Subject: **Minutes of Pre-Bid Meeting held at PMU Office on 06 September 2020**
ICB-Works/PICIIP-12
Construction of Wastewater Treatment Plant (WWTP) in North Zone, Sialkot

As per the Bidding Documents issued on **September 21, 2020** the date of pre-bid meeting was scheduled on **September 06, 2020.** The pre-bid meeting was convened and chaired by the Project Director (PD), Program Management Unit (PMU), Punjab Intermediate Cities Improvement Investment Program (PICIIP), Local Government & Community Development Department, Punjab, Pakistan. Following officials from PMU and EPCM Consultant attended the meeting:

i. Mr. Socrat Aman Rana, Project Director, PMU, PICIIP.
ii. Mr. Javed Iqbal (Chief Engineer), PMU, PICIIP.
iii. Mr. Shuja Dar (Director Procurement & Contracts), PMU, PICIIP.
iv. Mr. Ahmed Naveed Shahbaz (Project Manager/Deputy Team Lead) EPCM.
v. Mr. Muhammad Ayyub (Senior Resident Engineer) EPCM.
vi. Mr. Muhammad Nashad Khan (Procurement & Contract Specialist) EPCM.
vii. Mr. Mohsen Islam Khan (Independent Consultant, Procurement & Contract Specialist) PMU, PICIIP.

The meeting started with the recitation of Holy Quran. The chair welcomed the participants (list attached as **Annex-A**) and asked the Independent Consultant, Procurement & Contract Specialist to start the meeting. The participants were briefed on the bidding documents, particularly the contents of Section-2 (Bid Data Sheet), Section-3 (Evaluation and Qualification Criteria), Section-4 (Bidding Forms) and Section-8 (Particular Conditions of the Contract).

The meeting was held in two parts. During the first part, it was explained in detail by reading the important Instructions to Bidders clauses on preparation of bids and application of evaluation criteria (financial and experience). It was also stressed on significance of a responsive bid submission.

During second part of the meeting, the participants were invited to raise queries. Director Procurement & Contracts advised them to submit their written queries to PMU for written replies / advice accordingly. The Bidders submitted their written queries from time to time before **22nd October 2020** and the replies thereof, in writing, are attached as **Annex-B**.

The meeting was concluded with a vote of thanks to and from all the participants.

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RESPONSES TO BIDDERS' QUERIES
ICB-WORKS/PICIIP-12: CONSTRUCTION OF WASTEWATER TREATMENT PLANT (WWTP) IN NORTH ZONE, SIALKOT

Sr#	Bidder Queries	PMU Clarification
1.	The environmental quality standards for municipal & liquid industrial effluent has defined more than 30 parameters for discharged wastewater, however, the design parameters of discharge in IEE&EMP is only considered pH, BOD5, TSS and fecal coliform. Hence, in our project design, which parameters should we consider for WWTP DISCHARGE, please clear.	As per PEPA and also described in PC-I that the WWTP is designed for common pollutant (i.e. pH, BOD, COD, TSS and fecal coliform etc.) and any specific pollutant (heavy metals etc.), to be originated from industries will be removed by industry itself before discharging its industrial effluent into sewerage system of MC Sialkot, to comply with the requirements of PEPA. As per composite wastewater characteristics of existing disposal stations, all heavy metals are within NEQS limits.
2.	For the influent, please clear the source of influent and whether industrial wastewater will blend into WWTP influent.	Influent wastewater to the WWTP is predominately domestic sewage. Very small quantity of industrial wastewater is being mixed with domestic sewage. Despite no wastewater treatment is being done in the industries, industrial effluent has currently no major impact on characteristics of domestic wastewater in Sialkot (Zone-3) due to small in quantity and dilution with large quantity of domestic wastewater. As per wastewater testing results, most of specific pollutants (heavy metals etc.) are within PEQS limits in combined wastewater at disposal stations.
3.	The designed temperature of the wastewater treatment process is 20 ℃ while the local temperature is lower than 20 ℃ in most of the time for the whole year. Whether there is an excessive discharge standard in case of local temperature is far below 20 ℃.	Waste stabilization ponds are designed on average temperature of coldest month or coldest quarter. In Sialkot, average monthly temperature remains below 20 ^{o}C in winter months (December, January and February). In these months, effluent BOD values will exceed but remain within PEQS limits.
4.	Influent from the municipal pipe may bring large particle while there is no screen set in the beginning of this process which can lead to a decrease in wastewater treatment efficiency.	Disposal station will be provided before the WWTP. Mechanical screens will be installed at disposal stations. Large particles in the influent wastewater will be removed at disposal station. From disposal station, wastewater will be carried to the WWTP through forcemains. Construction of disposal station and installation of force mains are not included in the project and shall be executed under separate lot.
5.	There is no disinfect compound added into discharge and the faecal coliform maybe still very high in the effluent of MPs.	No additional disinfection component is provided in the project. Maturation Ponds will perform tertiary treatment.
6.	Geological exploration data is the necessary information for BBQ calculation, please provide.	The requisite data is attached in the email.
7.	Whether the local geological exploration is included in this EPC project, please clear.	Please refer response at Sr. No.6 For further assessment, the Contractor will have to make those arrangements at its own. It shall not be paid to the Contractor, separately.

Sr#	Bidder Queries	PMU Clarification
8.	The material for some equipment is manufactured in CHINA, and the raw material of these equipment are conformed to Chinese standards. Whether the material the standard can convert into Chinese standard in case of material characters is the same with international standards.	No change to the specification will be allowed during execution. All the materials, equipment and works shall be according to specifications and drawings. The material will be approved by The Engineer according to the specifications.
9.	Whether the floating geo-membrane cover is used for the anaerobic pond, please clear.	It is pertinent to mention that no floating geomembrane is used in the WWTP. Geomembrane will be used at the bed of all three ponds (AP, FP and MP) between the soil liner and soil protective cover to minimise the seepage of wastewater into groundwater. Details of geomembrane is provided in the Drawing No. 3976/11/C/7D01.
10.	Whether the Treated Effluent Pumping Station (including pumps) is included in Sialkot WWTP, please clear. If it is included, please provide the drawings.	It is not included in the project.
11.	Please provide the onsite conditions of this project, including road traffic, water supply, power supply, and current site leveling. And please clear the scope of dismantle work including construction structures, plants, etc.;	The bidder should visit the WWTP site to better ascertain the existing conditions. However, topo survey of the site is provided in the drawing. As per ITB 7.2 of the Bidding Document (BD), the Bidder is responsible to visit and examine the Site of Works and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the Bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.
12.	At present, it is described in the document that all the 40km sewage collection pipe network has been laid. Please provide the actual laying of the sewage collection pipe network to the project site, burial depth, pipe materials, etc. Elevation data of existing pipelines or future access pipelines or photo data with reference objects on site is preferred.	Laying of sewage collection pipes will be done in separate project (lot) and no sewer pipe laying is involved in the WWTP Area. Wastewater from catchment area of WWTP shall be carried to WWTP through forcemain pumping from the upstream city area. Diameter of forcemain, dimension and levels of inlet structure is provided in Drawings No. 3976/11/C/2J113. Layout of force mains is also shown in Drawings No. 3976/11/C/2J106.
13.	Please provide the discharge condition of the sewage pipe designed in the future, the actual condition of the existing drainage ditch, preferably with elevation and the photo of reference substances.	• Please refer to response at Sr.11 & 12 • Pease refer Drawing No. 3976/11/C/2J121 showing details of disposal drain.
14.	Please provide the geological investigation report of this project or near this project site for the follow-up engineering quantity accounting	The requisite data is attached in the email.
15.	No Water proofing item is available in BOQ as it is mention in DWG (3976/033/C/15G01).	Addendum - 01 is attached herewith to cover water proofing item.
16.	Hardcopy of drawings is not clear for reading. Please provide clear copy of drawings.	Fair copy of drawings in PDF format are attached with the email.

Sr#	Bidder Queries	PMU Clarification
17.	Will the Employer provide any place for contractor camp, storage and Plant facilities?	No. The Contractor has to make those arrangements on its own. The Employer may assist the Contractor in this regard.
18.	Will the Employer designate any disposal area for excess excavated material and debris?	No. During execution, the Contractor will identify suitable locations and send a submittal for the approval of the Engineer. The Contractor will locate and inform Employer/RE for disposal area. He will get required permissions from MC/relevant authorities before disposal of excess material/debris. Payment will be made as per actual lead chart to be approved by the Engineer.
19.	Refer to Annexure-A Bill of Quantities, Bill No. 1.1 (Non MRS Items), Sr. item 1 & 2 (Embankment fill with selected soil and clay). Please provided the lead from project site to borrow pit area. Furthermore, our understanding is that royalty of material will be paid by the Employer. Please clarify.	It is already mentioned in the item as follows: "Item rate include lead from any source within district upto WWTP site'' It is again clarified that contractor will be liable to arrange the requisite material from any approved source within district Sialkot. Furthermore, payment of royalty shall be included in the quoted rates by the bidders.
20.	Refer to Annexure-A Bill of Quantities, Bill No. 1.1 (MRS Items), Sr. item 4 & MRS clause 3/25 (compaction works). We understand that this item does not include any transportation of material and this transportation will be charged under MRS clause 3/17. Please clarify.	Confirmed
21.	Refer to Annexure-A Bill of Quantities, Bill No. 1.1 (MRS Items), Sr. item 2 & MRS clause 3/52 (Earth work in excavation). Rate include a lead of 100 ft but in MRS Clause 3/17 transportation start from 300 meter or 1000 ft. Please clarify that if the payment will only be made for the lead which is beyond 100 ft. and less than 1000 ft.	Addendum 01 is attached herewith to cover the lead item.
22.	Refer to Annexure-A Bill of Quantities, Bill No. 1.3 & 1.4 (MRS Items), section B Electrical works (Electrical section complete). Many MRS clauses are mentioned on each electrical items which makes it difficult to understand the composite unit rate. Kindly provide the quantities breakup for all items.	The rate of each items shall include cables, pipes, back boxes & gang switches for the scheduled MRS items as per reference numbers. The length has been taken from the drawings. For quantities refer to the BOQ and drawings.
23.	Reference is made to the Part 1, section 3: Evaluation and Qualification criteria, clause 2.1.6 "Registration with Pakistan Engineering Council" As the subject project have the major quantum of civil works so we understand that only PEC specialization codes CE 01, 09, 10 are applicable for this project so you are requested to waive off the requirements of specialization codes ME 07 and EE 11.	Related to PMU.

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PROGRAM MANAGEMNT UNIT
PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM

LOCAL GOVERNMENT AND COMMUNITY DEVELOPMENT DEPARTMENT
GOVERNMENT OF THE PUNJAB

CONSULTANCY SERVICES FOR ENGINEERING, PROCUREMENT AND CONSTRUCTION MANAGEMENT (EPCM) FOR PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM

(Wastewater Treatment Plant, Sialkot City)

GEOTECHNICAL INVESTIGATION DATA

March 2020

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED
Geotechnical & Geoenvironmental Engineering Division
NESPAK House, 1-C, Block N, Model Town Extension, Lahore
Email: geotech@nespak.com.pk; Tel: 042-99090000, Ext. 409/442/3017; Fax: 042-99231950

CONSULTANCY SERVICES FOR ENGINEERING, PROCUREMENT AND CONSTRUCTION MANAGEMENT (EPCM) FOR PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM

(Wastewater Treatment Plant, Sialkot City)

GEOTECHNICAL INVESTIGATION DATA

TABLE OF CONTENTS

As per geotechnical investigations data, composite liner should be used for the construction of wastewater treatment plant to control leakage/migration of contaminants from the impoundment into the underlying soil/groundwater. The components of composite liner are:

a) Compacted soil liner
b) Geomembrane (HDPE Liner)
c) Protective soil cover

Compacted Soil Liner:

The compacted soil liner shall be placed at the bottom and on side slopes of the ponds. The material suitable to be used for compacted soil liner shall meet the following specifications:

Vertical in-situ hydraulic conductivity in compacted state $\leq 1 \times 10^{-7}$ cm/sec
Fines (particles passing 0.075 mm sieve) ≥ 30 %
Plasticity index = 8 – 20 %
Gravels (particles passing 75 mm sieve and retaining 4.75 mm sieve) ≤ 20 %
Maximum particle size ≤ 10 mm

During current geotechnical investigations, eight (i.e. three onsite and five borrow area) soil samples were collected to check their suitability for compacted soil liner. Location of onsite and borrow area investigation points are attached herewith as ***Appendix - A***. Laboratory test results indicated that tested soil samples (collected from TP-2, TP-5, TP-9, Borrow Area-1, Borrow Area-2, Borrow Area-3, BAS-5 & BAS-7) have characteristics as per requirement as stated above.

Soft soil / fill material, if encountered during construction of treatment plants, it should be excavated and removed completely. The exposed surface should be compacted to at least 90 % of the maximum standard Proctor dry density at 2 to 3 % wet of optimum moisture content.

The compacted soil liner shall be placed at the bottom and on side slopes of the ponds and shall have a minimum thickness of 600 mm and shall meet the material specifications mentioned above. The soil liner shall be placed in layers with maximum compacted layer thickness of 150 mm and compacted to at least 90 % of the maximum standard Proctor dry density at 2 to 3 % wet of optimum moisture content.

After the placement of each layer, it shall be inspected and tested to ascertain compliance with specifications, including dry density, moisture content, hydraulic conductivity, etc. by an independent laboratory and Engineer's approval must be taken before laying the next layer.

Geomembrane (HDPE Liner):

High density polyethylene, HDPE Liner having minimum thickness of 60 mils (60/1000 inches) shall be placed over the compacted soil liner. HDPE liner must cover the entire area of earth material that would be in contact with the treated or stored effluent.

HDPE liners shall be installed according to the manufacturer's recommendations, with particular emphasis on seaming and QA/QC.

Protective Soil Cover:

HDPE Liner is required to be covered immediately after placement. The HDPE Liner shall be covered by at least 300 mm thick cover of soil to prevent puncture by equipment and to protect it from degradation by ultraviolet light. The on-site / borrow area fine grained soils classified as Lean Clay as per unified soil classification system (USCS), free of any objectionable material, can be used in the construction of protective soil cover.

The protective soil cover shall be placed in layers with maximum compacted layer thickness of 150 mm and compacted to at least 90 % of the maximum standard Proctor dry density at 2 to 3 % wet of optimum moisture content. Place protective soil cover within 24 hours after placement of the HDPE Liner to minimize the potential for damage from various sources, including precipitation, wind, and ultraviolet light exposure.

The Environmental Protection Agency (EPA) requires the highest level of supervision, i.e. Level 1 supervision for clay-lined waste stabilization ponds. It means that all the earth work operations must be continuously supervised and tested by people specializing in these kinds of works.

Treatment Plant / Pond Embankment:

A side slope of 3H: 1V may be considered during the construction of pond embankment. Material classified as A-2-4 / A-3 / A-4 as per AASHTO soil classification can be used for construction of embankment below compacted clay liner. A 2 ft thick layer of clayey soil (i.e. Protective Soil Cover) should be placed over embankment fill to protect it from ingress of water due to surface water / drainage. The requisite embankment material can be obtained from borrow area sources BAS-1, BAS-2, BAS-3 & BAS-4. The embankment material must be placed and compacted in layers appropriate to the type and size of compaction equipment to at least 95 % of modified AASHTO maximum dry density. At construction stage, appropriate laboratory testing must be carried out on borrow area material to confirm its suitability prior to its use for embankment.

Interior slopes must be kept free of vegetation that could cause liner damage. Trees must not be allowed to grow either in the base or on the banks of the pond. However, interior slopes should be protected by low growing grass above the water line to withstand erosion.

Dewatering:

During field investigations, groundwater table (GWT) was found at a depth of 1.28 m to 1.80 m below NSL at Treatment Plant location. Groundwater may encountered during construction of treatment plant if depth of excavation is more than 1 m below NSL. Therefore, appropriate dewatering measures / arrangements would be required at construction stage to lower the groundwater to at least 0.5 m below final excavation base level.

APPENDICES

- **APPENDIX-A:**

  LOCATION PLAN, GEOTECHNICAL INVESTIGATION PLAN & SUBSURFACE SOIL PROFILE

- **APPENDIX-B:**

  BOREHOLE, TEST PIT LOGS AND FIELD PERMEABILITY TEST RESULTS

- **APPENDIX-C:**

  SUMMARY OF LABORATORY TEST RESULTS & DETAILED RESULT SHEETS

- **APPENDIX-D:**

  REFERENCE FOR LINING MATERIAL

APPENDIX-A

LOCATION PLAN, GEOTECHNICAL INVESTIGATION PLAN AND SUBSURFACE SOIL PROFILE

LOCATION OF BORROW AREAS

Borrow Area	Location	Latitude	Longitude
BAS-01	Tawi-1	32.669452	74.530458
BAS-02	Tawi-2	32.718458	74.453689
BAS-03	Kuri-1	32.719222	74.45371
BAS-04	Kuri-2	32.719149	74.454811
BORROW AREA-1	Chak Sema	32.54794	74.46709
BORROW AREA-2	Lalpur	32.55649	74.48527
BORROW AREA-3	Chatta Pind	32.5614	74.45729
BAS-05	Mari Khokhran-1	32.665986	74.403627
BAS-07	Mari Khokhran-2	32.671468	74.403579

1425000
1450000
1475000
1500000
1525000
1875000
1850000
1825000
N
S
E
W
BAS-01
BAS-02
BAS-03
BAS-04
BAS-05
BAS-07
Borrow Area-1
Borrow Area-2
Borrow Area-3
WASTE WATER TREATMENT PLANT
CHENAB RIVER
Tavi Nullah
Dawara Nullah
Palkhu Nullah
Upper Chenab Canal
Marala Ravi Link Canal
Head Marala Road
Gujral Road
Ghalib Road
Channi Gondal Road
Sialkot Airport Road
Airport Rd
Jammu Road
Quaid e Azam Road
Aziz Bhatti Shaheed Road
Sialkot-Gondal Road
Sialkot Bajwat Rd
Surkhpur - Tanda Road
Mari Khokhran - Tanda Road
Jalalpur Jattan - Head Marala Road
Tanda - Karianwala Road
Barnalla Road
Jagatpur Road
Mudassar Shaheed Road
Naad e Ali Road Bharth
Tariq Road
Surkhpur
Kuri
Kakianwala
Behlolpur
Budan
Gujran
Mari Khokhran
Chobara
Noshera Miaana
Chopala
Shahbazpur
Majwal
Dhalewali
Nandpur
Gondal
Said Pur
Chaprar
Kakwal
Garni ruba
Chak Jogo
Chak Bhoga
Chak Chohar
Harna Pind
Badhian
Kotli Bhota
Sargpur
Najwal
Banut
Chak Karane
Chak Putliyan
Sherpur
Nizamuddinpur
Kotli Lohraan
Romala
Mohadipur
Tilakpur
Malanay
Rasulpur
Rangpur Malanian
Raspur
Kulluwal
Dhapai
Marakiwal
Chak Harrar
Jatta
Chak Ikhtiyar
Kotli Tallian
Khichian
Bharth
Chak Mandhar
Jhai
Dhalay
Kajilal
Kaman Wala
Sahaliya
Kundan Pur
Qulli Salah
Dalowali
Phullo Diota
Kot Chanda
Kala
Nangal
Tibbi
Jagatpur
LEGEND
Locality
Borrow Area
Chenab River
Nullah / Drain
Canal
Major Roads
0 1 2 4 Km

CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
LG & CD DEPARTMENT, GOVT. OF THE PUNJAB	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	BILAL	PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM (PICIIP), WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY	LOCATION PLAN OF BORROW AREAS	1:100,000
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	03				SUBMITTED	BADAR H.			
		02				RECOMMENDED	YAWAR S.		DATE: MARCH, 2020	REV. 0
		01				CHD/VER.	Umar A.		FIG. A-1	
						APPROVED	M. Ali			

1474750 1475500 1476250 1477000 1477750 1478500 1479250

11813500 11812750 11812000 11811250

BH-35
TP-01
TP-02
BH-36
BH-37
TP-03
TP-06
BH-34
BH-32
TP-04
TP-07
TP-05
BH-39
BH-33
TP-08
TP-10
TP-09
BH-38

N W E S

Legend

Geotechnical Investigation Points

- Borehole (7m)
- Test Pit (1.5m)

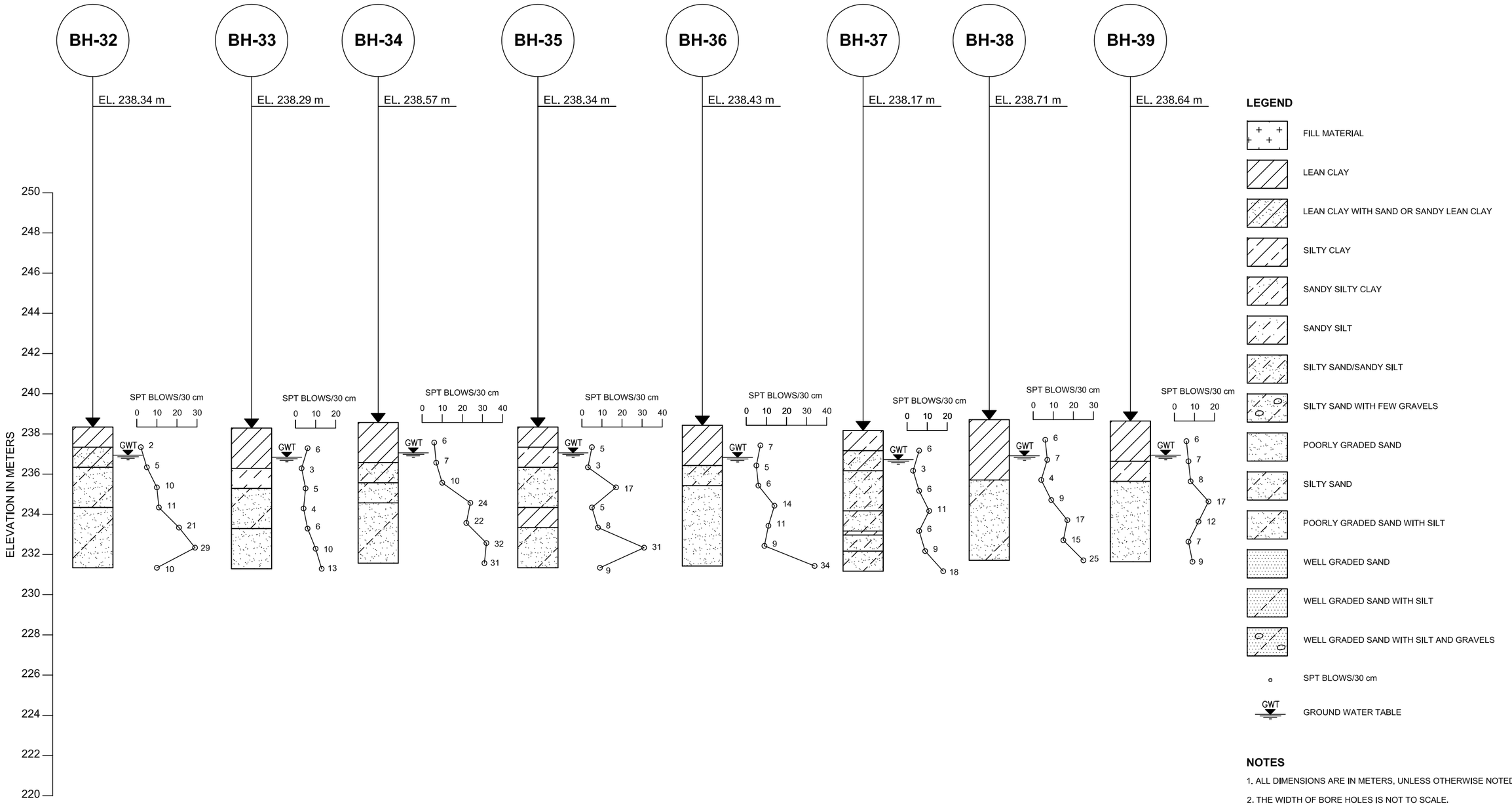
0 250 500 1,000 Feet

Note: The geotechnical investigation plan has been developed on the basis of layout plans provided by project manager.

CLIENT	CONSULTANT						PROJECT		
LG & CD DEPARTMENT, GOVT. OF THE PUNJAB	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	BILAL	PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM (PICIIP), WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY	GEOTECHNICAL INVESTIGATION PLAN WASTE WATER TREATMENT PLANT
		03				SUBMITTED	BADAR H.		
		02				RECOMMENDED	YAWAR S.		
		01				CHD/VER.	Umar A.		
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	M. Ali		

SCALE	DATE	REV.
1:4,500	MARCH, 2020	0

FIG. A-2



NOTES

1. ALL DIMENSIONS ARE IN METERS, UNLESS OTHERWISE NOTED.
2. THE WIDTH OF BORE HOLES IS NOT TO SCALE.
3. FOR LOCATION OF BORE HOLES REFER TO FIG. A-2b.

CLIENT: LG & CD DEPARTMENT, GOVERNMENT OF PUNJAB	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. HEAD OFFICE:- NESPAK HOUSE, I-C, BLOCK-N, MODEL TOWN EXTENSION, LAHORE, PAKISTAN.	04 / 03 / 02 / 01 / REV. / DATE / DESCRIPTION / APPROVED	DRAWN: RIAZ; SUBMITTED; RECOMMENDED; CHD./VER.; APPROVED	PROJECT: PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY	SUBSURFACE SOIL PROFILE (WASTE WATER TREATMENT PLANT) — DATE: MARCH, 2020 — FIG. A-3 — SCALE: HOR. NTS VER. 1:200 — REV. 0

APPENDIX-B

BOREHOLE, TEST PIT LOGS AND FIELD PERMEABILITY TEST RESULTS

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-32

SHEET 1 OF 1

BOREHOLE LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT

Job No. 3976 Project INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY Location WASTWE WATER TREATMENT PLANT

Site Incharge JUNAID Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Type of boring HAND AUGER Drilling Fluid NIL Ground Water Depth 1.4 m

Coordinates N: 11812481.5 ft E: 1477050.48 ft Ground Elevation 238.34 m Date 24-01-2020 To 24-01-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	Remarks
0.0						
	SPT-1		CL	Brown, LEAN CLAY with SILT, medium plastic, trace mica, moist.		
1.0	SPT-2		CL	Brown, very soft, LEAN CLAY with SAND, low plastic, little mica, moist.		GWT
2.0	SPT-3		SM	Light grey, loose, SILTY SAND, trace mica, wet.	100 mm	
3.0	SPT-4					
4.0	SPT-5		SP-SM	Grey, medium dense, fine grained, poorly graded SAND with SILT, trace mica, wet.		
5.0	SPT-6					
6.0	SPT-7					
7.0				BOTTOM OF BOREHOLE		

P.L. ▽ N.M.C. x L.L. O

SPT Blows/30cm

10 20 30 40 50 60 70 80 90 100

2 5 10 11 21 29 10

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-33

SHEET 1 OF 1

BOREHOLE LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT

Job No. 3976 Project INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Type of boring HAND AUGER Drilling Fluid NIL Ground Water Depth 1.45 m

Coordinates N: 11811692.51 ft E: 1476314.23 ft Ground Elevation 238.29 m Date 22-01-2020 To 22-01-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	SPT Blows/30cm (P.L. ▽, N.M.C. x, L.L. O)	Remarks
0.0							
	SPT-1		CL	Brown, LEAN CLAY, medium plastic, medium to high dry strength, trace roots, moist.	100 mm	6	
1.0				Brown, firm, LEAN CLAY, medium plastic, medium to high dry strength, trace roots, moist.			GWT
	SPT-2					3	
2.0			ML	Brown, loose, SILT, trace to little sand, trace concretions, moist.			
	SPT-3					5	
3.0			SM	Grey, loose, fine grained, SILTY SAND, trace mica, wet.			
	SPT-4					4	
4.0							
	SPT-5					6	
5.0			SP	Grey, loose to medium dense, fine to medium grained, poorly graded SAND, trace silt, trace mica, wet.			
	SPT-6					10	
6.0							
	SPT-7					13	
7.0				BOTTOM OF BOREHOLE			

SPT Blows/30cm: 10 20 30 40 50 60 70 80 90 100

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-34

SHEET 1 OF 1

BOREHOLE LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT

Job No. 3976 Project INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Type of boring HAND AUGER Drilling Fluid NIL Ground Water Depth 1.5 m

Coordinates N: 11812614.82 ft E: 1478066.19 ft Ground Elevation 238.57 m Date 26-01-2020 To 27-01-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. O SPT Blows/30cm	Remarks
0.0				Brown, LEAN CLAY, medium plastic,trace concretions, trace roots, trace mica, moist.	100 mm		
1.0	SPT-1		CL	Brown, firm, LEAN CLAY, medium plastic, trace concretions, moist.		6	GWT
2.0	SPT-2					7	
3.0	SPT-3		CL-ML	Brown, firm, SILTY CLAY with SAND, low to medium plastic, trace concretions, wet.		10	
4.0	SPT-4		SM	Grey, medium dense, fine grained, SILTY SAND, trace mica, wet.		24	
5.0	SPT-5		SP-SM	Grey, medium dense to dense, fine to medium grained, poorly graded SAND with SILT, trace mica, wet.		22	
6.0	SPT-6					32	
7.0	SPT-7					31	
				BOTTOM OF BOREHOLE			

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-35

SHEET 1 OF 1

BOREHOLE LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT

Job No. 3976 Project INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Type of boring HAND AUGER Drilling Fluid NIL Ground Water Depth 1.28 m

Coordinates N: 11813808.38 ft E: 1476971.18 ft Ground Elevation 238.34 m Date 25-01-2020 To 26-01-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	SPT Blows/30cm (P.L. ▽, N.M.C. x, L.L. O)	Remarks
0.0							
	SPT-1		CL	Brown, LEAN CLAY, medium plastic, medium to high dry strength.	100 mm	5	
1.0	SPT-2		CL-ML	Brown, firm, SILTY CLAY, low to medium plastic, trace to little concretions, moist.		3	GWT
2.0	SPT-3		SM	Greyish brown, very loose to medium dense, SILTY SAND, trace clay, trace mica, wet.		17	
3.0	SPT-4					5	
4.0	SPT-5		CL	Brown, firm, LEAN CLAY, medium to high plastic, moist.		8	
5.0	SPT-6		SM	Dark grey, loose, SILTY SAND, trace to little clay, trace mica, wet.		31	
6.0	SPT-7			Grey, dense, fine to medium grained, SILTY SAND, trace mica, wet.		9	
7.0				BOTTOM OF BOREHOLE			

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-36

SHEET 1 OF 1

BOREHOLE LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT

Job No. 3976 Project INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Type of boring HAND AUGER Drilling Fluid NIL Ground Water Depth 1.6 m

Coordinates N: 11813326.04 ft E: 1477853.69 ft Ground Elevation 238.43 m Date 26-01-2020 To 26-01-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	SPT Blows/30cm (P.L. ▽, N.M.C. x, L.L. O)	Remarks
0.0				Brown, LEAN CLAY, medium plastic, trace silt, little vegetation roots.	100 mm		
1.0	SPT-1		CL	Brown, firm, LEAN CLAY, medium plastic, medium to high dry strength, trace silt, trace concretions, moist.		7	GWT
2.0	SPT-2					5	
3.0	SPT-3		ML	Brown, loose, fine grained, SANDY SILT, little clay, trace mica, wet.		6	
4.0	SPT-4		SP	Grey, loose to medium dense, fine to medium grained, poorly graded SAND, trace mica, wet.		14	
5.0	SPT-5					11	
6.0	SPT-6					9	
7.0	SPT-7					34	
				BOTTOM OF BOREHOLE			

