

**HAZARD MICROZONATION AND ASSOCIATED SCIENTIFIC ASSESSMENT /
EVALUATION OF HAZARDS AND RISKS IN FIVE (05) SELECTED VALLEYS OF
GILGIT-BALTISTAN AND CHITRAL**

GEOTECHNICAL INVESTIGATION

TERMS OF REFERENCE

**LETTER OF OFFER
FORM OF CONTRACT AGREEMENT
BILL OF QUANTITIES
TECHNICAL SPECIFICATIONS**

JUNE, 2022



NATIONAL ENGINEERING SERVICES PAKISTAN (Pvt.) LIMITED
NESPAK HOUSE, SECTOR G-5/2, ISLAMABAD Tel: 051-9221910-13, 9007553

TERMS OF REFERENCE

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LETTER OF OFFER

Name of Works: Hazard Microzonation and Associated Scientific Assessment / Evaluation of Hazards and Risks in Five (05) Selected Valleys of Gilgit-Baltistan and Chitral.

GM / Head,

DM&RD

National Engineering Services Pakistan (Pvt.) Limited

NESPAK House, Sector G-5/2, Islamabad

Tel: 051-9221911-13 Fax: 051-9221914

Gentlemen,

1. Having examined the Scope of Work, Technical Specifications and Drawings for carrying out of the above-named Works,

We, the undersigned, under the name of
_____ and
address

_____ and being duly incorporated under the laws of Pakistan hereby offer to carry out and complete such Works in conformity with the said Documents including Addenda thereto for the Total Price of Pak Rs. _____ (Pak Rupees _____) or such other sum as may be ascertained in accordance with the said Documents.

2. We undertake, if our offer is accepted, to commence the Works and to deliver and complete the Works comprised in the Contract within the time(s) stated in these documents/Terms of Reference.
3. We agree to abide by this Offer for the period of 60 days from the date fixed for opening the same and it shall remain binding upon us and may be accepted at any time before the expiration of that period.
4. Unless and until a formal Agreement is prepared and executed, this Offer, together with your written acceptance thereof, shall constitute a binding contract between us.
5. We understand that you are not bound to accept the lowest or any Offer you may receive.
6. We do hereby declare that the Offer is made without any collusion, comparison of figures or arrangement with any other person or persons making a Offer for the Works.

Dated this _____ day of May 2022

Signature _____ in the capacity of _____
_____ duly authorized to sign Offer for and on behalf of

(Name of Offerer in Block Capitals)

(Seal)

Address

Witness:

(Signature) _____

Name: _____

Address: _____

FORM OF CONTRACT AGREEMENT

This CONTRACT AGREEMENT (hereinafter called the "Agreement") made on the _____ day of _____ 2022 between _____ (hereinafter called the "Employer") of the one part and _____ (hereinafter called the "Firm/institute") of the other part.

WHEREAS the Employer is desirous that certain Works, viz _____ should be executed by the Firm/institute and has accepted an offer by the Firm/institute for the execution and completion of such Works and the remedying of any defects therein.

NOW this Agreement witness as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
2. The following documents after incorporating addenda, if any shall be deemed to form and be read and construed as part of this Agreement, viz:
 - a) The Letter of Acceptance;
 - b) The Offer Submission Form;
 - c) The Priced Bill of Quantities;
 - d) The Technical Specifications
 - e) The Drawings
3. In consideration of the payments to be made by the Employer to the Firm/institute as hereinafter mentioned, the Firm/institute hereby covenants with the Employer to execute and complete the Works and remedy defects therein in conformity and in all respects within the provisions of the Contract.
4. The Employer hereby covenants to pay the Firm/institute, in consideration of the execution and completion of the Works as per provisions of the Contract, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS WHEREOF the parties hereto have caused this Contract Agreement to be executed on the day, month and year first before written in accordance with their respective laws.

Signature of the Firm/Institute

Signature of the Employer

(Seal)

(Seal)

Signed, Sealed and Delivered in the presence of:

Witness:

Witness:

(Name, Title and Address)

(Name, Title and Address)

SCOPE OF WORK

The Geotechnical investigations are aimed at revealing the general subsurface soil types & characteristics at the project site earmarked for the purpose of Hazard Microzonation and Associated Scientific Assessment / Evaluation of Hazards and Risks in Five (05) Selected Valleys of Gilgit-Baltistan and Chitral specifying an efficient and cost effective foundation design for the forthcoming development.

The subsoil investigations have been planned through execution of boreholes, test pits, field testing and sampling followed by appropriate laboratory testing, analysis & evaluation of raw data and test results and preparation of comprehensive soil investigation report. The investigations must be carried out in such a way to provide sufficient information about the condition and the strength of various sub-strata.

Upon award of work, the field investigations will be supervised by a NESPAK Geotechnical Engineer / Engineering Geologist on full time basis. The firm/institute shall mobilize to the site with the equipment required for the execution of work as per Scope of Works & BOQ.

TECHNICAL SPECIFICATIONS

FOR GEOTECHNICAL INVESTIGATIONS

1. GENERAL

Gilgit-Baltistan and Chitral are located in the “Himalayan Karakorum Hindukush (HKH)” mountainous region of Northern Pakistan which is among severe hazard prone areas due to its steep slopes, narrow gorges, vast glaciers and active geology. The Scope of Services and objective of the assignment as mentioned in the TORs of the Project is to carry out Hazard micro-zonation, geotechnical/hydrological and seismic investigations, scientific assessment/evaluation of geophysical, hydrological, and meteorological conditions that may be triggered by climate change and seismicity. In addition, identification of associated risk(s) and vulnerabilities, propose mitigation measures and recommendation for future landuse in Five (05) selected valleys of Gilgit-Baltistan & Chitral. Names, location and tentative areas are outlined hereunder:

- 1- **Gulaghmuli Valley** (District Ghizer) - 29 Km²;
- 2- **Immit Valley** (District Ghizer) - 37 Km²
- 3- **Arkari Valley** (District Lower Chitral) - 22 Km²
- 4- **Lower-Yarkhon Valley** (District Upper-Chitral) - 46 Km².
- 5- **Shimshal Valley** (District Hunza) - 12 Km².

1.1 Brief description of the site

The Project entails Hazard micro-zonation, geotechnical/hydrological and seismic investigations, scientific assessment/evaluation of geophysical, hydrological, and meteorological conditions that may be triggered by climate change and seismicity.

1.2 Access to the site

The sites are located in five different valleys of Gilgit-Baltistan & Chitral as shown in map attached.

1.3 Scope of the contract

The purpose of the work specified herein is to determine the type, nature, thickness, structure and texture of the various subsurface strata and the conditions and the engineering characteristics of the subsurface materials as they exist to the depth and at the locations specified. This is to be accomplished by means of light percussion boring, excavation of test pits, in situ testing and collection of disturbed samples from the project sites. The selected samples of soil and water shall be tested in the approved laboratory for their physical, chemical and engineering properties. The Bill of Quantities for geotechnical investigations is given in Terms of Reference/ Invitation Letter. The locations of boreholes will be finalized by the Employer’s Engineer in the field.

1.4 Work under instructions of engineer

The firm/institute shall carry out the specified works under the supervision of the Employer Engineer, his Representative or the Representative’s assistants.

1.5 Mobilization

Within seven (07) days of receiving a written order to commence the works, the firm/institute shall mobilize at site for the execution of work as per agreed schedule. Mobilization shall consist of the delivery at the site of all plant, equipment, accessories, spares, materials, and supplies to be furnished by the Firm/institute; the complete assembly of all such plant and equipment in a satisfactory working order and satisfactory storage at the Site of all materials and supplies. The equipment mobilized shall include but not limited to the items listed in Clause 1.6.

1.6 List of equipment which must be included but not limited to in items mobilized by the Firm/institute.

Sr. No.	Description
1)	Light Percussion Drilling Rig along with necessary equipment (Double Pulley and Manila Rope are mandatory).
2)	Standard penetration test equipment including AW, B rods and split spoon samplers and containers for sample preservation
3)	Field density tests by sand replacement method with accessories requirement

1.7 Permission to Start the Works

The Firm/institute shall not be allowed to commence the works until he has mobilized all the equipment required to complete works as per BOQ and any delay caused thereby shall not be allowed as a basis of a claim for additional expenditure or an extension of the time for completion of the Contract.

1.8 Demobilization

Demobilization shall consist of the removal from the site of all plant and equipment after completion of the work and leaving the site clear, clean and tidy to the satisfaction of the Engineer. Engineer's permission shall be sorted before demobilization from the site.

