and constant discharge minimum of 6hrs, estimate of discharge and static water level measurement. The Contractor shall drill to the total appropriate depth depending on the geological formation and to a diameter that shall allow minimum borehole nominal diameter bore of 4 inches (103mm) at the completion of the borehole, including casing installation. In any case the minimum drilled depth should be 150 metres and maximum 200 metres, on average 250 metres depth.

8. Drilling Method.

The Contractor may use any rotary drilling technique that he feels applicable to achieve the depth and diameter required, provided that the techniques used are those specified in his proposal or are approved by the Supervisor. 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 exceptionally cases. Any drilling fluid additives must be approved by the Supervisor, and must be of low solids, non-toxic degradable type.

9. Sampling.

Cuttings (min. 100 grams) of the strata penetrated shall be collected on site at every 1 metre interval and when required by the Supervisor, by whatever method is standard for the drilling technique in use and approved by the Supervisor. The Contractor shall take every possible precaution to guard against cutting contamination. Cuttings are not to be washed! Representative samples from the cuttings shall be put into approved containers supplied by the Contractor, labelled in a manner approved by the Supervisor with the borehole location, number and depth interval, and stored in a position where they will not be contaminated by site conditions or drilling operations.

10. 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 Employer.

11. Water supply for drilling.

The Contractor shall make his own arrangements for obtaining, storing, transporting and pumping of water, required for drilling purposes and for use by the drilling crew at their campsite.

12. Borehole design.

The final design of the borehole shall be confirmed by the Supervisor in consultation with the Contractor during the drilling process, or immediately after drilling is completed. Three types of standard borehole designs are given below:

Type A - open hole

- 1) Air rotary or mud rotary through overburden (alluvial, laterite, weathered or soft bedrock), minimum final drilling diameter is 1x10" (190mm) in overburden.
- 2) Rotary/percussion ("down the hole hammer"), using stabilisers (foam) where necessary, in consolidated hard rock, minimum final diameter is 1x8"1/2 (150 mm)
- 3) Boreholes should be drilled at least 6 metres below any water bearing fractures to allow sufficient space for a sedimentation sump.
- 4) Fractured bedrock considered not collapsing and left open
- 5) Installation of casing for overburden: minimum diameter 6"1/2 (160 mm), sealing of casing with grouting, back-filling, cementation of top (Sanitary Pad) 5 meters.

Type B - protected borehole in collapsing rocks

- 1) Air rotary or mud rotary through overburden (alluvial, laterite, weathered or soft bedrock), minimum final drilling diameter is 8" (202 mm) in overburden.
- 2) Fractured bedrock - water-bearing - considered to be collapsing and needs to be protected with casing/screen (minimum inner diameter 1x8" or 102 mm)
- 3) If necessary to prevent collapsing of overburden, installation of casing minimum diameter 1x8"1/2 (140 mm), sealing of casing with grouting, backfilling, cementation of top 5 meters.
- 4) Installation of casing for overburden: minimum diameter 1x8"1/2 (150 mm), sealing of casing with grouting, back-filling, cementation of top 5 meters.
- 5) Type C - Screened borehole with artificial gravel pack
- 6) Air rotary or mud rotary through alluvial or unconsolidated rocks, minimum final drilling diameter is 6"1/2 (165 mm). Final diameter of 8" (203 mm) is recommended.
- 7) A minimum annular space of 1"1/2 (38 mm) between casing and borehole walls is required for gravel pack installation. Annular space of 2" or even 3" is recommended.
- 8) Installation of screen or slotted casing with minimum inner diameter 4" (102 mm).
- 9) Installation of gravel pack at least 3 meters above the top of the first screen, topped with a one metre clay seal, with backfilling material and cementation of the top 5 meters.
- 10) Boreholes should be drilled at least 6 metres below any water bearing layers or fractures to allow sufficient space for sump. As far as possible, boreholes shall be drilled into the underlying bedrock or, if the depth to the bedrock is too deep, drilling should stop in an impervious formation underlying the aquifer - a clay layer for example.
- 11) The bottom of the hole acts as a sedimentation sump and a support for the casing and screen. The sump shall be a bottom plain casing of at least 1.5 meter length - 3 meters recommended - with the same diameter as the screen, and with its underside sealed with a bottom plug (wooden or PVC).