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-37

SHEET 1 OF 1

BOREHOLE LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT

Job No. 3976 Project INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Type of boring HAND AUGER Drilling Fluid NIL Ground Water Depth 1.45 m

Coordinates N: 11813133.31 ft E: 1476237.96 ft Ground Elevation 238.17 m Date 24-01-2020 To 25-01-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. O — SPT Blows/30cm (10 20 30 40 50 60 70 80 90 100)	Remarks
0.0							
	SPT-1		CL-ML	Brown, SILTY CLAY, low to medium plastic, trace vegetation roots, moist.			
1.0						6	
	SPT-2		CL-ML	Brown, firm, SILTY CLAY with SAND, low to medium plastic, some concretions, wet.			GWT
2.0						3	
	SPT-3		ML	Brown, very loose to loose, SANDY SILT, some clay, trace mica, wet.		6	
3.0							
	SPT-4					11	
4.0			SM	Grey, medium dense, fine to medium grained, SILTY SAND, trace mica, trace silt, wet.	100 mm		
	SPT-5					6	
5.0			ML	Brown grey, loose, SANDY SILT, some clay, trace mica, wet.			
	SPT-6					9	
6.0			SM	Brownish grey, loose, fine grained, SILTY SAND, trace to little clay, trace mica, wet.			
	SPT-7					18	
7.0				BOTTOM OF BOREHOLE			

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-38

SHEET 1 OF 1

BOREHOLE LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT

Job No. 3976 Project INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY Location WASTE WATER TREATMENT PLANT

Site Incharge M. UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Type of boring HAND AUGER Drilling Fluid NIL Ground Water Depth 1.8 m

Coordinates N: 11810989.04 ft E: 1477129.62 ft Ground Elevation 238.71 m Date 23-01-2020 To 23-01-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. O — SPT Blows/30cm	Remarks
0.0				Brown, LEAN CLAY, medium to high plastic, medium to high dry strength, trace silt, trace concretions, moist.	100 mm		
1.0	SPT-1			Brown, firm, LEAN CLAY, medium plastic, medium to high dry strength, trace silt, trace concretions, moist.		6	
2.0	SPT-2		CL			7	GWT
3.0	SPT-3			Grey, loose to medium dense, fine to medium grained, poorly graded SAND with SILT, trace mica, wet.		4	
4.0	SPT-4					9	
5.0	SPT-5		SP-SM			17	
6.0	SPT-6					15	
7.0	SPT-7			BOTTOM OF BOREHOLE		25	

SPT Blows/30cm: 10 20 30 40 50 60 70 80 90 100

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-39

SHEET 1 OF 1

BOREHOLE LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT

Job No. 3976 Project INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Type of boring HAND AUGER Drilling Fluid NIL Ground Water Depth 1.7 m

Coordinates N: 11811814.68 ft E: 1478032.65 ft Ground Elevation 238.64 m Date 27-01-2020 To 27-01-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. O SPT Blows/30cm	Remarks
0.0				Brown, LEAN CLAY, medium plastic, medium to high dry strength, trace silt, moist.	100 mm		
1.0	SPT-1		CL	Brown, firm, LEAN CLAY, medium plastic, medium to high dry strength, trace silt, trace concretions, moist.		6	GWT
2.0	SPT-2					7	
			CL-ML	Brown, firm, SILTY CLAY, low to medium plastic, medium dry strength, moist.			
3.0	SPT-3					8	
			SP	Brownish grey, loose to medium dense, fine, poorly graded SAND, trace to some silt, trace mica, wet.			
4.0	SPT-4					17	
5.0	SPT-5					12	
6.0	SPT-6					7	
7.0	SPT-7					9	
				BOTTOM OF BOREHOLE			

SPT Blows/30cm: 10 20 30 40 50 60 70 80 90 100

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-01

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID/UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 11813544.69 ft E: 1476551.39 ft Ground Elevation 238.26 m Date 08-02-2020 TO 08-02-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			CL	Brown, LEAN CLAY with SAND, medium plastic, trace concretions, trace mica, moist.	BS-1 FDT-1	15.7	18	19.3	12	81	
0.5											
1.0											
1.4				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-02

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID/UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 11813493.93 ft
E: 1477425.28 ft
Ground Elevation 238.39 m
Date 09-02-2020 TO 09-02-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			CL	Brown, LEAN CLAY with SAND, medium plastic, medium to high dry strength, trace mica, moist.	BS-1 FDT-1	15.5	20	19.7	11	79	
0.5											
1.0			CL-ML	Brown, SILTY CLAY with SAND, trace mica, trace concretions, moist.	BS-2						
1.5				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-03

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID/UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 11812896.46 ft E: 1476696.71 ft Ground Elevation 238.23 m Date 09-02-2020 TO 09-02-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			CH	Brown, FAT CLAY, high plastic, high dry strength, trace to little concretions, trace mica, moist.	FDT-1	15.3	22	-	-	-	
0.5											
1.0					BS-1						
			CL-ML	Brown, SANDY SILTY CLAY, some concretions, moist.							
1.5				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-04

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID/UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 11812391.9 ft E: 1476290.47 ft Ground Elevation 238.25 m Date 08-02-2020 TO 08-02-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			CL	Brown, LEAN CLAY, medium plastic, medium to high dry strength, some concretions, trace sand, trace mica, moist.	BS-1						
0.5											
1.0					FDT-1	15.5	19	18.4	14	84	
1.5				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-05

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID/UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 11812068.16 ft
E: 1476760.51 ft
Ground Elevation 238.28 m
Date 08-02-2020 TO 08-02-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			CH	Brown, FAT CLAY with SAND, high plastic, high dry strength, trace silt, moist.	BS-1						
0.5											
1.0					FDT-1	14.7	27	17.9	14.6	82	
1.5				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-06

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID/UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 11812840.66 ft E: 1477513.92 ft Ground Elevation 238.38 m Date 09-02-2020 TO 09-02-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			CL	Brown, LEAN CLAY with SAND, medium plastic, medium to high dry strength, trace concretions, trace silt, moist.	BS-1 FDT-1	15.9	20	-	-	-	
1.5				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-07

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID/UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 11812334.22 ft
E: 1477661.45 ft
Ground Elevation 238.47 m
Date 07-02-2020 TO 07-02-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			CH	Brown, FAT CLAY, medium plastic, medium to high dry strength, trace silt, moist.	BS-1						
0.5					FDT-1	15.5	21	19.1	12	81	
1.0			CL-ML	Brown, SILTY CLAY with SAND, low plastic, trace concretions, trace mica, moist.							
1.5				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-08

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID/UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 11811624.32 ft
E: 1477221.96 ft
Ground Elevation 238.49 m
Date 07-02-2020 TO 07-02-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			CH	Brown, FAT CLAY, high plastic, high dry strength, trace silt, moist.	BS-1						
0.5											
1.0											
1.5					FDT-1	15.3	21	-	-	-	
				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-09

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID/UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 11811176.38 ft E: 1476575.18 ft Ground Elevation 238.66 m Date 07-02-2020 TO 07-02-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			CL	Brown, LEAN CLAY with SAND, medium plastic, medium to high dry strength, trace silt, trace mica, moist.	FDT-1	15.4	21	18.7	14	82	
0.5					BS-1						
1.0											
1.5				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-10

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location WASTE WATER TREATMENT PLANT

Site Incharge JUNAID/UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 11811322.34 ft
E: 1477867.77 ft
Ground Elevation 238.67 m
Date 09-02-2020 TO 09-02-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			CL	Brown, LEAN CLAY, low to medium plastic, trace concretions, trace sand, trace mica, moist.	BS-1						
0.5											
1.0					FDT-1	15.5	21	19.2	12	81	
1.5				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. BAS-01

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location TAWI-1 NEAR GONDAL

Site Incharge JUNAID/UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 32669452 E: 74530458 Ground Elevation - Date 19-01-2020 TO 19-01-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			SP-SM	Grey, fine grained, poorly graded SAND with SILT, trace mica, moist to wet.							
0.5											
1.0											
1.5				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. BAS-02

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location TAWI-2 NEAR GONDAL

Site Incharge JUNAID/UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 327184580 E: 744536889 Ground Elevation - Date 19-01-2020 TO 19-01-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			SM	Grey, fine grained, SILTY SAND, trace mica, moist to wet.							
1.5				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. BAS-03

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location KURI-1 (MUNAWAR WALI)

Site Incharge JUNAID/UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 32719222 E: 74453710 Ground Elevation - Date 19-01-2020 TO 19-01-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			SP	Grey, fine to medium grained, poorly graded SAND, trace to little silt, moist.							
1.5				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. BAS-04

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location KURI-2 (MUNAWAR WALI)

Site Incharge JUNAID/UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 32719149 E: 74454811 Ground Elevation - Date 19-01-2020 TO 19-01-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			SP-SM	Grey, fine grained, poorly graded SAND with SILT, moist.							
0.5											
1.0											
1.5				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. Borrow Area-1

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location CHAK SEMA (SINDUWALA)

Site Incharge M. UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 3254794 E: 7446709 Ground Elevation - Date 11-02-2020 TO 11-02-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0				LEAN CLAY, grass vegetation, moist.							
0.5			CL	Brown, LEAN CLAY with SAND, medium plastic, trace to little silt, trace concretions, moist.	BS-1						
1.0											
1.2				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. Borrow Area-2

Sheet 1 OF 1

TESTPIT LOG

Job No. 3976 Project PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY Location LALPUR NEAR SINDUWALA

Site Incharge M. UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 3255649 E: 7448527 Ground Elevation - Date 13-02-2020 TO 13-02-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0				Brown, LEAN CLAY, little grass roots, moist.							
				Brown, LEAN CLAY with SAND, medium plastic, little silt, trace concretions, moist.	BS-1						
0.5			CL								
1.0											
1.2				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. Borrow Area-3

Sheet 1 OF 1

TESTPIT LOG

PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY

Job No. 3976 Project Location CHATTA PIND

Site Incharge M. UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 3256140 E: 7445729 Ground Elevation - Date 13-02-2020 TO 13-02-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0				Vegetation, LEAN CLAY.							
			CL	Brown, LEAN CLAY with SAND, low to medium plastic, trace to little sand, moist.	BS-1						
0.5											
1.0			CL-ML	Brown, SANDY SILTY CLAY, low plastic, moist.							
1.3				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. BAS-05

Sheet 1 OF 1

TESTPIT LOG

Job No. 3976 Project PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY Location MARI KOKHRAN (SAMPLE-2)

Site Incharge M. UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 326659859 E: 744036265 Ground Elevation - Date 19-02-2020 TO 19-02-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			CL	Reddish brown, LEAN CLAY, medium plastic, medium dry strength, some concretions, trace grass roots, moist to wet.							
0.5											
1.0											
1.5				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. BAS-07

Sheet 1 OF 1

TESTPIT LOG

Job No. 3976 Project PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM, WATER SUPPLY AND SEWERAGE SYSTEM IN SIALKOT CITY Location MARI KOKHRAN (SAMPLE-1)

Site Incharge M. UMAR Client LG & CD, GOVERNMENT OF PUNJAB Contractor M/S AJK ENGINEERS

Coordinates N: 32671468 E: 74403579 Ground Elevation - Date 19-01-2020 TO 19-01-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0			CL	Reddish brown, LEAN CLAY, medium plastic, medium to high dry strength, some silt, moist.							
0.5											
1.0											
1.5				BOTTOM OF TESTPIT							

National Engineering Services Pakistan (Pvt.) Limited

CONSTANT HEAD PERMEABILITY TEST

Name of Project: **PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM** **(Water Supply and Sewerage System in Sialkot City)**	Site: **Sialkot**	Location: **Wastewater Treatment Plant**
Depth below top of casing/standpipe to:	Job No. **3976**	Borehole No. **BH – 33**
(a) bottom of borehole: **4.40 m**	Date: **10/02/2020**	Sheet 1 of 1
(b) bottom of casing: **4.40 m**	Ground level: (Ordnance datum)	Crew/Operator:
(c) top of filter material:	Weather: **Sunny**	Temperature: **21** °C
(d) centre of piezometer tip:	Type of test: **CONSTANT**	Material: **Silty Sand**
(e) initial groundwater level:	Internal diameter of casing / standpipe: **7.60cm**	
Height of casing/standpipe above surface: **0.11 m**	Length of filter: mm	Dia. of filter mm
Elevation of casing/standpipe: (Ordnance datum)	Type of piezometer	

Test record

Time	Time elapsed 't' min	1 / √ t Loss in Lit	Measurement of flow: Fall in standpipe (m)	Internal dia. of standpipe (m)	Volume of flow (m^3)	Time for flow min sec	Flow q_t (m^3/s)	Head, H (m)	q_t/H m^2/s
1330	1	3.50							
	1	1.20							
	2	1.80							
	2	1.30							
	5	1.85							
	5	1.84							
	5	1.85							
	21 min	13.34 liters							

$K = q / (F \times H_C)$
$q = 10.58$ cm3/sec
$\Phi = 7.60$ cm
$H_C = 4.51$ m
$K = 10.58 / 2.75 \times 7.6 \times 4.51 \times 100 = 1.12 \times 10^{-3}$ cm/sec.

Remarks:

Reference: BS 5930:1990+A2:2010 (Code of Practice for site Investigations)

National Engineering Services Pakistan (Pvt.) Limited

CONSTANT HEAD PERMEABILITY TEST

Name of Project: **PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM** **(Water Supply and Sewerage System in Sialkot City)**	Site: **Sialkot**	Location: **Waste Water Treatment Plant**
Depth below top of casing/standpipe to:	Job No. **3976**	Borehole No. **BH – 34**
(a) bottom of borehole: **2.42 m**	Date: **10/02/2020**	Sheet 1 of 1
(b) bottom of casing: **2.42 m**	Ground level: (Ordnance datum)	Crew/Operator:
(c) top of filter material:	Weather: **Sunny**	Temperature: **20** °C
(d) centre of piezometer tip:	Type of test: **CONSTANT**	Material: **Silt with Sand**
(e) initial groundwater level:	Internal diameter of casing / standpipe: **7.60cm**	
Height of casing/standpipe above surface: **0.43 m**	Length of filter: mm	Dia. of filter mm
Elevation of casing/standpipe: (Ordnance datum)	Type of piezometer	

Test record

Time	Time elapsed 't' min	1 / √ t Loss in Lit	Measurement of flow: Fall in standpipe (m)	Internal dia. of standpipe (m)	Volume of flow (m^3)	Time for flow min sec	Flow q_t (m^3/s)	Head, H (m)	q_t/H m^2/s
1330	1	0.20							
	1	0.2							
	2	0.10							
	2	0.08							
	5	0.05							
	5	0.10							
	5	0.10							
	5	0.10							
	26 min	0.93 liters							

$K = q / (F \times H_C)$
$q = 0.596$ cm3/sec
$\Phi = 7.60$ cm
$H_C = 2.85$ m
$K = 0.596 / 2.75 \times 7.6 \times 2.85 \times 100 = 1 \times 10^{-4}$ cm/sec.

Remarks:

Reference: BS 5930:1990+A2:2010 (Code of Practice for site Investigations)

National Engineering Services Pakistan (Pvt.) Limited

CONSTANT HEAD PERMEABILITY TEST

Name of Project: **PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM** **(Water Supply and Sewerage System in Sialkot City)**	Site: **Sialkot**	Location: **Effluent Pumping Station**
Depth below top of casing/standpipe to:	Job No. **3976**	Borehole No. **BH – 46**
(a) bottom of borehole: **3.65 m**	Date: **10/02/2020**	Sheet 1 of 1
(b) bottom of casing: **3.65 m**	Ground level: (Ordnance datum)	Crew/Operator:
(c) top of filter material:	Weather: **Sunny**	Temperature: **15** °C
(d) centre of piezometer tip:	Type of test: **CONSTANT**	Material: **Silty Sand**
(e) initial groundwater level:	Internal diameter of casing / standpipe: **7.60cm**	
Height of casing/standpipe above surface: **0.70 m**	Length of filter: mm	Dia. of filter mm
Elevation of casing/standpipe: (Ordnance datum)	Type of piezometer	

Test record

Time	Time elapsed 't' min	1 / √ t Loss in Lit	Measurement of flow: Fall in standpipe (m)	Internal dia. of standpipe (m)	Volume of flow (m^3)	Time for flow min sec	Flow q_t (m^3/s)	Head, H (m)	q_t/H m^2/s
1330									
	1	6.50							
	1	3.50							
	1	3.40							
	1	4.00							
	2	5.00							
	2	5.55							
	2	5.50							
	2	4.50							
	5	6.70							
	5	7.20							
	5	7.50							
	5	7.50							
	5	7.50							
	37 min	67.90 liters							

$K = q / (F \times H_C)$
$q = 30.58$ cm3/sec
$\Phi = 7.60$ cm
$H_C = 4.35$ m
$K = 30.58 / 2.75 \times 7.6 \times 4.35 \times 100 = 3.36 \times 10^{-3}$ cm/sec.

Remarks:

Reference: BS 5930:1990+A2:2010 (Code of Practice for site Investigations)

National Engineering Services Pakistan (Pvt.) Limited

VARIABLE HEAD PERMEABILITY TEST

Name of Project: **PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM** **(Water Supply and Sewerage System in Sialkot City)**	Site: **Sialkot**	Location: **Effluent Pumping Station**
Depth below top of casing/ standpipe to:	Job No. **3976**	Borehole No **BH – 50**
(a) bottom of borehole: **1.40 m**	Date **10/02/2020**	Sheet 01 of 01
(b) bottom of casing: **1.40 m**	Ground level: m (Ordnance datum)	Crew/Operator:
(c) top of filter material:	Weather: **Sunny**	Temperature: **20** °C
(d) centre of piezometer tip:	Type of test: **Falling** Material: **Silt with clay/ Silty Clay**	
(e) initial groundwater level:	Diameter of casing / standpipe: **7.6 cm**	
Height of casing/standpipe above surface: **0.10 m**	Length of filter: mm Dia. of filter: mm	
Elevation of casing/standpipe: m (Ordnance datum)	Type of piezometer:	

Test record:

Time	Time elapsed 't' min	Depth to water level from casing Top (cm)	Time	Time Elapsed 't' hr min	Depth to water level (m)	Time	Time elapsed 't' hr min	Depth to water level (m)
	1	0.20						
	2	0.20						
	2	0.10						
	2	0.15						
	2	0.30						
	5	0.30						
	5	0.30						
	24 min	2.65 cm						

$K = 2.3\pi r_o / 5.5(t_2 - t_1) \log H_1/H_2$,
$H_1 = 1.50$ m, $H_2 = 1.474$ m, $r_o = 3.8$ cm
$t_2 = 1440$ sec, $t_1 = 0$ sec
$K = 2.63 \times 10^{-5}$ cm/sec.

Remarks:

Reference: BS 5930:1990+A2:2010 (Code of Practice for site Investigations)

APPENDIX-C

LABORATORY TEST RESULTS AND
DETAILED TEST RESULT SHEETS

CONSULTANCY SERVICES FOR ENGINEERING, PROCUREMENT AND CONSTRUCTION MANAGEMENT FOR PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM
(Wastewater Treatment Plant)

Summary of Laboratory Test Results

Sr No.	Location	BH/TP No.	Sample No.	Depth	Natural Moisture Content (NMC)	In-situ Bulk Density	In-situ Dry Density	Grain Size Analysis (% Passing)							Atterberg Limits			Material Classification			Unconfined Compression Test		Direct Shear Test		Consolidation Test with swell potential Measurement					Modified AASHTO Compaction Test		3 Point Soaked CBR at 95% of MDD	Chemical Analysis of Soil			Chemical Analysis of Water			
															LL	PI.	PI	Unified Soil Classification System (USCS) Symbol	AASHTO Classification Symbol	Material Description as per USCS	q_u	Failure Strain	c	ϕ	eo	Cc	Swell Pressure	mv	k	OMC	Max. Dry Density (MDD)		Sulphate Content	Chloride Content	Organic Matter	Sulphate Content	Chloride Content	Total Dissolved Solids	pH
-	-	-	-	(m)	(%)	(kN/m^3)	(kN/m^3)	#4	#10	#40	#100	# 200	0.02 mm	0.002 mm	(%)	(%)	(%)				(kPa)	%	(kPa)	(deg)	-	-	(kPa)	cm2/Kg	cm/sec	(%)	(kN/m^3)	(%)	(%)	(%)	(%)	(ppm)	(ppm)	(ppm)	-
56	Wastewater Treatment Plant	BH-32	SPT-1	1.00-1.45	-	-	-	100	100	90	89	79	54	8	33	23	10	CL	A-4	Lean Clay with sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57			SPT-4	4.00-4.45	-	-	-	100	100	62	7	5	-	-	-	-	-	SP-SM	A-3	Poorly Graded Sand with Silt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58			W/S	_	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	123	85	400	7.3
59		BH-33	SPT-2	2.00-2.45	-	-	-	100	100	100	98	95	55	7	33	25	8	ML	A-4	Silt	-	-	-	-	-	-	-	-	-	-	-	-	-	0.07	0.07	0.29	-	-	-	-
60			SPT-7	7.00-7.45	-	-	-	100	100	37	9	4	-	-	-	-	-	SP	A-1-b	Poorly Graded Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61		BH-34	SPT-5	5.00-5.45	-	-	-	100	100	51	16	7	-	-	-	-	-	SP-SM	A-3	Poorly Graded Sand with Silt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
62		BH-35	SPT-4	4.00-4.45	-	-	-	100	100	100	98	96			40	24	16	CL	A-6	Lean Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	0.08	0.05	0.31	-	-	-	-
63			W/S	_	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	165	390	300	7.8
64		BH-36	SPT-4	4.00-4.45	-	-	-	100	100	49	8	4	-	-	-	-	-	SP	A-1-b	Poorly Graded Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
65		BH-37	SPT-6	6.00-6.45	-	-	-	100	100	99	81	35						SM	A-2-4	Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
66		BH-38	SPT-2	2.00-2.45	-	-	-	97	96	94	91	89	54	8	35	23	12	CL	A-6	Lean Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
67			SPT-6	6.00-6.45	-	-	-	100	100	47	9	5			Non-Plastic			SP-SM	A-1-b	Poorly Graded Sand with Silt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
68		BH-39	SPT-1	1.00-1.45	-	-	-	100	98	96	94	93	55	13	38	22	16	CL	A-6	Lean Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	0.08	0.05	0.32	-	-	-	-
69			SPT-7	7.00-7.45	-	-	-	100	100	42	1	0	-	-	-	-	-	SP	A-1-b	Poorly Graded Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
89	On-site Samples	TP-1	BS-1	0.00-1.40	-	-	-	100	97	90	84	80	-	-	38	22	16	CL	A-6	Lean Clay with Sand	-	-	-	-	-	-	-	-	-	11.8	19.3	0.5	-	-	-	-	-	-	-
90		TP-2	BS-1	0.00-1.00	-	-	-	100	99	96	87	84	55	22	42	24	18	CL	A-7-6	Lean Clay with Sand	-	-	-	-	0.388	0.050	262.0	0.0197	2.4 X 10^{-7}	11.2	19.7	-	-	-	-	-	-	-	-
91		TP-3	BS-1	0.00-1.50	-	-	-	100	98	96	94	93	-	-	51	27	24	CH	A-7-6	Fat Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
92		TP-4	BS-1	0.00-1.50	-	-	-	100	100	99	98	97	-	-	49	27	22	CL	A-7-6	Lean Clay	-	-	-	-	-	-	-	-	-	14.0	18.4	0.3	-	-	-	-	-	-	-
93		TP-5	BS-1	0.00-1.50	-	-	-	100	97	90	86	85	56	22	59	31	28	CH	A-7-5	Fat Clay with Sand	-	-	-		0.663	0.111	161.5	0.0686	8.6 X 10^{-7}	14.6	17.9	-	-	-	-	-	-	-	-
94		TP-6	BS-1	0.00-1.50	-	-	-	100	93	87	82	79	-	-	44	25	19	CL	A-7-6	Lean Clay with Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
95		TP-7	BS-1	0.00-1.20	-	-	-	100	100	99	96	95	-	-	50	27	23	CH	A-7-6	Fat Clay	-	-	-	-	-	-	-	-	-	11.7	19.1	0.6	-	-	-	-	-	-	-
96		TP-8	BS-1	0.00-1.50	-	-	-	100	96	93	92	92	-	-	50	27	23	CH	A-7-6	Fat Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
97		TP-9	BS-1	0.00-1.50	-	-	-	100	99	91	83	82	-	-	45	25	20	CL	A-7-6	Lean Clay with Sand	-	-	-	-	0.396	0.023	177.0	0.0166	2.30 X 10^{-9}	13.6	18.7	-	-	-	-	-	-	-	-
98		TP-10	BS-1	0.00-1.50	-	-	-	100	99	96	93	91	59	22	-	-	-	CL	A-6	Lean Clay	-	-	-	-	-	-	-	-	-	12.2	19.2	0.4	-	-	-	-	-	-	-

CONSULTANCY SERVICES FOR ENGINEERING, PROCUREMENT AND CONSTRUCTION MANAGEMENT FOR PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM
(Wastewater Treatment Plant)

Summary of Laboratory Test Results

Sr No.	Location	BH/TP No.	Sample No.	Depth	Natural Moisture Content (NMC)	In-situ Bulk Density	In-situ Dry Density	Grain Size Analysis (% Passing)							Atterberg Limits			Material Classification			Unconfined Compression Test		Direct Shear Test		Consolidation Test with swell potential Measurement					Modified AASHTO Compaction Test		3 Point Soaked CBR at 95% of MDD	Chemical Analysis of Soil			Chemical Analysis of Water			
																		Unified Soil Classification System (USCS) Symbol	AASHTO Classification Symbol	Material Description as per USCS	q_u	Failure Strain	c	ϕ	eo	Cc	Swell Pressure	mv	k	OMC	Max. Dry Density (MDD)		Sulphate Content	Chloride Content	Organic Matter	Sulphate Content	Chloride Content	Total Dissolved Solids	pH
															LL	PI.	PI																						
-	-	-	-	(m)	(%)	(kN/m^3)	(kN/m^3)	#4	#10	#40	#100	# 200	0.02 mm	0.002 mm	(%)	(%)	(%)				(kPa)	%	(kPa)	(deg)	-	-	(kPa)	cm2/Kg	cm/sec	(%)	(kN/m^3)	(%)	(%)	(%)	(%)	(ppm)	(ppm)	(ppm)	-
99	Borrow Area Sample	BAS-1	CS	0.00-1.50	-	-	-	100	100	73	15	9	-	-	-	-	-	SP-SM	A-3	Poorly Graded Sand with Silt	-	-	-	-	-	-	-	-	-	13.1	17.8	13.6	-	-	-	-	-	-	-
100		BAS-2	CS	0.00-1.50	-	-	-	100	100	68	23	14	-	-	-	-	-	SM	A-2-4	Silty Sand	-	-	-	-	-	-	-	-	-	13.6	17.4	13.5	-	-	-	-	-	-	-
101		BAS-3	CS	0.00-1.50	-	-	-	100	100	28	2	1	-	-	-	-	-	SP	A-1-b	Poorly Graded Sand	-	-	-	-	-	-	-	-	-	13.6	17.3	13.7	-	-	-	-	-	-	-
102		BAS-4	CS	0.00-1.50	-	-	-	100	100	65	17	9	-	-	-	-	-	SP-SM	A-3	Poorly Graded Sand with Silt	-	-	-	-	-	-	-	-	-	12.9	17.6	10.8	-	-	-	-	-	-	-
103		Borrow Area 1	BS	0.20-1.20	-	-	-	96	92	90	87	74	48	19	48	27	21	CL	A-7-6	Lean Clay with Sand	-	-	-	-	0.586	0.039	230.8	0.0261	3.2 X 10^{-6}	13.5	18.8	-	-	-	-	-	-	-	-
104		Borrow Area 2	BS	0.10-1.20	-	-	-	100	99	94	84	78	52	20	44	25	19	CL	A-7-6	Lean Clay with Sand	-	-	-	-	0.520	0.147	61.6	0.0996	1.3 X 10^{-6}	12.1	19.4	-	-	-	-	-	-	-	-
105		Borrow Area 3	BS	0.10-1.00	-	-	-	100	99	97	91	84	-	-	34	21	13	CL	A-6	Lean Clay with Sand	-	-	-	-	0.396	0.173	31.0	0.1259	1.7 x 10^{-6}	10.6	19.7	-	-	-	-	-	-	-	-
106		BAS-5	BS	-	-	-	-	100	99	98	96	95	59	22	34	21	13	CL	A-6	Lean Clay	-	-	-	-	0.563	0.117	69.2	0.0766	1.6 X 10^{-6}	11.5	18.8	-	-	-	-	-	-	-	-
107		BAS-7	BS	-	-	-	-	100	99	98	97	96	63	24	44	25	19	CL	A-7-6	Lean Clay	-	-	-	-	0.526	0.041	200.0	0.0278	5.8 X 10^{-7}	15.1	17.8	-	-	-	-	-	-	-	-

LEGEND:

BH	BOREHOLE	TP	TESTPIT	CS	BULK SAMPLE
SPT	STANDARD PENETRATION TEST	CS	COMPOSITE SAMPLE		
UDS	UNDISTURBED SOIL SAMPLE	BAS	BORROW AREA SAMPLE		
W/S	WATER SAMPLE	BA	BORROW AREA		

CONSULTANCY SERVICES FOR ENGINEERING, PROCUREMENT AND CONSTRUCTION MANAGEMENT FOR PUNJAB INTERMEDIATE CITIES IMPROVEMENT INVESTMENT PROGRAM
(Wastewater Treatment Plant)

Summary of Field Density Tests

Sr. No.	Location	Testpit No.	FDTs	Depth (m)	Natural Moisture Content (%)	Density		Modified AASHTO Compaction Test		Relative Compaction (%)
						Bulk (kN/m^3)	Dry (kN/m^3)	Max. Dry Density (kN/m^3)	OMC(%)	
1	On-site Samples	TP-1	FDT-1	0.9	18	18.5	15.7	19.3	12	81
2		TP-2	FDT-1	0.5	20	18.6	15.5	19.7	11	79
3		TP-3	FDT-2	0.6	22	18.5	15.3	-	-	-
4		TP-4	FDT-1	1.3	19	18.3	15.5	18.4	14	84
5		TP-5	FDT-1	1.1	27	18.6	14.7	17.9	15	82
6		TP-6	FDT-2	1.0	20	19.0	15.9	-	-	-
7		TP-7	FDT-1	0.8	21	18.7	15.5	19.1	12	81
8		TP-8	FDT-2	1.5	21	18.5	15.3	-	-	-
9		TP-9	FDT-1	0.7	21	18.5	15.4	18.7	14	82
10		TP-10	FDT-1	1.20	21	18.7	15.5	19.2	12	81

SOILCON

18-Km, Multan Road, Lahore. Ph: 042-7510942-43 Fax:042-7515267

SUMMARY OF FIELD DENSITY TEST

Project: PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM **Client:** AJK ENGINEERS
Location: TREATMENT PLANTS IN SIALKOT CITY **Lab. Ref:** 14/2020