1.9 Plant and Equipment

The Firm/institute shall keep on the site sufficient plant to meet the requirements of the work. The plant and equipment shall be in good operating condition and capable of efficiently performing the work as set forth.

1.10 Drillers and supervisory staff

The Firm/institute shall have on site, at all times, qualified, experienced, orderly and thoroughly competent persons including geotechnical engineers or engineering geologist who shall conduct and supervise drilling, boring operations, sampling, logging and in situ testing. The Firm/institute shall remove from the site any of his employees that in the opinion of the Engineer do not meet these requirements.

1.11 Setting up at each hole

The Firm/institute shall make all the necessary arrangements for setting up at the location of each hole, everything necessary for carrying out the work specified at that hole, and for the preparation and reinstatement of the work areas, improvement to access routes and all other temporary works.

1.12 Housing and storage

The Firm/institute shall make his own arrangements for housing of his personnel and storage of the equipment and supplies at the site. However, the Firm/institute shall provide a temporary site office properly furnished for the Engineer or Engineer's Representative.

1.13 Health, Safety and Environmental (HSE) Measures

- a. The Firm/institute shall ensure that all necessary measures are undertaken to maintain good health of its staff and hygienic conditions at the job site.
- b. The Firm/institute shall ensure the safety of all the personnel engaged in the WORK including the Employer and engineer supervising staff, and shall take necessary precautions and preventive measures to that end including the use of personal protective equipment (PPE) and safe working procedures.
- c. The Firm/institute shall take effective steps to assure that during the Work no air, water or soil pollution is generated.

1.14 Interference with others

It is possible that the Engineer may engage some other agency for the executions of other investigations at the Project site, which will start within the period of this contract. The Firm/institute shall ensure that neither he nor his staff cause any interference with as well as delays to any other agency working on or near the site and that his plant and equipment or supplies shall not prevent or hinder the movement of personnel or of plant, equipment or supplies belonging to others who are lawfully in the area. If the Firm/institute receives any complaint either verbally or in writing that his operations have caused or causing delays or hindrance to others, he shall inform the Engineer immediately and pass on the original or a copy of any written complaint received. Likewise the Engineer shall inform the Firm/institute of such complaint which he has received concerning the Firm/institute's operations.

1.15 Measurement of quantities

The quantities shown in Bill of Quantities are only approximate. The payment shall be made on the basis of actual work performed in accordance with the specifications.

1.16 Submission of Field Data

The Firm/institute shall supply complete field investigation data to the Engineer within the Three (03) days after the completion of field work. This data shall include copies of all approved logs and test records prepared during the course of the contract including any alterations or amendments required by the Engineer. No separate payment shall be made for this work.

1.17 Order of work

The order of the execution of the work will be specified by the Engineer.

2. DEFINITIONS

2.1 Holes

Any borehole or drill hole is referred to generally as a hole

2.2 Boring

Boring shall mean advancing a hole using machine-driven bailer, chisel or clay-cutter. The rig used shall be called a boring rig and the hole formed shall be called a borehole.

2.3 Drilling

Drilling shall mean the use of a machine-driven rig for advancing a hole in rock or soil required with a Light Percussion tool. The hole formed shall be called a drill hole and the rig used shall be called a Percussion rig, which term shall include a boring rig with auxiliary equipment for drilling.

2.4 Sampler

A 'sampler' shall mean the sample tube and all the accessories that are required to obtain the disturbed or undisturbed sample of soil.

3. METHODS OF WORKING

3.1 Areas to be investigated

The limits of the project site and the approximate locations of the boreholes shall be indicated on Drawing, but the Engineer may change the locations within the limits of the area to be investigated during the progress of the work. The Engineer will specify from time to time during the Contract period the exact location and reference number of all holes/boreholes, but locating the holes/boreholes accurately in the field shall be the Firm/institute's responsibility.

3.2 Boring

The Engineer will indicate the type and maximum depth likely for each hole before it is started, and the Firm/institute shall use the equipment necessary for continuing the hole to that depth.

3.3 Casing

A hole shall be cased in any stratum which is not sufficiently strong to stand unsupported, or when directed by the Engineer's Representative.

The Firm/institute shall ensure that casings are of a suitable size and are inserted in such a manner so as to render them recoverable. The Contract Rates for boring and drilling shall be deemed to include the supply, insertion and recovery of casing and any damage, loss or delay caused by difficulty or failure in recovery of casing.

3.4 Removal of casing

Casing shall not be removed from any hole nor any filling introduced into a hole until permission is given by the Engineer. This permission will normally be given as soon as work in the hole is completed and the groundwater level has been measured in accordance with Clause 3.8 of Technical Specifications.

3.5 Display of material removed

The material removed from all holes, except for disturbed samples in their containers and undisturbed samples in their samplers shall be laid out in sequence on a clean dry board for examination by the Engineer. The material shall be displayed in such a manner that, when required by the Engineer, further small, disturbed samples can be taken unmixed with other material. No material shall be removed from the board until authorized by the Engineer. All the material displayed shall be protected from adverse effects of the weather including hot sun and rain.

3.6 Supplementary holes

Holes that are abandoned shall be supplemented by other holes adjacent to the original location. In addition, holes from which unsatisfactory samples have been obtained and/or in which unsatisfactory field tests have been performed due to the negligence of the Firm/institute shall be supplemented by other holes adjacent to the original location. The exact location of such supplementary holes shall be specified by the Engineer in the field.

Penetration to the depth where the unacceptable holes were abandoned or to the depths where unsatisfactory samples were obtained or unsatisfactory field testing was performed may be made by any method selected by the Firm/institute that in the opinion of the Engineer will permit satisfactory field testing and sampling below those depths. The deepening of the supplementary hole below the depth at which original hole was abandoned shall be carried out using only the specified method of advancing the hole.

No payment will be made for that portion of the supplementary hole above the depth paid for in the unacceptable hole.

3.7 Daily field records

Each day during the work on the Site, the Firm/institute shall hand over to the Engineer the original and a legible copy of the records of the previous day's work containing the following information in respect of each hole where work in progress.

- a. Name of Contract.
- b. Number, type and size of the hole
- c. Date and hours worked on the Site
- d. Brief description of the weather
- e. Total depth of hole at the beginning and end of each shift
- f. Make and type of machine in use
- g. The groundwater levels in accordance with Clause 3.8 and the depths at which water inflows were encountered.
- h. The approximate quantity of water poured into a hole and the time when it was done.
- i. Diameter of the hole and depths of any reduction in diameter.
- j. The length of hole for which casing was used and the diameter of such casing.
- k. A full geotechnical description of each stratum encountered.
- l. Depth below ground of each change of stratum
- m. Reference number, depths and other details of all small and large disturbed samples, field moisture content samples and undisturbed samples (giving serial number and type of the sampler, length of sample recovered and number of blows used if driven).
- n. Commencing and terminating depths of each drilling run, details of type of bit used and length of samples recovered.

- o. Data obtained during in situ tests, together with the water level in the hole during the test on specified preforms.
- p. Details of any instrumentation installed
- q. Details of backfilling and grouting including the quantity of material used.
- r. Details of delays and breakdowns.
- s. Any other relevant information and details of any other operation for which the Firm/institute may require additional payments.

3.8 Ground Water level

Readings of groundwater levels in all holes and that the depth of the hole in progress shall be taken with an electrically operated sounder and by other means recorded in the daily field records and logs at the following times:-

- a) Before work commences in the morning.
- b) After work has finished in the evening, both before and after water (if any) is added to stabilize the hole.
- c) When a hole has been completed.
- d) Immediately prior to backfilling a hole
- e) At the time of undisturbed sampling and standard penetration and other in situ tests.
- f) At the completion of the field work.

An electrically operated sounder in proper working order shall be maintained at each hole where work is in progress whether or not water has previously been observed in that hole.

The level of the bottom of the hole and the bottom of the casing, if any, shall be measured and recorded at the same time as each water level reading.

The times when water levels are measured shall also be recorded.

If, at any time, the level of the water in a hole fluctuates, a record shall be kept of the fluctuation. If the hole 'makes or 'loses' water the Engineer shall be informed immediately.

Any addition of water to assist the advance of a hole shall be recorded and any extraordinary smell or color of the water and any other unusual circumstances shall be reported. Water shall not be added or removed from a hole when in the opinion of the Engineer such action might adversely affect undisturbed sampling and the results of in situ tests.

3.9 No additional payment for water level observations

The Contract Rates for drilling and boring shall be deemed to include the cost of taking and recording all water levels as specified in Clause 3.8.