13 Casing and screens.

Aquifer zones shall be completely or partly lined with uPVC screen as approved by the Supervisor. The uPVC casings and screens to be supplied by the Contractor shall have a minimum wall thickness of 6mm for 5" ND casing. The Supervisor however reserves the right to vary these specifications and reject materials if found substandard. The permanent casing shall comply with DIN 8061 and DIN 8062 or (ISO 161/1) standards. The casings shall be minimum 102 mm nominal diameter and shall have a minimum thickness of 6 mm and tensile strength of at least 45MN/m². The PVC pipes shall be joined by threads and the Flush joints shall be water tight.

Screens shall be of slotted uPVC, complying with DIN 4925: 1981 and IS 12818: 1995. Sections of the screen shall be provided in maximum 3m length and joined water tight by either flush threaded connections or by an appropriate method recommended by the screen manufacturer or an equivalent standard, so that the resulting joint shall be strong and have the same structural integrity as the casings and screens.

In particular Cases the lower end of the screen should be completed with a sump of minimum 0.5m and maximum 2m length. The bottom end should be sealed with an uPVC bottom cap in case of Design A.

14 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 3mm per 1,000mm 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.

15 Gravel pack.

Suitable gravel pack shall be supplied by the Contractor. Gravel pack should consist of washed, well-rounded particles of a uniform grading of between 2.5 and 4.0 mm, shall comprise 90% siliceous material and must contain no clay, shale, silt, fines, excessive amounts of calcareous material or crushed rock. The Contractor will install gravel pack (2-3mm) (not laterite) 50kgs X minimum 14 bags per borehole (covering 3 screens in case) In terms of grain size, 90% of the gravel pack material shall conform to the grading specified by the Supervisor prior to the commencement of the Works. Prior to delivery, the Contractor shall subject samples of the gravel to a grain size analysis at the Contractors expense and the results submitted together with a sample of the gravel to the Supervisor for approval. The Supervisor shall approve the gravel before its installation. Sufficient gravel pack shall be installed to cover completely the uppermost screen, including an additional 2m length (to allow for settling). Emplacement should be by means of a conductor pipe, and a good supply of water should be introduced with the gravel to prevent "bridging". The tremie (conductor) pipe should be raised gradually as the level of the gravel builds up. The gravel pack should be capped with a clay seal to prevent contamination. The annular space above this seal can be back-filled with inert drill cuttings up to 3 metres below the ground level

16. Sanitary seal.

To provide an effective seal against the entry of contaminants, the upper 3 meters of the annular space between the casing and the borehole wall shall be grouted using cement slurry of 1.852.15 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 0.4 meters of the annulus shall be left ungrouted but temporarily back-filled with inert drill cuttings, to allow for installation of the hand pump pedestal.

17. Yield estimates during drilling.

Yield estimates shall be made during the course of drilling using a method agreed upon by the Contractor and Supervisor. Preferably the calibrated bucket or velocity-area method should be used. Average yields shall be read as directed by the Supervisor, and recorded in the Daily Record (ref. Clause 23 below). Pumping test, draw-down, and yields recovery and data analysis should be done and using a submersible pump for accurate results and reported on the borehole logs.

18. Development and cleaning of boreholes.

The Contractor shall develop and clean the boreholes upon completion of the drilling and installation of casing, screens, grouting and filter pack are installed, 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 may be carried out by airlift pumping, surging, backwashing or jetting, to the approval of the Supervisor. Clay desegregation by means of Sodium Hex metaphosphate ("Calgon") treatment may, in some cases, also be called for by the Supervisor.

The minimum requirement is the "air-lift" method until the ground water runs clean and turbidity free, but in any case for a minimum of 3 hours. If this condition is not achieved after 6 hours, air-lift will be carried-out until the water becomes limpid, but up to a maximum of 12 hours with any extra hours on top of 6 hours to be invoiced accordingly. Upon completion of development, any accumulation of material shall be removed from the bottom of the borehole by airlifting.

