



## **NEW BOREHOLES DRILLING TENDER DOCUMENTS/TECHNICAL SPECIFICATION**

### ***(TERM OF REFERENCES)***

### ***"CONTRACTOR TO DRILL 6 BOREHOLES IN FANGAK COUNTY - JONGLEI STATE"***

#### **1.0. Background**

With funding from SSHF Reserve 4 allocation, Africa Development Aid is implementing Water, Sanitation and Hygiene (WASH) mainstreaming with nutrition response in Old Fangak, Mareang and Paguir Payam, Fangak County, Jonglei State. Six locations (6) locations have been identified in three payam of Fangak County for drilling boreholes to be fitted with hand pumps. Africa Development Aid therefore, seeks a contractor to carry out the works of mobilizing machinery, drilling boreholes, and provide all the required tools, equipment, materials, labor and ensure that all the necessary requirements of borehole development and testing are up to the required standards as clearly specified on the technical specifications in the Bill of Quantity attached therein.

#### **2.0. Scope of Work (SOW)**

Under the guidance of the ADA WASH team in Fangak, the selected contractor must perform in a satisfactory manner, the drilling of six (6) boreholes to be installed with hand pumps at locations determined and/or to be determined in Old Fangak, Mareang and Paguir Payam of Fangak County

#### **3.0. Groundwater Investigation**

The selected contractor should perform geophysical analysis (hydrogeological survey) in the ADA pre-identified locations using geo-electrical techniques to find the best location for borehole siting in coordination with ADA WASH team in Fangak. For each of the six boreholes, the hydrogeologist shall recommend suitable sites with the view that the proposed drilling will take place in the location where the demanded yield shall be attained as described in the TOR. Upon submission of the hydrogeological survey report and that is acceptable to ADA, then ADA WASH team will validate the start of the drilling works.

#### **4.0. Drilling Stipulations**

Drilling of borehole in all geologic possible environments to a minimum internal diameter of 200mm (8") to an average depth of 80 meters below ground level. ADA will consider a borehole successful only if it meets the above stated conditions of depth and a minimum critical yield of 3M<sup>3</sup>/hr . Confirmed through a critical yield analysis obtained after 8 hours of step draw down pump test. If the borehole doesn't meet the stated condition in the (A) above, ADA will not consider the borehole successful. As such, ADA will neither accept nor pay any of the items in the contract or expenses incurred during the drilling process; mobilization to the next site and commencement of the works will all lie under the contractor's responsibility.

The contractors applying will quote in the Bill of Quantity taking in consideration that the borehole depth can vary and ADA will not make any payment beyond this quoted amount, independent of the drilling depth beyond 80 meters that the selected contractor need to undertake in order to meet the design specification in terms of yield.

Borehole drilling and construction will be supervised by the ADA WASH Officer representative in collaboration with State Ministry of Physical Infrastructure (MoPI) and Rural Water Department (RWD) of Fangak County. ADA will have the final authority in making technical decisions to the contractor.

The contractor shall ensure that the drilling rig to be used must have the capability of drilling beyond the anticipated depth by 30%. Cuttings (min. 125 grams) of the strata penetrated shall be collected on site at every 2-meter interval or every drill pipe; whichever gives the smallest interval and when required by ADA 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. Representative lithological samples shall be packed in sealed containers and with clear marked labels





covering the borehole location, number and depth interval. The samples shall be stored in a location where they will not be contaminated by site conditions or drilling operations.

The contractor shall ensure that the materials supplied are of good quality, adhering to the specifications provided in this ToRs and in the ADA will not authorize the installation or utilization of any material that is not in line with the requirements established in the ToR and BoQ.

The selected contractor will supply and install U-PVC, class 10, drinking water standards, nontoxic plain casings with a 126.6mm (5") internal diameter and 6.7mm thickness for total depth of well except where screen casings are installed. There should be at least 3m of plain casing as well as a sump/plug at the bottom of each well. The contractor should ensure verticality of the casing installed.