3.10 Backfilling of holes

Boreholes shall be backfilled with grout as explained below or as directed by the Engineer: Grouting for backfilling holes shall consist of a mud formed by mixing one part by weight of bentonite with 10 parts of water, to which shall be added two parts by weight of cement after the bentonite and water have been thoroughly mixed. Alternatively, holes may be backfilled with purpose- made pellets of bentonite or bentonite/cement, provided they are of

a size which, in the opinion of the Engineer is compatible with the size of hole. If there is no standing water in the hole, grout may be poured in from the top. If there is standing water in the hole, the grout shall be fed into the bottom of the hole by a tremie pipe, the end of which shall always be below the groundwater junction while grouting is being carried out.

Grout backfill shall be taken up to 30 cm below the original ground level. Any apparent loss of grout due to leakage or consolidation within one week shall be made-up with fresh grout and then the remaining depth of the hole shall be filled with concrete. No separate payment shall be made for this work and the contract rates for drilling shall be deemed to include cost of backfilling of boreholes.

3.11 Logs

Logs of boreholes/ drill holes/ boreholes shall be provided on forms specified by the Engineer. They shall include descriptions of all strata including details of the soil macro fabric (such as frequency, orientation and nature of discontinuities) and details of samples taken, and an account of all observations and field tests. Logs of drill holes and boreholes shall include notes on the nature, quantity and color of the drilling fluid returns. All logs shall be subject to the approval of the Engineer and one draft copy shall be submitted to the Engineer, not more than two days after the hole is backfilled. Soil descriptions shall conform to ASTM designation D 2488-84 and classified according to ASTM designation D 2487-85. All depths and thicknesses of topsoil and strata shall be recorded in meters and all reduced levels shall be recorded in meters with respect to mean sea level.

3.12 Firm/institute's responsibility for records

The presence of the Engineer or any of his staff and their keeping separate drilling records shall not relieve the Firm/institute of any of his responsibilities for keeping records.

4. DRILLING

4.1 Depth of drilling

Drilling will be done to a maximum required depth at a minimum nominal hole size of 6 inches or as approved by the Engineer; boreholes shall be continued as drill holes when directed by the Engineer.

4.2 Accuracy of alignment of drill holes

Drill holes shall be within 1 degree of the required angle

4.3 Drilling plant

Light Percussion Drilling Rig along with necessary equipment (Double Pulley and Manila Rope are mandatory) or an approved equivalent capable of drilling in soil / overburden.

4.4 Drilling/ Boring procedure

The approved Light Percussion boring method of drilling shall be used in soils or overburden for the purpose of advancing the hole by digging the interval between designated depths at which sampling and testing is to be undertaken.

4.5 Stabilizing holes in loose soil

The drilling mud shall be a mixture of bentonite and water with approved chemical additives if required, to assist in modifying its density and viscosity.

Where drilling mud is not effective, casing of appropriate size and strength may be used subject to the approval of the Engineer. It will be the responsibility of the firm/institute to use

appropriate means to stabilize the walls of the boreholes. The level of drilling mud shall at all time be maintained at the top of the borehole.

It shall be ensured that there is no jetting action of the drilling fluid. The minimum amount of drilling fluid necessary to carry away the cuttings shall be used. During drilling the Firm/institute shall regulate the pressure of the drilling fluid to ensure minimum disturbance in the underlying material in which the in situ testing and sampling is to be carried out.

5. SAMPLING

5.1 General

The Firm/institute shall take samples from any hole when ordered to do so by the Engineer. This shall include the provision of all necessary sampling equipment, tubes and containers crates and boxes, as well as handling and transportation to the approved laboratory or store.

5.2 Approval of equipment

No equipment or containers shall be used unless approved by the Engineer.

5.3 Care of samples

The Firm/institute shall be responsible for the safe keeping of samples of all kinds until they have been handed over to the Engineer or disposed off on the Engineer's instructions as the case may be. Any sample damaged or showing signs of deterioration while in the Firm/institute's care shall be replaced by the Firm/institute at no expense to the Engineer as specified by the Engineer. All samples shall be prepared and packed as quickly as possible after removal from the ground to preserve the natural condition of the soil.

5.4 Numbering of samples

The Firm/institute shall assign a reference number to each soil and water sample taken from holes. The number shall be unique for that hole and shall be in order of depth below ground level.

5.5 Labeling samples

All disturbed and undisturbed soil samples and water samples taken from holes shall be clearly labeled. Each label shall include the following information:-

- a) Name of Contract
- b) Reference number of the hole
- c) Reference number of the sample
- d) Date of sampling
- e) Brief description of the sample
- f) Depth of the top and bottom of the sample below ground level.
- g) Number of the sampler tube.

5.6 Small disturbed soil samples

In all the holes, small, disturbed samples shall be taken at the top of each stratum, and at intervals as directed by the Engineer. Material from the cutting shoes of open drive undisturbed samples, and from the split spoon sampler used for Standard penetration tests shall also be taken as disturbed samples.

Disturbed samples shall be truly representative of the composition of the in situ soil. When the samples have been taken from the hole, they shall be placed without delay in airtight container of not less than 1 kg capacity. The container shall be labeled in accordance with Clause 5.5

5.7 Large disturbed soil samples

Large truly representative disturbed samples at least weighing 60 kg shall be taken from the boreholes from the layer of sands and cohesive soils or as directed by the Engineer. At the same time, small, disturbed samples of the same material shall be taken, in accordance with Clause 5.6.

5.8 Sealing, labeling and dispatch of large disturbed soil samples to the approved laboratory

All large samples shall be sealed into heavy duty plastic bags of at least 500 gauge thicknesses immediately after they are taken. The sealed bag shall then be placed inside another similar plastic bag. Each outer bag shall be labeled in accordance with Clause 5.5 and a second label giving the same information shall be placed inside the outer bag. These samples shall be transported to the approved testing laboratory.

5.9 Field moisture content samples

Field moisture content samples shall be taken with (and separate from) each small disturbed sample or as otherwise directed by the Engineer. The samples shall be placed in airtight containers immediately after sampling. One sample shall be enough to fill the container.

They shall be kept wrapped in damp cloths in boxes and delivered to the laboratory within twenty four hours of sampling or as directed by the Engineer.

5.10 Withdrawing the sampler

Before withdrawal of an open drive sampler the sampler shall (if practicable) be rotated through one complete revolution to shear the soil horizontally at the bottom of the sampler. The sampler shall then be withdrawn smoothly so as to cause the minimum disturbance to the sample. The total length of the sample shall be measured and recorded and, if any of the soil has fallen out of the bottom of the tube, this fact shall also be recorded.

5.11 Unsuccessful open drive sampling

There shall be no payment for a failure to obtain an open drive undisturbed sample and will be paid if the sample recovered is not less than 5 inch long, or the Engineer is satisfied that the failure was in no way caused by negligence of the Firm/institute.

5.12 Water samples

The Firm/institute shall take water samples from holes when directed by the Engineer, before the addition of water to the hole unless this is impossible. If necessary the hole shall be bailed out before taking the sample to ensure that any potential contaminant is removed. No fuel or other potential contaminant shall be allowed to enter the hole.

The method of sampling shall be to the approval of the Engineer. Samples shall only be stored in approved airtight and scrupulously clean containers, and shall not be less than 1.0 liter in volume. Water samples shall be transported to the approved laboratory.

5.13 Transport of samples

All samples shall be transported to the store at the site the day the sample is collected. Samples in tubes shall be transported with the tubes in a horizontal position. Selected samples shall be transported by the Firm/institute to the laboratory approved by the Engineer.

The samples shall be well packed in suitable material to protect the samples against vibration. The Firm/institute shall not expose sealed and coated samples to direct sunlight or extreme temperatures.

6. FIELD TESTING

6.1 Standard Penetration Test (SPT)

When directed by the Engineer, the Firm/institute shall carry out Standard Penetration Test (SPT) in any type of material. The penetration resistance 'N' shall be expressed as the number of blows of a 140 lbs hammer dropping freely from height of 30 inches to force the standard split barrel sampler 18 inches into the soil. The penetration resistance 'N' shall be expressed as the number of blows of the hammer required to force the sampler the last 12 inches into the soil.

Equipment to be furnished by the Firm/institute for carrying out SPT shall include split tube sampler, drive shoe with core catcher, 'A' or 'AW' rods (OD 1.718 inches, ID 1.344 inches) for depth less than 50 ft and 'N' or 'NW'; rods for greater depth, 140 lbs weight donut type hammer, manila rope and free running pulley, guide pipe and driving head supplies, all casing, pumps, power tools for sampling and containers for preserving tools for sampling and containers for preserving samples. The anvil in all respects shall conform to ASTM Designation D 1586-99.