19 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 each productive borehole, as assessed by the Supervisor from the yields indicated during drilling. In the case of boreholes with indicative yields of between 500 and 1500 litres per hour, the borehole will be tested at a constant discharge rate of 600 litres per hour for a minimum period of four (4) hours or until the water level stabilises. The pump test will be conducted with a submersible pump able to deliver at least 3000 litres per hour at the foreseen depth of the hand-pump cylinder installation. Pumping yield, draw-down and recovery data should be reported on the standard borehole log. In the case of boreholes with an indicative yield of greater than 1500 litres per hour, the boreholes will be tested in the manner of a step-test, with the initial step being at 600 litres per hour. The duration of each step shall be 90 minutes, and a minimum of three steps of increasing discharge will be undertaken. 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. It is anticipated that the maximum testing and recovery time per borehole should not exceed 6 hours for hand pumps and 24 hours for motorised boreholes. Discharge shall be measured by volumetric methods, or by means of some other approved calibrated measuring device. During the test pumping, the discharged water must be handled and disposed of in an appropriate manner to a point of overland drainage sufficiently far from the borehole to prevent recharge. This distance shall be at least 100m from the borehole, but may be reduced with the approval of the Supervisor if the pumped aquifer is confined. 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.

20 Borehole disinfections.

All boreholes shall be disinfected after completion. This can be achieved by placing a chlorine solution into the well so that a concentration of at least 50 mg/l (0.005%) of available chlorine exists in all parts of the well at static conditions. All borehole parts above the water level should be completely flushed with the solution. The solution shall remain in the well a minimum of 12 hours before pumping the well to waste. The borehole must be disinfected using the required calculated amount of chlorine solution (depending on the volume of water in the borehole) or, conservatively for the type of boreholes considered in the Sudan context, by using 30 grams of active chlorine solution (three tea spoons of HTH 70%. (Mixed in clean water) Not PUR.

21 Water level observations.

The Contractor shall supply appropriate electric contact water level gauges, suitably calibrated such that measurements can be made to an accuracy of 5mm, for measuring water levels in the boreholes. Water levels shall be measured during test pumping at pre-determined intervals, dependent 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.

The contractor should have on the site at least 2 electric gauges suitable for a maximum depth of 100m. The devices should fit into the ¾ -1" observation pipes and should permit direct, convenient and accurate reading of depth of static and dynamic water levels.

22 Electrical conductivity measurements.

The Contractor shall provide an operational Electrical Conductivity meter, and shall take electrical conductivity readings of the discharge water during test pumping. The borehole shall be tested on site for biological purity and acceptance for human consumption.

23 The Apron, Drainage System and the hand pump assembly.

The apron of the platform is to be a minimum of 3 meters diameter with an 80cm square foundation around the pump pedestal. A weld mesh should be casted and the drainage must be a minimum of 10m meters long;

The hand pumps to be installed must be as follows:

- Indian Mark II hand pump for all boreholes less than 40m in depth
- Indian Mark II Extra Deep hand pump for all boreholes more than 40m in depth
- Each hand pump must be given a unique serial number

24 problems encountered.

(With accessibility, formations, equipment and community, etc.)

1.Suggestion for improvement

(On supervision, documentation, durations, etc.)

2. Borehole Completion Records,

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

3. Any other information that the Contractor may deem important or necessary

Two copies of the End of Contract Report (one without the Borehole Completion Records) shall be submitted to the Supervisor.

25 Water Sampling and Quality testing.

The Contractor shall take water samples for testing the physical-chemical and bacteriological quality at the end of the test pumping. For this purpose the Contractor shall supply and keep on site a minimum of 4 suitable two-litre capacity water containers, and shall collect water samples as directed by the Supervisor. Samples shall be tested at a certified laboratory, and the test results shall form part of the monthly and End of Contract Reports. The minimum standard shall be 0 coliforms per 100ml .The borehole shall be tested on site for an aesthetic, physical and Chemical and turbidity with a maximum tolerance of turbidity to be 5 NTU.The borehole shall be tested for chemical purity and acceptance for human consumption. This shall be done by collected a sample of water in a sterilised water container and sending for testing to an approved laboratory.

