Republic of the Philippines

PHILIPPINE PORTS AUTHORITY

TERMS OF REFERENCE FOR THE TECHNICAL SERVICES FOR THE CONDUCT OF SOIL INVESTIGATION AT DAVILA PORT, DAVILA, PASUQUIN, ILOCOS NORTE

I. OBJECTIVE

The purpose of this soil investigation is to obtain the needed information for foundation design analysis for the proposed RC pier, platform and passenger shed, provide settlement analysis of the proposed back-up area and for the evaluation of alternative type of structures.

II. GENERAL

There are no existing or updated record on soil investigation at the Davila Port, Davila, Pasuquin, Ilocos Norte on which to base the preliminary or detailed engineering design of structures to be constructed at the site.

III. SCOPE OF WORK

A. Coverage

The work shall cover the drilling and testing of soil samples from three (3) boreholes offshore, each to a depth of about 30 meters below seabed and/or there is 5 consecutive SPT N values of at least 50 blows but with less than 1 foot (30 cm.) of soil penetration recorded during (two) 2 – successive 15 cm. penetrations of the Split-Spoon Sampler or 4.5-meters coring into bedrock, whichever comes first. Soil boring/drilling deeper than 30 meters shall be referred to the PPA Engineer/Authorized Representative witnessing the drilling on-site. However, the minimum depth of drilling for each borehole is 15 meters deep. All boreholes must be referred to benchmarks designated by the PPA. The actual number of boreholes, their locations and depths are subject to change depending on field conditions. A Geodetic Engineer using visible/appropriate marker buoys shall determine the actual location of the borehole based on the coordinates specified in the development plan using GPS technology/system and the elevation on the seabed based on MLLW. The contract duration for this package is 45 calendar days.

B. Description of Work

1. Soil Exploration. This shall consist of drilling test holes, classification of soils and making of field tests on soil characteristics. In addition, laboratory tests shall be made as specified. The Consultant should be able to identify areas with geological, problems and difficulties, which could affect the stability of the proposed structures i.e. buildings, pier/wharf, back-up area, causeway, etc. A complete report shall be required giving soil classifications and their engineering characteristics including a ***3D settlement analysis and analysis on the rate of backfilling to counteract/avoid slip failure for projects where there are proposed reclamation (back-up area and causeway)***. The dimension of the back-up area shall be coordinated with PPA.

   - Depth of seabed with respect to Mean Lower Low Water (MLLW)
   - Soil borings through ordinary soils (depth: 0-15m)
   - Soil borings through hard soils/rock (depth: 5m)
   - Split-spoon sampling (1m interval for the first 3 meters, 1.5m interval thereafter or when there is noticeable change in the soil characteristics based on texture and color, whichever comes first
   - Standard Penetration Tests (similar to split-spoon sampling criteria)
   - Undisturbed sampling using thin-walled Shelby tube sampler (one sampler every 10m deep when there is encountered soft to medium stiff cohesive samples with SPT readings ranging from 2 to 7 blows per foot of soil penetration)
   - Stop criterion of soil boring for each borehole when: there is 5 consecutive SPT N values of at least 50 blows but with less than 1 foot (30 cm.) of soil penetration recorded during (two) 2 – successive 15 cm. penetrations of the Split-Spoon Sampler or 4.5-meters coring into bedrock or 30 meters deep below existing seabed, whichever comes first. Soil boring/drilling deeper than 30 meters shall be referred to the PPA Engineer/Authorized Representative witnessing the drilling

on-site. However, the minimum depth of drilling for each borehole is 15 meters deep.

Pertinent ASTM standards are to be met in the conduct of the investigation.