Standard penetration tests shall be carried out in the holes as and when directed by the Engineer during the progress of work.

The split barrel sampler attached to drill rod shall then be lowered to the bottom of the hole. The drive weight shall then be allowed to fall on the anvil freely until the sampler has penetrated 6 inches into the soil (the seating drive). The penetration test shall then be started and the number of blows for each 3 inches penetration shall be recorded until 18 inches penetration is achieved.

In case, the driving of the shoe cannot be achieved even by performing one of the following efforts:

- A total of 50 blows have been applied during any one of the three 6 inches increments.
- A total of 100 blows have been applied (including the seating drive) or
- There is no observed advance of the sampler during the application of 10 successive blows of the hammer.

Then, the test shall be considered as presenting Refusal to Penetration and shall be terminated even if the required Penetration of the sampler has not been obtained. In such cases the number of blows and the penetration attained shall be recorded. Immediately

after each test, the sampler shall be carefully disassembled and any soil sample collected classified. The most representative portion of the soil sample from the bottom of the 12 inches drive shall be placed in an airtight container. This soil sample shall be made for the collection and preservation of such disturbed samples. The cost of such sampling shall be deemed to be included in the unit rate for performance of standard penetration test. After performing the first test in this way the hole shall be drilled with tricone bit using mud, and sounding shall be taken to ensure that the hole is clean to the bottom of the previous test. Then a second SPT shall be performed in the same manner as described above or undisturbed samples shall be collected as directed by the Engineer.

During the performance of SPT, including the seating drive, extreme care must be exercised in obtaining an accurate 30 inches free fall of the hammer. The rod above the hole collar should be held in vertical position to prevent energy loss due to rod

whip or buckling uniformity must be obtained in all SPTs to be done. The rate of application of hammer blows should be between 10 and 20 blows/minute.

In case of gravelly soil the SPT shoe should be replaced by the solid cone with apex at 60° in accordance with BS 5930. (1981)

The test data obtained shall be recorded in the field and shall include the following:

- a) Test number and depth
- b) Description of soil
- c) Thickness of layer
- d) Depth of water level; time at which test was made.
- e) Number of blows for each 3 inch penetration and total length of penetration.
- f) Penetration resistance 'N' value.

One copy of the field data for each test shall be supplied to the Engineer within 24 hours of completing the test.

6.2 Seismic Downhole Survey

Drilling, Reaming and washing of 30-35 m deep borehole, with 150-200 mm diameter and installation of 76-101 mm (3 to 4 inches) diameter PVC pipe (D-class) with bottom plug in each borehole. Grouting of annular space between borehole wall and PVC casing with pressure grouting from bottom of borehole.

Preparation of a concrete pad of 50cm×50cm and 100cm near the ground surface for borehole protection. Minimum 50 cm of PVC pipe should be above ground surface and should be properly plugged from top.

Preparation of high strength concrete pads of 60cm×60cm×60cm with minimum 50 mm diameter steel rods embedded inside for each borehole. (Keep Pad distance from Borehole= 4 to 5 meters).

7. LABORATORY TESTING

7.1 Material Testing Laboratory

The soil / water samples shall be tested at a local Material Testing Laboratory capable of conducting all types of soil / rock tests. The Engineer shall have access to the laboratories to supervise and check the laboratory testing of the samples. The testing shall be carried out in accordance with ASTM, BS or

AASHTO Standards or as directed by the Engineer.

7.2 Testing Program

The Firm/institute shall arrange to carry out the laboratory tests on the specified samples of the subsoil materials and water. The Engineer shall issue particular instructions for any tests, if required. The samples to be tested and the tests to be carried out for each sample shall be specified by the Engineer.

7.3 Type of Tests

The testing in the laboratory shall comprise, but not limited to, the following tests:

Grain size Analysis

Hydrometer analysis

Liquid and plastic limits

NMC, Bulk density & dry density

Chemical Analysis of Soil Samples i/c Sulphate, chloride, CaCO₃ and pH

Complete chemical analysis of water samples i/c TDS, Cl, SO₄ & pH

8. EXCAVATION OF TEST PITS

8.1 Areas to be investigated

The limits of the project site and the approximate locations of the testpits shall be indicated on Drawing, but the Engineer may change the locations within the limits of the area to be investigated during the progress of the work. The Engineer will specify from time to time during the contract period the exact location and reference number of all test pits, but locating the test pits accurately in the field shall be the Firm / Institute 's responsibility.

8.2 Excavation

8.2.1 Excavation method

The Firm / Institute shall perform excavation in test pits to final dimensions, lines and depths as specified or approved by the Engineer. The Firm / Institute will be free to choose any method of excavation with prior approval of the Engineer. The Firm / Institute shall be entirely responsible for the success of the method of excavation used regardless of approval by the Engineer. The Firm / Institute shall carry out his excavation operations in a manner so as to cause least disturbance to the in situ material outside the lines of excavation

8.2.2 Excavation extent

The test pits shall be up to a maximum of 3.0 m depth or as specified in BOQ at least 1.0 m x 1.0 m throughout their depth or as directed by the engineer. The Firm / Institute shall

excavate test pit so as not to have any protrusions inside the clear section. Excess excavation performed by the Firm / Institute for any purpose or reason, except that ordered in writing by the Engineer, shall be at the expense of the Firm / Institute . The Firm / Institute shall keep the walls and floor of the test pits accessible and clean for inspection by the Engineer. The Firm / Institute will prepare a detailed test pit log of the strata encountered as directed by the Engineer.

8.2.3 Removal and Disposal of Excavated Materials

The Firm / Institute shall remove all excavated materials and any caved in debris from the test pits and shall be responsible for disposal of such excavated material away from top of the test pits as directed by the Engineer.

8.3 Supports of test pits excavation

The Firm / Institute shall properly support the test pit excavation as and when instructed by the Engineer in writing. The Firm / Institute alone shall be responsible for the adequacy of the supports regardless of the approval by the Engineer. Timber supports shall be used and left in place after completion of test pits for sampling and logging. The Firm / Institute shall be free to use his own system of timber supports with the approval of Engineer. However nothing contained in this clause shall relieve the Firm / Institute of his responsibilities in respect of adequacy of supports of the excavations. If necessary, the Engineer shall direct the Firm / Institute to install additional supports or to abandon an unsafe pit without any payment to the Firm / Institute . The support system shall be removed before backfilling of Test pits.

8.4 Rain and surface water

Surface water shall be prevented from entering the test pit. For this purpose suitable earth dykes or interceptor ditches shall be constructed by the Firm / Institute around the test pit at suitable locations with the approval of the Engineer. The Firm / Institute shall also remove any accumulated water from within the pits.

8.5 Hoisting arrangements

8.5.1 Hoisting equipment

The Firm / Institute shall provide, install, operate and maintain hoisting equipment wherever required as approved by the Engineer and operate such equipment for removal of excavated material and all other related purposes.

8.5.2 Mucking buckets

The Firm / Institute shall provide, install, maintain and operate mucking buckets. The buckets shall be of suitable size and sound construction as approved by the Engineer. In addition, the Firm / Institute will provide such other equipment, as he may deem necessary for efficient handling and disposal of excavated material.

8.6 Blasting in test pit

Blasting shall not be allowed for breaking up material encountered in a test pit except with the written permission of the Engineer. Such permission shall only be given if a boulder with diameter larger than half the width of the pit is encountered.

8.7 Supplementary test pit

Test pits that are abandoned due to fault of the Firm / Institute shall be supplemented by other test pits adjacent to the original location. The exact location of such supplementary test pits shall be specified by the Engineer in the field.

No payment will be made for the portion of supplementary test pit above the depths paid for the unacceptable test pit.

8.8 Daily field records

Each day during the work on the Site, the Firm / Institute shall hand over to the Engineer the original and a legible copy of the records of the previous day's work containing the following information in respect of each test pit where work was in progress.

- a. Name of Contract
- b. Number, and size of the test pit
- c. Date and hours worked on the site
- d. Brief description of the weather
- e. Total depth of test pit at the beginning and end of each shift.
- f. Reference number, depths and other details of all small and large disturbed samples.
- g. Description of material encountered.
- h. Details of backfilling if any
- i. Details of reasons of delays
- j. Any other relevant information and details of any other operation.

8.9 Backfilling test pits

When instructed by the Engineer, the Firm / Institute shall backfill the Test pits. The materials for backfilling shall come from material excavated and the procedures shall be approved by the Engineer.