26 .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.

27. 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.

28. 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 contractor's expense. The contractor shall be entitled to no payment for such tools or equipment.

29. Lost Bore hole.

Should any incident to the plant, behaviour of the ground, jamming of the tools, or casing, or any other cause prevent the satisfactory completion of the borehole, a borehole shall be deemed to be lost and no payment shall be made for that bore or for any materials not recovered there from, nor for any time spent during drilling or while attempting to overcome problems.

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.

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) Any material supplied by the Employer and salvaged damaged shall become the property of the Contractor, and the Contractor shall compensate the Employer accordingly.
- (c) 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.
- (d) 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.

30. 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 filled to the satisfaction of the Supervisor. A site not delivered clean may render the borehole unacceptable. The borehole shall be numbered as specified by the Supervisor and the number marked on the casing with indelible ink or in such a way that the marking is permanent.

31. Platform construction.

The Contractor shall construct a concrete platform for each successful borehole carrying out the following activities in order (see section 5 Layout and Drawing Designs):

Excavate square pit 760x760x400mm deep around casing pipe.

Place stand assembly (pedestal) over casing pipe, ensuring third leg (corresponding to the water tank spout pipe position) faces the proposed direction of the drain.

Making sure the pedestal is vertical, construct concrete in layers of 100mm up to top of legs.

Cover stand assembly with a cover plate and, level the ground around the pump pedestal.

Lay the mild steel shuttering (moulds) and cast platform in mass concrete (mix 1:2:4/20mm agg.) conforming to the dimensions and other specifications shown in drawing No. 1

Cure concrete for 3 days and protect it from evaporation (using gunny bags, thorny bushes, etc.).

Plaster platform and drain in cement screed (mix 1:3) to a smooth finish, then engrave the borehole details provided by the Supervisor on the platform as instructed.

Construct a drainer of 10m long away from the platform tightened with Rcc bars Y3 with a mouth attached to 2x2m soak pit filled fired bricks .

32. Hand Pump Installation.

The Contractor shall supply and install Indian Mark II pumps with galvanised iron (GI) grade "B" and parts, as recommended by the Supervisor or install Indian Mark II pumps and other pumps items provided by Engineer as the case may be, as spelled out in the main contract.

33. Personnel

- The Contractor will provide an experienced project Coordinator to oversee the drilling and testing to be carried out under this Contract. The name and work resume of the project Coordination will be included in the tender.
- The Contractor will maintain a full crew on each drilling unit and test pump unit. If a member of crew quits for personal reasons or must leave because of illness or injury, the Contractor will replace him as soon as possible with a worker of similar experience.
- If the Client is dissatisfied with the performance of members of the crew, such members shall be informed of their shortcomings and warned by the contractor. If no change results within a reasonable period, the Contractor will be notified and requested to take necessary measures on the unsatisfactory crew member.
- If the Client wishes to operate drilling equipment more than one shift per day, the Contractor shall increase the size of the drilling crew as required. However, in the percussion drilling, the rig will be operated for a minimum of 20 hours a day.
- In the case of absence of one or more members of the drilling crew the decision of whether to proceed with drilling operations will be at the discretion of the Engineering Supervisor.

34. Environmental guidelines and code of conduct.

Groundwater exploration and development work should be conducted in an environmentally and socially sensitive and responsible manner. These guidelines are intended to ensure that all parties are aware of the potential impacts of their activities, and carry out the work in an appropriate way.

These guidelines are a written statement of intent for Contractors to adhere to, and to which recourse can be made in the event of a perceived undesirable impact. Contractors are required to familiarize all employees with the content and spirit of these guidelines. This document will also be made available to State authorities for their use in similar work.

1. Camps.

If and where field camps are needed, their construction and removal should be carried out along the following lines:

- Permission for camp areas must be obtained in writing from the relevant local authorities.
- Suitable latrines and other sanitary arrangements at the camps and sites where work is in progress should be availed to the crew.
- Access roads and the camp area should be sited to cause minimum disturbance. No trees should be cut down, the use of firewood must be restricted to dead wood only and should not conflict with the needs of the residents of the area.
- No permanent structures should be built at the camp.
- The camp should be removed; the site cleared and cleaned free of all debris, waste and hydrocarbons at end of the Contract and local authorities should be shown the cleared site.
- Rubbish (except for oils and other mechanical or chemical waste) should be buried or removed.