BH / TP No.	Sample No.	Depth (m)	Location	M.C.%	Field Dry Density (g/cu.cm)	Specific Gravity	Remarks
TP-1	FDT-1	0.90		18.43			
TP-2	FDT-1	0.50		20.36			
TP-3	FDT-1	0.60		21.53			
TP-4	FDT-1	1.30		18.64			
TP-5	FDT-1	1.10		26.73			
TP-6	FDT-1	1.00		19.72			
TP-7	FDT-1	0.80		20.55			
TP-8	FDT-1	1.50		21.15			
TP-9	FDT-1	0.70		20.63			
TP-10	FDT-1	1.20		20.59			

Tested By: IKRAM ULLAH
Checked By: MAHMOOD
Dated: 04.03.2020

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BH-32	**Sampled Date**	-
Sample.	SPT-01	**Test Started**	11-Feb-20
Sample Depth (m)	1.00-1.45	**Test Completed**	13-Feb-20

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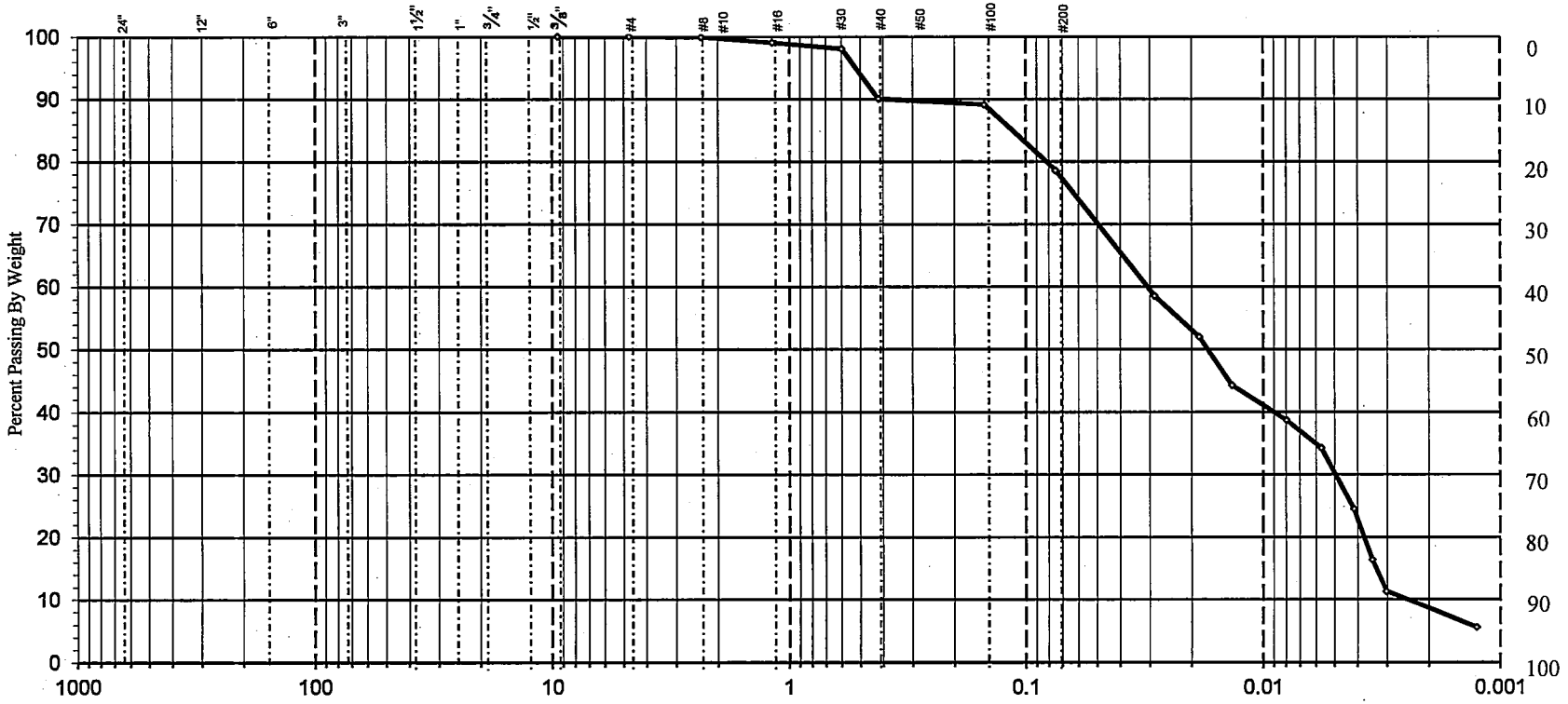
Soil and Concrete Testing Laboratory (Pvt) Ltd

GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 21.40 %			Silt = 48.42 %	Clay 30.18 %
		Coarse	Fine	Coarse	Medium	Fine		

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	99.94	99.06	98.05	90.03	89.11	78.60	70.12	41.04	30.18	8.54

Tested By	Jawad Nasir	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

Drillers, Engineers & Constructors ★ decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BH-32	**Sampled Date**	-
Sample.	SPT-04	**Test Started**	11-Feb-20
Sample Depth (m)	4.00-4.45	**Test Completed**	13-Feb-20

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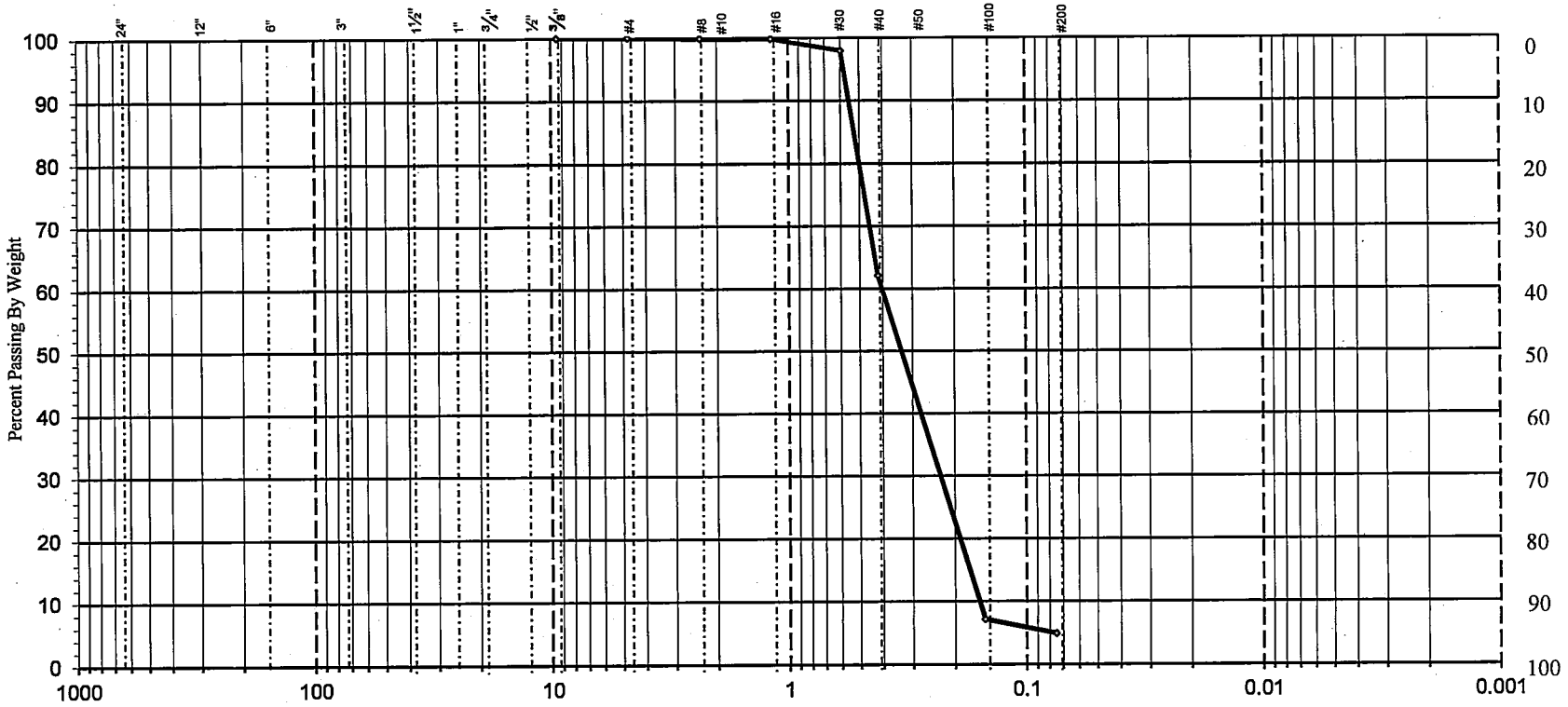
Soil and Concrete Testing Laboratory (Pvt) Ltd

GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 95.10 %			Silt + Clay = 4.90 %
		Coarse	Fine	Coarse	Medium	Fine	

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	99.86	99.82	97.92	62.10	7.13	4.90	-	-.	-	-

Tested By	Jawad Nasir	**Checked By**	Muhammad Ramzan	**Approved By**	Muhammad Daniyal

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BH-33	**Sampled Date**	-
Sample.	SPT-02	**Test Started**	11-Feb-20
Sample Depth (m)	2.00-2.45	**Test Completed**	13-Feb-20

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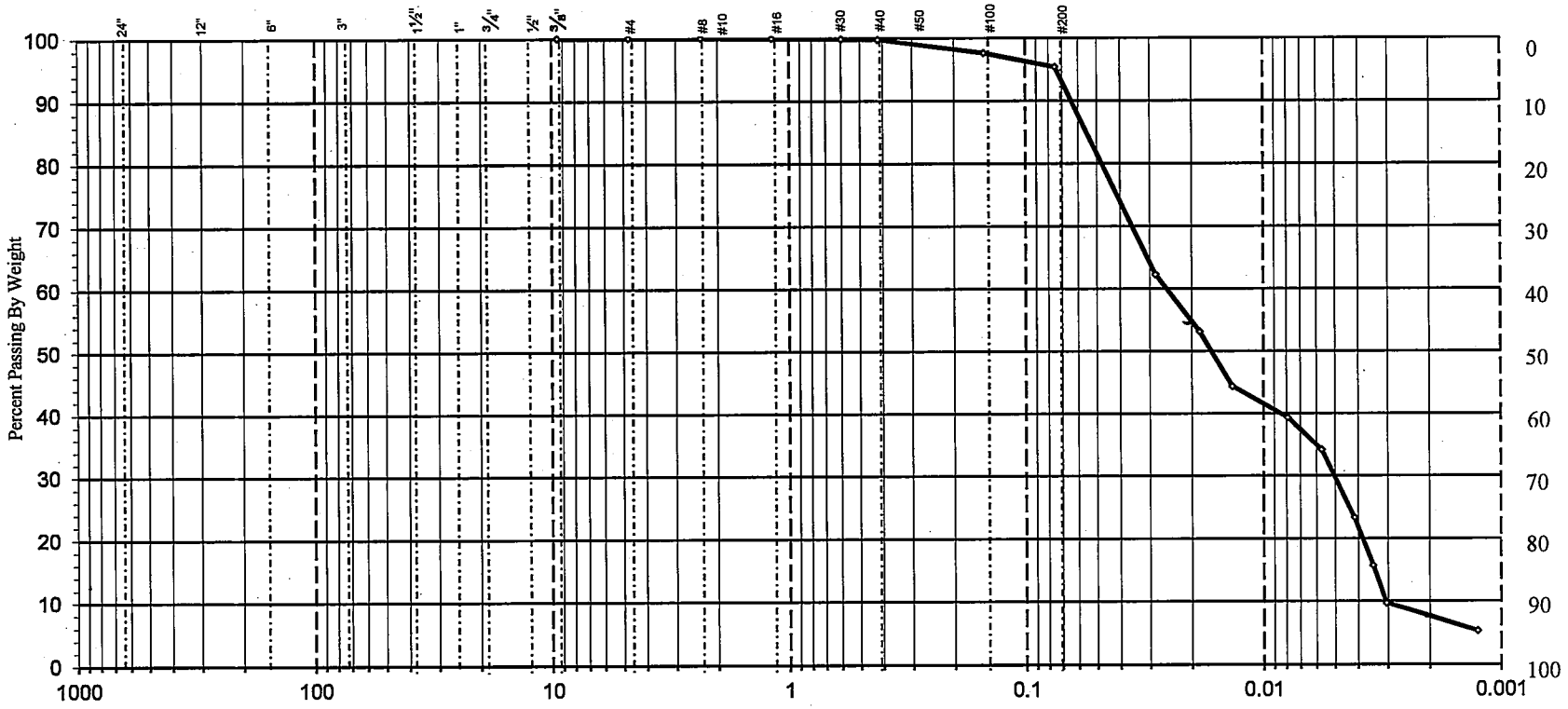
GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 4.61 %			Silt = 65.77 %	Clay 29.62 %
		Coarse	Fine	Coarse	Medium	Fine		

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	100.00	99.95	99.84	99.74	97.62	95.39	81.52	41.49	29.62	7.56

Tested By	Jawad Nasir	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

Drillers, Engineers & Constructors * decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BH-33	**Sampled Date**	-
Sample.	SPT-07	**Test Started**	11-Feb-20
Sample Depth (m)	7.00-7.45	**Test Completed**	13-Feb-20

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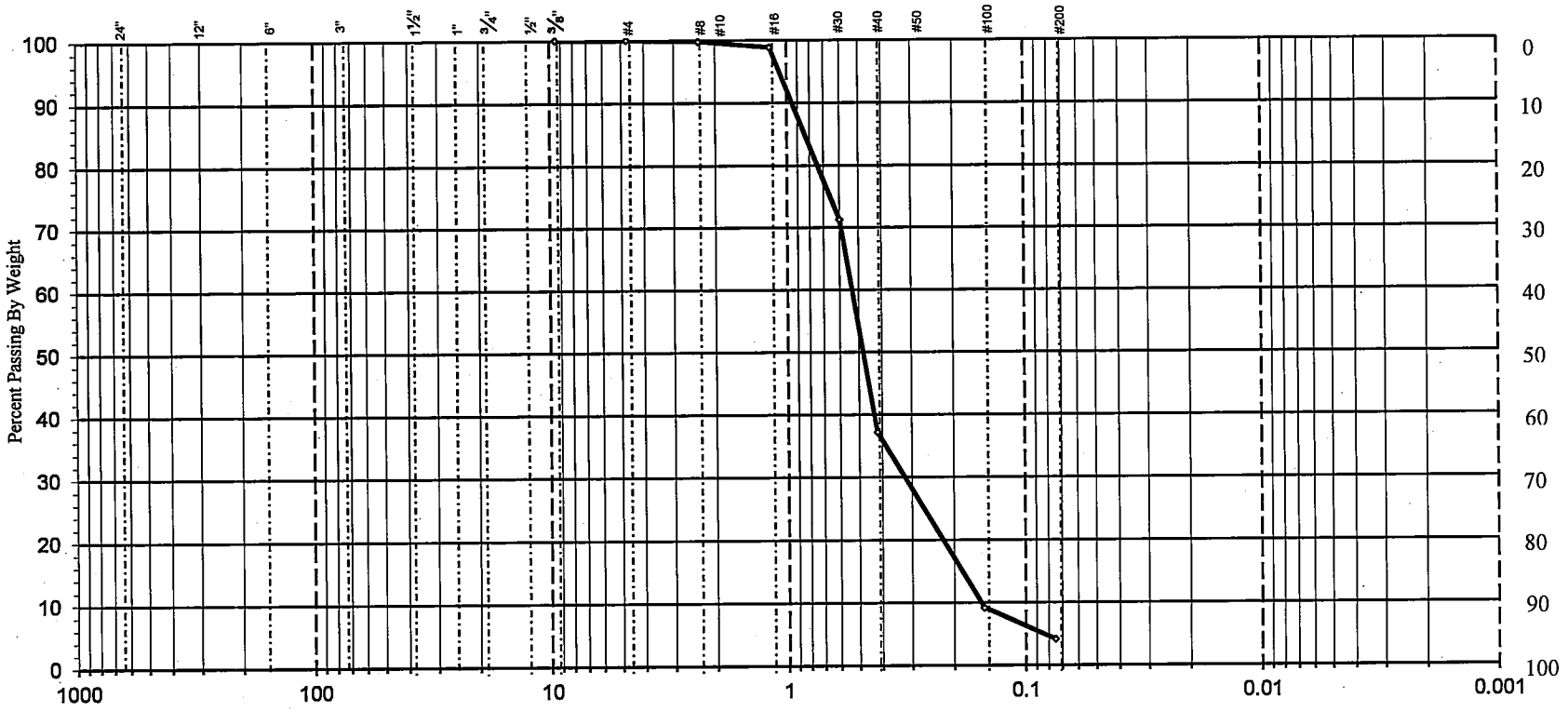
Soil and Concrete Testing Laboratory (Pvt) Ltd

GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 95.89 %			Silt + Clay = 4.11 %
		Coarse	Fine	Coarse	Medium	Fine	

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	99.80	98.86	71.21	37.16	9.15	4.11	-	-	-	-

Tested By	Jawad Nasir	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

Drillers, Engineers & Constructors ★ decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BH-34	**Sampled Date**	-
Sample.	SPT-05	**Test Started**	11-Feb-20
Sample Depth (m)	5.00-5.45	**Test Completed**	13-Feb-20

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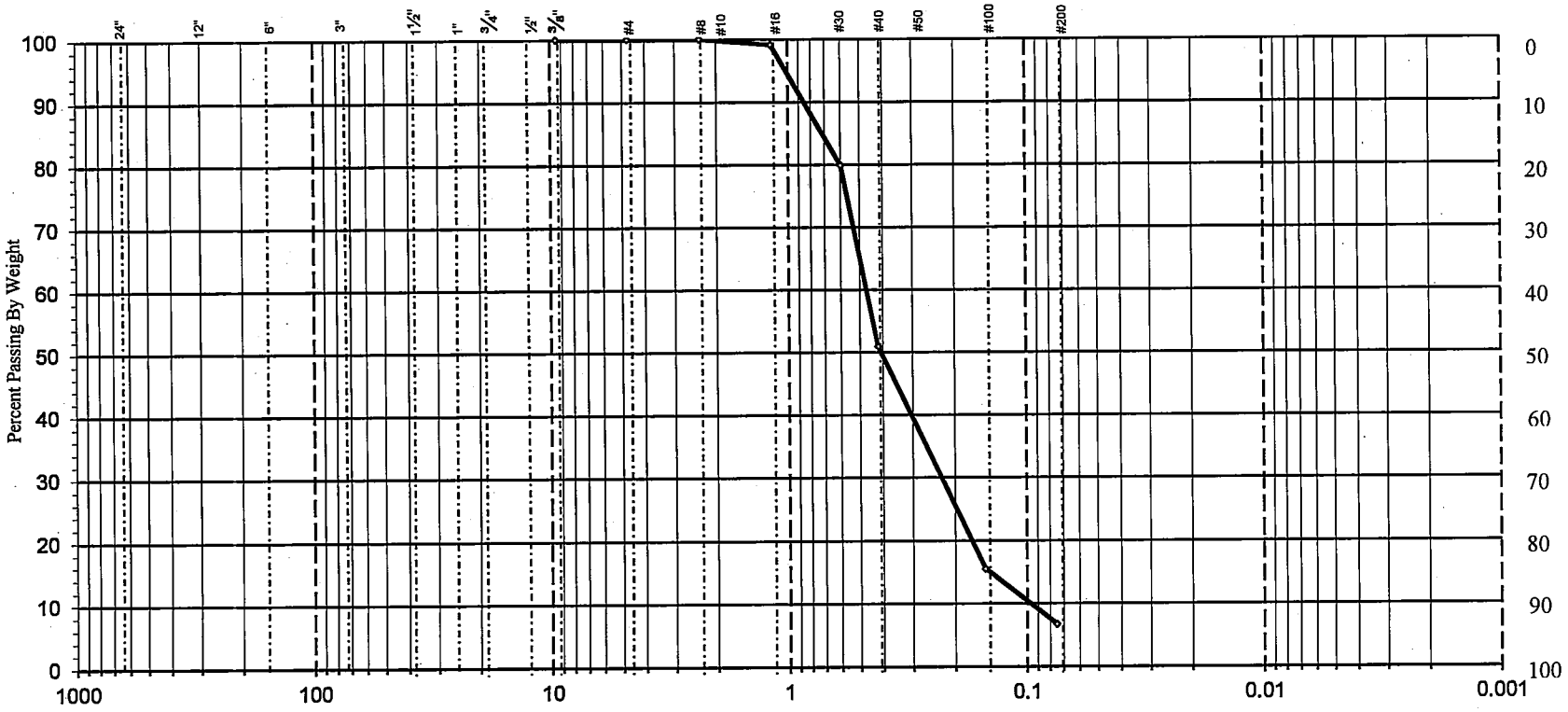
GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 93.31 %			Silt + Clay = 6.69 %
		Coarse	Fine	Coarse	Medium	Fine	

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	100.00	99.14	79.88	50.95	15.51	6.69	-	-	-	-

Tested By	Jawad Nasir	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

Drillers, Engineers & Constructors
decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BH-35	**Sampled Date**	-
Sample.	SPT-04	**Test Started**	11-Feb-20
Sample Depth (m)	4.00-4.45	**Test Completed**	13-Feb-20

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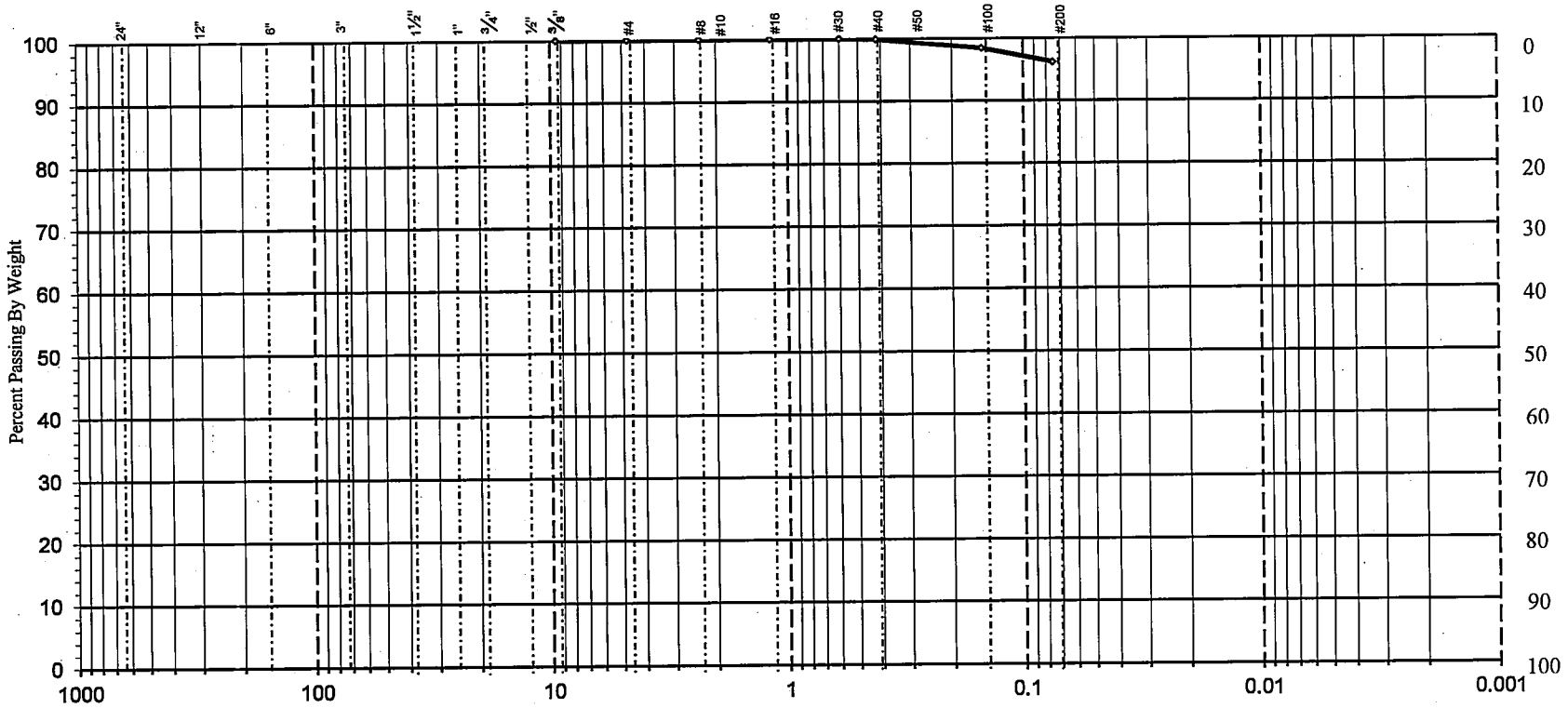
GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 3.82 %			Silt + Clay = 96.18 %
		Coarse	Fine	Coarse	Medium	Fine	

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	100.00	100.00	100.00	99.91	98.41	96.18	-	-	-	-

Tested By	Jawad Nasir	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

Engineers & Constructors * Driller's
decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BH-36	**Sampled Date**	-
Sample.	SPT-04	**Test Started**	11-Feb-20
Sample Depth (m)	4.00-4.45	**Test Completed**	13-Feb-20

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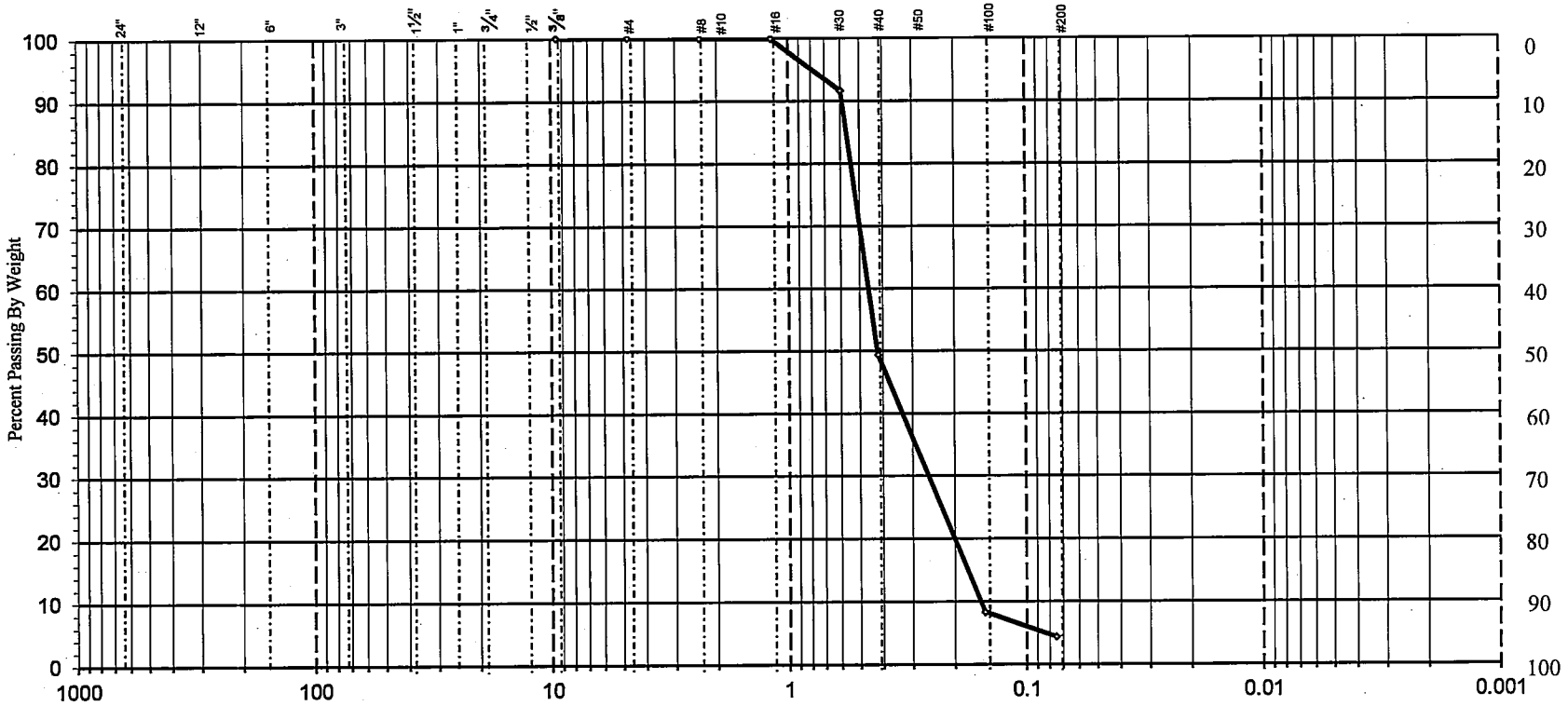
GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 95.66 %			Silt + Clay = 4.34 %
		Coarse	Fine	Coarse	Medium	Fine	

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	99.94	99.86	91.62	49.38	8.26	4.34	-	-	-	-

Tested By	Jawad Nasir	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

Drillers, Engineers & Constructors
decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BH-37	**Sampled Date**	-
Sample.	SPT-06	**Test Started**	11-Feb-20
Sample Depth (m)	6.00-6.45	**Test Completed**	13-Feb-20

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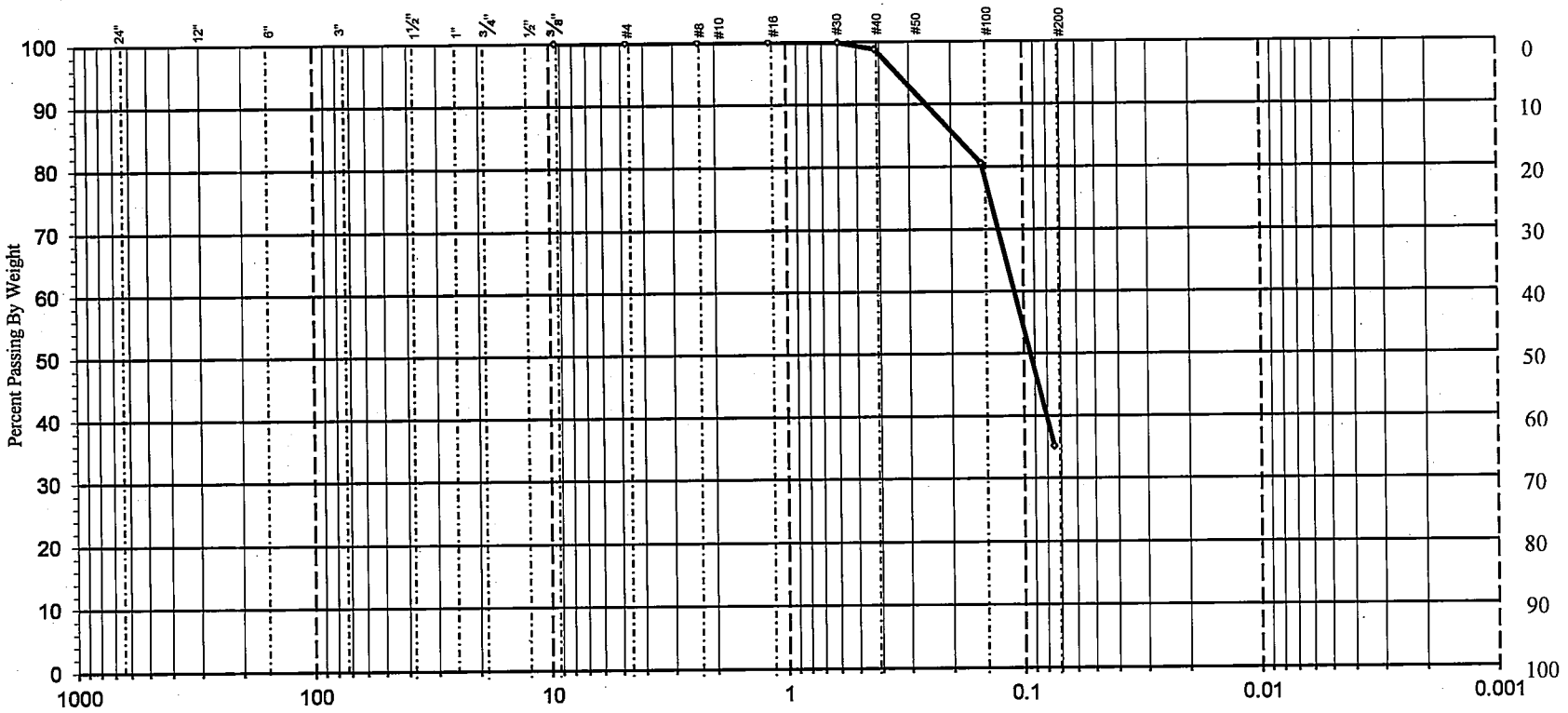
Soil and Concrete Testing Laboratory (Pvt) Ltd

GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 64.80 %			Silt + Clay = 35.20 %
		Coarse	Fine	Coarse	Medium	Fine	

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	100.00	100.00	99.88	98.81	80.51	35.20	-	-	-	-

Tested By	Jawad Nasir	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

Engineers & Constructors * Drillers
decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BH-38	**Sampled Date**	-
Sample.	SPT-02	**Test Started**	11-Feb-20
Sample Depth (m)	2.00-2.45	**Test Completed**	13-Feb-20

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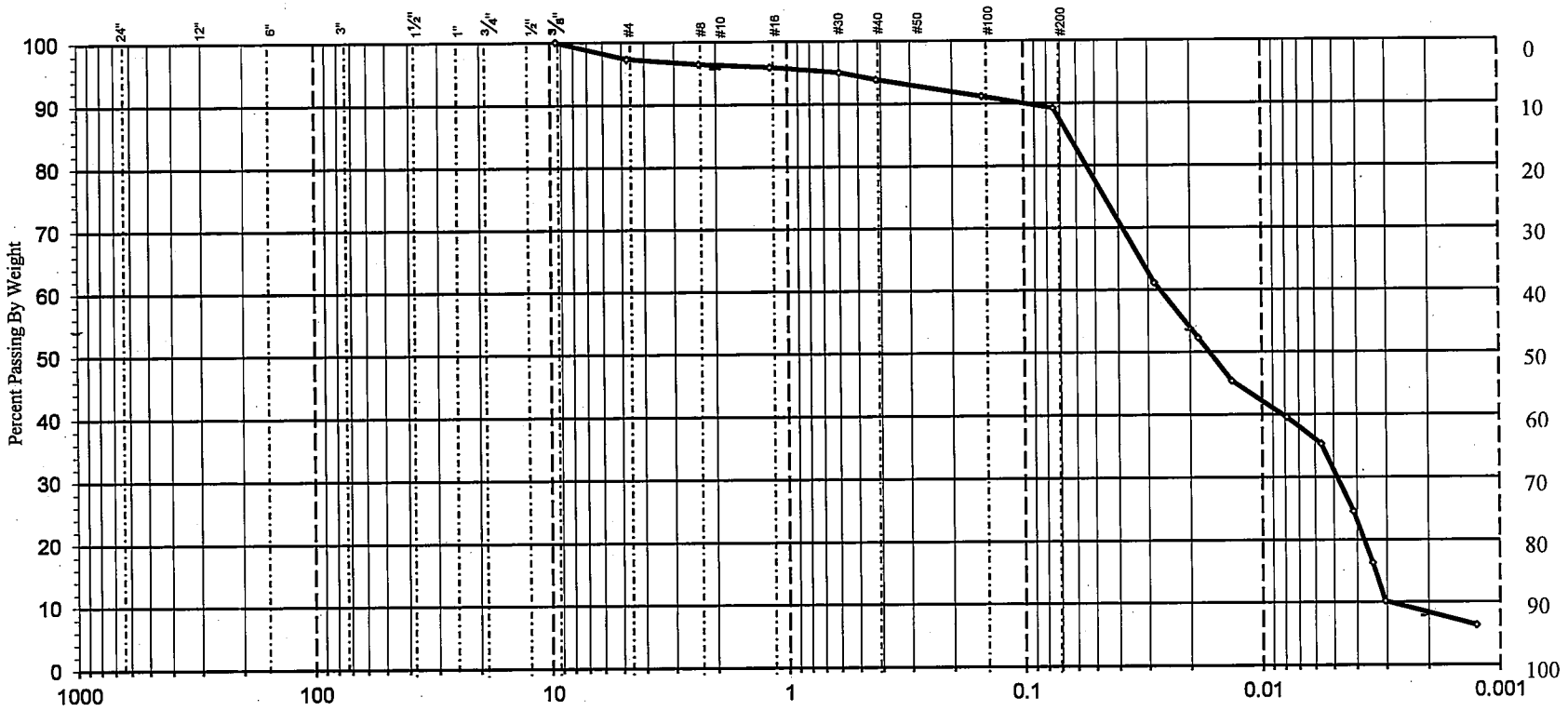
Soil and Concrete Testing Laboratory (Pvt) Ltd

GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 2.70 %		Sand = 8.10 %			Silt = 58.21 %	Clay 30.99 %
		Coarse	Fine	Coarse	Medium	Fine		

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	97.30	96.45	95.89	95.01	93.89	91.14	89.20	77.51	42.12	30.99	8.27

Tested By	Jawad Nasir	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

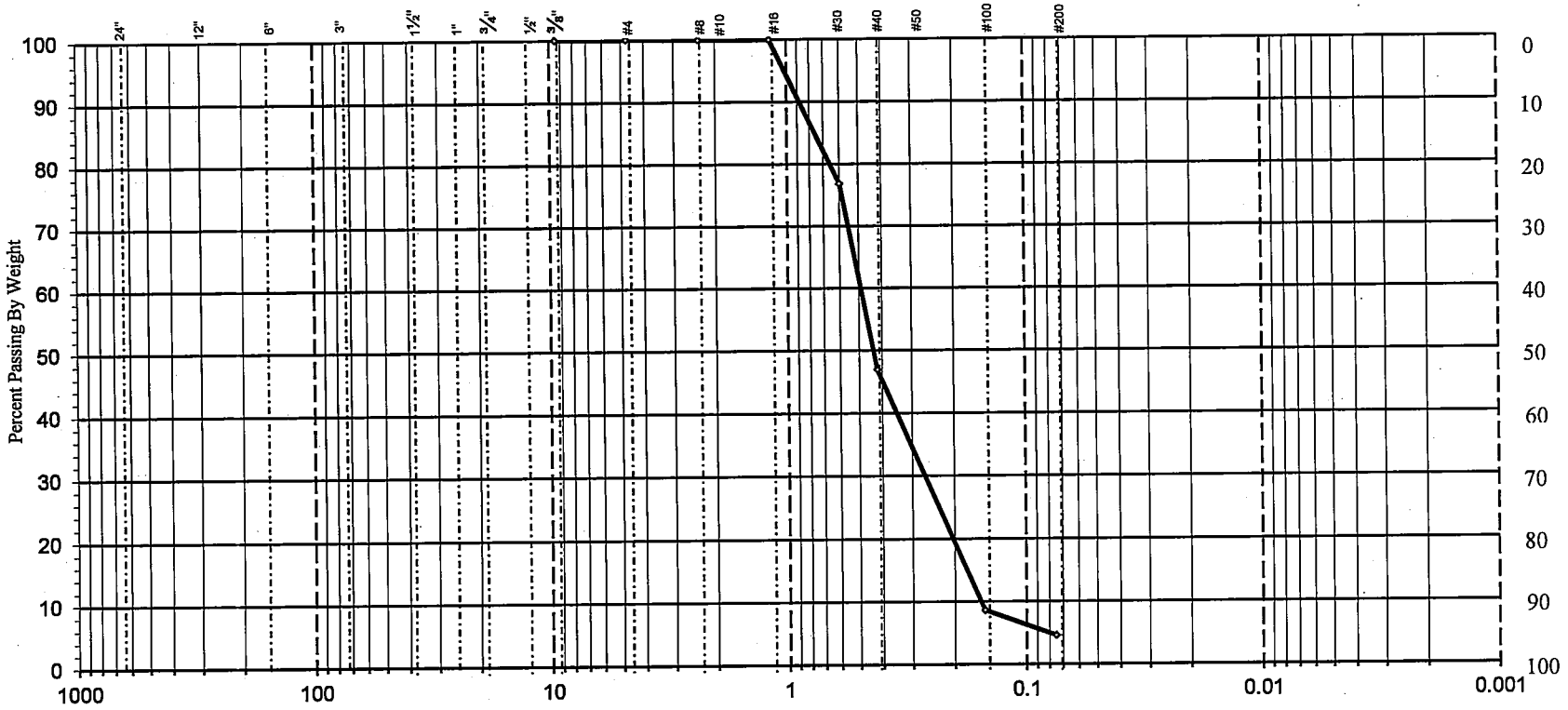
Drillers, Engineers & Construction * decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BH-38	**Sampled Date**	-
Sample.	SPT-06	**Test Started**	11-Feb-20
Sample Depth (m)	6.00-6.45	**Test Completed**	13-Feb-20

decon
Soil and Concrete Testing Laboratory (Pvt) Ltd

GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 95.40 %			Silt + Clay = 4.60 %
		Coarse	Fine	Coarse	Medium	Fine	

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	99.95	99.93	76.80	46.94	8.57	4.60	-	-	-	-

Tested By	Jawad Nasir	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

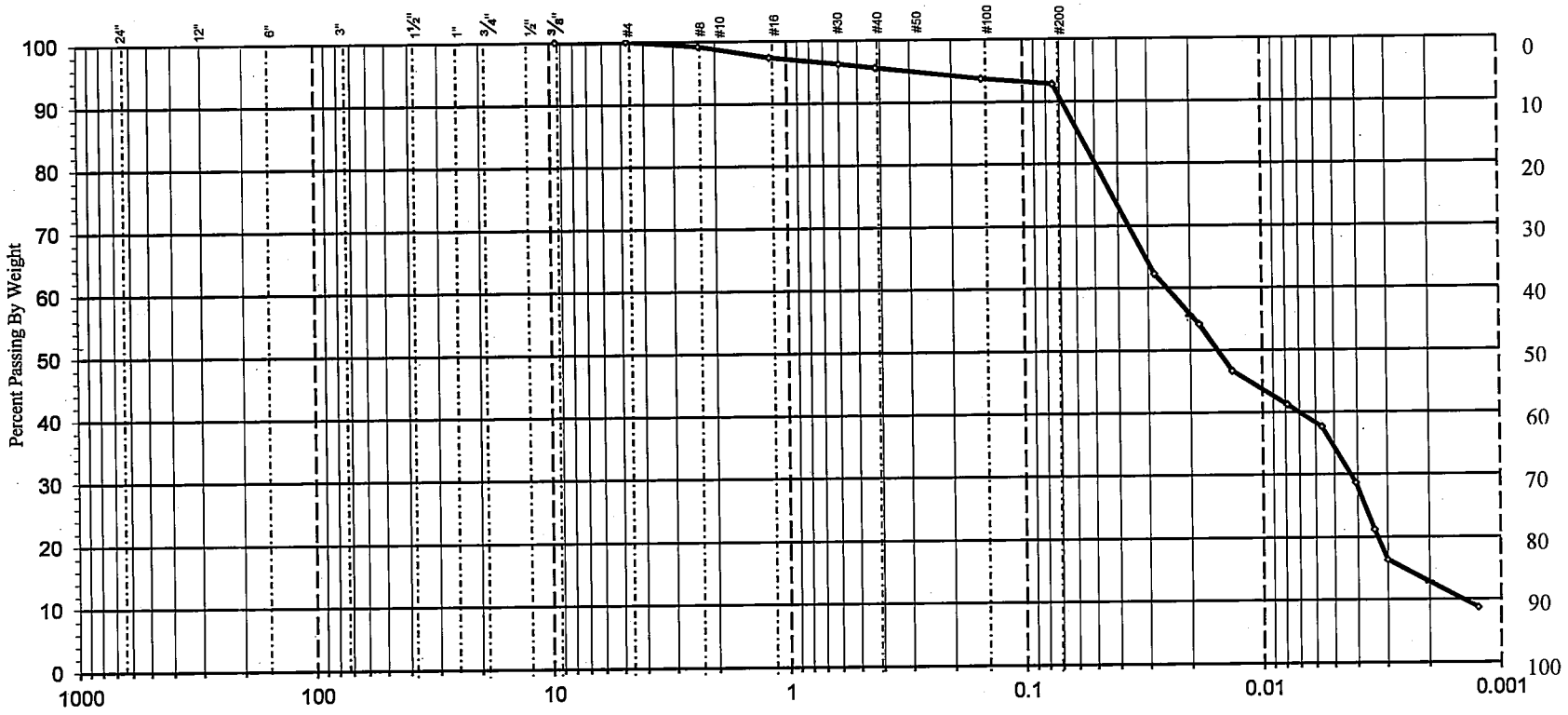
Drillers, Engineers & Constructors

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BH-39	**Sampled Date**	-
Sample.	SPT-01	**Test Started**	11-Feb-20
Sample Depth (m)	1.00-1.45	**Test Completed**	13-Feb-20

decon
Soil and Concrete Testing Laboratory (Pvt) Ltd

GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 7.19 %			Silt = 58.56 %	Clay 34.25 %
		Coarse	Fine	Coarse	Medium	Fine		

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	99.21	97.36	96.25	95.58	93.76	92.81	80.08	43.62	34.25	12.74

Tested By	Jawad Nasir	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

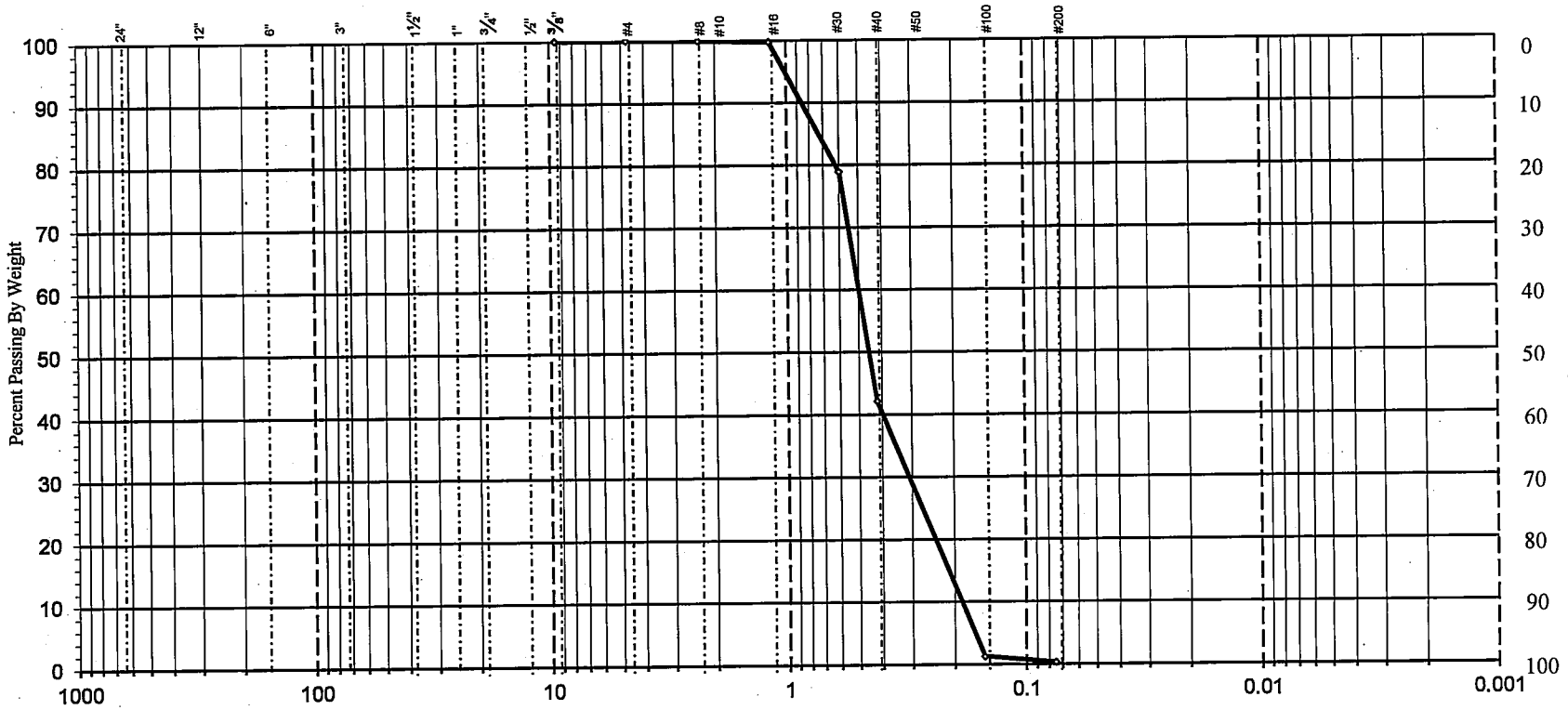
Engineers & Constructors * Drillers
decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BH-39	**Sampled Date**	-
Sample.	SPT-07	**Test Started**	11-Feb-20
Sample Depth (m)	7.00-7.45	**Test Completed**	13-Feb-20

decon
Soil and Concrete Testing Laboratory (Pvt) Ltd

GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 99.71 %			Silt + Clay = 0.29 %
		Coarse	Fine	Coarse	Medium	Fine	

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	99.95	99.73	78.87	42.10	1.24	0.29	-	-	-	-

Tested By	Jawad Nasir	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

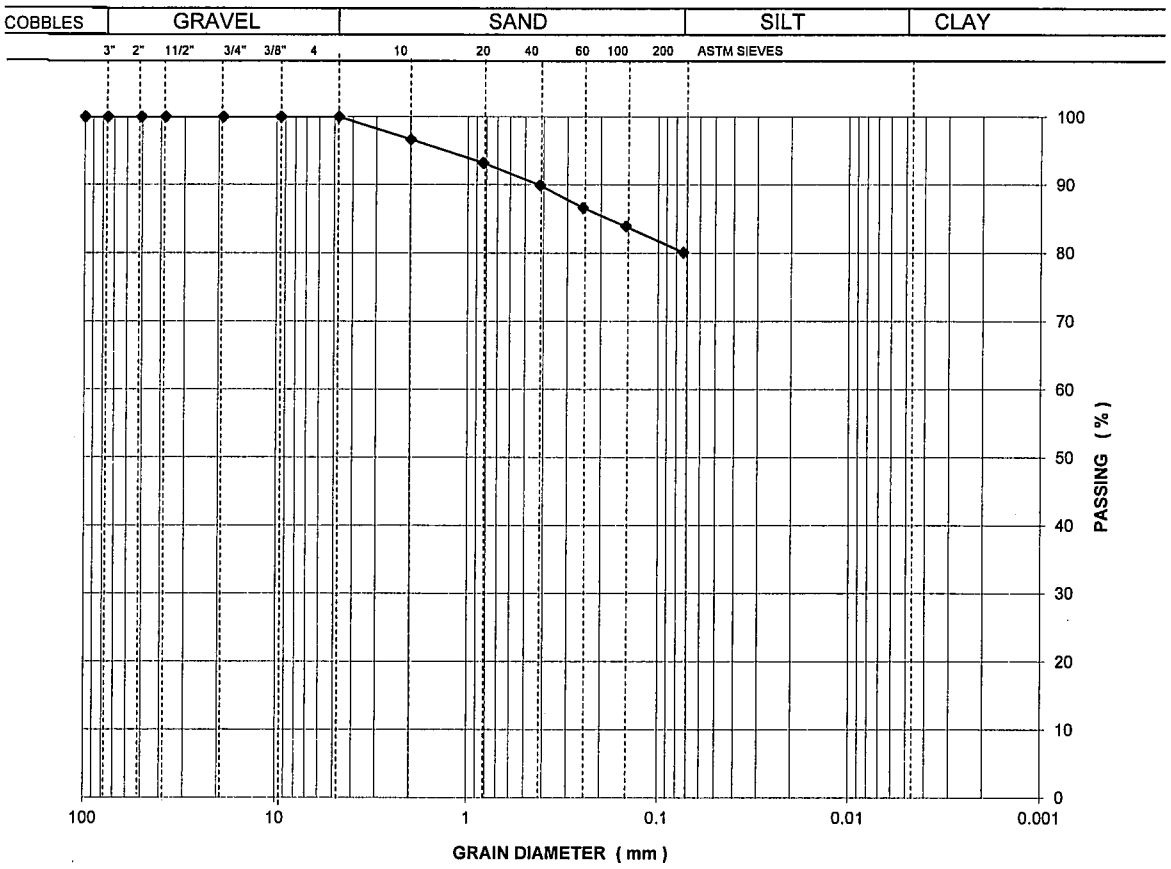
Engineers & Constructors * Drillers

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY (ON-SITE)		
BORE HOLE	TP-1	SAMPLE	BS-1
TYPE	DISTURBED	DEPTH(m)	0.00-1.40
SPECIMEN	1	DATE	27.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	97	90	84	80

LAB. REF.	11/2020

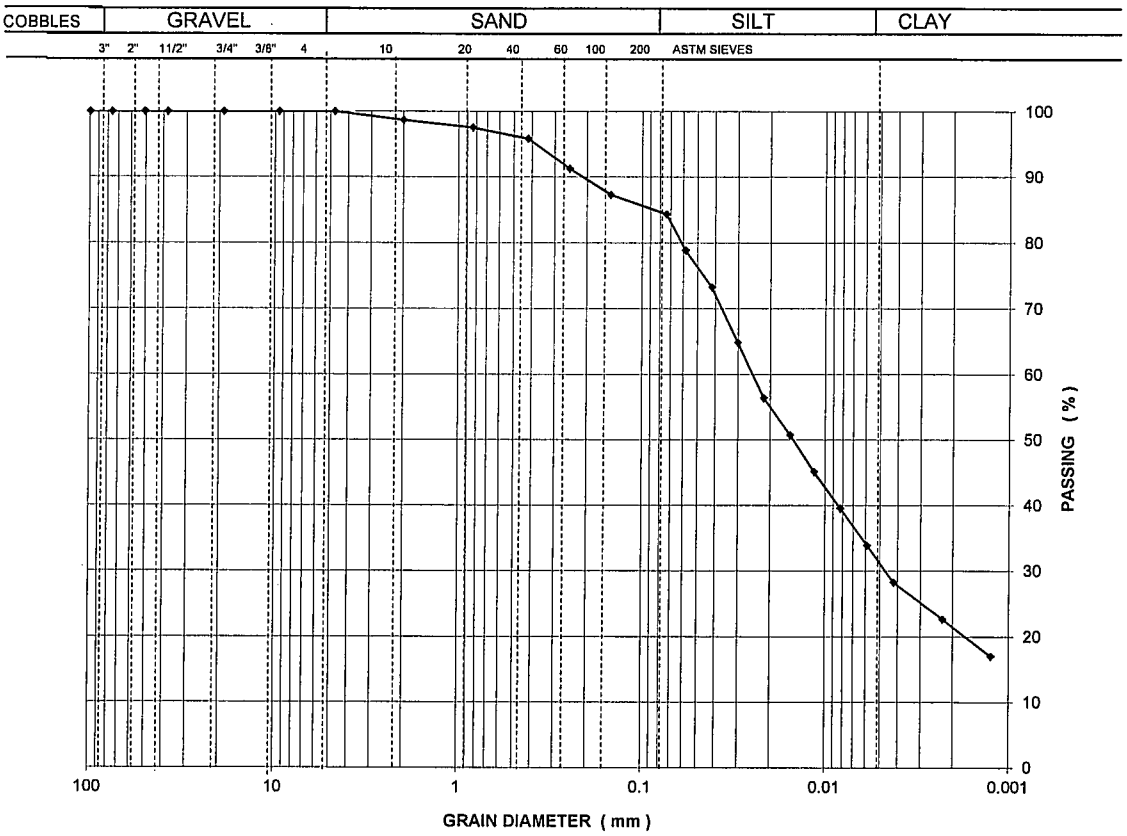
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	TP-2	**SAMPLE**	BS-1
TYPE	DISTURBED	**DEPTH m**	0.00-1.00
SPECIMEN	1	**DATE**	28.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	99	96	87	84

LAB. REF.	11/2020

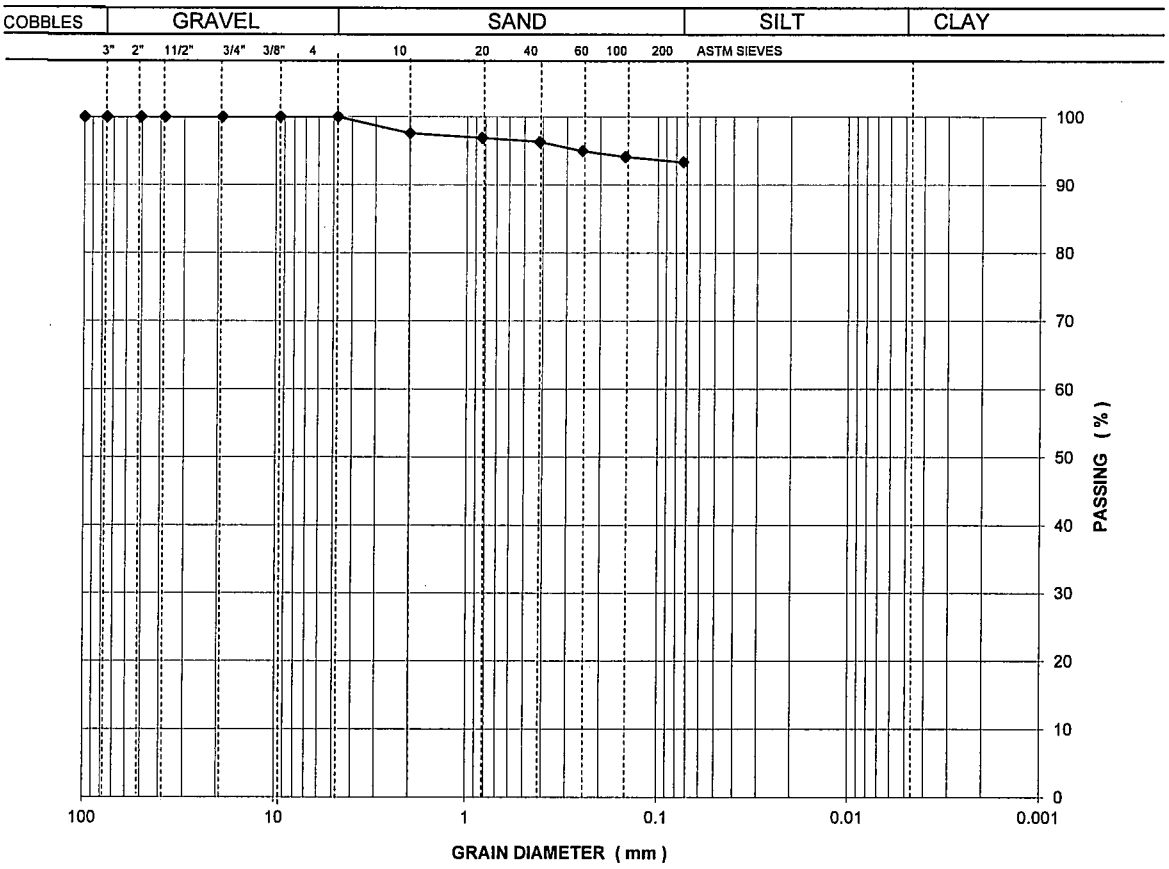
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY (ON-SITE)		
BORE HOLE	TP-3	SAMPLE	BS-1
TYPE	DISTURBED	DEPTH(m)	0.00-1.50
SPECIMEN	1	DATE	27.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	98	96	94	93

LAB. REF.	11/2020

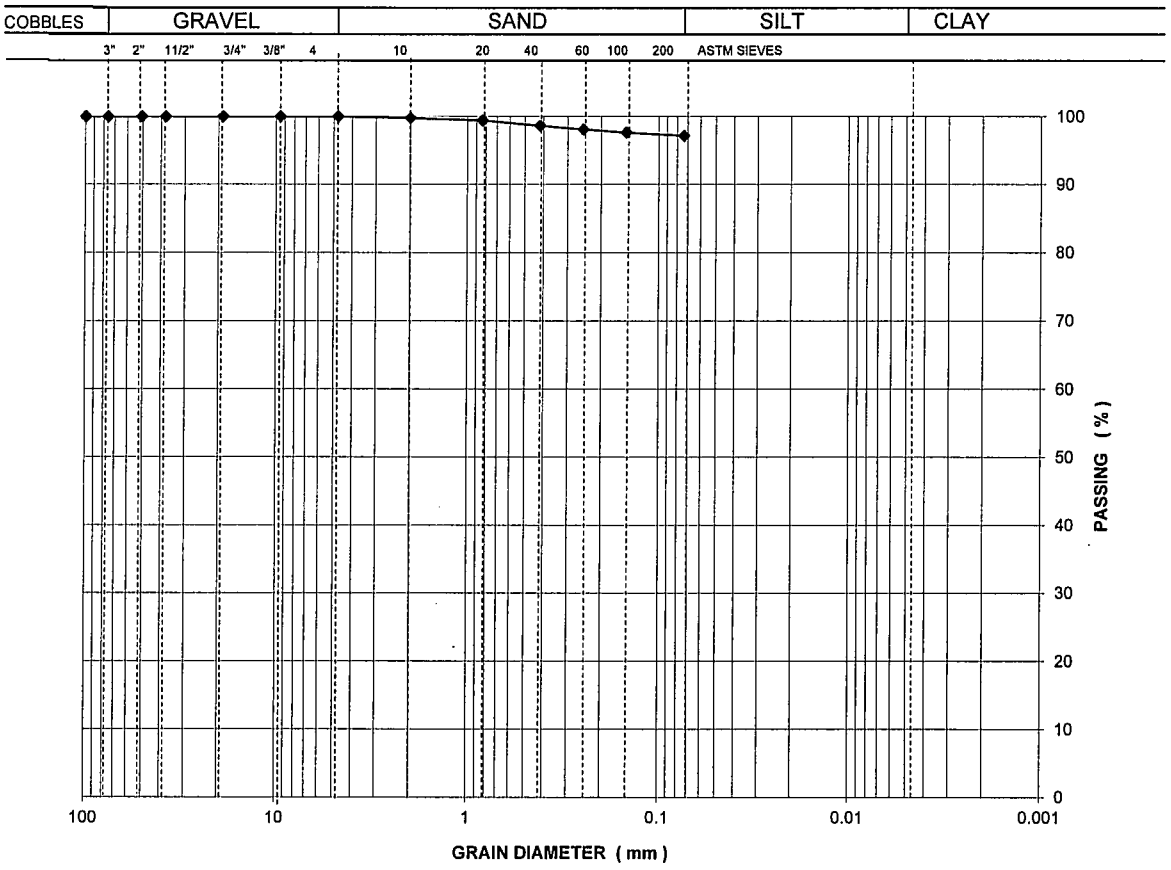
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY (ON-SITE)		
BORE HOLE	TP-4	SAMPLE	BS-1
TYPE	DISTURBED	DEPTH(m)	0.00-1.50
SPECIMEN	1	DATE	27.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	100	99	98	97