8.10 Logging, collection of samples and in situ testing

The Engineer or his staff shall inspect strata exposed by the excavation to prepare test pit logs on approved forms and direct the Firm / Institute to collect disturbed and undisturbed samples during the progress of excavation. Whenever the Engineer or his staff enters a test pit the Firm / Institute shall temporarily suspend his operations inside the test pit and shall provide to Engineer or his staff all facilities including labor and access through ladders into and out of the pit.

8.11 Firm / Institute's responsibility for records

The presence of the Engineer or any of his staff and their keeping separate test pit excavation records shall not relieve the Firm / Institute of any of his responsibilities for keeping records.

8.12 Field testing and sampling in test pits

8.12.1 Field density

Field density tests shall generally be carried out in the test pits at depths below the natural ground surface as specified by the Engineer.

Field density test shall be carried out in accordance with ASTM D 2937 (Density of soil in place by Drive Cylinder Method) or D 1556 (Density of soil in place by the Sand Cone

Method) appropriate to the site conditions. The Engineer will examine and decide which method of field density test is most suitable for the site. Moisture content test shall be carried out by laboratory oven method or speedy moisture tester or as directed by the Engineer.

8.12.2 Sampling

a) Disturbed samples

Disturbed samples shall be collected for carrying out classification test at the depth and location to be specified by the Engineer at the site.

b) Composite samples

Composite samples shall generally be collected in those horizons where field density tests are carried out. The quantity of each sample shall be enough to allow carrying out classification and laboratory compaction test.

9. LABORATORY TESTING

9.1 Material Testing Laboratory

The soil / rock / water samples shall be tested at a local Material Testing Laboratory capable of conducting all types of soil / rock / water tests. The Engineer shall have access to the laboratories to supervise and check the laboratory testing of the samples. The testing shall be carried out in accordance with ASTM, BS or AASHTO Standards or as directed by the Engineer.

9.2 Testing Program

The Firm / Institute shall arrange to carry out the laboratory tests on the specified samples of the subsoil materials and water. The Engineer shall issue particular instructions for any tests, if required. The samples to be tested and the tests to be carried out for each sample shall be specified by the Engineer.

9.3 Type of Tests

The testing in the laboratory shall comprise, but not limited to, the following tests:

1. Sieve analysis
2. Hydrometer analysis
3. Liquid and plastic limits
4. NMC, Bulk density & dry density
5. Chemical Analysis of Soil Samples i/c sulphate, chloride, CaCO₃ and pH
6. Complete chemical analysis of water samples i/c TDS, Cl, SO₄ & pH

10. REPORTS AND RECORDS

10.1. Introduction

The Firm/institute shall prepare and submit to the Engineer, one copy of a report/data on all work at site and such other details as required by the Engineer appropriate to the work performed.

10.2. Daily Report

The Firm/institute shall prepare a Daily Report signed by the Firm/institute's agent or representative on site for each exploratory hole/boreholes, which shall be submitted to the Engineer within 24 hours of the completion of the exploration to which they refer and contain the following information where relevant.

i General

- a) Job name, location and coordinates.
- b) Rig foreman's name.
- c) Exploratory hole reference number and level.
- d) Visitors to rig site (including Firm/institute's head office staff).
- e) Name of Supervisory Staff.

ii Borings

- a) Diameters and depths of all casings used
- b) Any addition of water to the boring
- c) Method of penetration and flushing system

iii Drilling of boreholes

- (a) Elevation of top of borehole
- (b) Records of groundwater, if any
- (c) Depth at the end of each working day or shift
- (d) Depth to each change of stratum
- (e) Description of subsoil strata encountered.
- (f) Details of obstructions and time spent in and method of overcoming them.
- (g) Details of backfill

10.3. Submission of complete field and laboratory data

The results of each borehole and field tests carried out shall be communicated to the Engineer as follows:

- i) Oral reports as the work proceeds.
- ii) One set of complete data of the work in the form of a bound document, which shall contain but not limited to:
 - a) A site plan showing the position of the boreholes and giving their map reference.
 - b) The borehole and boreholes logs.
 - c) Complete results of field tests.
 - d) Complete results of Laboratory tests.
 - e) Comments on any point, which the Engineer has put to the firm/institute for inquiry and investigation during the works..

10.4 Compilation of Geotechnical Investigations Report

After the completion of Geotechnical Investigations in the field and material testing in the laboratory the Firm/institute shall review & analyze the field and laboratory results and other information collected during the investigation and shall compile a detailed Geotechnical Investigations Report of the Project Site, defining work methodology, foundation design recommendations & conclusions for Shallow Foundations that will include Ultimate and Allowable Bearing Capacity verses depth of footings. The recommendations shall also be presented in the form of graph showing bearing capacity values verses depth of foundations and for all structures with in the Project Area.

The firm/institute shall submit two (02) copies of draft report for review and comments of the Employer (NESPAK). The firm/institute shall submit three (03) copies of final report after attending the comments/observations of the Employer.

10.5 Payment for Geotechnical Investigation Reports

The cost of the Geotechnical Investigations Report shall be entered by the firm/institute into the BOQ and same shall be paid separately to the Firm/institute upon completion of the works and submission of final report.

10.6 Time Schedule

The time period allocated for this assignment is Seven (07) weeks inclusive of compilation and preparation of Geotechnical Investigations Report. The field work shall have to be completed within Five (05) week time following issuance of Letter of Award. The whole work including laboratory testing and Report Writing shall have to be completed in Seven (07) weeks time following award of work.

11. MEASUREMENT AND PAYMENT

The price offered by the Firm / Institute in the Bill of Quantities (BOQ) shall be inclusive of all applicable taxes and duties as specified by Government of Pakistan.

BOQ Item A-1 Mobilization and demobilization

a) Measurement

No quantity measurement will be made of the work under this item and payment shall be based on the completion of work as specified herein.

b) Payment

The payment shall constitute full compensation for all costs for mobilization and demobilization. The contract rates shall be deemed to include all costs for providing, transporting, operating and maintaining all the equipment and plant necessary for site investigation work along with providing water, power, providing all insurance covers, providing any other expense not covered in the item rates of the BOQ and shifting and setting up at each borehole location.

BOQ Item A2 Excavation of Testpits:

a) Measurement

Measurement under this item will be computed by actual measurement methods and will be made of number of linear meters actually excavated below ground surface (according to a specified size and depth). Measurement will be correct to a centimeter. This also includes backfilling after logging.

b) Payment

Payment shall be made at the Contract unit price for this item and shall constitute full compensation for the tools, plant labour etc. required to excavate the test pit and later on backfill the testpits.

BOQ Item A3 Carrying out standard penetration tests (SPT) Testpits:

a) Measurement

The measurement for standard penetration tests shall be made as number of standard penetration tests actually performed on the instructions of the Engineer in a Testpits

Payment

Payment shall be made as a unit for each test. The contract rate shall be deemed to include all labour and equipment required to perform the tests including standing time of labour and plant while the test is being set up and dismantled or in progress and the preparation and supply to the Engineer of any preliminary copies of test data and results as well as all the costs for providing jars, labeling, preservation and transportation of samples to the laboratory.

BOQ Item A4 Carrying out Field Density Test (FDT) in Testpits:

a) Measurement

Measurement for field density tests shall be made as number of field density tests actually performed on the instructions of the Engineer. Determination of moisture content shall be considered inclusive in the field density test.

b) Payment

Payment shall be made as a unit for each test. The contract rate shall be deemed to be include all labour and equipment required to perform the tests including standing time of labour and plant while the test is being performed and preparation and supply to the Engineer preliminary copies of the test data as well as cost of containers for NMC and transportation of samples to the laboratory and performance of NMC in the laboratory.

BOQ Item A5-A6 Carrying out standard penetration tests (SPT) in drill / boreholes

a) Measurement

The measurement for standard penetration tests shall be made as number of standard penetration tests actually performed on the instructions of the Engineer in a drill hole or a bore hole.

b) Payment

Payment shall be made as a unit for each test. The contract rate shall be deemed to include all labour and equipment required to perform the tests including standing time of labour and plant while the test is being set up and dismantled or in progress and the preparation and supply to the Engineer of any preliminary copies of test data and results as well as all the costs for providing jars, labeling, preservation and transportation of samples to the laboratory.