- Waste oils, chemical and mechanical waste should be stored and removed to Government/Municipal designated dumping sites or recycling plants.

2. Human relations.

People, water, land and livestock must be respected. Access routes should not normally transgress gardens. But if found necessary, permission to enter the gardens must be sought from the owner. Work should be done with minimal damage to fences, trees or crops. All conflicts / disagreements and any agreements (use of water supply etc.) no matter how trivial, must be logged and dated, with details of persons involved and subject matter, in a book for this purpose at the base camp.

3. Drillings Site Locations.

Each drilling site should be completely cleared of all waste after use. Drilling waste (chippings and mud) should be buried. Rubbish, waste oil and chemicals should be returned to the main camp for disposal as outlined in one (1) above.

No spillage of oils or fuels should occur.

| Table showing Locations for drilling and Installation of New Boreholes. | | | | | |
|---|---------|--------|--------|--------------|----------|
| Lot 1 Gumruk, Greater Pibor. | | | | | |
| No. | Village | Payam | Boma | Remarks | Quantity |
| 1 | Gumruk | Gumruk | Gumruk | New drilling | 01 |
| 2 | Gumruk | Gumruk | Gumruk | New drilling | 01 |

| Name | Descriptions | Frequency |
|--|---|---|
| <p>1. Sketch Map showing the drilling plan. See annex-1</p> | <p>A table to show the locations, names, borehole number, and distances in kilometres from the last drilling location along with a sketch map showing the above information and sequence in which the drilling will progress i.e. route of movement of the rig.</p> | <p>Once, before the starting of drilling operations. .</p> |
| <p>2. Results of Geophysical surveys</p> | <p>A table showing the location by Boma or payam and Wards, borehole number, GPS co-ordinates, and results of geophysical surveys showing geology type, type of resistivity sounding curve with the thickness of interpreted layers and their thickness, recommended depth to be drilled.</p> | <p>Once after the completion of geophysical survey. Submitted to client before drilling Commences and also as part of final report.</p> |
| | <p>Detailed report on resistivity surveys on each borehole with i)sketch map to show the locations of three sites investigated , ii)data collection sheet for Vertical Electrical Sounding(VES); iii) VES curves with interpretation on a log-log paper showing with thickness and resistivity and recommendations for drilling. (A sample report will be provided)</p> | <p>Once - One report for each locations. To be submitted along with the invoices for final payment.</p> |
| <p>3. Strata log, penetration rate Log and location of main strikes.</p> | <p>An accurate record of strata passed through and the depths at which strata were intercepted; also progressive measured (Vnotch) airlifted yields after reaching water. An accurate record of the penetration rates achieved in minutes for each meter drilled, together with type, size and grade of bit.</p> | <p>Recorded daily as drilling progress. Submitted to client with invoices for payment.</p> |
| | <p>An accurate record of time spent each day on different phases of drilling, to include rig down time, with causes.</p> | |

| | | |
|---|---|--|
| | A record of depth at which the water zones were struck during the drilling. This information can be combined with strata log and penetration log. | |
| | | |
| 4. Pumping Test data and recovery test results. | A detail report on the pump test, including the data of draw down with time and recover test, specific yield and draw down, recommendations on hand pump installation. | Once, recorded during pump test Submitted to client with invoices for payment. |
| | | |
| 5. Construction log | An accurate record and a figure showing the details of well construction- position of all casing, slotted casing, sand trap, end cap placed in the borehole, their quantities, hand pump installation- position of cylinder, number of connecting rods and riser pipes. | Recorded for each borehole after completing borehole construction. Submitted to client with invoices for payment. |
| 6. Invoices for works done. | Invoices in same form in which rate schedule were quoted for each borehole and a summary sheet of all invoices. | Once after completion bathes of 10 boreholes. |

| | | |
|----------------------------------|---|--|
| 7. Certificate of Completion ion | A certificate of Completion &.acceptance of hand pump facility constructed from Client staff. | Once after the inspection of hand pump facility by Client staff and Submitted to Client with the invoices... |
|----------------------------------|---|--|

4. Test of acceptability and reports:

Subject to meeting the requirements of the maintenance period, the borehole shall be accepted for payment on presentation of the following reports at schedules shown in the table below and sample of the formats given in the annexes:

The Contractor is expected to submit four (3) bonded copies of the above reports for each district separately and a summary in the beginning for each instalment of payment. Client will provide Standard report format to the contractor.