LAB. REF.	11/2020

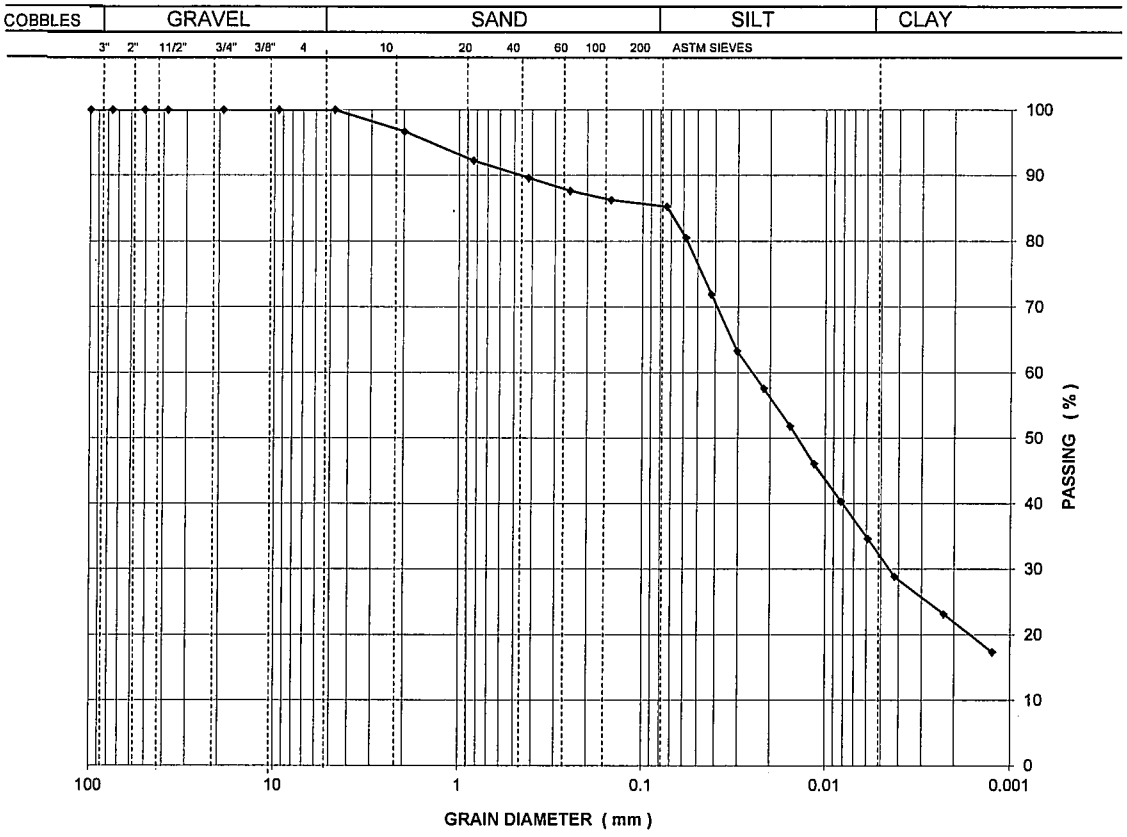
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	TP-5	**SAMPLE**	BS-1
TYPE	DISTURBED	**DEPTH m**	0.00-1.50
SPECIMEN	1	**DATE**	28.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	97	90	86	85

LAB. REF.	11/2020

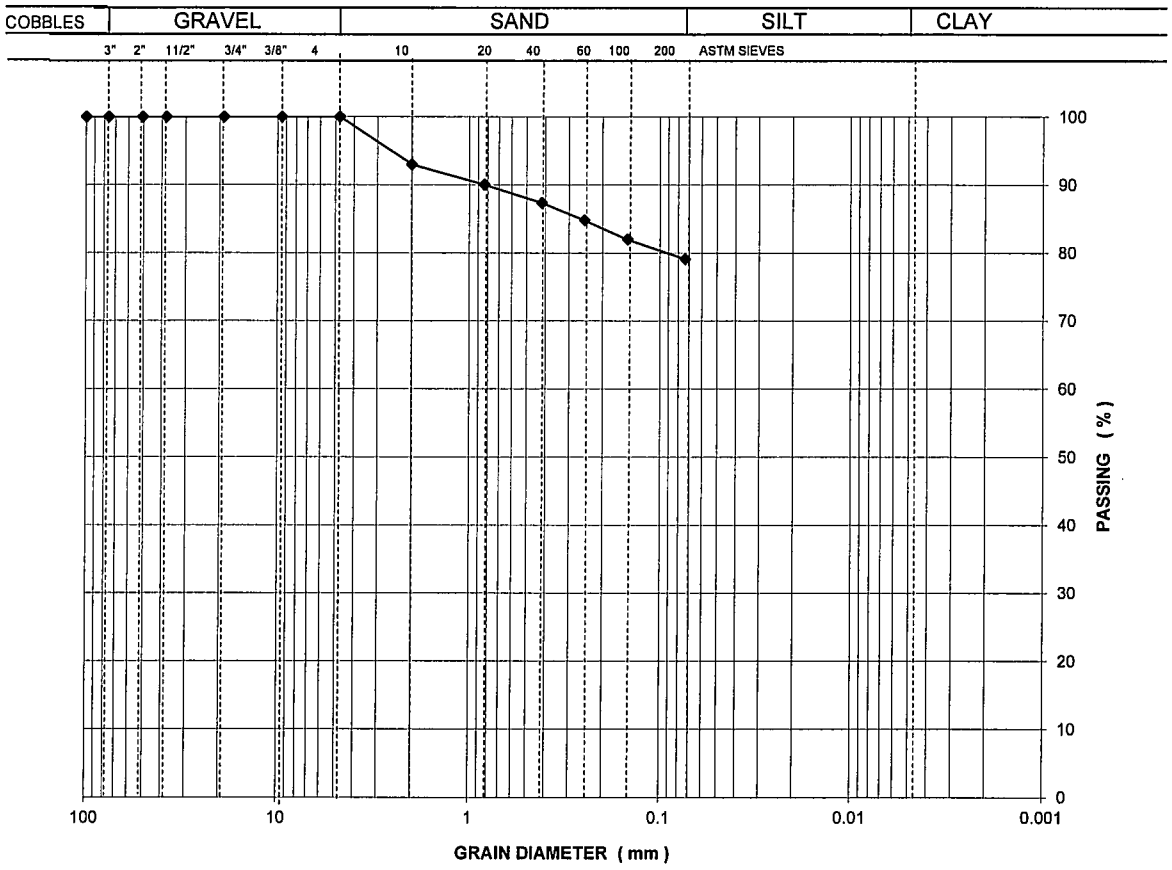
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY (ON-SITE)		
BORE HOLE	TP-6	**SAMPLE**	BS-1
TYPE	DISTURBED	**DEPTH(m)**	0.00-1.50
SPECIMEN	1	**DATE**	28.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	93	87	82	79

LAB. REF.	11/2020

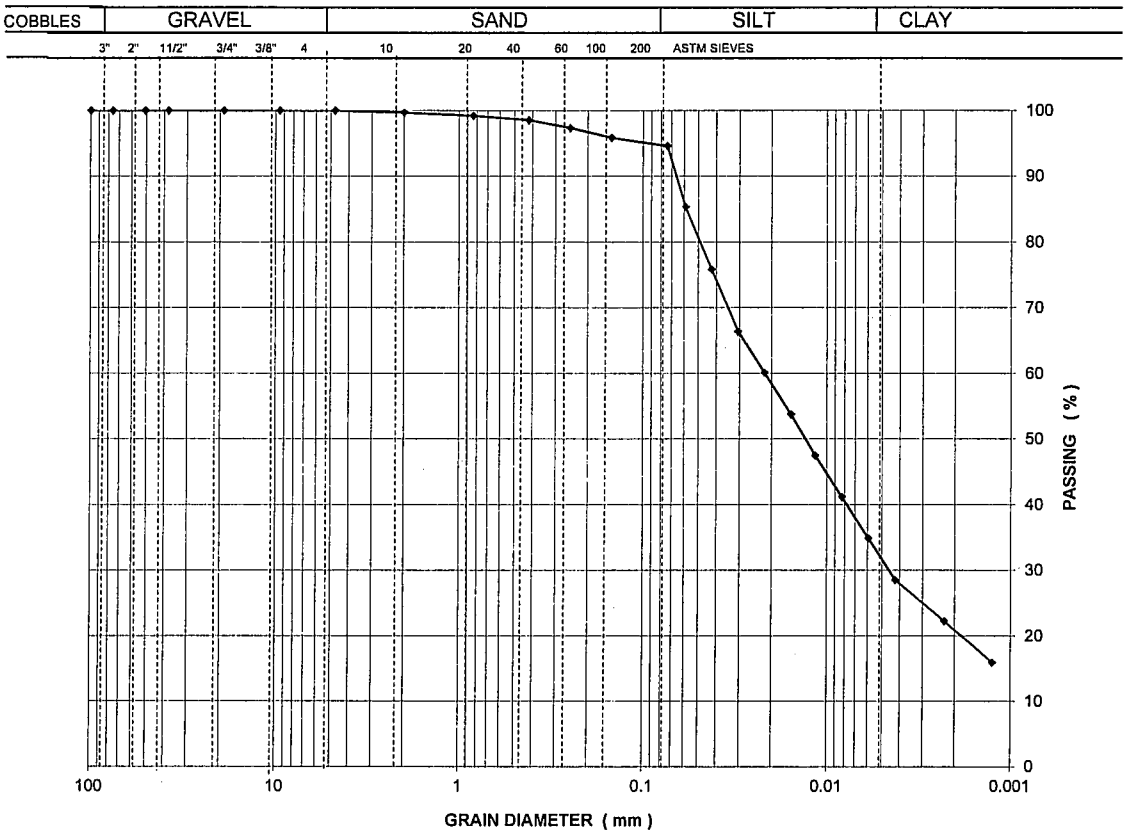
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY (ON-SITE)		
BORE HOLE	TP-7	**SAMPLE**	BS-1
TYPE	DISTURBED	**DEPTH m**	0.10-1.20
SPECIMEN	1	**DATE**	27.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	100	99	96	95

LAB. REF.	11/2020

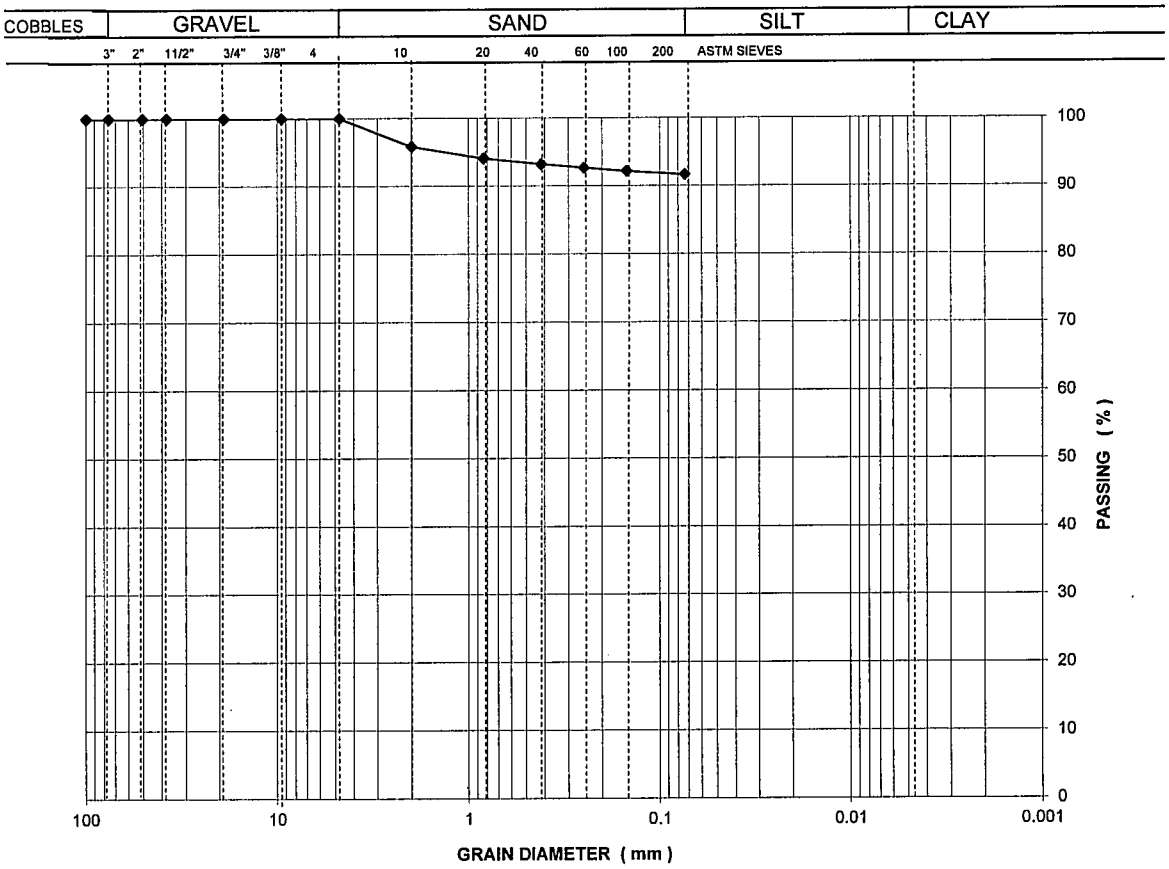
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY (ON-SITE)		
BORE HOLE	TP-8	SAMPLE	BS-1
TYPE	DISTURBED	DEPTH(m)	0.00-1.50
SPECIMEN	1	DATE	27.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	96	93	92	92

LAB. REF.	11/2020

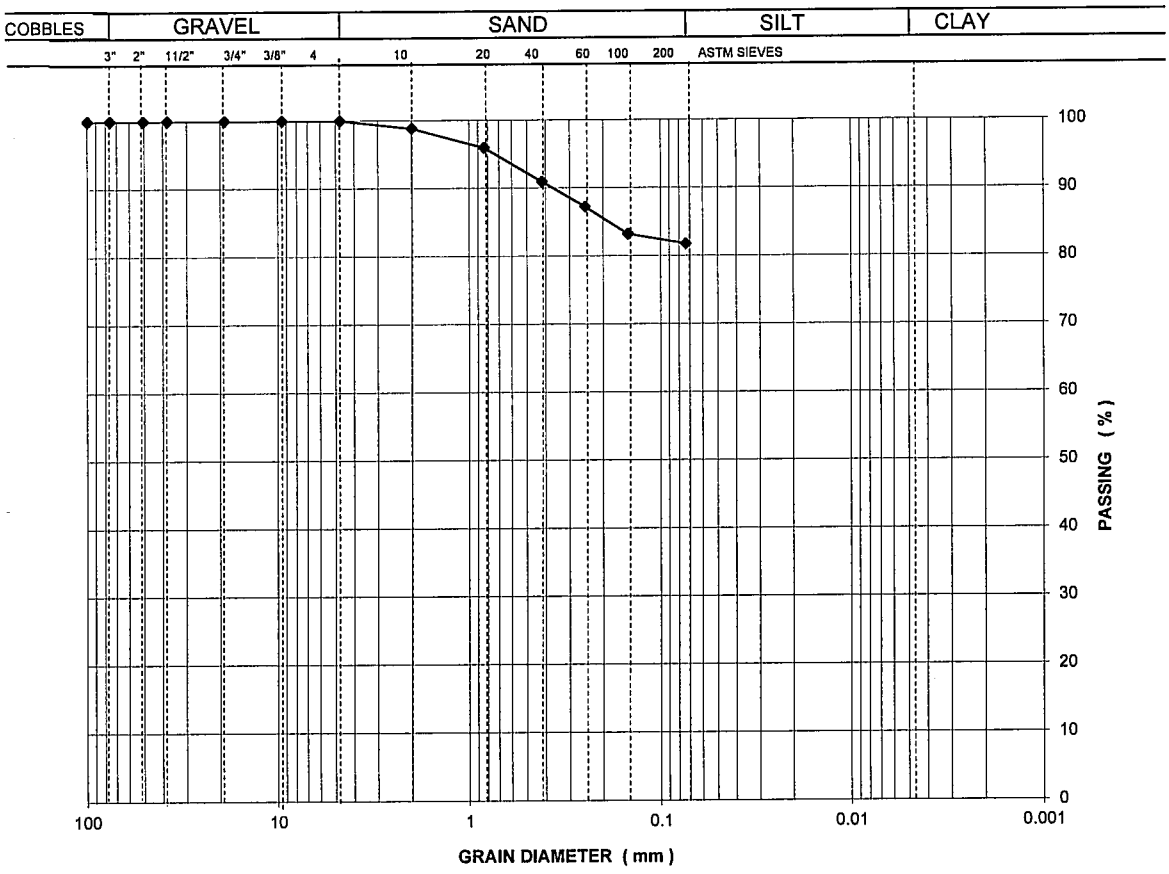
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY (ON-SITE)		
BORE HOLE	TP-9	SAMPLE	BS-1
TYPE	DISTURBED	DEPTH(m)	0.00-1.50
SPECIMEN	1	DATE	27.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	99	91	83	82

LAB. REF.	11/2020

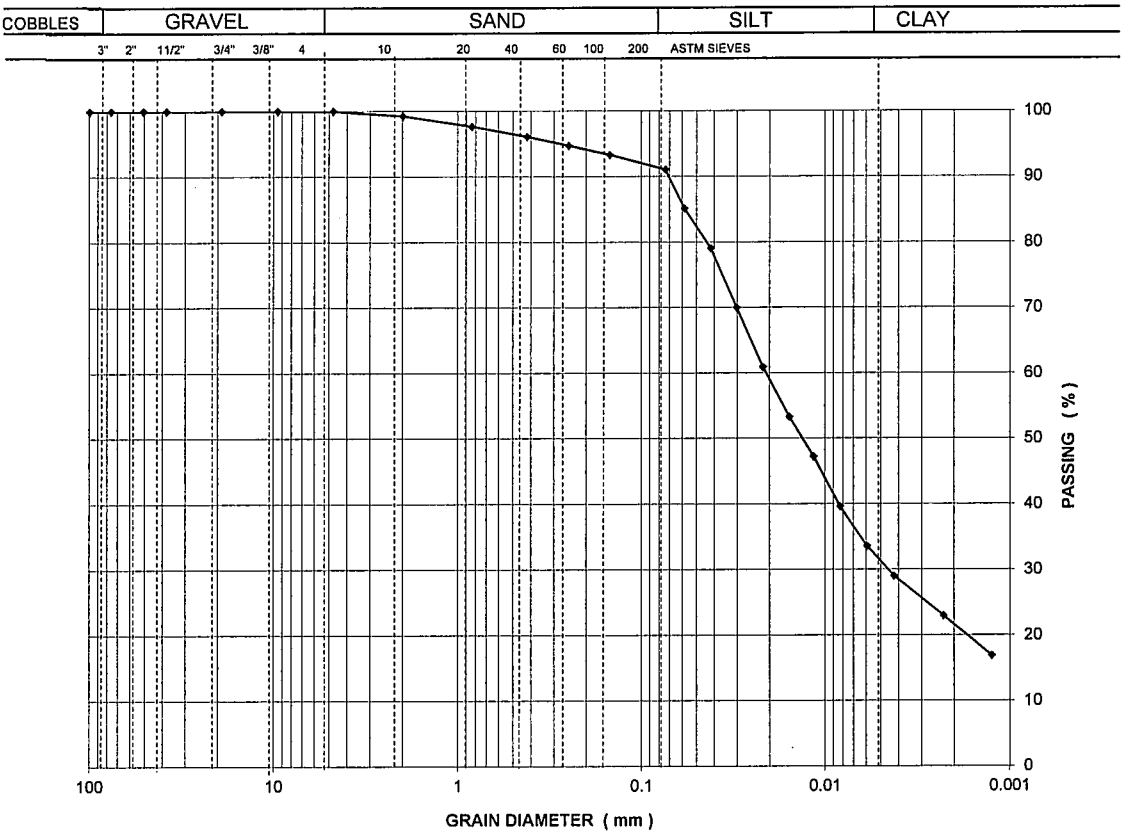
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	TP-10	**SAMPLE**	BS-1
TYPE	DISTURBED	**DEPTH m**	0.00-1.50
SPECIMEN	1	**DATE**	28.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	99	96	93	91

LAB. REF.	11/2020

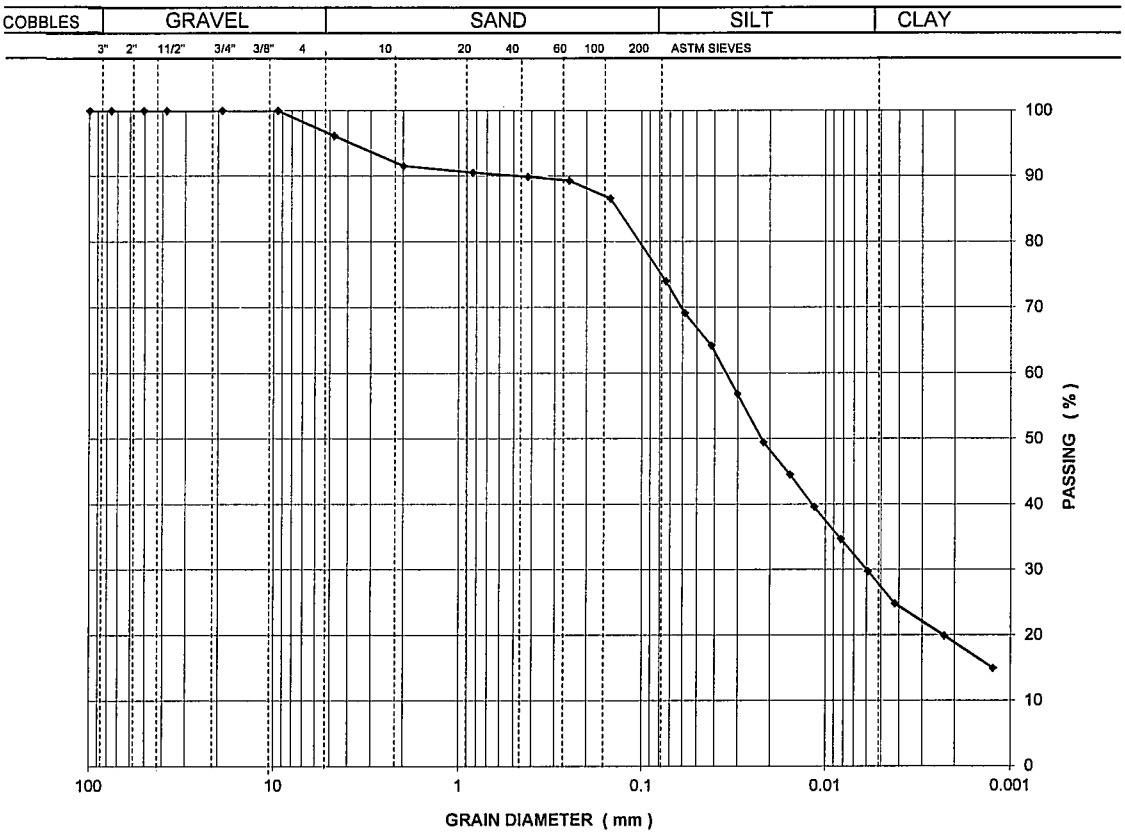
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	BA-1	**SAMPLE**	BS-1
TYPE	DISTURBED	**DEPTH m**	0.20-1.20
SPECIMEN	1	**DATE**	27.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	96	92	90	87	74

LAB. REF.	11/2020

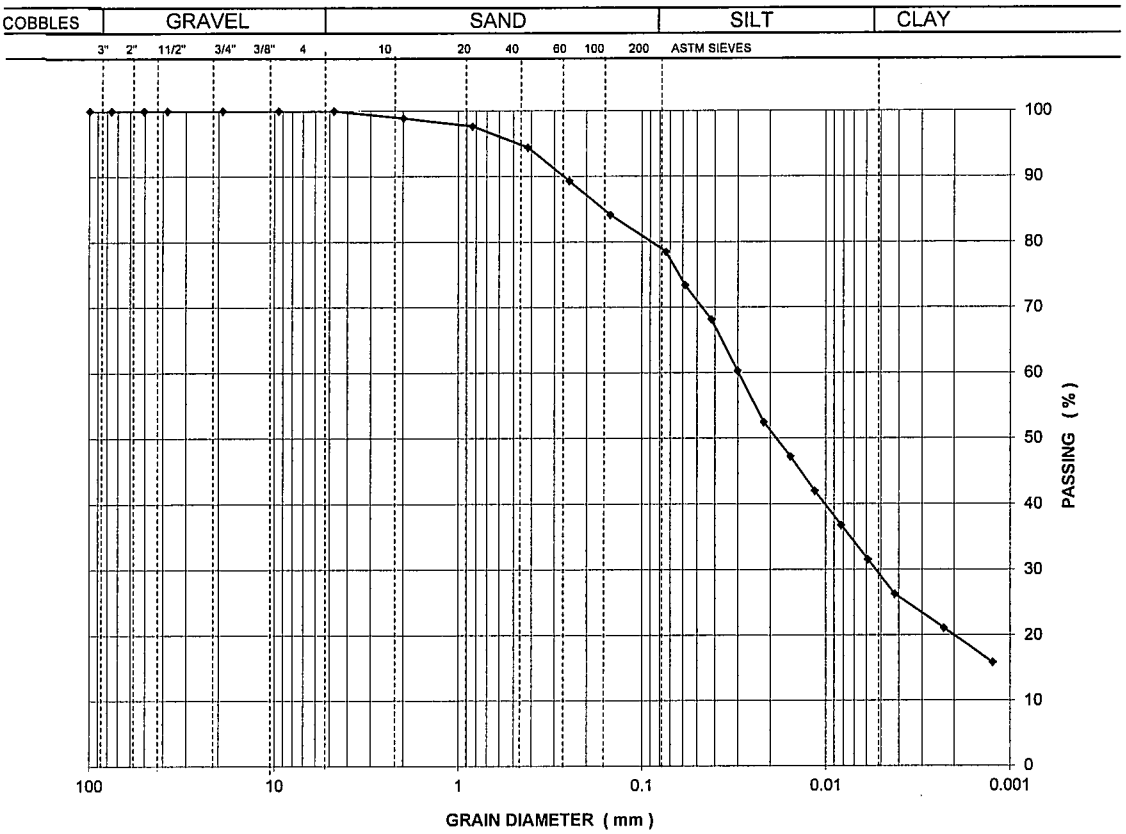
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	BA-2	**SAMPLE**	BS
TYPE	DISTURBED	**DEPTH m**	0.10-1.20
SPECIMEN	1	**DATE**	28.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	99	94	84	78

LAB. REF.	11/2020

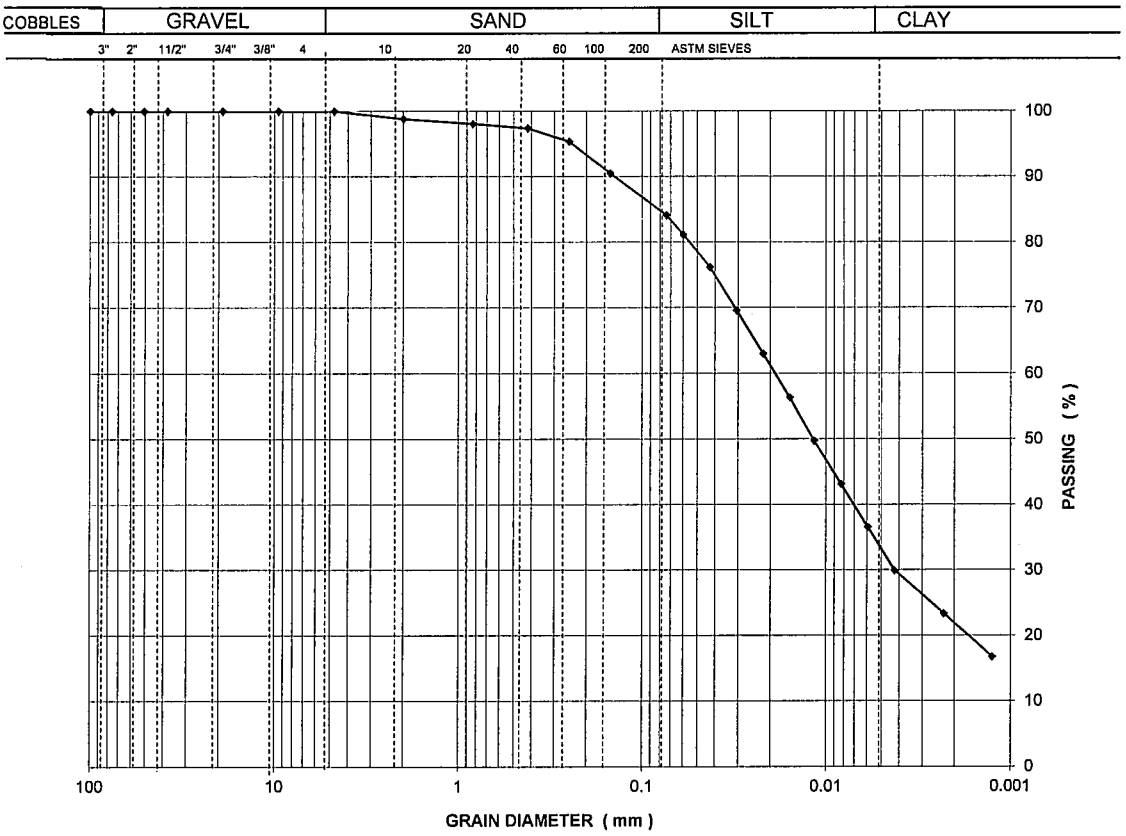
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY (ON-SITE)		
BORE HOLE	BA-3	**SAMPLE**	BS-1
TYPE	DISTURBED	**DEPTH m**	0.10-1.00
SPECIMEN	1	**DATE**	27.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	99	97	91	84