BOQ Item A7-A8 Carrying Out Field Arrangement For Seismic Downhole

a) Measurement

The measurement for field arrangement for seismic downhole test shall be made as Lump sum on the instructions of the Engineer.

b) Payment

Payment shall be made as a unit for each test. Reaming and washing of two (02) boreholes, with 150-200 mm diameter bailer and installation of 76-101 mm (3 to 4 inches) diameter PVC pipe (D-class) with bottom plug in each borehole, Grouting of annular space between borehole wall and PVC casing with pressure grouting from bottom of borehole. Preparation of two (02) concrete pads of 50cm×50cm and 100cm near the ground surface for borehole protection. Minimum 50 cm of PVC pipe should be above ground surface and should be properly plugged from top. Preparation of high strength concrete pads of 60cm×60cm×60cm with minimum 50 mm diameter steel rods embedded inside for each borehole. (Keep Pad distance from Borehole= 4 to 5 meters).

The contract rate shall be deemed to include all labour and equipment required to perform the tests including standing time of labour and plant while the test is being set up and dismantled or in progress and the preparation and supply to the Engineer.

BOQ Item A9 Collection and preservation of groundwater samples from boreholes/Boreholes

a) Measurement

Measurement shall be made as number of water samples actually taken on the instructions of the Engineer.

b) Payment

Payment shall be made as a unit for each water sample. All costs incurred for providing equipment, material, labour and bailing out of the hole, if necessary and taking sealing, labeling, transporting the water samples as well as the cost of the containers shall be deemed to be included in the contract rate for water sampling.

BOQ Item B1-B9 Laboratory testing

a) Measurement

Measurement under the item "Laboratory Testing" shall be made as per actual number of laboratory tests performed according to ASTM, AASHTO or the equivalent British Standards, or as directed by the Engineer.

b) Payment

Payment shall be made for number of laboratory test actually performed in the laboratories approved by the Engineer according to the price bid by the Firm/institute in the Bill of Quantities as a lump sum for each test. The lump sum shall be deemed to include complete laboratory testing for the specified test according to ASTM, AASHTO or British Standards and presentation of reports in standard form as directed by the Engineer.

**HAZARD MICROZONATION AND ASSOCIATED SCIENTIFIC ASSESSMENT EVALUATION OF HAZARDS
AND RISKS IN FIVE (05) SELECTED VALLEYS OF GILGIT-BALTISTAN AND CHITRAL**

IMMIT VALLEY (District Ghizer)

GEOTECHNICAL INVESTIGATIONS

BILL OF QUANTITIES

Sr. No.	Description	Unit	Qty.	Rate	Amount
B.	LABORATORY TESTING			(Rs.)	(Rs.)
B1	Sieve analysis	No.	15		
B2	Hydrometer analysis	No.	3		
B3	Liquid and plastic limits	No.	3		
B4	NMC, Bulk density & dry density	No.	8		
B5	Consolidation with Swell Pressure Measurements	No.	0		
B6	Direct Shear	No.	0		
B7	Unconfined Compression (Soil Sample)	No.	0		
B8	Chemical Analysis of Soil Samples i/c sulphate, chloride, CaCO ₃ and pH	No.	2		
B9	Complete chemical analysis of water samples i/c TDS, Cl, SO ₄ & pH	No.	1		
Sub- Total B				Rs.	

Total (A+B)=

Rs.	
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**HAZARD MICROZONATION AND ASSOCIATED SCIENTIFIC ASSESSMENT EVALUATION OF HAZARDS AND RISKS IN FIVE
(05) SELECTED VALLEYS OF GILGIT-BALTIKISTAN AND CHITRAL**

IMMIT VALLEY (District Ghizer)

GEOTECHNICAL INVESTIGATIONS

BILL OF QUANTITIES (BOQ)

Sr. No.	Description	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
A	FIELD INVESTIGATIONS				
A1	Mobilization and demobilization of Two (02) sets of Light Percussion Drilling Rig alongwith necessary equipment (Double Pulley and Manila Rope are mandatory) at site including shifting from one investigation point to another. The equipment should be sufficient to carryout insitu testing and to meet the time schedule.	L.S.	Job		
A2	Excavation of Three (03) testpits marked on the plan attached up to a maximum depth of 10 ft depth at various structure locations in overburden soil or upto bed rock which ever strike first including backfilling of pits to their original condition. The Scope of work shall also includes logging of Testpits by a Professional Geologist / Geotechnical Engineer, Labeling, preservation, transportation and photography of the soil samples.	L.F.	30		
A3	Performance of field density tests by sand replacement method ASTM D-4914-08 in testpits generally @ 2 test / pit at selected horizons, collection of small disturbed samples in moisture tins, alongwith determination of moisture content to determine the in-situ bulk and dry density.	No.	6		
A4	Performance of Standard Penetration Tests (SPTs) / Dutch Cone Penetration Tests (DCPTs) in Testpits (where possible) along with collection of SPT samples at 5 ft depth interval in general, or as specified by the Consultant Representative at site, including their labelling, packing, storage & transportation to an approved material testing laboratory.	No.	9		
A5	Execution of Three (03) boreholes in overburden soils upto a maximum depth of thirty (30) ft or upto bed rock which ever strike first, identification of cavities and backfilling of boreholes to their original position by cement:sand:bentonite mix. The Scope of Work shall also includes logging of Boreholes by a Professional Geologist / Geotechnical Engineer, Labeling, preservation, transportation and photography of the soil samples.	L.F.	90		
A6	Performance of Standard Penetration Tests (SPTs) / Dutch Cone Penetration Tests (DCPTs) in boreholes (where possible) along with collection of SPT samples/core barrel samples at 5 ft depth interval in general, or as specified by the Consultant Representative at site, including their labelling, packing, storage & transportation to an approved material testing laboratory.	No.	15		
A7	Reaming and washing of two (02) boreholes, with 150-200 mm diameter bailer and installation of 76-101 mm (3 to 4 inches) diameter PVC pipe (D-class) with bottom plug in each borehole, Grouting of annular space between borehole wall and PVC casing with pressure grouting from bottom of borehole	Lump sum			
A8	Preparation of two (02) concrete pads of 50cm×50cm and 100cm near the ground surface for borehole protection. Minimum 50 cm of PVC pipe should be above ground surface and should be properly plugged from top. Preparation of high strength concrete pads of 60cm×60cm×60cm with minimum 50 mm diameter steel rods embedded inside for each borehole. (Keep Pad distance from Borehole= 4 to 5 meters).	Lump sum			
A9	Collection of water samples (if encountered) from boreholes/testpits including their labelling, packing, storage & transportation to an approved testing laboratory.	No.	3		
	Sub-Total A	Rs.			

NOTES:

- 1 Establishment of coordinates and ground elevations of all the boreholes and testpits are included in the scope of work. The coordinates should be provided with reference to a permanent local bench mark.
- 2 All soil samples must be labelled, stored and transported as per ASTM.
- 3 The quantities are tentative and will be finalized as per site actual conditions.

**HAZARD MICROZONATION AND ASSOCIATED SCIENTIFIC ASSESSMENT EVALUATION OF HAZARDS AND RISKS IN FIVE
(05) SELECTED VALLEYS OF GILGIT-BALTISTAN AND CHITRAL**

ARKARI VALLEY (District Lower Chitral)

GEOTECHNICAL INVESTIGATIONS

BILL OF QUANTITIES (BOQ)