If rock is encountered, holes shall be terminated after core drilling continuously for five (5) meters in the rock.

a. Soil Classification. Soils shall be described according to the Unified Classification System of ASTM D2487. A visual field classification of soils by a competent Geologist or Geotechnical Engineer supplemented by laboratory tests shall be made.

b. Penetration. The Standard Penetration Test (SPT) shall be carried out in accordance with ASTM D1586. Disturbed (split-spoon) samples shall be performed at intervals of 1 meter for the first 3 meters and every 1.5 meters thereafter. Representative samples shall be collected and shipped for laboratory testing. At least one undisturbed (Shelby tube) sample, 2½ inch diameter x 24" long or larger, shall be extracted from each distinct soft to medium stiff cohesive stratum. The depth of the undisturbed sample shall be subject to the directions of PPA.

c. Testing . The soil/rock samples to be scheduled for laboratory tests shall be selected by the Consultant. The types of test shall be referred to ASTM standard procedures as follows:

1)	Visual Soil Classification (SPT)	ASTM D2488/D2487 2217/ASTM D1586
2)	Gradation	ASTM D422/E100 Part 41
3)	Atterberg Limits	ASTM 421/423
4)	Natural Water Content	ASTM D2216
5)	Unit Weight	ASTM 2049/D1556/D2167
6)	Organic Content	ASTM D2974
7)	Specific Gravity	ASTM D854/C127
8)	Consolidation Test	ASTM D2435
9)	Unconfined Compression Test	ASTM D2166-06

2. Procedure

a. Pre-drilling Coordination Meeting. Prior to the mobilization of the drilling teams/crews of the Contractor to the port site, a coordination meeting with the PPA Engineers in charge of monitoring the project activities to discuss among others, other parameters that maybe required relevant to the specific structure to be constructed, the type and size of structures (pier, causeway, wharf, back-up area, building, among others) to be built on each port site as clearly indicated in the Port Development Plan in relation to the borehole location and designation as superimposed therewith.

b. Technical Advice. The Contractor's Experts/Engineers shall be made available, if consulted, to give/submit their professional written opinion and recommendations on technical matters that may arise in the course of the PPA Engineer's design of such foundation structures and during the implementation of the proposed structure.

c. Inspection. No work shall be performed in the absence of an authorized representative of the PPA.

The Contractor shall not remove casing or equipment from any completed boring except with the express permission of the authorized representative and until said representative has had the opportunity to obtain all relevant data prior to removal.

d. Size of Boring in Sampling. Samples shall be obtained either intermittently or continuously as specified herein with a minimum diameter of 1-3/8 inch. The sizes of boreholes shall be sufficient for the above size of sample. Intermittent sampling shall mean disturbed (split-spoon) samples taken at specified intervals and undisturbed (Shelby tube) samples at each change of soil type or if soft cohesive soils are required, they shall be obtained with thin-wall samplers. Samples shall be prepared in accordance with the applicable requirements of the section herein on "Preserving Samples."

e. Penetration on Boulders or Rock Layers. Boulders or rock layers encountered in drilling shall be cored to determine the character and size or thickness of the materials. After coring, the hole may be enlarged by reaming or by other means as approved by the PPA. Where it will be necessary to reduce the size of the borehole in order to reach the target depth and obtain the required samples, the minimum casing diameter shall be of such size as to permit the use of a 1-5/8 inch core bit.

3. Supplemental Boring

a. Abandoned Borings. Borings that are abandoned or lost before reaching the required depth, or from which unsatisfactory samples are obtained, shall be supplemented by other borings adjacent to the original in order to obtain satisfactory samples and the required information. Penetration to the depth where the original boring was abandoned may be made by any method selected by the Contractor that in the opinion of the PPA will permit satisfactory completion and sampling below the elevation not satisfactorily reached by the abandoned boring.

b. False Start. It is intended that the borings be made so as to clear all underwater pipes, conduits, and other underwater structures. However, should the Contractor be unable to complete any boring due to underwater structures, obstacles or obstructions which the PPA considers are of unusual nature and that failure to penetrate them is not the fault of the Contractor's method or equipment, a false start will be allowed. In such cases, if directed by the PPA representative, another boring will be made in the adjacent vicinity.

4. Casing

a. Advancing. Boring through overburden soils shall be suitably cased to permit obtaining samples of the size or sizes specified or as directed. Casing may consist of standard pipes and couplings or flush pointed pipes, and shall be advanced vertically by driving, chopping and washing, coring or by any method consistent with the manner and type of sampling described for the specified boring, and as approved by the PPA. In all borings where rock is to be cored below the cased overburden, the casing shall be firmly seated to the rock, and the hole cleaned of all loose material before commencing coring operations.

b. Removal. All casings shall remain the property of the Contractor and shall be removed on the completion of the work.