LAB. REF.	24/2007

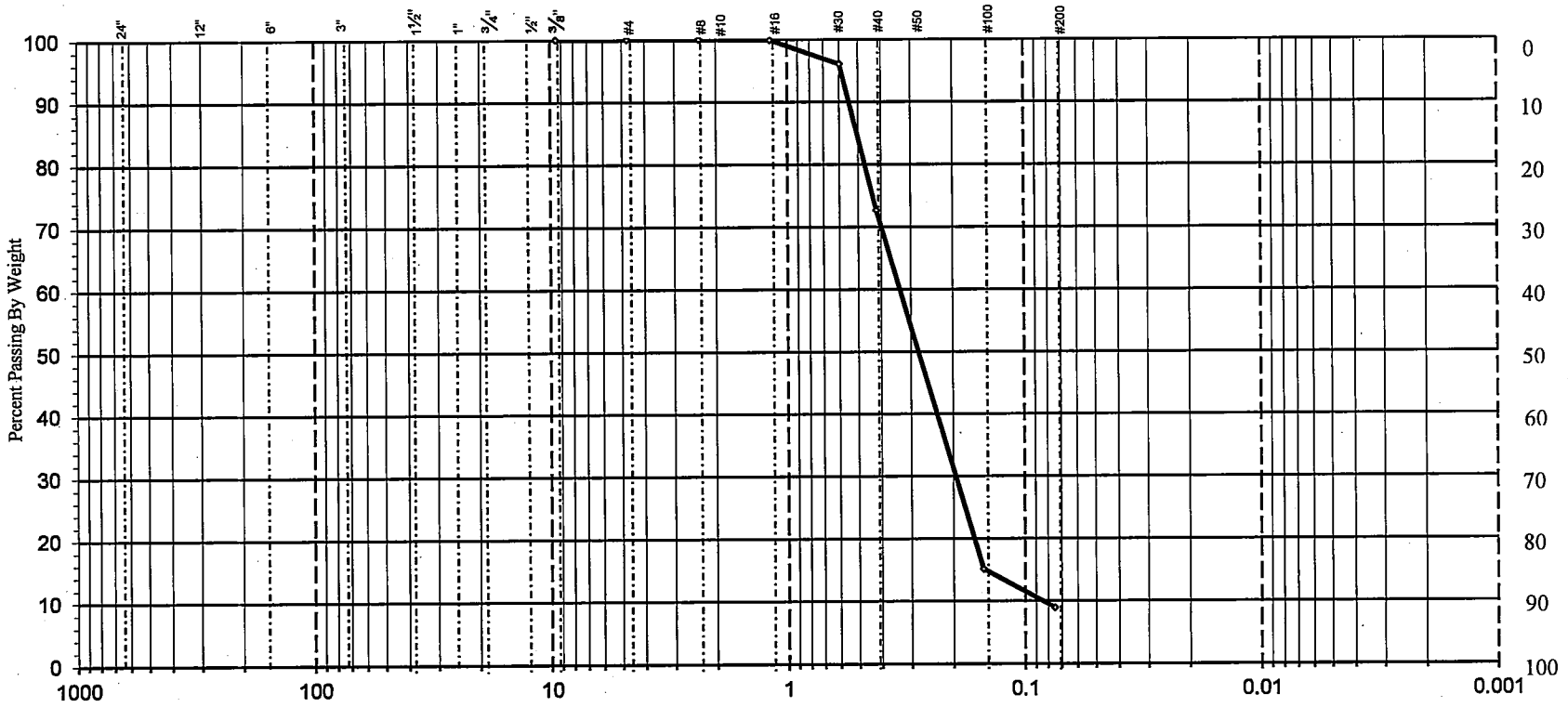
REMARKS :

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BAS-01	**Sampled Date**	-
Sample.	CS	**Test Started**	14-Feb-20
Sample Depth (m)	0.00-1.50	**Test Completed**	16-Feb-20

decon
Soil and Concrete Testing Laboratory (Pvt) Ltd

GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 91.11 %			Silt + Clay = 8.89 %
		Coarse	Fine	Coarse	Medium	Fine	

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	100.00	99.92	96.06	72.68	15.09	8.89	-	-	-	-

Tested By	Faryad Ali	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

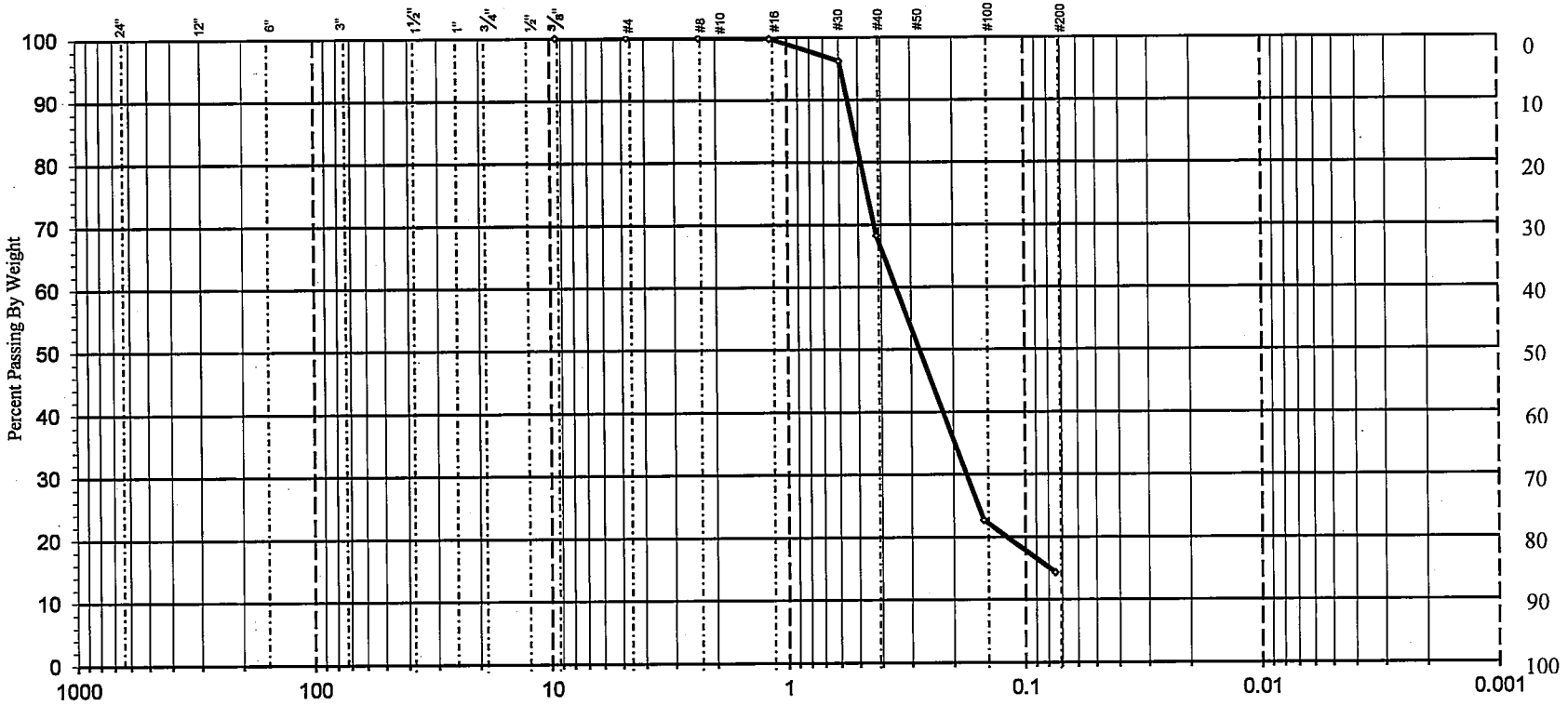
Drillers, Engineers & Constructors
decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BAS-02	**Sampled Date**	-
Sample.	CS	**Test Started**	14-Feb-20
Sample Depth (m)	0.00-1.50	**Test Completed**	16-Feb-20

decon
Soil and Concrete Testing Laboratory (Pvt) Ltd

GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 85.70 %			Silt + Clay = 14.30 %
		Coarse	Fine	Coarse	Medium	Fine	

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	99.98	99.78	96.22	68.26	22.65	14.30	-	-	-	-

Tested By	Faryad Ali	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

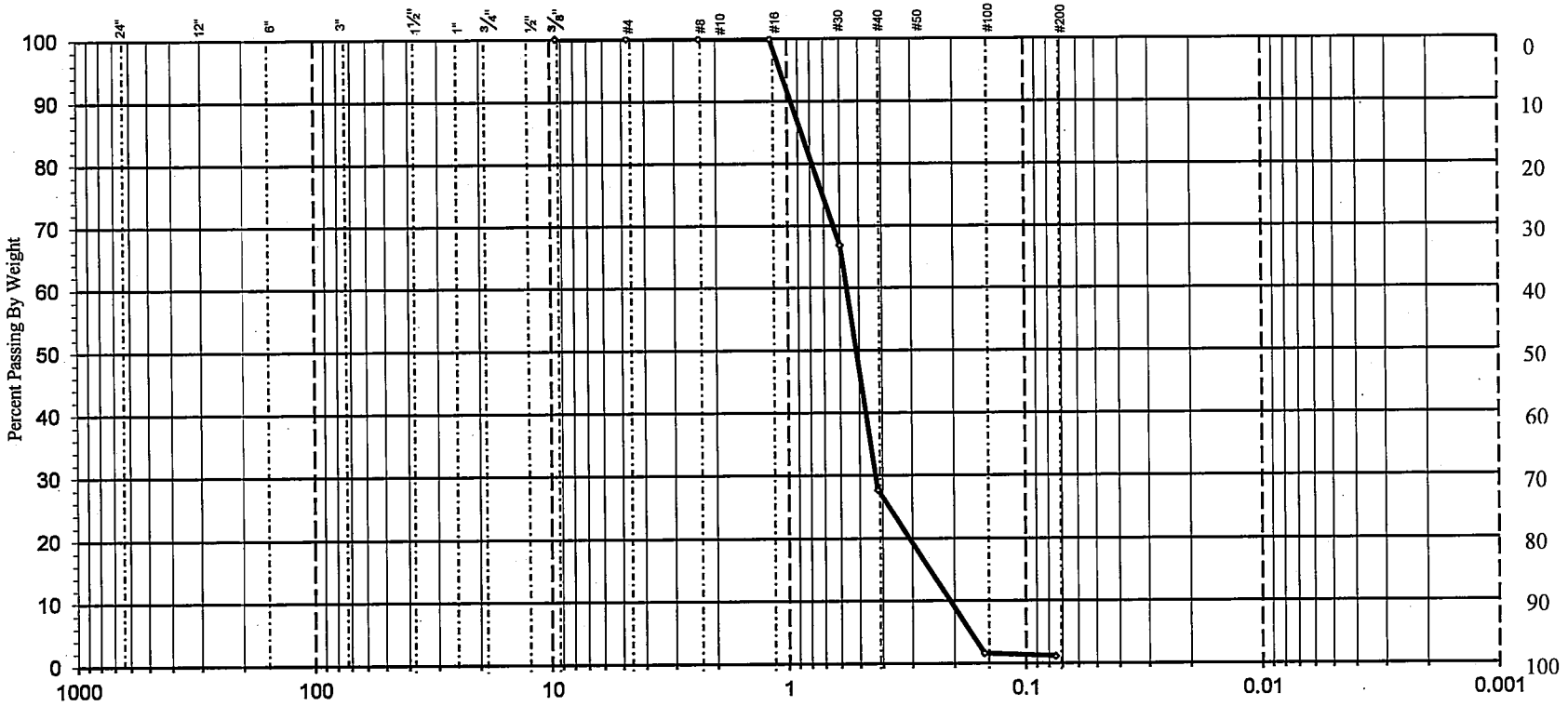
Engineers & Constructors * Drillers
decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BAS-03	**Sampled Date**	-
Sample.	CS	**Test Started**	14-Feb-20
Sample Depth (m)	0.00-1.50	**Test Completed**	16-Feb-20

decon
Soil and Concrete Testing Laboratory (Pvt) Ltd

GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 98.89 %			Silt + Clay = 1.11 %
		Coarse	Fine	Coarse	Medium	Fine	

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	99.96	99.87	66.82	27.67	1.56	1.11	-	-	-	-

Tested By	Faryad Ali	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

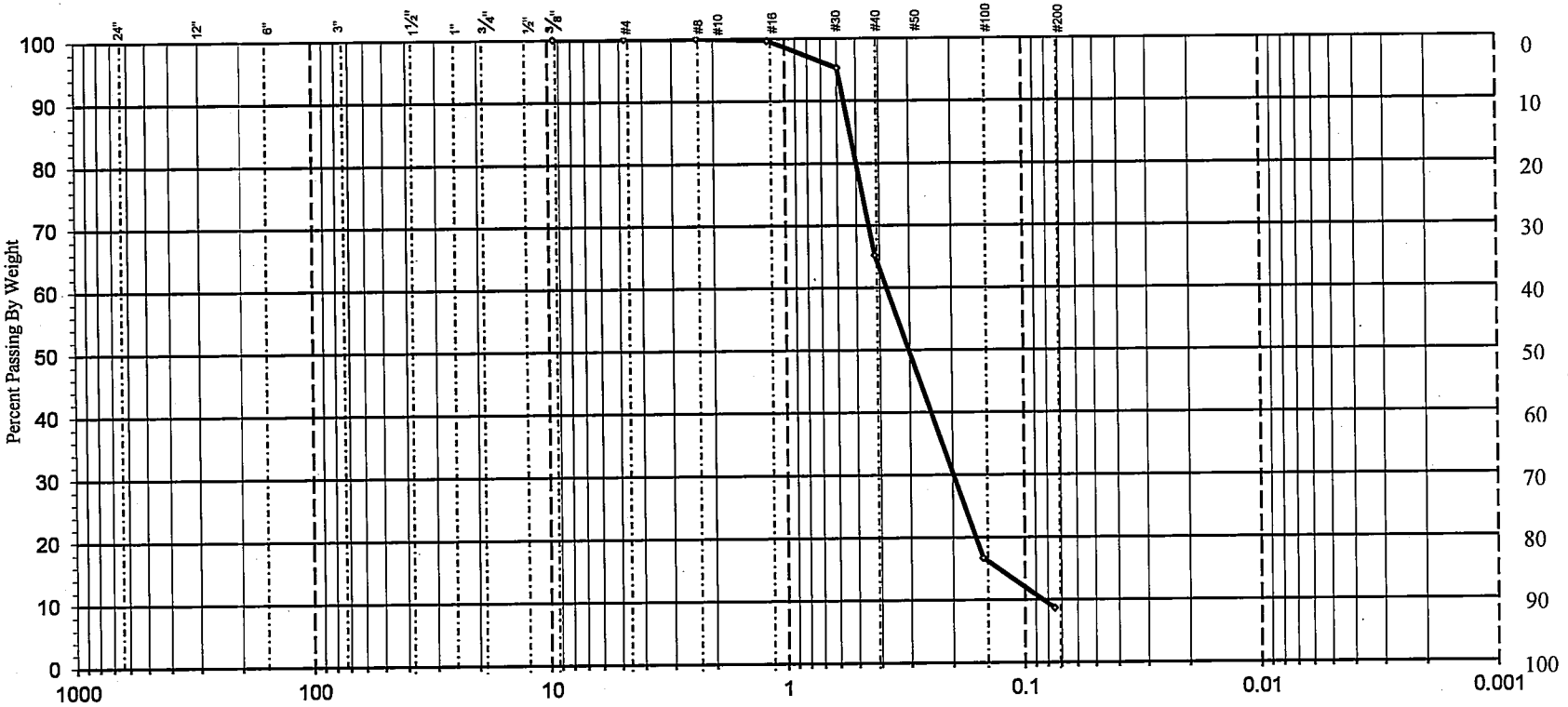
Engineers & Constructors * Drillers

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**Job No.**	-
Location	Sialkot City	**Lab No.**	603
BH / TP No.	BAS-04	**Sampled Date**	-
Sample.	CS	**Test Started**	14-Feb-20
Sample Depth (m)	0.00-1.50	**Test Completed**	16-Feb-20

decon
Soil and Concrete Testing Laboratory (Pvt) Ltd

GRAIN SIZE ANALYSIS (ASTM D 422)



Boulders	Cobbles	Gravels = 0.00 %		Sand = 91.38 %			Silt + Clay = 8.62 %
		Coarse	Fine	Coarse	Medium	Fine	

Sieve Size	6"	3"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#100	#200	0.05mm	0.01mm	0.005mm	0.002mm
Passing %	-	-	-	-	-	-	100.00	100.00	100.00	99.65	95.26	65.21	16.65	8.62	-	-	-	-

Tested By	Faryad Ali	Checked By	Muhammad Ramzan	Approved By	Muhammad Daniyal

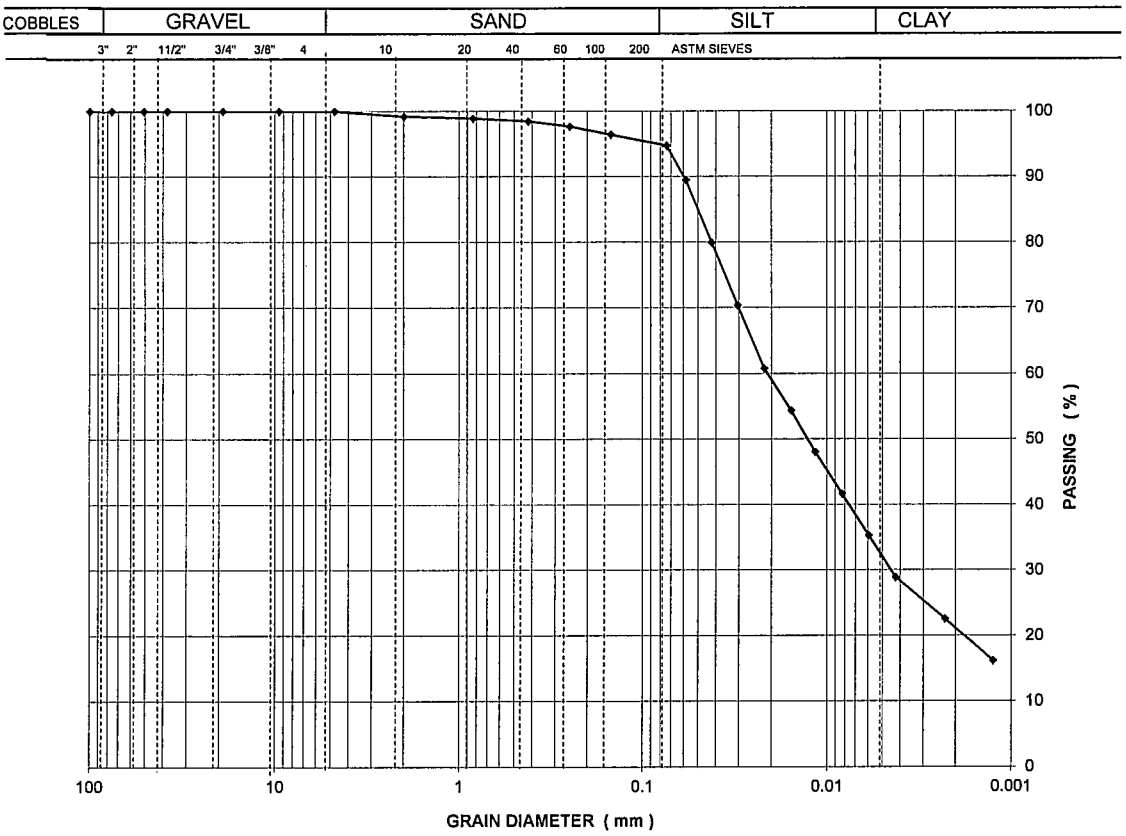
Engineers & Constructors * Drillers

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	BAS-5	**SAMPLE**	BS
TYPE	DISTURBED	**DEPTH m**	
SPECIMEN	1	**DATE**	28.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	99	98	96	95

LAB. REF.	11/2020

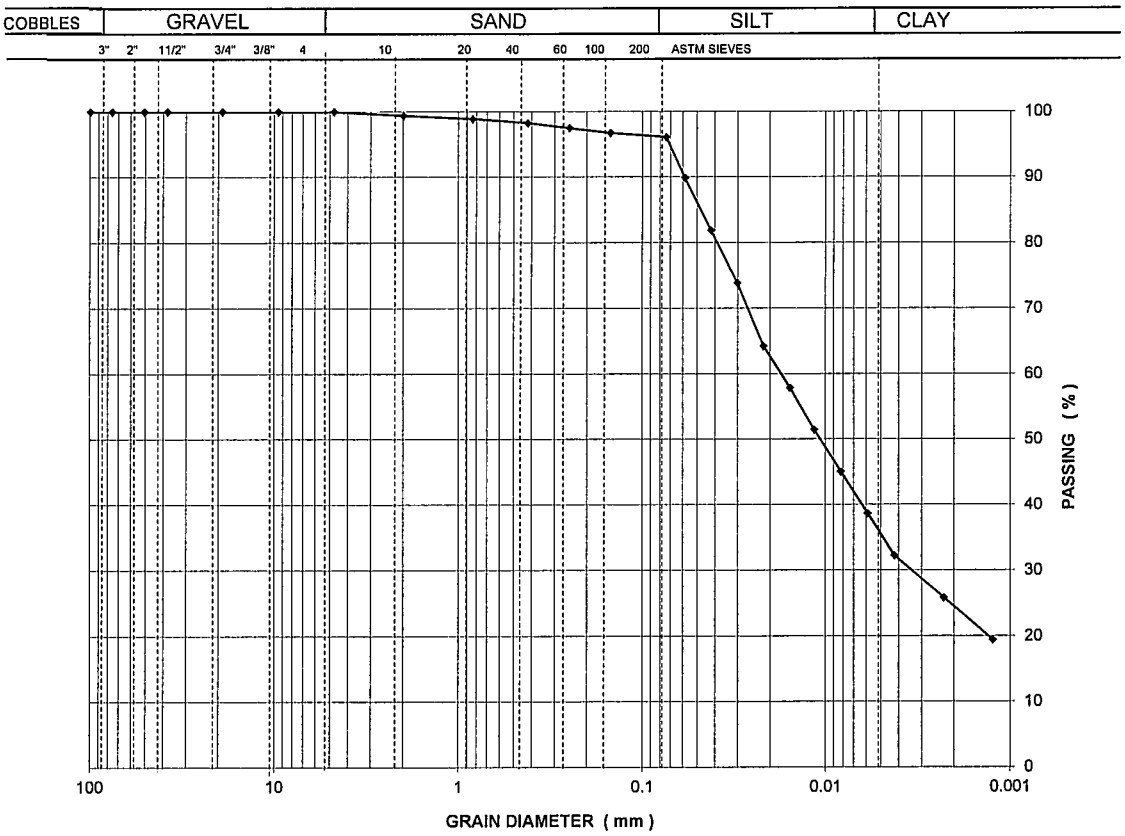
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	BAS-7	SAMPLE	BS
TYPE	DISTURBED	DEPTH m	
SPECIMEN	1	DATE	28.02.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	99	98	97	96

LAB. REF.	11/2020

REMARKS :

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

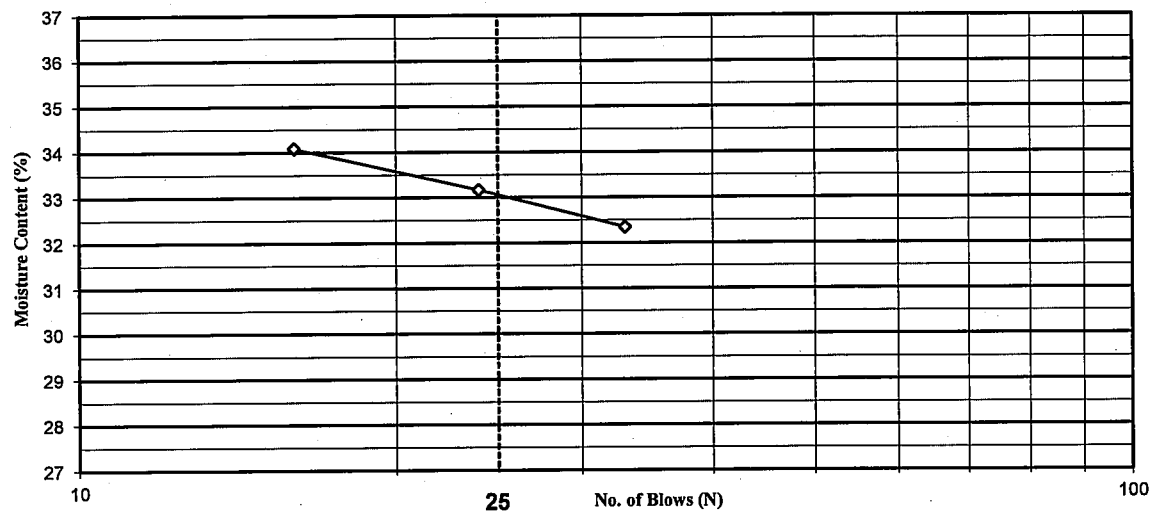
Project	Construction of Water Supply & Sewerage System	**decon** Soil and Concrete Testing Laboratroy (Pvt) Ltd
Location	Sialkot City	

BH / TP No.	BH-32	**Job No.**	-
Sample No.	SPT-01	**Lab No.**	603
Sample Depth (m)	1.00-1.45	**Test Started**	11-Feb-20
Sampled Date	-	**Test Completed**	13-Feb-20

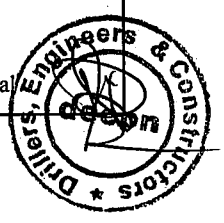
ATTERBERG LIMITS (ASTM D 4318)

LIQUID LIMIT						PLASTIC LIMIT	
No. of Blows (N)	16	24	33				
Container No.	D-13	D-32	D-27			D-17	D-19
Weight of Container (g)	18.20	24.11	19.19			18.36	19.12
Weight of Container + Wet Soil (g)	33.23	39.21	34.21			24.21	25.26
Weight of Container + Dry Soil (g)	29.41	35.45	30.54			23.11	24.13
Weight of Dry Soil (g)	11.21	11.34	11.35			4.75	5.01
Weight of Water (g)	3.82	3.76	3.67			1.10	1.13
Moisture Content (%)	34.08	33.16	32.33			23.16	22.55

Liquid Limit	**33**	**Plastic Limit**	**23**	**Plasticity Index**	**10**



Tested By	Checked By	Approved By
Nesrullha Khan	Muhammad Ramzan	Muhammad Daniyal



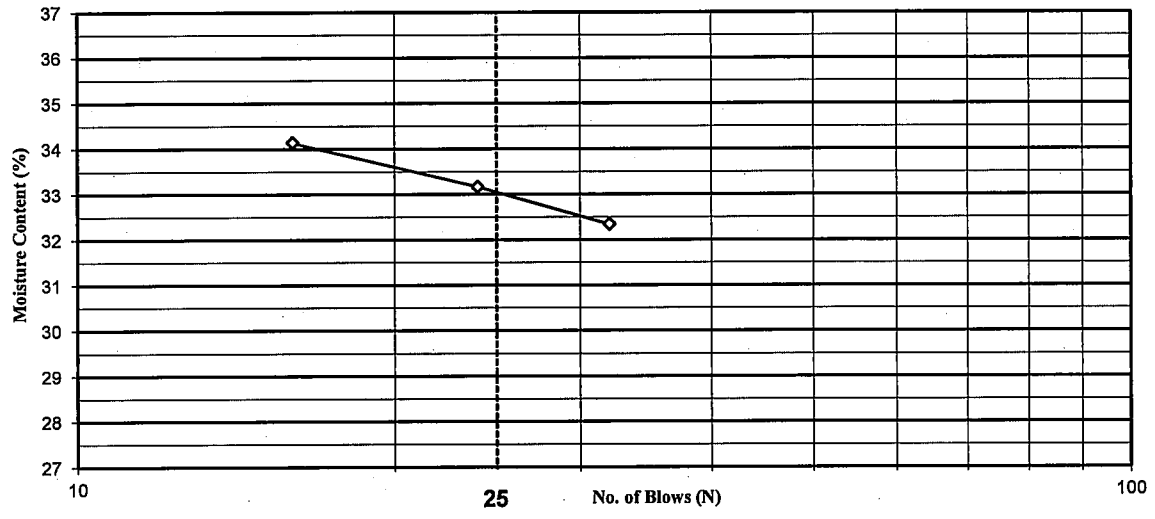
CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System		**decon** Soil and Concrete Testing Laboratroy (Pvt) Ltd
Location	Sialkot City		
BH / TP No.	BH-33	**Job No.**	-
Sample No.	SPT-02	**Lab No.**	603
Sample Depth (m)	2.00-2.45	**Test Started**	11-Feb-20
Sampled Date	-	**Test Completed**	13-Feb-20

ATTERBERG LIMITS (ASTM D 4318)

LIQUID LIMIT						PLASTIC LIMIT	
No. of Blows (N)	16	24	32				
Container No.	D-50	D-30	D-54			D-57	D-34
Weight of Container (g)	18.06	24.01	18.23			18.26	23.46
Weight of Container + Wet Soil (g)	33.23	39.31	33.21			24.15	29.52
Weight of Container + Dry Soil (g)	29.37	35.50	29.55			22.97	28.33
Weight of Dry Soil (g)	11.31	11.49	11.32			4.71	4.87
Weight of Water (g)	3.86	3.81	3.66			1.18	1.19
Moisture Content (%)	34.13	33.16	32.33			25.05	24.44

Liquid Limit	33	**Plastic Limit**	25	**Plasticity Index**	8



Tested By	Checked By	Approved By
Nesrullha Khan	Muhammad Ramzan	Muhammad Daniyal

Drillers, Engineers & Constructors ★ decon

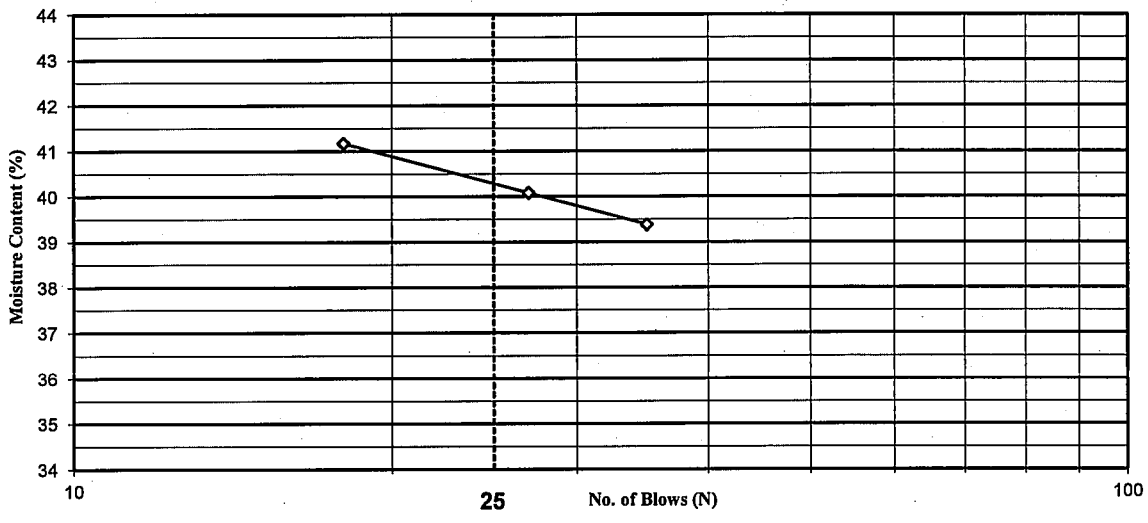
CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System		**decon** Soil and Concrete Testing Laboratroy (Pvt) Ltd
Location	Sialkot City		
BH / TP No.	BH-35	**Job No.**	-
Sample No.	SPT-04	**Lab No.**	603
Sample Depth (m)	4.00-4.45	**Test Started**	11-Feb-20
Sampled Date	-	**Test Completed**	13-Feb-20

ATTERBERG LIMITS (ASTM D 4318)

LIQUID LIMIT						PLASTIC LIMIT	
No. of Blows (N)	18	27	35				
Container No.	D-39	D-20	D-43			D-26	D-47
Weight of Container (g)	10.41	19.19	10.35			15.39	17.88
Weight of Container + Wet Soil (g)	25.26	34.15	25.11			21.15	23.23
Weight of Container + Dry Soil (g)	20.93	29.87	20.94			20.03	22.21
Weight of Dry Soil (g)	10.52	10.68	10.59			4.64	4.33
Weight of Water (g)	4.33	4.28	4.17			1.12	1.02
Moisture Content (%)	41.16	40.07	39.38			24.14	23.56