Sr. No.	Description	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
A	FIELD INVESTIGATIONS				
A1	Mobilization and demobilization of Two (02) sets of Light Percussion Drilling Rig alongwith necessary equipment (Double Pulley and Manila Rope are mandatory) at site including shifting from one investigation point to another. The equipment should be sufficient to carryout insitu testing and to meet the time schedule.	L.S.	Job		
A2	Excavation of Three (03) testpits marked on the plan attached up to a maximum depth of 10 ft depth at various structure locations in overburden soil or upto bed rock which ever strike first including backfilling of pits to their original condition. The Scope of work shall also includes logging of Testpits by a Professional Geologist / Geotechnical Engineer, Labeling, preservation, transportation and photography of the soil samples.	L.F.	30		
A3	Performance of field density tests by sand replacement method ASTM D-4914-08 in testpits generally @ 2 test / pit at selected horizons, collection of small disturbed samples in moisture tins, alongwith determination of moisture content to determine the in-situ bulk and dry density.	No.	6		
A4	Performance of Standard Penetration Tests (SPTs) / Dutch Cone Penetration Tests (DCPTs) in Testpits (where possible) along with collection of SPT samples at 5 ft depth interval in general, or as specified by the Consultant Representative at site, including their labelling, packing, storage & transportation to an approved material testing laboratory.	No.	9		
A5	Execution of Three (03) boreholes in overburden soils upto a maximum depth of thirty (30) ft or upto bed rock which ever strike first, identification of cavities and backfilling of boreholes to their original position by cement:sand:bentonite mix. The Scope of Work shall also includes logging of Boreholes by a Professional Geologist / Geotechnical Engineer, Labeling, preservation, transportation and photography of the soil samples.	L.F.	90		
A6	Performance of Standard Penetration Tests (SPTs) / Dutch Cone Penetration Tests (DCPTs) in boreholes (where possible) along with collection of SPT samples/core barrel samples at 5 ft depth interval in general, or as specified by the Consultant Representative at site, including their labelling, packing, storage & transportation to an approved material testing laboratory.	No.	15		
A7	Reaming and washing of two (02) boreholes, with 150-200 mm diameter bailer and installation of 76-101 mm (3 to 4 inches) diameter PVC pipe (D-class) with bottom plug in each borehole, Grouting of annular space between borehole wall and PVC casing with pressure grouting from bottom of borehole	Lump sum			
A8	Preparation of two (02) concrete pads of 50cm×50cm and 100cm near the ground surface for borehole protection. Minimum 50 cm of PVC pipe should be above ground surface and should be properly plugged from top. Preparation of high strength concrete pads of 60cm×60cm×60cm with minimum 50 mm diameter steel rods embedded inside for each borehole. (Keep Pad distance from Borehole= 4 to 5 meters).	Lump sum			
A9	Collection of water samples (if encountered) from boreholes/testpits including their labelling, packing, storage & transportation to an approved testing laboratory.	No.	3		
	Sub-Total A	Rs.			

NOTES:

- 1 Establishment of coordinates and ground elevations of all the boreholes and testpits are included in the scope of work. The coordinates should be provided with reference to a permanent local bench mark.
- 2 All soil samples must be labelled, stored and transported as per ASTM.
- 3 The quantities are tentative and will be finalized as per site actual conditions.

**HAZARD MICROZONATION AND ASSOCIATED SCIENTIFIC ASSESSMENT EVALUATION OF HAZARDS
AND RISKS IN FIVE (05) SELECTED VALLEYS OF GILGIT-BALTISTAN AND CHITRAL**

ARKARI VALLEY (District Lower Chitral)

GEOTECHNICAL INVESTIGATIONS

BILL OF QUANTITIES

Sr. No.	Description	Unit	Qty.	Rate	Amount
B.	LABORATORY TESTING			(Rs.)	(Rs.)
B1	Sieve analysis	No.	15		
B2	Hydrometer analysis	No.	3		
B3	Liquid and plastic limits	No.	3		
B4	NMC, Bulk density & dry density	No.	8		
B5	Consolidation with Swell Pressure Measurements	No.	0		
B6	Direct Shear	No.	0		
B7	Unconfined Compression (Soil Sample)	No.	0		
B8	Chemical Analysis of Soil Samples i/c sulphate, chloride, CaCO ₃ and pH	No.	2		
B9	Complete chemical analysis of water samples i/c TDS, Cl, SO ₄ & pH	No.	1		
Sub- Total B				Rs.	

Total (A+B)=

Rs.	
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**HAZARD MICROZONATION AND ASSOCIATED SCIENTIFIC ASSESSMENT EVALUATION OF HAZARDS AND RISKS IN FIVE
(05) SELECTED VALLEYS OF GILGIT-BALTISTAN AND CHITRAL**

GULAGHMULI VALLEY (District Ghizer)

GEOTECHNICAL INVESTIGATIONS

BILL OF QUANTITIES (BOQ)

Sr. No.	Description	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
A	FIELD INVESTIGATIONS				
A1	Mobilization and demobilization of Two (02) sets of Light Percussion Drilling Rig alongwith necessary equipment (Double Pulley and Manila Rope are mandatory) at site including shifting from one investigation point to another. The equipment should be sufficient to carryout insitu testing and to meet the time schedule.	L.S.	Job		
A2	Excavation of Three (03) testpits marked on the plan attached up to a maximum depth of 10 ft depth at various structure locations in overburden soil or upto bed rock which ever strike first including backfilling of pits to their original condition. The Scope of work shall also includes logging of Testpits by a Professional Geologist / Geotechnical Engineer, Labeling, preservation, transportation and photography of the soil samples.	L.F.	30		
A3	Performance of field density tests by sand replacement method ASTM D-4914-08 in testpits generally @ 2 test / pit at selected horizons, collection of small disturbed samples in moisture tins, alongwith determination of moisture content to determine the in-situ bulk and dry density.	No.	6		
A4	Performance of Standard Penetration Tests (SPTs) / Dutch Cone Penetration Tests (DCPTs) in Testpits (where possible) along with collection of SPT samples at 5 ft depth interval in general, or as specified by the Consultant Representative at site, including their labelling, packing, storage & transportation to an approved material testing laboratory.	No.	9		
A5	Execution of Three (03) boreholes in overburden soils upto a maximum depth of thirty (30) ft or upto bed rock which ever strike first, identification of cavities and backfilling of boreholes to their original position by cement:sand:bentonite mix. The Scope of Work shall also includes logging of Boreholes by a Professional Geologist / Geotechnical Engineer, Labeling, preservation, transportation and photography of the soil samples.	L.F.	90		
A6	Performance of Standard Penetration Tests (SPTs) / Dutch Cone Penetration Tests (DCPTs) in boreholes (where possible) along with collection of SPT samples/core barrel samples at 5 ft depth interval in general, or as specified by the Consultant Representative at site, including their labelling, packing, storage & transportation to an approved material testing laboratory.	No.	15		
A7	Reaming and washing of two (02) boreholes, with 150-200 mm diameter bailer and installation of 76-101 mm (3 to 4 inches) diameter PVC pipe (D-class) with bottom plug in each borehole, Grouting of annular space between borehole wall and PVC casing with pressure grouting from bottom of borehole	Lump sum			
A8	Preparation of two (02) concrete pads of 50cm×50cm and 100cm near the ground surface for borehole protection. Minimum 50 cm of PVC pipe should be above ground surface and should be properly plugged from top. Preparation of high strength concrete pads of 60cm×60cm×60cm with minimum 50 mm diameter steel rods embedded inside for each borehole. (Keep Pad distance from Borehole= 4 to 5 meters).	Lump sum			
A9	Collection of water samples (if encountered) from boreholes/testpits including their labelling, packing, storage & transportation to an approved testing laboratory.	No.	3		
	Sub-Total A	Rs.			

NOTES:

- 1 Establishment of coordinates and ground elevations of all the boreholes and testpits are included in the scope of work. The coordinates should be provided with reference to a permanent local bench mark.
- 2 All soil samples must be labelled, stored and transported as per ASTM.
- 3 The quantities are tentative and will be finalized as per site actual conditions.

**HAZARD MICROZONATION AND ASSOCIATED SCIENTIFIC ASSESSMENT EVALUATION OF HAZARDS
AND RISKS IN FIVE (05) SELECTED VALLEYS OF GILGIT-BALTISTAN AND CHITRAL**

GULAGHMULI VALLEY (District Ghizer)

GEOTECHNICAL INVESTIGATIONS

BILL OF QUANTITIES

Sr. No.	Description	Unit	Qty.	Rate	Amount
B.	LABORATORY TESTING			(Rs.)	(Rs.)
B1	Sieve analysis	No.	15		
B2	Hydrometer analysis	No.	3		
B3	Liquid and plastic limits	No.	3		
B4	NMC, Bulk density & dry density	No.	8		
B5	Consolidation with Swell Pressure Measurements	No.	0		
B6	Direct Shear	No.	0		
B7	Unconfined Compression (Soil Sample)	No.	0		
B8	Chemical Analysis of Soil Samples i/c sulphate, chloride, CaCO ₃ and pH	No.	2		
B9	Complete chemical analysis of water samples i/c TDS, Cl, SO ₄ & pH	No.	1		
Sub- Total B				Rs.	