The contractor will supply and install U-PVC, class 10, drinking water standards, and non-toxic plain screen casings with an internal diameter of 126.6mm (5") and 6.7 mm thickness and with a slot size between 0.5mm to 1mm. The quantity/length of screen casings to be installed in the borehole will vary respectively to the soil/aquifer formations. The contractor will supply and install filter gravel pack which is clean, uniform and of approved quality collected from river beds consisting of particles with a diameter of 1-5mm. The volume of the filter pack required must be calculated taking into account the length of the screened area and an additional 50% to allow for settlement above screen casings, and the annular space between the borehole and the external diameter of the casing. The installation of the filter pack should be done with the aid of a termite pipe to ensure an even distribution of materials and to reduce the risk of materials bridging in the annulus. The use a funnel (sheet metal, plastic sheet or pipe) and flowing water shall also be accepted as a method of passing the gravel through the annular space between the casing and the sides of the borehole.

The contractor should ensure the installation of sanitary seal in the annular space between the screen casing and the borehole above the filter gravel pack to reach a minimum height of 3 meters. The sanitary seal shall consist of bentonite pellets of size between ¼" and ½". The bentonite pellets shall be installed in the annular space from the filter pack using tremmie pipe system. Above the sanitary seal, the annular space shall be backfilled with cuttings extracted through drilling up to 3 meters deep below the ground level. The sanitary top seal in cement grout, corresponds to the first 3 meters below the surface. Including 2m of bentonite pellets and 1m of grout at the surface. If the contractor cannot supply the bentonite pellets, a written request should be sent to ADA providing the justification and the specifications of an alternative sealing and plugging material in order for ADA to approve its installation.

The boreholes must be developed by airlifting for a minimum of 4 hours until a stabilized satisfactory yield is reached and the turbidity is less than 5 NTU. Step draw down pumping test should be conducted by the contractor for a minimum of 8 hours considering 4 steps with different yield ( $Q_{mx}/5$ ,  $Q_{mx}/3$ ,  $Q_{mx}/2$  and  $Q_{max}$ ) and a recovery step. Each test should last a minimum of 1.5hr. In addition, 4 hours' constant pump test should be conducted by the contractor using the optimal yield identified during the step draw down test. Recovery test will be for one hour or such time when there is at least recovery of 80% of the static water level noted at the start of the pump test. Step draw down, constant pump test and recovery data should be reported on the borehole log and should contain at least: Date of Test (Day, Month, Year); Depth of BH at time of test (m); Static Water Level (SWL) before test (m); Type of Pump used; Depth of Pump Intake (m); Discharge (Ltrs/Minute); Dynamic/Pumping water level (m).

ADA's supervisory staff should be informed, in writing (email), at least 24hr before the scheduled time for carrying out of the pumping test. The procedure should be discussed and agreed by both parties (ADA and contractor) before the contractor could initiate the pumping test.





After a successful completion of drilling and water testing, the borehole should be thoroughly disinfected with a chlorine-rich solution, preferably granular Calcium Hypochlorite (HTH) or Sodium Hypochlorite at a concentration of 500 grams per cubic meter of pack. This will initiate the process of sterilizing the borehole and the chlorine solution should stay in the well for at least 4 hours at the specified concentration, leaving a concentration of residual chlorine of 50 milligrams/liters (as per WHO standards). The disinfection procedure shall be discussed with GBI's supervisory staff in order to seek approval. The contractor shall supply and install India Mark II hand-pumps with all the components including GI rising pipe, the handle assembly, the pedestal, the water tank assembly, the pump head assembly, connecting rods and rising mains, pump cylinder. For lifting water beyond 45 m, the contractor must supply an India Mark II Extra Deep-well hand-pump. Construction of re-enforced concrete borehole apron, drainage channel with a minimum length of 6m long.

The contractor will coordinate with the ADA WASH Fangak County team for the collection of samples of water from the borehole for full physical, chemical and bacteriological analysis of the water to ascertain its suitability for human consumption. The Results need to be submitted in the GoSS' Drinking Water Quality Monitoring Report Form, dully filled and signed by the authorized authority. The contractor will provide the original copy of GoSS' Borehole Completion Record Certificate in the approved form, dully completed and signed by the Fangak County.

Upon completion of the borehole, the selected contractor should submit a report of the borehole drilling in which all the relevant information and drilling velocity, well casing and other well construction operations will be recorded. The contractor will also annotate all information pertaining to the appearance of water filtrations and aquifer, types of rock found and sampling details including geophysical testing analysis, drilling lithology log, sieve analysis, GPS coordinates, casing details, filter pack details, constant rate testing procedures and results, recovery testing results, yield, draw-down, disinfectant calculations and procedures, pump cylinder installation depth and water quality analysis and photographs. No payment will be made prior to reception of all the documents described above as per ADA borehole template.