IV. SOIL INVESTIGATION FOR PROPOSED STRUCTURES

Sub-surface exploration shall be carried out for the proposed engineering structures in order to obtain sufficient and adequate subsoil data for the detailed engineering design of the project. Driller's log and records of all accomplished work at the site shall be accurately recorded by an assigned field engineer of the Contractor

a.) Soil Borings and Core Drilling

Borings through underlying soils shall be advanced by drilling with either diamond or carbide NW casing shoe bits or such other method consistent with the manner and types of soil sampling to be employed, as may be approved by the PPA Engineer. Borings shall be cased to permit soil sampling by split-spoon and Shelby tube methods and shall extend down to the program depth of boreholes at respective area covered by the survey or deeper as directed by the PPA Engineer on-site.

For coring into rock or hard strata, rotary drilling method shall be employed. Core drillings shall be performed in accordance with ASTM or AASHTO procedures and the following provisions. At the start of coring, the casings through the substrata shall be tightly seated. The coring of rocks shall employ NQ size double tube core barrels or triple tube core barrels, to provide a sample run from 0.5 m to 1.5 m long within the liner, and shall be continued 4.50 m penetration deep into the bedrock. Length of recovered rock in each run shall be recorded and recovery expressed as a percentage of total recovery for each drilling run. Cores shall be recovered and placed in core boxes in the correct sequence. Core boxes shall be of robust timber construction and to the satisfaction of the PPA Engineer. The Contractor shall exercise particular care in recording water losses, rod jerks, and other unusual coring experience that is supplementary to the core record, and shall indicate, the nature and the extent of any fracturing.

The Contractor's Field Engineer shall record groundwater levels in each boring upon completion of boring, during the removal of the casings and 24 hours after the removal of the casing. Where the borings are made over a period of several days, the ground water readings shall be made each evening at the end of the drilling operations, and each morning prior to the resumption of drilling. In all cases the recorded data shall include the date and time of reading.

b.) Standard Penetration Test and Split-Spoon Sampling

This work shall be performed in accordance with ASTM of AASHTO standard procedures, and the following provisions. Where discrepancies exist, these specifications shall govern. All procedures are subject to the approval of the PPA Engineer.

Representative soil samples (disturbed) shall be obtained at regular intervals of 1.0 meter for the first 3 meters or every 1.50 meters interval, thereafter or every change in soil characteristics, whichever is observed first.

Split-spoon sampler shall be driven into the soil at the bottom of the cleaned out casing using a 64.0 kg. hammer falling 75 cm. The hammer will be raised preferably by means of a mechanical free drop system. The sampler shall have a steel shoe with a sharp cutting edge, and a reliable check valve. A record by the Contractor's Field Engineer shall be made of the number of blows for the sampler to penetrate the first 15 cm. and is called the seating drive. The sampler shall be driven a further 30 cm. or until 60 to 70 blows of the hammer have been applied. The number of blows for each 15 cm penetration shall be recorded. The penetration resistance, N, will be the total number of blows required to drive the sampler the last 30 cm.

If the sampler is driven less than a total of 45 cm, the penetration resistance shall be number of blows for the last 30 cm of penetration. If less than 30 cm. is penetrated, the number of blows shall be stated and the depth of penetration measured. If the rate of penetration of the sampler is less than 2.5 cm for the 50 blows, refusal shall be considered to have been obtained.

The sampler shoe shall be provided or fitted with a flap valve to obtain samples in soils that are too granular to be retained in the sampler.

Tests shall be repeated if necessary to obtain acceptable samples. However, the sampler shall not be driven more than 60 cm below the bottom of the casing, in which case, the casing shall be advanced before repeating the test procedure.

The split-spoon retrieved from the hole shall be handled carefully and shall be opened, with minimum disturbance of the sample, then placed into a clean plastic sheeting bag for visual classification. The soil sample shall be preserved and stored as specified in Section III. If the sampler is found to contain more than one type of soil, each type shall be classified and preserved separately.