- Bore hole Completion Report.
- Water Quality Test Report.
- Test Pumping Log
- Lithological Report.

Upon completion of each borehole the site must be left clean and free from all debris, hydrocarbons and waste, and all pits filled to the satisfaction of the Supervisor.

5. Completion schedule

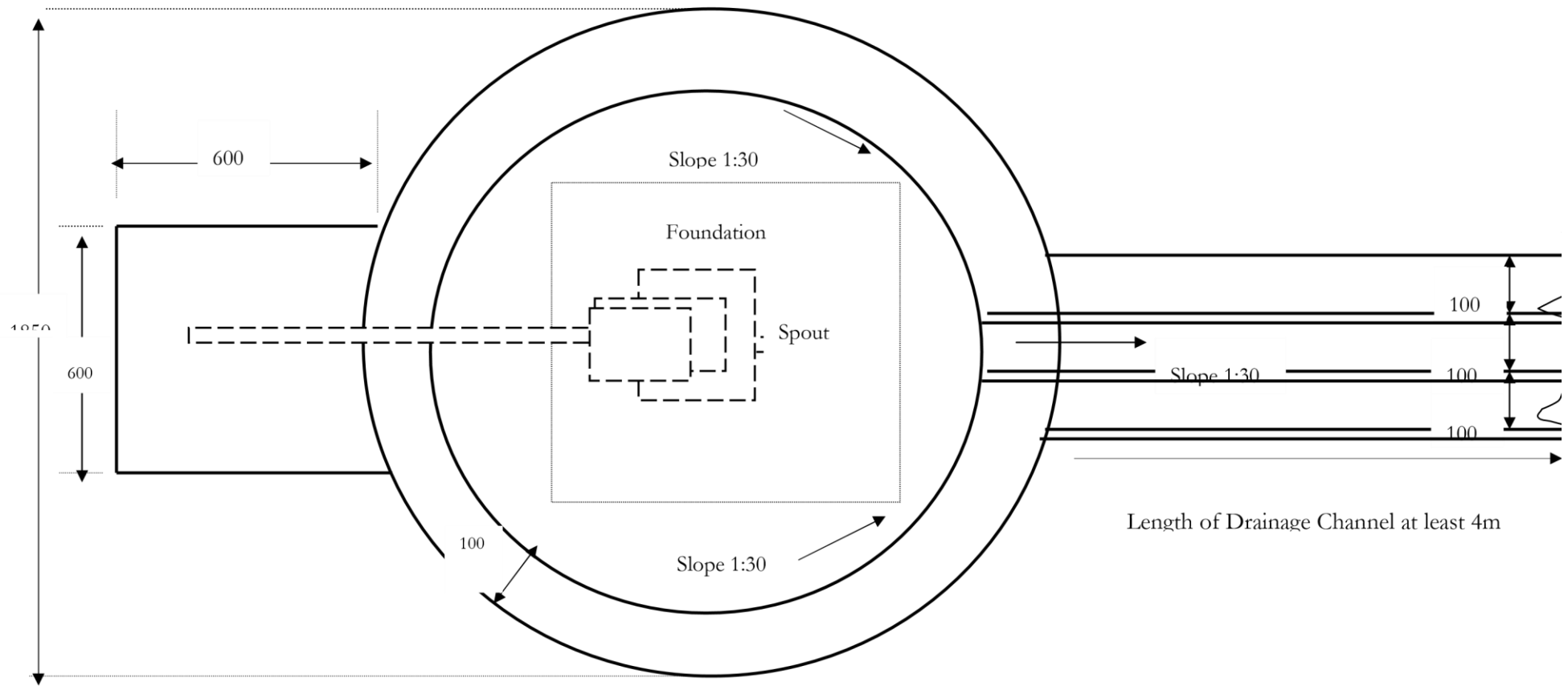
The Bidder should clearly indicate the period for implementation and completion of each schedule using the following format:

The Works period shall commence within [Not More than 2 Weeks] after contract award.

| Item number | Brief Description of Works | Completion Period <i>(in dys/wks./mths)</i> | Works Site |
|--------------------|-----------------------------------|---|-------------------|
| | | | |
| | | | |

BOREHOLE PLATFORM DESIGN

Dimensions i



| | | |
|----------------------|---------------|---------------------|
| Start date | End date..... | Diesel.....[Lt] |
| Total depth[m] | SWL..... | Engine Oil.....[Lt] |

| | | |
|--|-------------------|---|
| Main water strike[m] | Yield..... [...] | Hydraulic Oil.....[Lt] |
| Dynamic water level[m] | | Hammer Oil.....[Lt] |
| Drilling diameter <input type="checkbox"/> inch <input type="checkbox"/> mm | | Foam/polymer.....[Lt] |
| ∅ From ... [m] To..... [m] Method..... | | Method of drilling |
| ∅ From ... [m] To..... [m] Method..... | | <input type="checkbox"/> Percussion <input type="checkbox"/> Hand-drilled |
| ∅ From ... [m] To..... [m] Method..... | | <input type="checkbox"/> Air rotary <input type="checkbox"/> Mud rotary |
| ∅ From ... [m] To..... [m] Method..... | | <input type="checkbox"/> DTH <input type="checkbox"/> Rig make..... |

| | | |
|------------------------------|--|---|
| Borehole construction | Casing type <input type="checkbox"/> uPVC <input type="checkbox"/> Threaded <input type="checkbox"/> Bottom plug Height above/below ground level [m] | Filter pack (gravel pack) Composition Source Units <input type="checkbox"/> bags [.... kg] <input type="checkbox"/> kg <input type="checkbox"/> Amount used Depth to top.....[m] |
| | Plain casing & Screen installation <input type="checkbox"/> inch <input type="checkbox"/> mm ∅ Type..... From[m] To [m] ∅ Type From[m] To [m] Slot ∅ Type From[m] To [m] Slot ∅ Type From[m] To [m] Slot ∅ Type From[m] To [m] Slot | Grouting <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> Cement <input type="checkbox"/> Mikolit <input type="checkbox"/> Type..... From[m] To[m] Amount..... Type..... From[m] To[m] Amount..... Type..... From[m] To[m] Amount..... Backfilling |

Comments

| | |
|---------------|--|
| | Comment..... |
| | Disinfection |
| | Chemical used Volume..... |
| | Nearest sources of possible contamination |
| Type | Distance |
| Remarks | |

| | |
|---------------------------------|--|
| Borehole completion date | |
|---------------------------------|--|

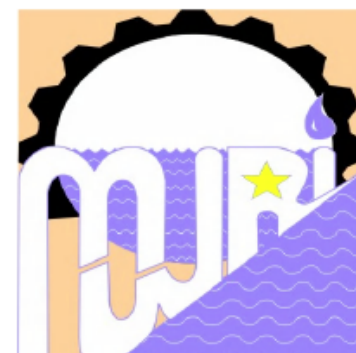
| |
|--------------------------------|
| Comments |
|--------------------------------|

DRWSS - data collection form



Government of Southern Sudan

Ministry of Water Resources & Irrigation



DRINKING WATER QUALITY MONITORING REPORT FORM

Location

| | |
|----------------------|--|
| Water Point Location | Longitude: |
| Village | Latitude: |
| Payam | Sampled by: (Name of person/Organization) |
| County | Date of sampling/time |
| State | Date of analysis |

LOCATION DESCRIPTION (rural, urban, dense settlement, agricultural areas, mining area etc.)