#### **5.0. Role of the contractor**

The contractor will have to provide for the construction and completion in every detail of the work described in the contract and contractual documents such as ToRs and annexes. All labors, materials, tools, equipment, transportation, food and supplies required to complete the work in accordance with the specifications and terms of the contract should have to be well furnished. The contractor cannot deviate from the construction designs or specifications without seeking for permission and approval from ADA.

If the contractor is not able to finish the drilling or has to abandon the borehole due to loss of tools, accidents or any unforeseeable circumstances, the contractor should remove the casings or drive pipes already in the hole and refill it with clay or concrete. All materials extracted from the hole, after refilling it will be the property of the contractor. ADA will not pay for any of the work carried out, and will authorize in advance the drilling of a new hole, at a site near the abandoned one if need be, at the contractor's expenses.

#### **6.0. Health and Safety**

The contractor's team leader shall take all reasonable precautions to prevent any death or injury to persons during said undertaken activities. These precautions shall include but not be limited to providing his crew with safety helmets, hard-toed boots (safety boots) or gumboots, heavy duty gloves, protective glasses and ensuring that all tools and equipment are in a safe condition and ensuring that his employees adopt safe working methods.





The drilling crew will wear a uniform provided by ADA at the site. No military-looking clothing will be accepted at any time. Under this contract, the contractor's team leader has the obligation and responsibility to safeguard the safety and security of its Personnel, the drilling crew's equipment and other property, ADA furnished equipment and supplies and Personnel's personal effects and other property. The contractor's team leader shall develop a security plan in consultation with ADA, including detailed procedures to cover evacuation, personnel, equipment, safeguarding of ADA-furnished equipment and supplies, unlawful interference and prevention of sabotage.

## **7.0. Requirements of the contractor for the tender**

### **a. Experience:**

For a contractor to be accepted to participate in the tender process, must provide evidence (satisfactory contract completion certificates) of at least 10 boreholes drilled in South Sudan with other NGOs or government amounting to a total value of 100,000 USD during the last 3 years. At least one contract should be for an amount of 13,000 USD. The scope in the certifications should clearly mention drilling and are not valid for this purpose auger manual drilling.

### **8.0. Equipment and work force:**

Changes are required during the execution of contract; equipment of similar characteristics needs to be put in place and ADA has to be informed in written. The contractor must provide a list of the work force that it intends to use for execution of the project, detailed percentage of females and males.

### **9.0. Time for completion.**

The contractor should perform the activity in a maximum period of 3 months after the signature of the contract. For the tender process, the contractor should submit a work schedule (project Gant chart) aligning activities to match the completion period. Any bid which schedule goes beyond the project estimated completion period of 1 month will not be accepted in the tender process. In the case of delays in the implementation process of the project, penalties will follow with immediate effect and the penalty criteria will be stipulated on the contract document.

### **10.0. Legal documents from the government of South Sudan.**

The contractor must present a copy of the valid drilling certificate; a copy of the company's registry in the South Sudan's RRCs valid registration certificate, tax license certificate from South Revenue authority and a copy of the trading license.

### **11.0. Bidding amount.**

The companies participating in this tender should present the BoQ in Annex fully completed with the unit prices for each activity. The full amount quoted should cover all expenses for the completion of the activities under the contract, as well any indirect cost and/or administrative costs that the contractor must incur.

### **11.0. Defect liability period.**

The borehole will be guaranteed for a period of 4 months after completion. In an event that there are defects found on the borehole within the 6 months' period, the contractor will be notified and authorized to correct all the said defects before the contractor is paid the retention amount.

### **12.0. 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/m<sup>2</sup>. The PVC pipes shall be joined by threads and the 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 flange 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.

### 12.D. 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 1,000 mm 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 back filled 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.

### 13.D. 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.

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 meters below the ground level.





#### 14.0. 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 1.85-

2.15 kg cement/liter. 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.

#### 15.0. 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

#### 16.0. 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 Hexametaphosphate ("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, airlift will be carried-out until the water becomes limpid (clear), 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.

#### 17.0. 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. The minimum daily sustainable yield from each borehole must be at least 5000 litres per day.