1. Split Spoon Drive Sampling

   a. Sampler Description. Samplers for drive samples shall be of the standard split spoon type having an outside diameter of two (2) inches and an inside diameter of one and three eighths (1-3/8) inches for NW size holes. The sampler shall have a minimum inside length of sixteen (16) inches and shall be equipped with hardened tool shoe valve at the top. The Contractor shall also provide a core catcher at the bottom of the sampler when difficulty is experienced in recovering samples.

   b. Sampling Procedures. At the points where drive samples are to be taken, advancement of the borehole shall be stopped and the hole or casing shall be completely cleaned of disturbed soil, segregated coarse material and any clay adhering to the walls of the casing. The cleaning shall extend to at least the bottom edge of the casing and should preferably advance the hole a few inches further in order to by-pass disturbance caused by the cutting edge of the casing. Cleaning shall be done with shielded jets suitable to the relative resistance of the various subsurface strata; the drive sampler shall be driven in the following manner:

      1) The 1-3/8 inch inside diameter drive sampler shall be driven with a 140-lb. hammer a free fall of 30 inches.
      2) The drive sampler shall be driven to a depth of 18 inches or as directed by the PPA representative and the number of blows shall be recorded for each 6-inch depth of penetration. If the samples obtained are less than 12 inches long, the sampling operation shall be repeated.

2. Undisturbed Sampling of Soils

   1. Shelby-Tube

      This work shall be performed in accordance with ASTM or ASSHTO procedure and the following provisions. Where discrepancies exist between these provisions and ASTM and ASSHTO specifications, these specifications will prevail. All procedures are subject to the approval of the PPA Engineer.

      In layers of soft to medium stiff cohesive soils (i.e. N-values ranging between 2 to 7 blows per foot of soil penetration), undisturbed Shelby-tube samples shall be obtained at intervals of not more than ten (10) meters or otherwise directed by the PPA Engineer. Undisturbed samples are required for consolidation and unconfined compression tests and other specified laboratory tests.

      The following procedures shall be adopted:

      Clean out the hole to the deep of sampling such that the soil immediately below the casing shall be as undisturbed as possible. The casing shall be kept above the sampling position.

      Attach a 70 mm diameter thin-wall tube sample to the drill rod and let it rest on the bottom of the hole.

      Push the sampler into the soil either manually or by hydraulic jack with a continuous and rapid motion without impact or twisting to fill the sampler.

In no case shall the sampler tube be driven with a hammer or pushed further than the length provided for the soil sampler. If resistance is encountered when manually pushing the sampler tube, a heavy weight may be used without hammering to drive the sampler.

Before retrieving the tube, turn the rod at least two (2) revolutions to shear the sampler off, at the bottom. Raise the rod and detach the tube sampler.

Remove and store the disturbed material at the ends of the tube and preserve the undisturbed section in the tube as specified in Section III. Great care must be observed in handling and transporting the samples.

a. General. Undisturbed Shelby tube samples, 2-1/2 inches in diameter x 24 inches long, shall be taken from all holes as specified herein and called for in these Technical Specifications.
Undisturbed samples shall be taken in cohesive soils whenever the soil conditions would permit driving of the Shelby tube sampler.

b. Sampler Description. The thin wall tube (Shelby tube) sampler shall consist of 16 or 18 gauge barrel, approximately 36 inches, or longer and will be equipped with a reliable check valve at the top. The tubes shall be provided with a sharp cutting edge and a positive inside clearance. The inside diameter of the cutting edge shall be 0.7 to 1.5 percent less than the inside diameter of the sampler tube.

c. Sampling Procedure. Before each sample is taken, the casing or borehole shall be carefully cleaned out with a deflected jet or clean out auger as approved by the PPA. The inside of the tube shall be thoroughly cleansed prior to taking the sample. The sampler shall be forced into the soil at a distance of 24 inches at the rate ranging from ¼ to ½ foot per second by hydraulic pressure. The sampler shall not be driven with a drop hammer to obtain samples. No undisturbed samples shall be accepted if the recovery is less than 24 inches long, unless expressly approved by the PPA field representative. After an acceptable undisturbed sample is obtained, the sample shall be preserved as specified in Section 4 "Preserving Samples."