Liquid Limit	**40**	**Plastic Limit**	**24**	**Plasticity Index**	**16**



Tested By	Checked By	Approved By
Nesrullha Khan	Muhammad Ramzan	Muhammad Daniyal

Drillers, Engineers & Constructors
decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

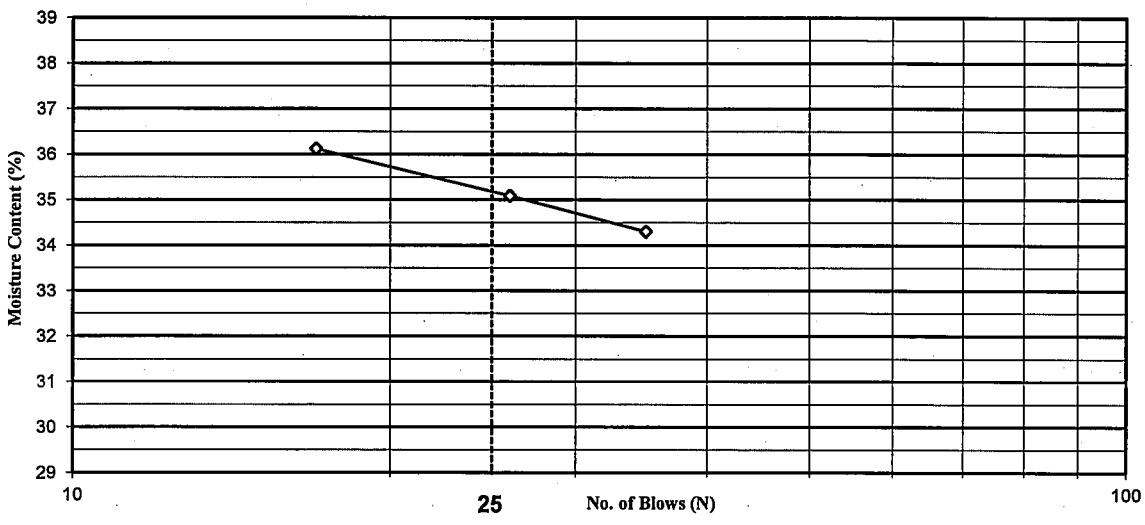
Project	Construction of Water Supply & Sewerage System	**decon** Soil and Concrete Testing Laboratroy (Pvt) Ltd
Location	Sialkot City	

BH / TP No.	BH-38	**Job No.**	-
Sample No.	SPT-02	**Lab No.**	603
Sample Depth (m)	2.00-2.45	**Test Started**	11-Feb-20
Sampled Date	-	**Test Completed**	13-Feb-20

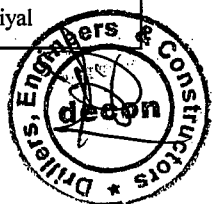
ATTERBERG LIMITS (ASTM D 4318)

	LIQUID LIMIT					PLASTIC LIMIT	
No. of Blows (N)	17	26	35				
Container No.	D-09	D-05	D-01			D-35	D-14
Weight of Container (g)	17.41	19.44	18.80			10.49	19.18
Weight of Container + Wet Soil (g)	32.26	34.15	33.21			16.52	25.32
Weight of Container + Dry Soil (g)	28.32	30.33	29.53			15.39	24.19
Weight of Dry Soil (g)	10.91	10.89	10.73			4.90	5.01
Weight of Water (g)	3.94	3.82	3.68			1.13	1.13
Moisture Content (%)	36.11	35.08	34.30			23.06	22.55

Liquid Limit	35	**Plastic Limit**	23	**Plasticity Index**	12



Tested By	Checked By	Approved By
Nesrullha Khan	Muhammad Ramzan	Muhammad Daniyal



CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

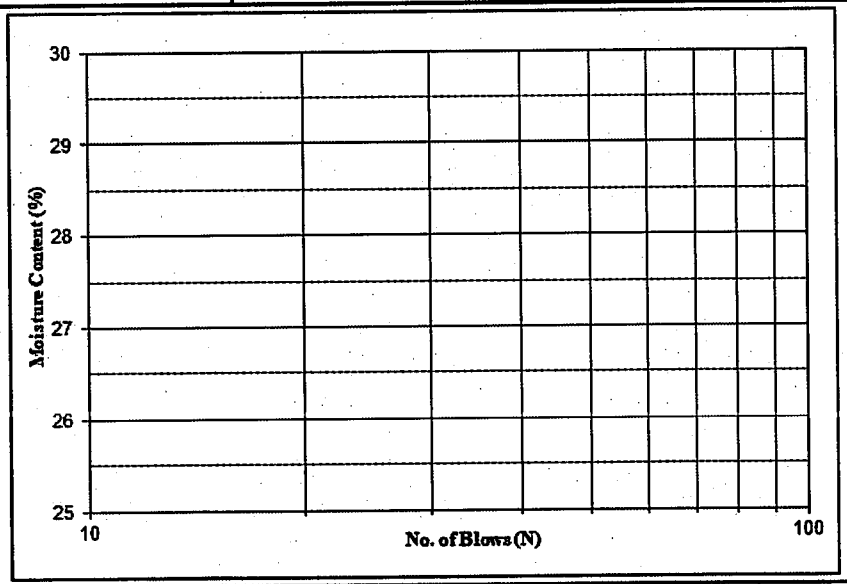
Project	Construction of Water Supply & Sewerage System	**decon** Soil and Concrete Testing Laboratroy (Pvt) Ltd
Location	Sialkot City	

BH / TP No.	BH-38	**Job No.**	-
Sample No.	SPT-06	**Lab No.**	603
Sample Depth (m)	6.00-6.45	**Test Started**	11-Feb-20
Sampled Date	-	**Test Completed**	13-Feb-20

ATTERBERG LIMITS (ASTM D 4318)

LIQUID LIMIT						PLASTIC LIMIT	
No. of Blows (N)							
Container No.							
Weight of Container (g)							
Weight of Container + Wet Soil (g)	N.P					N.P	
Weight of Container + Dry Soil (g)							
Weight of Dry Soil (g)							
Weight of Water (g)							
Moisture Content %							

Liquid Limit	**Plastic Limit**	**Plasticity Index**



Tested By	**Checked By**	**Approved By**
Nesrullha Khan	Muhammad Ramzan	Muhammad Danish

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

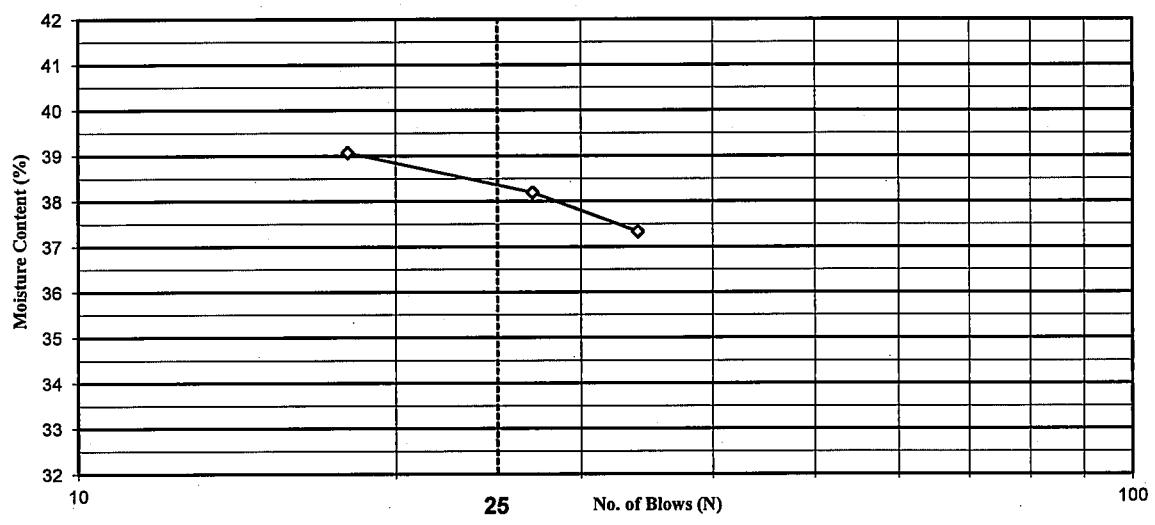
Project	Construction of Water Supply & Sewerage System	**decon** Soil and Concrete Testing Laboratroy (Pvt) Ltd
Location	Sialkot City	

BH / TP No.	BH-39	**Job No.**	-
Sample No.	SPT-01	**Lab No.**	603
Sample Depth (m)	1.00-1.45	**Test Started**	11-Feb-20
Sampled Date	-	**Test Completed**	13-Feb-20

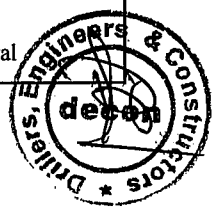
ATTERBERG LIMITS (ASTM D 4318)

	LIQUID LIMIT					PLASTIC LIMIT	
No. of Blows (N)	18	27	34				
Container No.	D-48	D-25	D-03			D-58	D-36
Weight of Container (g)	18.48	15.14	17.91			18.93	10.71
Weight of Container + Wet Soil (g)	33.36	30.05	32.26			24.29	16.22
Weight of Container + Dry Soil (g)	29.18	25.93	28.36			23.32	15.24
Weight of Dry Soil (g)	10.70	10.79	10.45			4.39	4.53
Weight of Water (g)	4.18	4.12	3.90			0.97	0.98
Moisture Content (%)	39.07	38.18	37.32			22.12	21.52

Liquid Limit 38	**Plastic Limit** 22	**Plasticity Index** 16



Tested By	Checked By	Approved By
Nesrullha Khan	Muhammad Ramzan	Muhammad Daniyal



SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION	TREATMENT PLANTS IN SIALKOT CITY (On-site)				
CLIENT	AJK ENGINEERS				
BOREHOLE	TP-1	SAMPLE	BS-1	TYPE	DISTURBED
LAB. REF.	11/2020	DEPTH m	0.00-1.40	DATE	27.02.2020

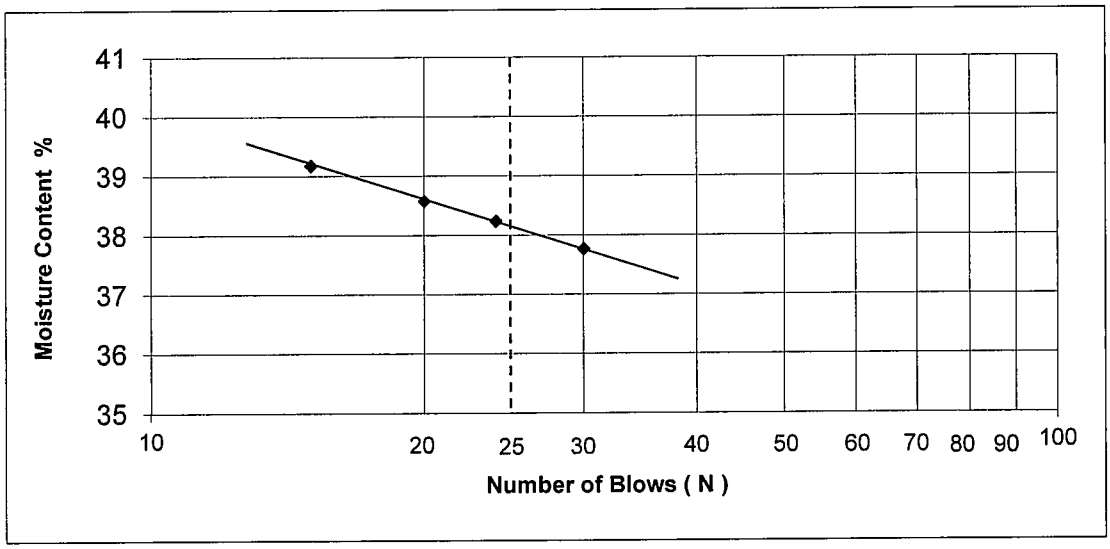
LIQUID LIMIT

Number of Blows N	15	20	24	30	
Moisture Content %	39.18	38.58	38.24	37.77	

PLASTIC LIMIT

Moisture Content %	22.07	22.11	22.16

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
38	22	16



TESTED BY	CHECKED BY
TARIQ	MAHMOOD

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION	TREATMENT PLANTS IN SIALKOT CITY (On-site)				
CLIENT	AJK ENGINEERS				
BOREHOLE	TP-2	SAMPLE	BS-1	TYPE	DISTURBED
LAB. REF.	11/2020	DEPTH m	0.00-1.00	DATE	28.02.2020

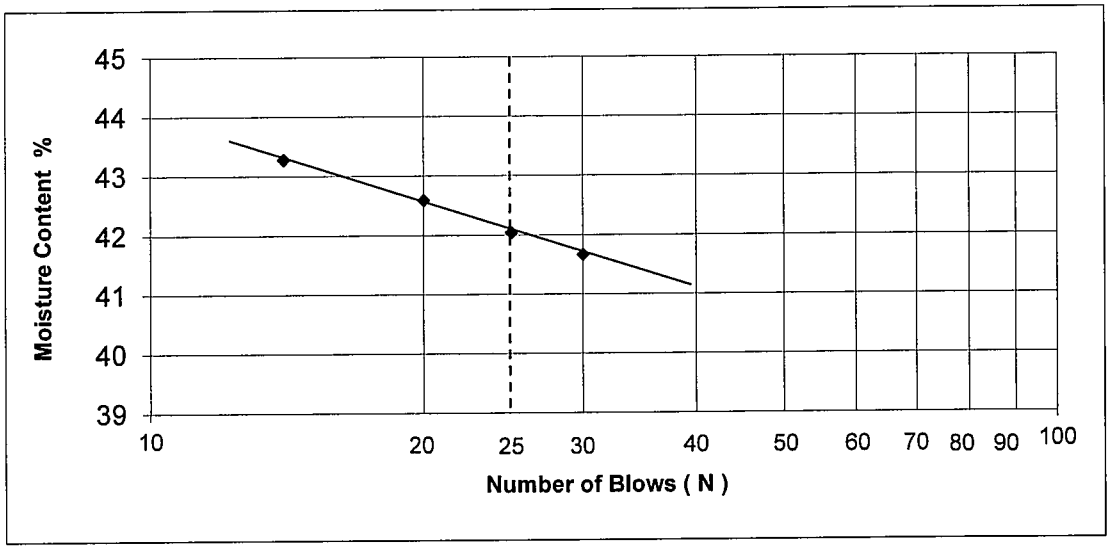
LIQUID LIMIT

Number of Blows N	14	20	25	30	
Moisture Content %	43.28	42.59	42.04	41.67	

PLASTIC LIMIT

Moisture Content %	24.10	24.15	24.19

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
42	24	18



TESTED BY	CHECKED BY
TARIQ	MAHMOOD

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION	TREATMENT PLANTS IN SIALKOT CITY (On-site)				
CLIENT	AJK ENGINEERS				
BOREHOLE	TP-3	**SAMPLE**	BS-1	**TYPE**	DISTURBED
LAB. REF.	11/2020	**DEPTH m**	0.00-1.50	**DATE**	28.02.2020

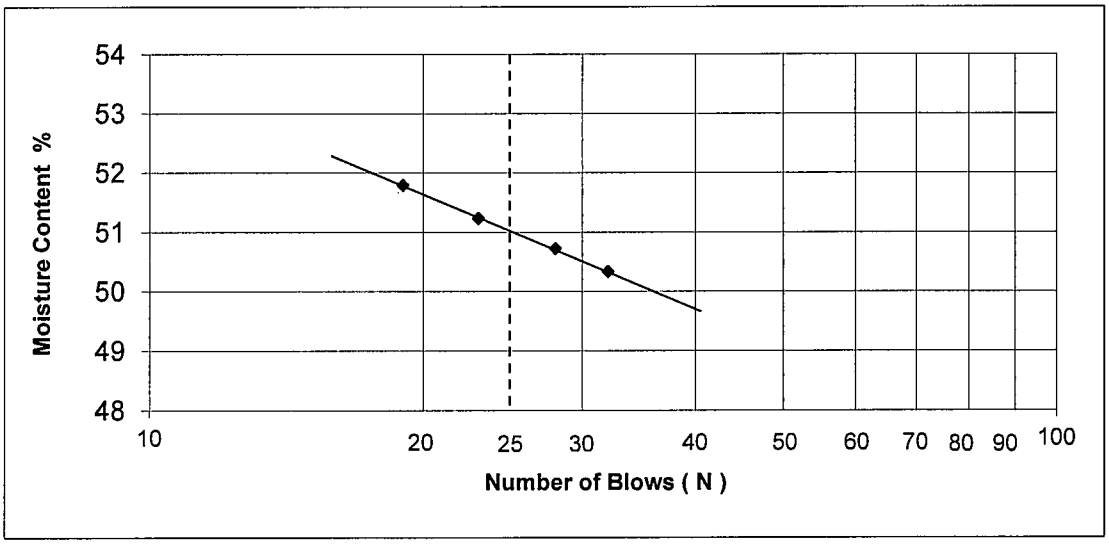
LIQUID LIMIT

Number of Blows N	19	23	28	32	
Moisture Content %	51.80	51.24	50.73	50.34	

PLASTIC LIMIT

Moisture Content %	26.99	27.05	27.11

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
51	27	24



TESTED BY	CHECKED BY
TARIQ	MAHMOOD

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION	TREATMENT PLANTS IN SIALKOT CITY (On-site)				
CLIENT	AJK ENGINEERS				
BOREHOLE	TP-4	SAMPLE	BS-1	TYPE	DISTURBED
LAB. REF.	11/2020	DEPTH m	0.00-1.50	DATE	27.02.2020

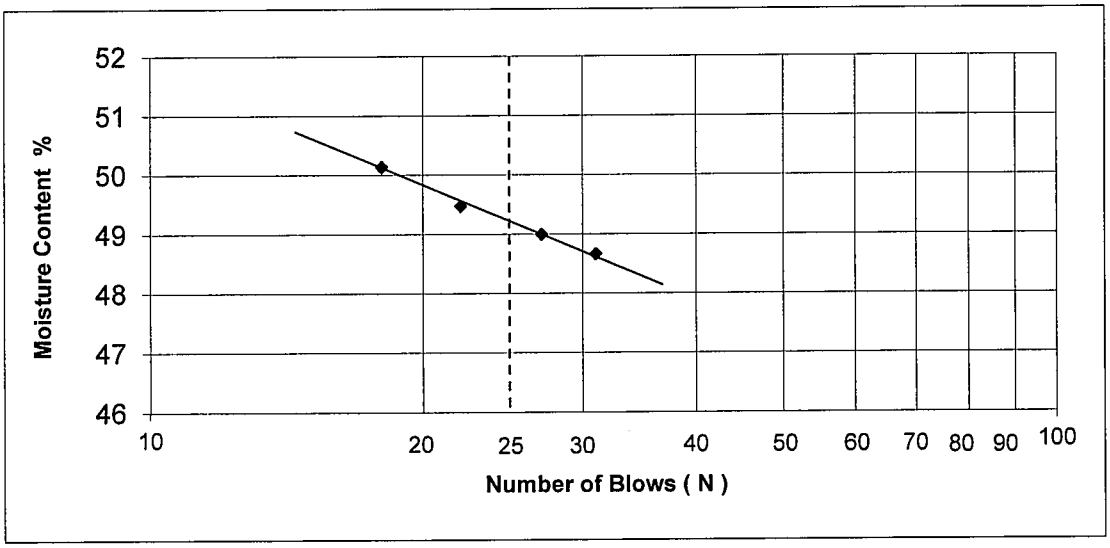
LIQUID LIMIT

Number of Blows N	18	22	27	31	
Moisture Content %	50.14	49.48	49.00	48.67	

PLASTIC LIMIT

Moisture Content %	27.11	27.15	27.20

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
49	27	22



TESTED BY	CHECKED BY
TARIQ	MAHMOOD

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION	TREATMENT PLANTS IN SIALKOT CITY (On-site)				
CLIENT	AJK ENGINEERS				
BOREHOLE	TP-5	SAMPLE	BS-1	TYPE	DISTURBED
LAB. REF.	11/2020	DEPTH m	0.00-1.50	DATE	28.02.2020

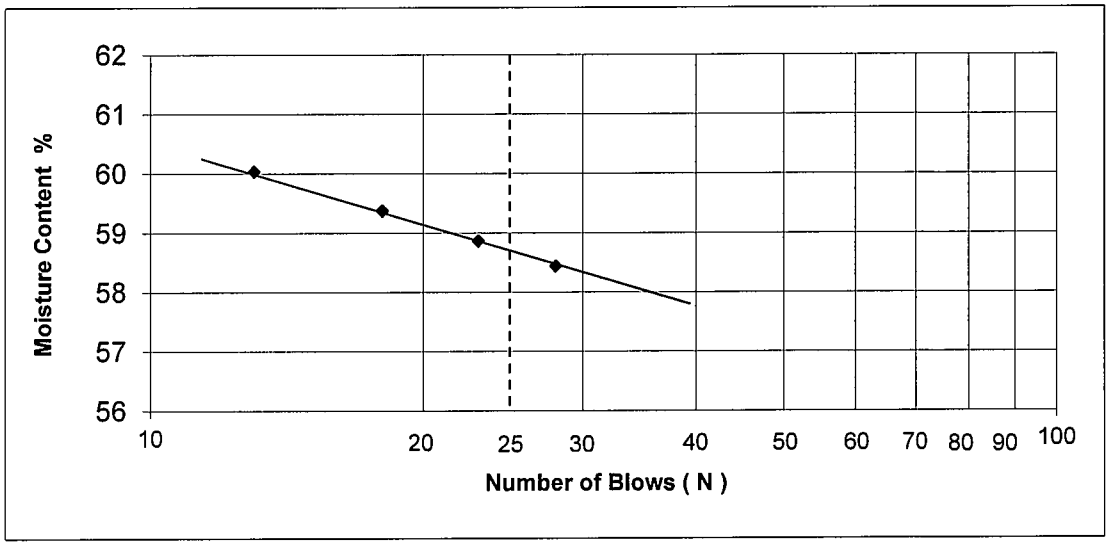
LIQUID LIMIT

Number of Blows N	13	18	23	28	
Moisture Content %	60.04	59.38	58.87	58.44	

PLASTIC LIMIT

Moisture Content %	30.74	30.80	30.85

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
59	31	28



TESTED BY	CHECKED BY
TARIQ	MAHMOOD

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION	TREATMENT PLANTS IN SIALKOT CITY (On-site)				
CLIENT	AJK ENGINEERS				
BOREHOLE	TP-6	**SAMPLE**	BS-1	**TYPE**	DISTURBED
LAB. REF.	11/2020	**DEPTH m**	0.00-1.50	**DATE**	28.02.2020

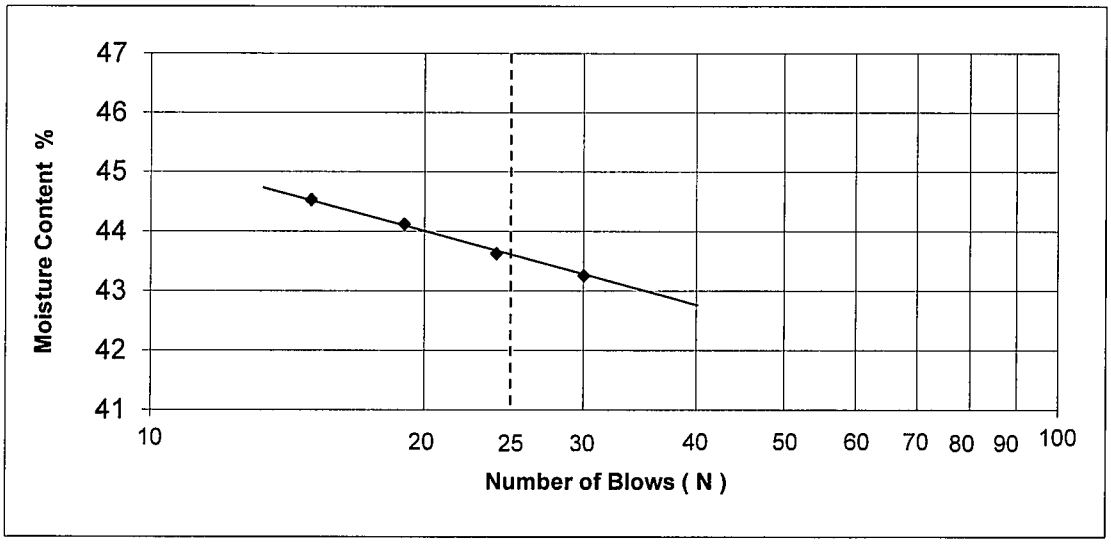
LIQUID LIMIT

Number of Blows N	15	19	24	30	
Moisture Content %	44.53	44.12	43.63	43.26	

PLASTIC LIMIT

Moisture Content %	24.83	24.89	24.96

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
44	25	19



TESTED BY	CHECKED BY
TARIQ	MAHMOOD

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION	TREATMENT PLANTS IN SIALKOT CITY (On-site)				
CLIENT	AJK ENGINEERS				
BOREHOLE	TP-7	**SAMPLE**	BS-1	**TYPE**	DISTURBED
LAB. REF.	11/2020	**DEPTH m**	0.00-1.20	**DATE**	28.02.2020

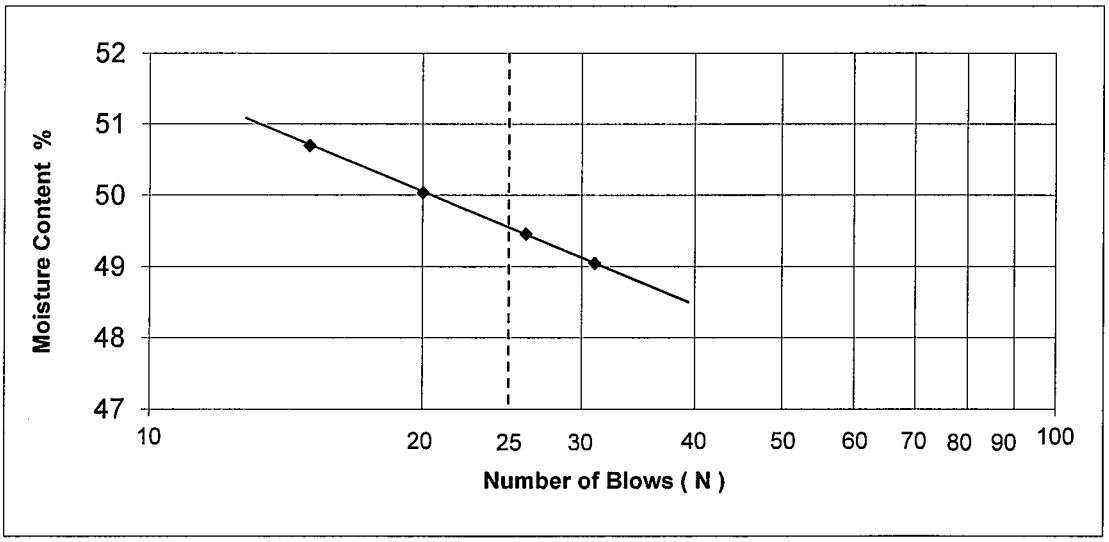
LIQUID LIMIT

Number of Blows N	15	20	26	31	
Moisture Content %	50.70	50.04	49.46	49.05	

PLASTIC LIMIT

Moisture Content %	26.63	26.70	26.76

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
50	27	23



TESTED BY	CHECKED BY
TARIQ	MAHMOOD

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION	TREATMENT PLANTS IN SIALKOT CITY (On-site)				
CLIENT	AJK ENGINEERS				
BOREHOLE	TP-8	SAMPLE	BS-1	TYPE	DISTURBED
LAB. REF.	11/2020	DEPTH m	0.00-1.50	DATE	27.02.2020

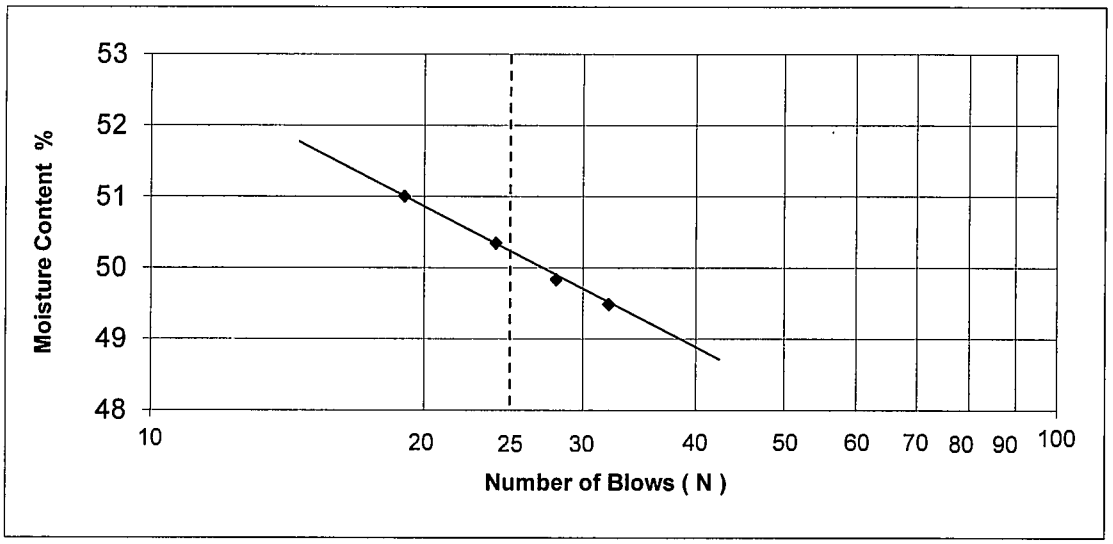
LIQUID LIMIT

Number of Blows N	19	24	28	32	
Moisture Content %	51.01	50.35	49.84	49.49	

PLASTIC LIMIT

Moisture Content %	27.23	27.28	27.32

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
50	27	23



TESTED BY	CHECKED BY
TARIQ	MAHMOOD

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION	TREATMENT PLANTS IN SIALKOT CITY (On-site samples)				
CLIENT	.				
BOREHOLE	TP-9	SAMPLE	BS-1	TYPE	DISTURBED
LAB. REF.	11/2020	DEPTH m	0.00-1.50	DATE	27.02.2020