In the case of boreholes with indicative yields of between 500 and 1500 liters per hour, the borehole will be tested at a constant discharge rate of 1000 liters per hour for a minimum period of three (3) hours or until the water level stabilizes

In the case of boreholes with an indicative yield of greater than 1500 liters per hour, the boreholes will be tested in the manner of a step-test, with the initial step being at 1000 liters 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 meters 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 motorized (electric) 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 100 m 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.

#### **18.0. Borehole disinfection**

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.

#### **19.0. 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 100 m. The devices should fit into the 1" observation pipes and should permit direct, convenient and accurate reading of depth of static and dynamic water levels.





## 20.D. 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.

## 21.D. Records and reporting

The Contractor shall keep daily activity records for each borehole. The records shall contain the information as specified below. In addition, separate records should be supplied for each borehole upon completion.

### Daily Record

- Site name

Reference number of boreholes

GPS Co-ordinates of borehole (latitude /longitude)

Date of reporting

Names of foreman and drillers

- Method of drilling

Make, model, type and size of drilling rig

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

Description of strata drilled with depth of transitions encountered

- Depth at which water is struck

Yield of air lifted water, when drilling or developing with air in liters per second.

Time log showing rate of penetration in minutes per meter, 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

Electrical conductivity measurements during test pumping

- Problems encountered during drilling

Details of installations in the borehole (if any) Depth, size and description of well

casing Depth, size and description of well screens Aquifer depth and SWL after

completion of well

## 22.D. Annexes

Annex A – Schematic layout of the Borehole design with animals' trough

Annex B – BOQ for drilling Six (6) boreholes

Annex C – Check list







**This bill of quantity is for one borehole only - Has to be multiplied by six (06) for overall total**

S/n	Item Description	Unit	Quantity
1	Preliminaries: Survey that includes desk top study of the proposed site to establish information that can guide in decision making regarding the proposed location	Borehole	6
2	Geophysical survey- Conduct geophysical survey using recommended equipment, resistivity meter to identify the most promising site for drilling of a successful borehole	Borehole	6
3	Carryout drilling 6" borehole from 0 - 80 meters depth in all types of soil formation mad drilling	Borehole	6
4	Supply and Install 125mm (5 inch) nominal internal diameter plain UPVC casings.	Borehole	6
5	Supply and Install 125mm (5 inch) nominal internal diameter plain UPVC casings.	Borehole	6
6	Supply and Install 125mm (5 inch) nominal internal diameter Slotted UPVC casings, Including UPVC end caps	Borehole	6
7	Supply and Install Permanent casing 8-inch nominal internal diameter UPVC plain casing up to hard formation.	Borehole	6
8	Supply and insert filter gravel packing 2mm - 4mm size of round and clean siliceous material. Insert sanitary seal (grout) not less than 1.50m deep from ground level.	Borehole	6
9	Allow for borehole development work, surging by air of a completed well until the water is crystal clear	Borehole	6
10	Pump testing completed well, time taken until pump is removed, recovery should be around 80%. hour 4 10	Borehole	6
11	Allow for water quality test based on recommended parameters for South Sudan, both physical, bacteriological and chemical.	Borehole	6
12	Apron construction-general Excavation of top soil & cart away depth n.e 200mm (assume 3.00m dia. channel inclusive)	Borehole	6
13	Filling well compacted approved material thickness n.e 300mm. Blinding on top fill approved material well compacted thick n.e 50mm.	Borehole	6
14	Provision and placement of BRC Mesh as apron reinforcement, drainage channel length 6.00m	Borehole	6
15	Provision and placing of RC in pump platform, Apron and drainage channel Slab 150mm thick mix 1:2:4, well finished in grout cement	Borehole	6
16	Provision and installation of Indian MK II/III hand pump- pedestal, head assembly, water tank, 1 1/4" G.I. pipes & connecting rods and cylinder assembly to depth not exceeding 60 m	Borehole	6
17	General Landscaping around Bore hole 10m radius	Borehole	6
18	Provide and allow for excavation of soakage pit 1.20m diameter, filled with recommended filling materials and well covered.	Borehole	6
19	Provide and allow for fixing of a metallic signed post as specified in the description of visibility length	Borehole	6
20	1.20mx 0.80m width x 1.70 m legs using 2mm iron plate and 30mmx30mm hollow section pipes for main frame and legs (See item No 6 in the TOR)	Borehole	6