In layers of soft to medium stiff cohesive soils (i.e. N-values ranging between 2 to 7 blows per foot of soil penetration), undisturbed Shelby-tube samples shall be obtained at an interval of not more than ten meters or as otherwise directed by the PPA Engineer.

3. Rock Coring

a. General. The term rock shall apply to any material that cannot be sampled by drive sampling as described herein. Where rock layers or boulders are encountered in the overburden above the specified bottom elevation of any borings, it shall be cored as described under "Penetration on Boulders or Rock Layers." Where ledge rock is encountered above the specified bottom elevation of any boring, it shall be cored to the depths as specified in the Proposal and as directed by PPA representative.

b. Sampler Description. Rock coring shall be performed with a double tube swivel type core barrel as standardized by the Diamond Core Drill Manufacturers Association (DCMA) equipped with diamond-set bottom discharge core bits and standard core lifters and core gage. Core barrels shall be of 5 to 10 ft. length to obtain a continuous rock core 5 feet long, and unless otherwise specified or directed by PPA representative, the sampler shall produce a minimum core of 1-3/4 inches in diameter.

c. Sampling Procedure. Casing through overburden shall be seated tightly on the rock at the elevation of the rock coring. The Contractor shall operate his drills at such speeds and with such water pressures that will ensure maximum core recovery in whatever kind of rock is being drilled. Where soft or broken rocks are encountered the Contractor shall reduce the length of "runs" to less than 1.5m. as may be required to reduce core loss and core disturbance to the minimum.

Failure to comply with the foregoing procedures shall constitute justification for PPA to require redrilling at the Contractor's expense of any boring from which the core recovery is unsatisfactory. The Contractor shall exercise particular care in recording water losses, rod jerks and other unusual experience that will throw light on the nature and extent of any fractures in the core samples.

4. Preserving Samples

a. General. The Contractor shall provide material, equipment and labor necessary for preserving samples. Wax or masking tape shall be used to ensure proper sealing of sample containers.

b. Drive Samples. Representative specimen of each sample shall be preserved. The containers for preserving samples shall be maximum ten-ounce large-necked, round, screw top, air-tight, durable clear plastic jars, and the specimen shall be sealed with a threaded cap, and cohesive soil samples shall be further sealed by dipping the cap and threads into wax immediately after capping.

Each glass jar or undisturbed sample core liner shall have weatherproof labels giving the following information:

Project: _____
Type of Sample: _____
Borehole No: ____ Elevation: _____ Location: _____
Coordinates of the borehole: _____
Jar No.: _____
Top Elevation of Hole: _____ Depth of Sample: _____
Visual Description of Samples: _____
Penetration (Blows/15 cm): _____

Shipping boxes: Each box of samples shall be identified with weatherproof labels or marking indicating the following:

Project Description: _____
Project Location: _____
Boring No.:_____ Sample No.: _____

c. Undisturbed Samples. Undisturbed samples from boring for preservation shall be treated in the following manner: A maximum of one inch of the undisturbed materials from the top and bottom of each sample shall be preserved as prescribed for Drive Samples. The ends of the sample tube shall be filled to the top with wax added in the increments to prevent voids, after which they shall be capped with tight fitting copper or galvanized steel caps bound on with friction tape and dipped in wax. Undisturbed samples shall be labeled and identified as directed by PPA.

d. Rock Cores. Rock cores shall be suitably boxed, marked and identified in a manner satisfactory to PPA. Cores shall be boxed in the same sequence in which they were obtained in the field.

Cores from each drilling run shall be separated from adjacent with from wooden blocks on which the depths of the beginning and end of the run shall be clearly, accurately and permanently indicated. Cores of soft rock which may be damaged in the normal course of shipping shall be

further preserved by wrapping them first in polyethylene plastic. The container itself shall be marked to show borehole number, box number, depth and the date the sample was taken.