Facility

Initial monitoring for a new water

Routine monitoring for

| | |
|---|---|
| | <input type="checkbox"/> Digitally Dated Photo of this Borehole during drilling is attached to this Completion Record. |
| | <input type="checkbox"/> Digitally Dated Photo after Borehole is completed and functioning is attached to this Completion Report. |
| | Reporting and Location Verification |
| | <input type="checkbox"/> Latitude and Longitude were provided with GPS level accuracy. |
| | <input type="checkbox"/> Serial Number was mechanically punched into and hand pump pedestal. (Example: 2007-SDC-004) |
| <input type="checkbox"/> Date completed, implementing agency and drilling contractor were inscribed in the concrete platform. | |

TEST PUMPING: PROJECT PAGE 4/4

**Pump tests must be completed in a continuous 4 hour period or otherwise be restarted after a 6 hour recovery period.

| Time | Drawdown(m) | Yield(l/m) | Recovery(m) | Comments |
|-------------|--------------------|-------------------|--------------------|-----------------|
| 0:00 | | | | |
| 0:01 | | | | |
| 0:02 | | | | |
| 0:03 | | | | |
| 0:04 | | | | |
| 0:05 | | | | |
| 0:06 | | | | |
| 0:07 | | | | |
| 0:08 | | | | |
| 0:09 | | | | |
| 0:10 | | | | |
| 0:15 | | | | |
| 0:20 | | | | |
| 0:25 | | | | |
| 0:30 | | | | |
| 0:35 | | | | |
| 0:40 | | | | |
| 0:45 | | | | |
| 0:50 | | | | |
| 0:55 | | | | |
| 1:00 | | | | |
| 1:10 | | | | |
| 1:20 | | | | |
| 1:30 | | | | |
| 1:40 | | | | |
| 1:50 | | | | |
| 2:00 | | | | |
| 2:15 | | | | |
| 2:30 | | | | |
| 2:45 | | | | |
| 3:00 | | | | |
| 3:15 | | | | |
| 3:30 | | | | |
| 3:45 | | | | |
| 4:00 | | | | |

CONTRACTOR

EMPLOYER

Company name:
Signature:
Date:

Stamp:

LOCAL AUTHORITIES

Name and Title:
Signature:
Date:
Stamp:

Organization name:
Signature:
Date:

Stamp:

COUNTY AUTHORITIES

Name and Title:
Signature:
Date:
Stamp:

The following information shall be supplied for each borehole:

- Name and location (GPS) of the site; Dates of works, Name of Master Driller, Equipment used
- Drawing and photo of location of borehole
- Geological formations, drilling depth, drilling diameters, drilling methods, water strikes and complete description of well design
- Pump test records (yield and recovery));
- The amount of chlorine used to disinfect the borehole.
- Type of Hand-pump installed, date, cylinder depth. Etc
- The water quality certification from a viable laboratory

ii) Borehole Completion Record

As per standard Borehole Completion Form.

Driller's geological log.

Borehole design and installation details (as-built drawing) ii) Monthly Contract progress report

The contractor shall submit a monthly progress report detailing progress on the contract. The month report shall include the progress of projects successfully completed, problems accounted that are hindering progress and remedial recommendations to accelerate contract progress. Iii) End of Contract Report.

The Contractor shall prepare an end of Contract report, which should address at the minimum the following issues; 1. The selected sites

(Suitability, accessibility)

The drilling /test pumping methodologies

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

Contract schedules and duration

(Summarised diary of events and actual durations)

Summary of results and analysis

(Table showing locations, well numbers, depths, casing type and depths, driller's and test pumping yields, water quality and any other information necessary)

Casing /screens received and used on the Contract (if any)

(Table showing casings received, used, damaged and balances)

III –Visibility (sign post)

Upon the Completion of Drilling and Installation of new bore hole the Constructor Must craft the NCA Name, and Details of the Bore Static level, total depth, Dynamic Level, Coordinates Drilling Date and Drilling Company Details and Contact Information's

The Information Must be Clearly Written on One of the Pedestal (Telescopic Pump Stand). Metallic Punch for writing on the Body of the Pedestal with the information given by NCA focal Person and Coloured with Durable all season Paint with Font Size Not less than 12

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