Total (A+B)=

Rs.	
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**HAZARD MICROZONATION AND ASSOCIATED SCIENTIFIC ASSESSMENT EVALUATION OF HAZARDS AND RISKS IN FIVE
(05) SELECTED VALLEYS OF GILGIT-BALTISTAN AND CHITRAL**

LOWER-YARKHON VALLEY (District Upper-Chitral)

GEOTECHNICAL INVESTIGATIONS

BILL OF QUANTITIES (BOQ)

Sr. No.	Description	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
A	FIELD INVESTIGATIONS				
A1	Mobilization and demobilization of Two (02) sets of Light Percussion Drilling Rig alongwith necessary equipment (Double Pulley and Manila Rope are mandatory) at site including shifting from one investigation point to another. The equipment should be sufficient to carryout insitu testing and to meet the time schedule.	L.S.	Job		
A2	Excavation of Three (03) testpits marked on the plan attached up to a maximum depth of 10 ft depth at various structure locations in overburden soil or upto bed rock which ever strike first including backfilling of pits to their original condition. The Scope of work shall also includes logging of Testpits by a Professional Geologist / Geotechnical Engineer, Labeling, preservation, transportation and photography of the soil samples.	L.F.	30		
A3	Performance of field density tests by sand replacement method ASTM D-4914-08 in testpits generally @ 2 test / pit at selected horizons, collection of small disturbed samples in moisture tins, alongwith determination of moisture content to determine the in-situ bulk and dry density.	No.	6		
A4	Performance of Standard Penetration Tests (SPTs) / Dutch Cone Penetration Tests (DCPTs) in Testpits (where possible) along with collection of SPT samples at 5 ft depth interval in general, or as specified by the Consultant Representative at site, including their labelling, packing, storage & transportation to an approved material testing laboratory.	No.	9		
A5	Execution of Three (03) boreholes in overburden soils upto a maximum depth of thirty (30) ft or upto bed rock which ever strike first, identification of cavities and backfilling of boreholes to their original position by cement:sand:bentonite mix. The Scope of Work shall also includes logging of Boreholes by a Professional Geologist / Geotechnical Engineer, Labeling, preservation, transportation and photography of the soil samples.	L.F.	90		
A6	Performance of Standard Penetration Tests (SPTs) / Dutch Cone Penetration Tests (DCPTs) in boreholes (where possible) along with collection of SPT samples/core barrel samples at 5 ft depth interval in general, or as specified by the Consultant Representative at site, including their labelling, packing, storage & transportation to an approved material testing laboratory.	No.	15		
A7	Reaming and washing of two (02) boreholes, with 150-200 mm diameter bailer and installation of 76-101 mm (3 to 4 inches) diameter PVC pipe (D-class) with bottom plug in each borehole, Grouting of annular space between borehole wall and PVC casing with pressure grouting from bottom of borehole	Lump sum			
A8	Preparation of two (02) concrete pads of 50cm×50cm and 100cm near the ground surface for borehole protection. Minimum 50 cm of PVC pipe should be above ground surface and should be properly plugged from top. Preparation of high strength concrete pads of 60cm×60cm×60cm with minimum 50 mm diameter steel rods embedded inside for each borehole. (Keep Pad distance from Borehole= 4 to 5 meters).	Lump sum			
A9	Collection of water samples (if encountered) from boreholes/testpits including their labelling, packing, storage & transportation to an approved testing laboratory.	No.	3		
	Sub-Total A	Rs.			

NOTES:

- 1 Establishment of coordinates and ground elevations of all the boreholes and testpits are included in the scope of work. The coordinates should be provided with reference to a permanent local bench mark.
- 2 All soil samples must be labelled, stored and transported as per ASTM.
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**HAZARD MICROZONATION AND ASSOCIATED SCIENTIFIC ASSESSMENT EVALUATION OF HAZARDS
AND RISKS IN FIVE (05) SELECTED VALLEYS OF GILGIT-BALTISTAN AND CHITRAL**

LOWER-YARKHON VALLEY (District Upper-Chitral)

GEOTECHNICAL INVESTIGATIONS

BILL OF QUANTITIES

Sr. No.	Description	Unit	Qty.	Rate	Amount
B.	LABORATORY TESTING			(Rs.)	(Rs.)
B1	Sieve analysis	No.	15		
B2	Hydrometer analysis	No.	3		
B3	Liquid and plastic limits	No.	3		
B4	NMC, Bulk density & dry density	No.	8		
B5	Consolidation with Swell Pressure Measurements	No.	0		
B6	Direct Shear	No.	0		
B7	Unconfined Compression (Soil Sample)	No.	0		
B8	Chemical Analysis of Soil Samples i/c sulphate, chloride, CaCO ₃ and pH	No.	2		
B9	Complete chemical analysis of water samples i/c TDS, Cl, SO ₄ & pH	No.	1		
Sub- Total B				Rs.	

Total (A+B)=

Rs.	
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**HAZARD MICROZONATION AND ASSOCIATED SCIENTIFIC ASSESSMENT EVALUATION OF HAZARDS AND RISKS IN FIVE
(05) SELECTED VALLEYS OF GILGIT-BALTISTAN AND CHITRAL**

SHIMSHAL VALLEY (District Hunza)

GEOTECHNICAL INVESTIGATIONS

BILL OF QUANTITIES (BOQ)

Sr. No.	Description	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
A	FIELD INVESTIGATIONS				
A1	Mobilization and demobilization of Two (02) sets of Light Percussion Drilling Rig alongwith necessary equipment (Double Pulley and Manila Rope are mandatory) at site including shifting from one investigation point to another. The equipment should be sufficient to carryout insitu testing and to meet the time schedule.	L.S.	Job		
A2	Excavation of Three (03) testpits marked on the plan attached up to a maximum depth of 10 ft depth at various structure locations in overburden soil or upto bed rock which ever strike first including backfilling of pits to their original condition. The Scope of work shall also includes logging of Testpits by a Professional Geologist / Geotechnical Engineer, Labeling, preservation, transportation and photography of the soil samples.	L.F.	30		
A3	Performance of field density tests by sand replacement method ASTM D-4914-08 in testpits generally @ 2 test / pit at selected horizons, collection of small disturbed samples in moisture tins, alongwith determination of moisture content to determine the in-situ bulk and dry density.	No.	6		
A4	Performance of Standard Penetration Tests (SPTs) / Dutch Cone Penetration Tests (DCPTs) in Testpits (where possible) along with collection of SPT samples at 5 ft depth interval in general, or as specified by the Consultant Representative at site, including their labelling, packing, storage & transportation to an approved material testing laboratory.	No.	9		
A5	Execution of Three (03) boreholes in overburden soils upto a maximum depth of thirty (30) ft or upto bed rock which ever strike first, identification of cavities and backfilling of boreholes to their original position by cement:sand:bentonite mix. The Scope of Work shall also includes logging of Boreholes by a Professional Geologist / Geotechnical Engineer, Labeling, preservation, transportation and photography of the soil samples.	L.F.	90		
A6	Performance of Standard Penetration Tests (SPTs) / Dutch Cone Penetration Tests (DCPTs) in boreholes (where possible) along with collection of SPT samples/core barrel samples at 5 ft depth interval in general, or as specified by the Consultant Representative at site, including their labelling, packing, storage & transportation to an approved material testing laboratory.	No.	15		
A7	Reaming and washing of two (02) boreholes, with 150-200 mm diameter bailer and installation of 76-101 mm (3 to 4 inches) diameter PVC pipe (D-class) with bottom plug in each borehole, Grouting of annular space between borehole wall and PVC casing with pressure grouting from bottom of borehole	Lump sum			
A8	Preparation of two (02) concrete pads of 50cm×50cm and 100cm near the ground surface for borehole protection. Minimum 50 cm of PVC pipe should be above ground surface and should be properly plugged from top. Preparation of high strength concrete pads of 60cm×60cm×60cm with minimum 50 mm diameter steel rods embedded inside for each borehole. (Keep Pad distance from Borehole= 4 to 5 meters).	Lump sum			
A9	Collection of water samples (if encountered) from boreholes/testpits including their labelling, packing, storage & transportation to an approved testing laboratory.	No.	3		
	Sub-Total A	Rs.			

NOTES:

- 1 Establishment of coordinates and ground elevations of all the boreholes and testpits are included in the scope of work. The coordinates should be provided with reference to a permanent local bench mark.
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**HAZARD MICROZONATION AND ASSOCIATED SCIENTIFIC ASSESSMENT EVALUATION OF HAZARDS
AND RISKS IN FIVE (05) SELECTED VALLEYS OF GILGIT-BALTISTAN AND CHITRAL**

SHIMSHAL VALLEY (District Hunza)

GEOTECHNICAL INVESTIGATIONS

BILL OF QUANTITIES

Sr. No.	Description	Unit	Qty.	Rate	Amount
B.	LABORATORY TESTING			(Rs.)	(Rs.)
B1	Sieve analysis	No.	15		
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B7	Unconfined Compression (Soil Sample)	No.	0		
B8	Chemical Analysis of Soil Samples i/c sulphate, chloride, CaCO ₃ and pH	No.	2		
B9	Complete chemical analysis of water samples i/c TDS, Cl, SO ₄ & pH	No.	1		
Sub- Total B				Rs.	

Total (A+B)=

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