5. Records

a. General. The Contractor shall keep accurate driller's logs and records of all work accomplished under this contract and shall deliver complete, legible copies of these logs and records to PPA upon completion of the work or at such other time or times as he may be directed. The PPA or his representative shall have the right to examine such records at any time prior to their delivery to him. Separate logs shall be made for each boring. All depths and elevations shall be measured in meters, and shall be referenced to proper benchmarks or datum as designated by PPA representative.

b. Records. Records shall contain the following information:

1) Results of all details of each borehole arranged in tabular form, giving full information on the location, type of boring, vertical arrangement, and the thickness and classification of the materials penetrated.
2) Location, elevation and depth, type, number and date of each sample and test taken.
3) Heights of drop and weight of drop hammer for taken drive samples.
4) Size and length of casing used in each borehole.
5) Length in inches of samples of coring run.
6) Length in recovery for all samples and coring.
7) Elevation of refusal or rock if encountered.
8) Approximate force required to press in undisturbed samples.
9) Driving energy in inch-pounds and blow count data for six-inch penetration of drive sampler and for each twelve-inch penetration of casing.

6. Reference Elevation

The seabed elevation of each borehole should be included in the boring log based on Mean Lower Low Water (MLLW). Elevations above MLLW shall be marked positive (+) while those below shall be marked negative (-).

7. Submission of Samples

At such time as PPA may direct, all samples and cores selected by the Contractor shall be carefully boxed and shipped accordingly. Boxing shall be made in such a manner that will protect all soil and core samples from excessive disturbance while being shipped to the Soils Laboratory for testing. Payment for shipping samples shall be included in the bid proposal.

V. MEASUREMENT AND PAYMENT

The quantities listed in the Proposal are approximate only and do not govern final payment. Payments to the Contractor will be made only for the actual quantities of the contract items performed in accordance with the Technical Specifications and shall be considered as full compensation for furnishing all labor, materials, equipment plant, facilities, and services for the performance of the work.

VI. SETS OF TESTS REQUIRED AND REPORTS

A. Soil Classification. Soils shall be described in accordance with the Unified Soil Classification System (USCS). Each individual stratum shall be measured and described in writing. All thin layers, joints or partings shall be noted. Slices of samples may be prepared and slowly air-dried to reveal stratifications and laminations.

The visual description shall state the color, class of soil (gravel, sand, silt, clay or peat), the relative sizes of non–cohesive soil particles (coarse, medium or fine sand) and the relative cohesiveness and strength of clayey soils (high, medium or low). Any significant factors shall be noted such as the presence of shells, varves, roots and odor of the soil. All soil samples shall be tested in accordance with the ASTM or AASHTO specifications where applicable.

a. Partial Reports of Investigation Results

The Consultant shall submit partial reports consisting of completed results of boring in the form of a final boring log and soil profile for immediate use in the preliminary design work.

b. Photographs

Photographs showing the borehole drilling and sampling at each site shall be taken by the Consultant and form part of the report. The photographs shall depict the following:

1. Equipment used
2. Core drilling operation
3. Water level measurements
4. Performance of SPT sampling
5. All cores and SPT sample placed in core boxes
6. Date photographs were taken
7. Location or station

B. Final Report. After completion of the laboratory-testing program, a draft report clearly defining and summarizing all the works performed together with the *3D settlement analysis and analysis on the rate of backfilling to counteract/avoid slip failure for projects where there are proposed reclamation (back-up areas, causeway),* for traffic load of 500 and 750 pounds per square foot (psf), soil bearing capacity, pile capacity, recommended foundation and pile length depending on the type of structure to be constructed, including the findings and recommendations of a competent Soils Engineer of the Contractor, shall be submitted to PPA. The draft report shall be book-bound and shall contain among others a description of the test procedure, the number of tests for each type, boring logs, maps, summary tables of the results and complete details and analysis/computation and evaluation of the results of each test, grain size analysis curves, summary or recommended soil particles and Atterberg Limit worksheets.

In determining the pile bearing capacity as option/recommendation for foundation works, the Soil Engineer shall use the Design Manual for Ports and Harbor Facilities in the PPA. The provisions in the Design Manual shall serve as the technical reference in computing the bearing capacity of pile foundation based on the recorded borehole logs.

The Final Geotechnical Report shall contain the methodology of geotechnical investigation performed, the result of field investigation including field logs, description of site conditions, profile of soil conditions, result of laboratory tests, summary of geotechnical data and photos. The Final Report (6 copies) in book-bound form and (1 copy) in electronic media (CD-R disks and/or CD-RW disks) in a format and form replicating the paper-print copies, incorporating all revisions deemed appropriate by the Philippine Ports Authority should be submitted within 10 days after receipt of comments on the Draft Final Report from the PPA. The boreholes logs, development plan indicating the actual borehole location and soil profile shall be submitted in AUTOCAD format.

VII. PAY ITEMS

A. Mobilization and Demobilization

1. Payment will be made at the contract lump sum price for mobilization and demobilization for this exploration work, and shall include full compensation for all labor, materials, transportation charges, and incidentals necessary to complete the mobilization, manning and demobilization of all equipment, including the drilling rigs, appurtenances, supports, etc. Payment on this item will be made only after completion of fieldwork for this exploration.

B. Boring

1. Measurement will be made based on the actual depth of soil boring in lineal meter of the borehole in place and accepted.

2. Payment will be computed based on the number of linear meters, measured as provided above, using the contract unit price for borings. Such payment shall include full compensation for furnishing, installing and removing the drill rig and accessories for all drilling work, penetrating boulders or hard layers encountered, installing and removing casing, for submitting records or borings and/or excavation for incidentals necessary to complete the item.

C. Standard Penetration Tests (SPT)

1. Each test performed and accepted will be measured as a complete unit.
2. Payment will be made and measured based on the actual number of units performed and at the applicable unit price for SPT.

D. Undisturbed Sample (UDS)

1. Each sample taken and accepted will be measured as a complete unit.
2. Payment will be made and measured based on the actual number of units performed and at the applicable unit price for UDS.

E. Coring in Rocks

1. Measurement for payment will be made based on the actual number of lineal meters penetrated with the use of coring bit in rock, boulder, gravel, or hard formations.
2. Payment will be computed based on the actual number or lineal meters measured as specified above and at the applicable contract unit price for coring in rock.

F. Laboratory Tests.

Payment will be made based on the actual number of specified tests, as required in the specification, or as may be required by PPA, and at the applicable contract unit price.

G. Equipment and Miscellaneous Items

The Contractor shall specify the major equipment whether owned, rented or leased and to be purchased that will be utilized in the performance of these services, their main specifications and the estimated times of use shown in an equipment utilization schedule. The minimum equipment requirements for this undertaking are as follows:

Quantity	Unit	Particulars
1	unit	Rotary Spindle Hydraulic Rig; (owned)
1	unit	3.5hp Water Supply Pump; (owned)
1	unit	5hp Duplex (two piston) Engine Water Pump; (owned or leased)
1	set	Tripod (owned)
10	pc.	NW Casing (10 owned)
25	pc.	AW Rod (25 owned)
1	set	Split Spoon with 70 kgs. Jar Hammer plus Plate (owned)
1	pc.	NQ Core Barrel (owned)
1	pc.	Startling Barrel (owned)
1	set	Water Swivel (owned)
1	assembly	Drilling Barge or Pontoon with at least 4 anchors for each project site (owned)
1	unit	Motorized Service Boat (owned or leased)
1	set	Surveying Equipment (Total Station, Theodolite or GPS) (owned)

Miscellaneous items such as rental of service vehicles, shipment of samples, and employment of security services, provision of safety signage (caution tape and barricades) and individual safety gears/gadgets of the drilling team e.g. safety shoes, safety vest, hard hat, goggles, gloves, safety belts, among others shall be made in lump sum after the work has been completed.

VIII. BILLING AND OTHER FORMS

The Contractor shall prepare their billing and other forms in accordance with those that may be prescribed by PPA.

IX. REQUIRED EXPERTISE AND PROPOSALS

The Contractor shall specify the key personnel or experts that will be utilized in the performance of these services, their qualifications (education, training and experience) and the times that they will serve shown in a manpower schedule. The following minimum specialization is anticipated to be required in the Study:

- Project Manager
- Geotechnical Engineer
- Geologist
- Geodetic Engineer/Civil Engineer
- Laboratory Chief

X. REPORTS

The Draft and Final Reports shall include the results of all required tests performed and accepted on this exploration work including the settlement analysis and analysis on the rate of backfilling to counteract/avoid slip failure for proposed reclamation (back-up area and causeway). The report shall include the findings, evaluations and recommendations as more specifically defined in Section No. VI.B.

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