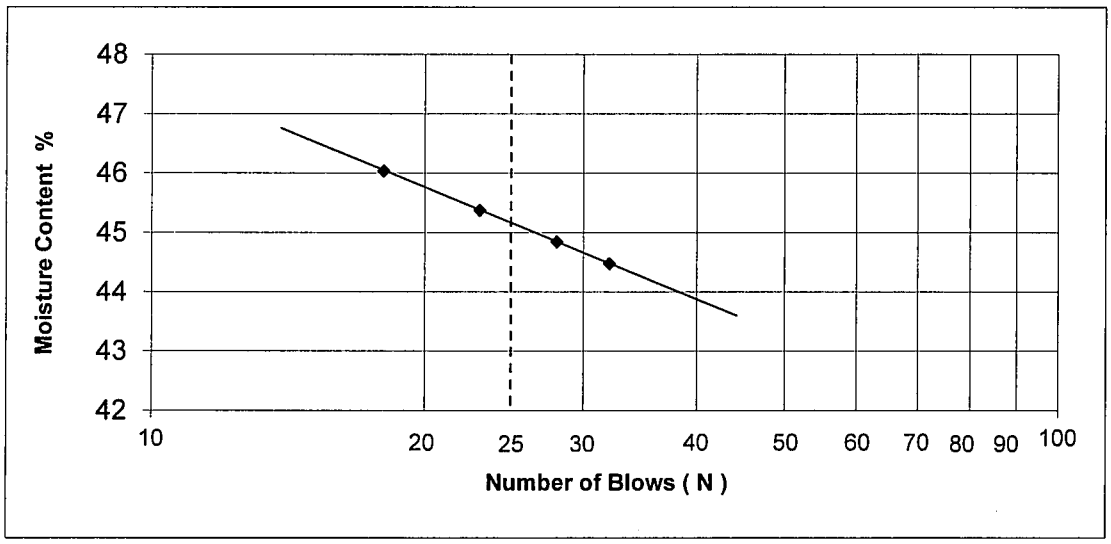
LIQUID LIMIT

Number of Blows N	18	23	28	32	
Moisture Content %	46.04	45.38	44.85	44.48	

PLASTIC LIMIT

Moisture Content %	25.19	25.23	25.28

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
45	25	20



TESTED BY	CHECKED BY
TARIQ	MAHMOOD

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION	TREATMENT PLANTS IN SIALKOT CITY (On-site)				
CLIENT	AJK ENGINEERS				
BOREHOLE	BA-1	SAMPLE	BS	TYPE	DISTURBED
LAB. REF.	11/2020	DEPTH m	0.20-1.20	DATE	28.02.2020

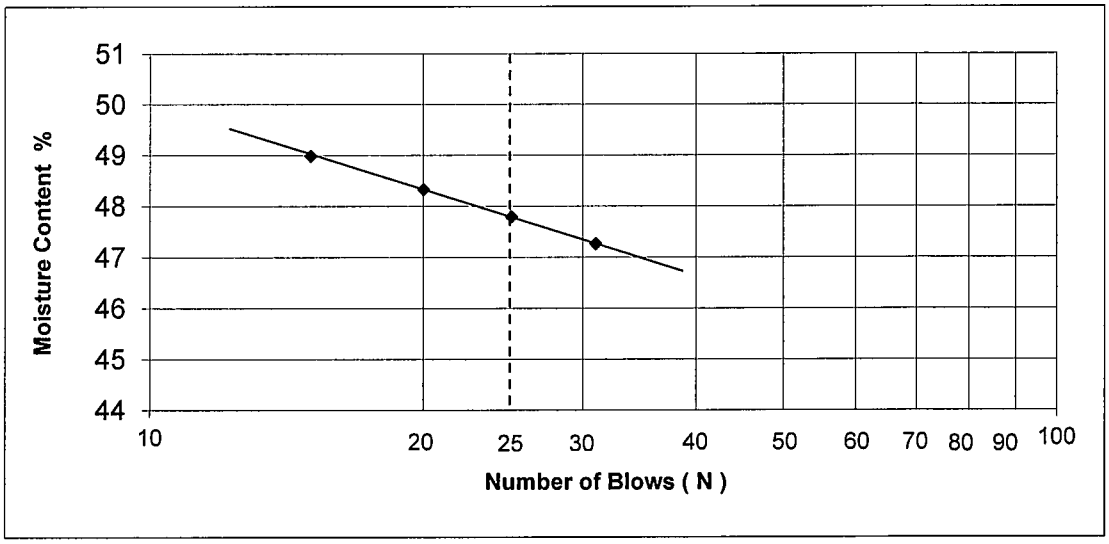
LIQUID LIMIT

Number of Blows N	15	20	25	31	
Moisture Content %	48.99	48.33	47.80	47.27	

PLASTIC LIMIT

Moisture Content %	26.65	26.75	26.82

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
48	27	21



TESTED BY	CHECKED BY
TARIQ	MAHMOOD

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION	TREATMENT PLANTS IN SIALKOT CITY (On-site)				
CLIENT	AJK ENGINEERS				
BOREHOLE	BA-2	**SAMPLE**	BS	**TYPE**	DISTURBED
LAB. REF.	11/2020	**DEPTH m**	0.10-1.20	**DATE**	28.02.2020

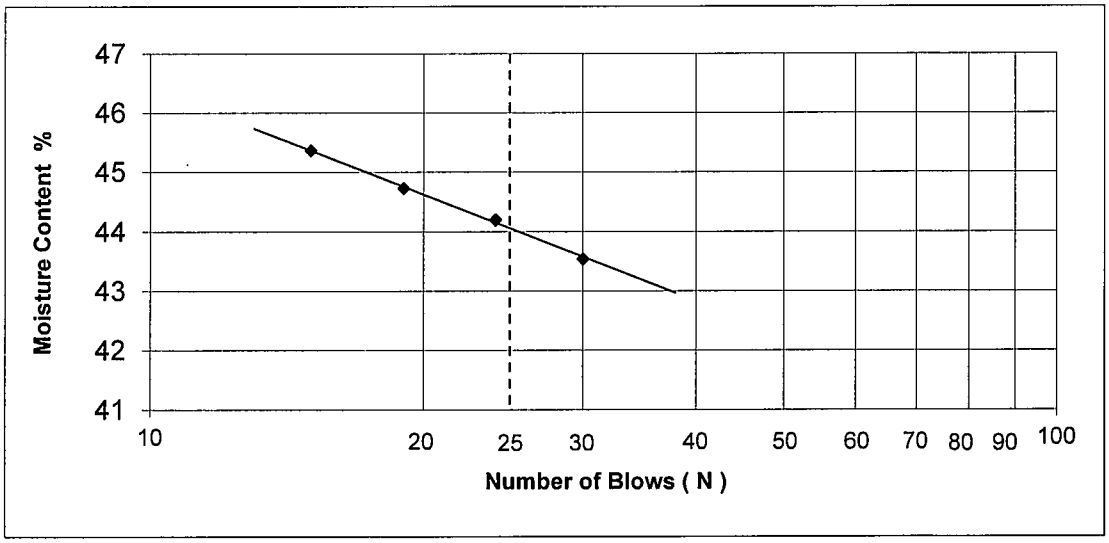
LIQUID LIMIT

Number of Blows N	15	19	24	30	
Moisture Content %	45.37	44.73	44.20	43.54	

PLASTIC LIMIT

Moisture Content %	25.05	25.09	25.13

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
44	25	19



TESTED BY	CHECKED BY
TARIQ	MAHMOOD

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION	TREATMENT PLANTS IN SIALKOT CITY				
CLIENT	AJK ENGINEERS				
BOREHOLE	BA-3	SAMPLE	BS	TYPE	DISTURBED
LAB. REF.	11/2020	DEPTH m	0.010-1.00	DATE	27.02.2020

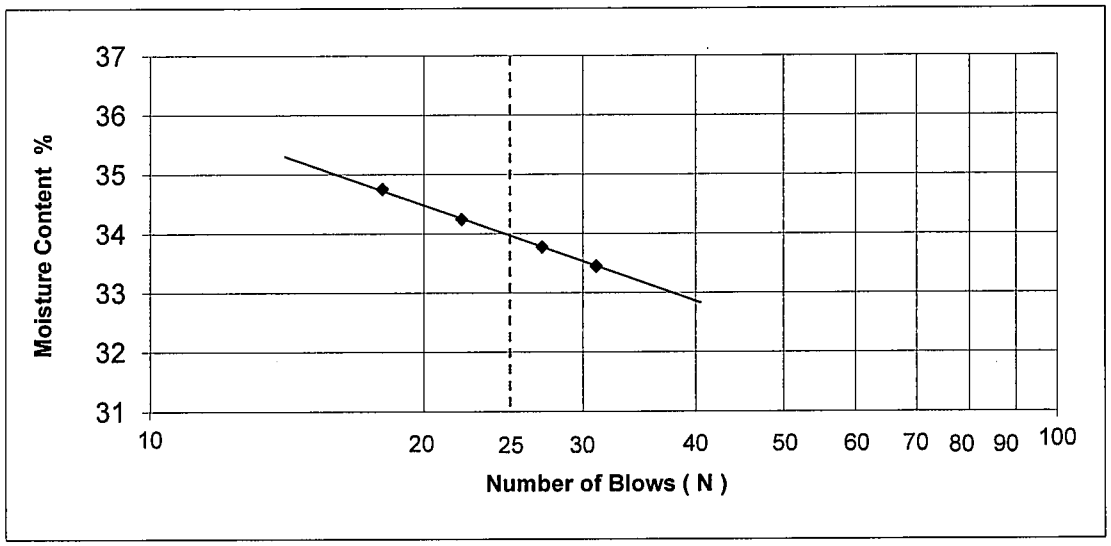
LIQUID LIMIT

Number of Blows N	18	22	27	31	
Moisture Content %	34.76	34.25	33.78	33.45	

PLASTIC LIMIT

Moisture Content %	20.97	21.02	21.08

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
34	21	13



TESTED BY	CHECKED BY
TARIQ	MAHMOOD

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION	TREATMENT PLANTS IN SIALKOT CITY (On-site)				
CLIENT	AJK ENGINEERS				
BOREHOLE	BAS-5	SAMPLE	BS	TYPE	DISTURBED
LAB. REF.	11/2020	DEPTH m		DATE	28.02.2020

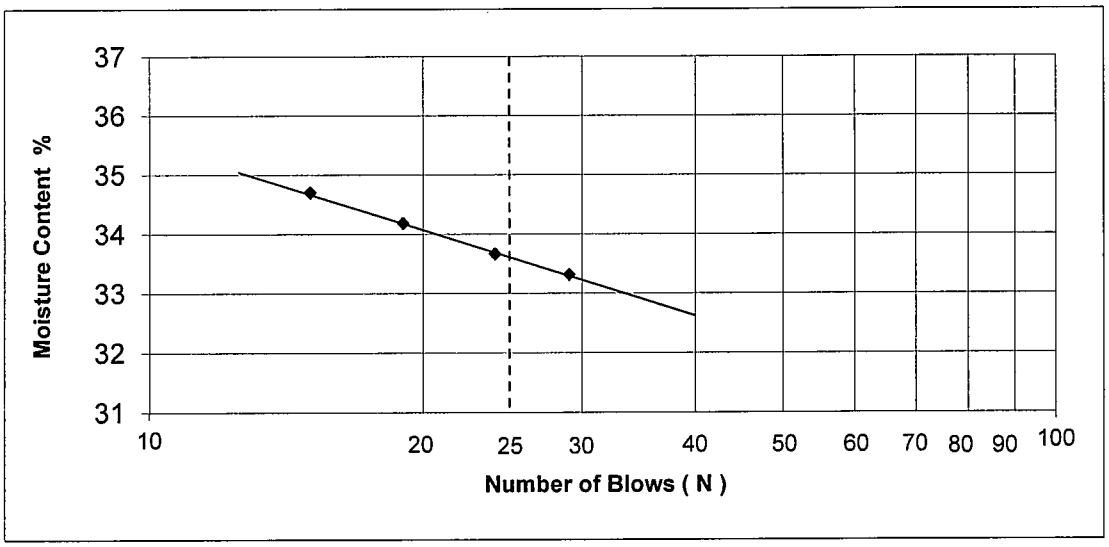
LIQUID LIMIT

Number of Blows N	15	19	24	29	
Moisture Content %	34.71	34.19	33.67	33.32	

PLASTIC LIMIT

Moisture Content %	20.96	21.01	21.06

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
34	21	13



TESTED BY	CHECKED BY
TARIQ	MAHMOOD

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION	TREATMENT PLANTS IN SIALKOT CITY (On-site)				
CLIENT	AJK ENGINEERS				
BOREHOLE	BAS-7	**SAMPLE**	BS	**TYPE**	DISTURBED
LAB. REF.	11/2020	**DEPTH m**		**DATE**	28.02.2020

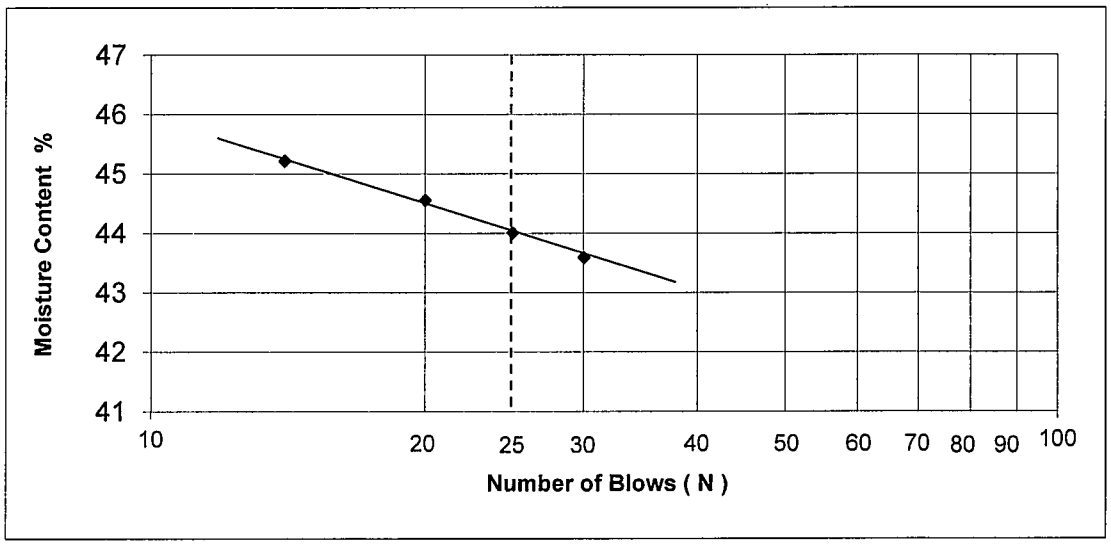
LIQUID LIMIT

Number of Blows N	14	20	25	30	
Moisture Content %	45.22	44.56	44.01	43.59	

PLASTIC LIMIT

Moisture Content %	25.04	25.08	25.11

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
44	25	19



TESTED BY	CHECKED BY
TARIQ	MAHMOOD

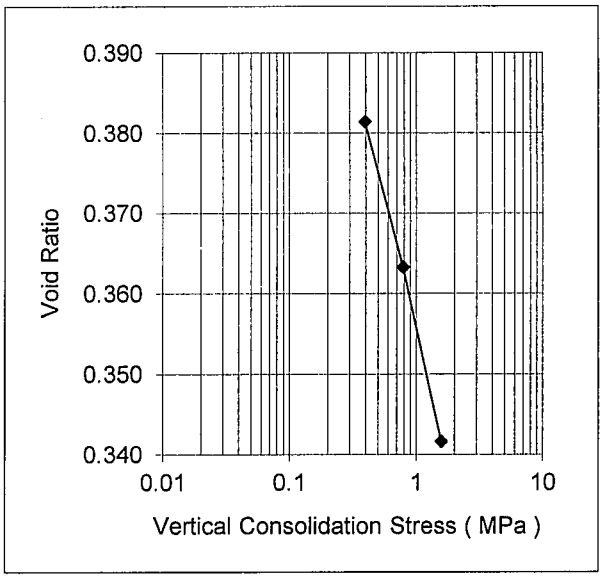
SOILCON

18-Km, Multan Road Lahore. Ph: 042-7510942, Fax: 042-7510944

CONSOLIDATION TEST

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	TP-2	SAMPLE	BS-1
SPECIMEN	1	TYPE	REMOULDED
DEPTH m	0.00-1.00	DATE	27.02.2020

Operator	Checked by
Nisar Ahmad	Mahmood



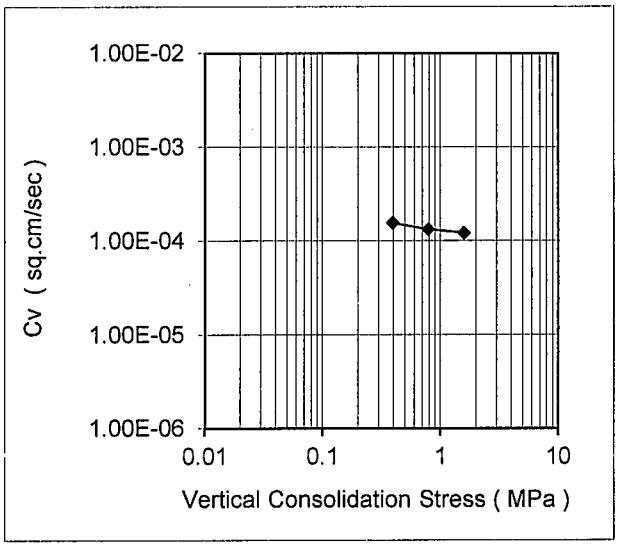
SOIL AND SPECIMEN CHARACTERISTICS

Initial Bulk Density		2173	Kg/m^3
Final Bulk Density		2275	Kg/m^3
Initial Water Content		11.16	%
Final Water Content		12.51	%
Initial Specimen Height		20.00	mm
Specimen Diameter		63.70	mm
Specific Gravity	App.	2.713	
Initial Void Ratio		0.388	

TEST CHARACTERISTICS

No. of Loading Steps	3
No. of unloading Steps	

LAB REF.	11/2019



Pressure	Void Ratio	Cv
Mpa		cm^2/sec
0		
0.392	0.381	1.56E-04
0.785	0.363	1.33E-04
1.569	0.342	1.22E-04

REMARKS:

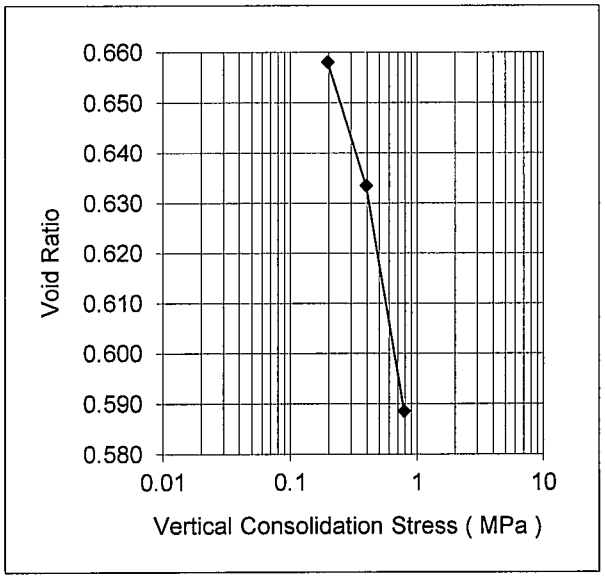
SOILCON

18-Km, Multan Road Lahore. Ph: 042-7510942, Fax: 042-7510944

CONSOLIDATION TEST

Operator	Checked by
Nisar Ahmad	Mahmood

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	TP-5	SAMPLE	BS-1
SPECIMEN	1	TYPE	REMOULDED
DEPTH m	0.00-1.50	DATE	04.03.2020



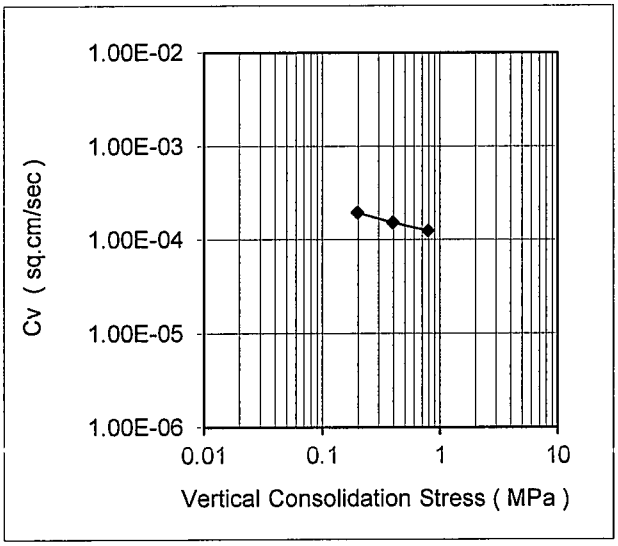
SOIL AND SPECIMEN CHARACTERISTICS

Initial Bulk Density	1881	Kg/m^3
Final Bulk Density	2087	Kg/m^3
Initial Water Content	14.55	%
Final Water Content	21.48	%
Initial Specimen Height	20.00	mm
Specimen Diameter	63.70	mm
Specific Gravity App.	2.730	
Initial Void Ratio	0.663	

TEST CHARACTERISTICS

No. of Loading Steps	3
No. of unloading Steps	

LAB REF.	11/2019



Pressure	Void Ratio	Cv
Mpa		cm^2/sec
0		
0.196	0.658	1.95E-04
0.392	0.633	1.53E-04
0.785	0.589	1.25E-04

REMARKS:

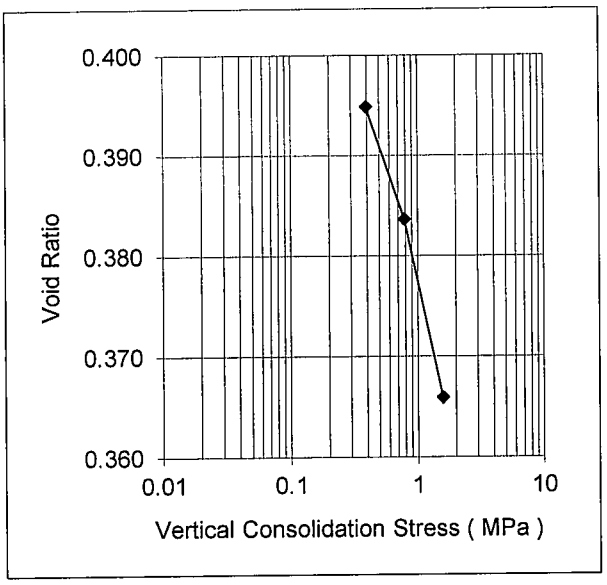
SOILCON

18-Km, Multan Road Lahore. Ph: 042-7510942, Fax: 042-7510944

CONSOLIDATION TEST

Operator	Checked by
Nisar Ahmad	Mahmood

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	TP-9	SAMPLE	BS-1
SPECIMEN	1	TYPE	REMOULDED
DEPTH m	0.00-1.50	DATE	27.02.2020



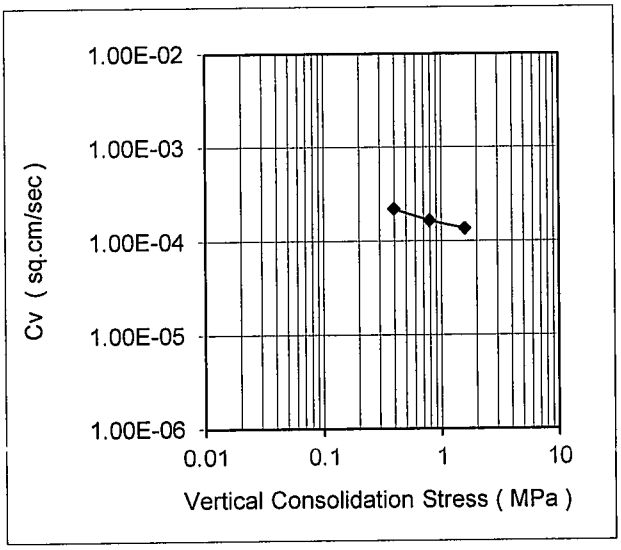
SOIL AND SPECIMEN CHARACTERISTICS

Initial Bulk Density	2185	Kg/m^3
Final Bulk Density	2231	Kg/m^3
Initial Water Content	13.63	%
Final Water Content	13.54	%
Initial Specimen Height	20.00	mm
Specimen Diameter	63.70	mm
Specific Gravity App.	2.684	
Initial Void Ratio	0.396	

TEST CHARACTERISTICS

No. of Loading Steps	3
No. of unloading Steps	

LAB REF.	11/2019



Pressure	Void Ratio	Cv
Mpa		cm^2/sec
0		
0.392	0.395	2.21E-04
0.785	0.384	1.65E-04
1.569	0.366	1.37E-04

REMARKS:

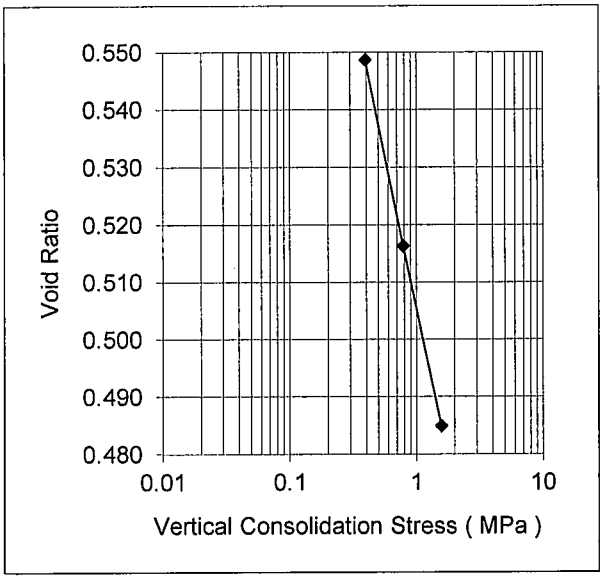
SOILCON

18-Km, Multan Road Lahore. Ph: 042-7510942, Fax: 042-7510944

CONSOLIDATION TEST

Operator	Checked by
Nisar Ahmad	Mahmood

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	BA-1	SAMPLE	BS
SPECIMEN	1	TYPE	REMOULDED
DEPTH m	0.10-1.20	DATE	04.03.2020



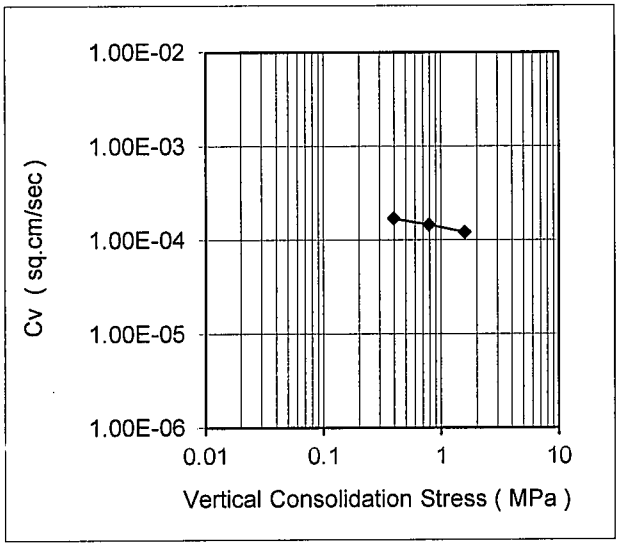
SOIL AND SPECIMEN CHARACTERISTICS

Initial Bulk Density		1958	Kg/m^3
Final Bulk Density		2168	Kg/m^3
Initial Water Content		13.48	%
Final Water Content		17.62	%
Initial Specimen Height		20.00	mm
Specimen Diameter		63.70	mm
Specific Gravity	App.	2.737	
Initial Void Ratio		0.586	

TEST CHARACTERISTICS

No. of Loading Steps	3
No. of unloading Steps	

LAB REF.	11/2019



Pressure	Void Ratio	Cv
Mpa		cm^2/sec
0		
0.392	0.549	1.70E-04
0.785	0.516	1.46E-04
1.569	0.485	1.22E-04

REMARKS:

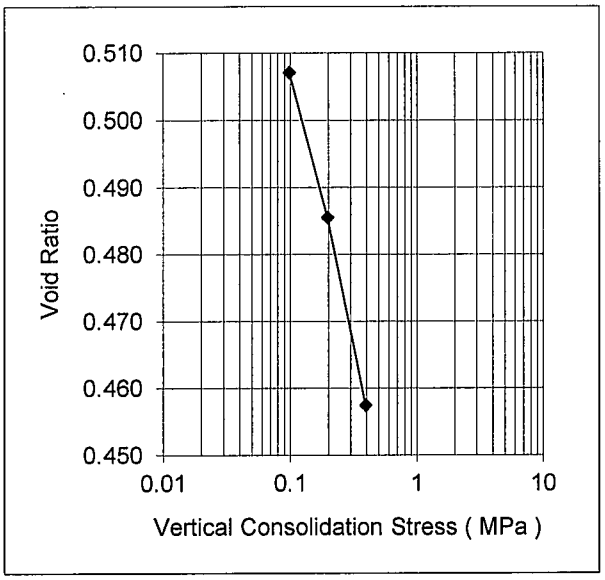
SOILCON

18-Km, Multan Road Lahore. Ph: 042-7510942, Fax: 042-7510944

CONSOLIDATION TEST

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	BA-2	SAMPLE	BS
SPECIMEN	1	TYPE	REMOULDED
DEPTH m	0.10-1.20	DATE	04.03.2020

Operator	Checked by
Nisar Ahmad	Mahmood



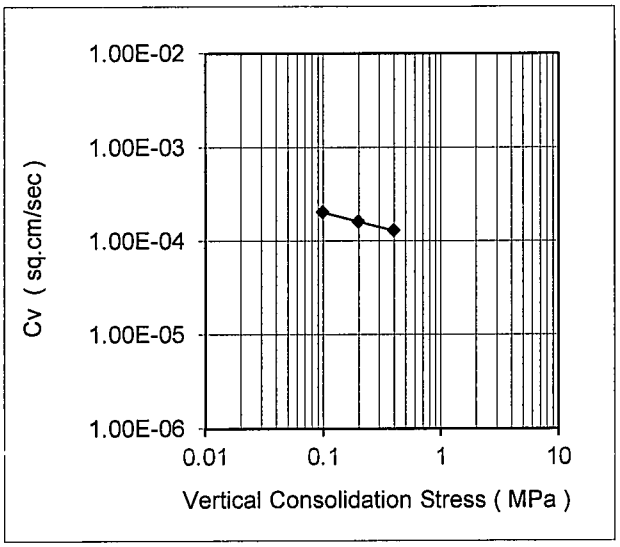
SOIL AND SPECIMEN CHARACTERISTICS

Initial Bulk Density		1997	Kg/m^3
Final Bulk Density		2161	Kg/m^3
Initial Water Content		12.63	%
Final Water Content		16.86	%
Initial Specimen Height		20.00	mm
Specimen Diameter		63.70	mm
Specific Gravity	App.	2.695	
Initial Void Ratio		0.520	

TEST CHARACTERISTICS

No. of Loading Steps	3
No. of unloading Steps	

LAB REF. 11/2019



Pressure	Void Ratio	Cv
Mpa		cm^2/sec
0		
0.098	0.507	2.03E-04
0.196	0.486	1.62E-04
0.392	0.457	1.30E-04

REMARKS:

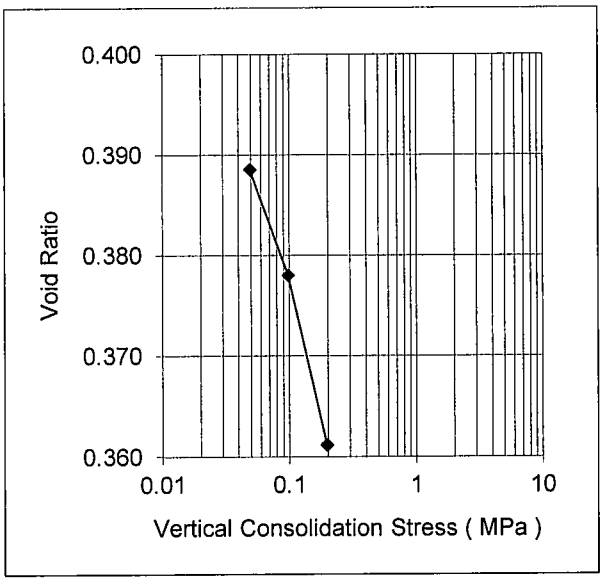
SOILCON

18-Km, Multan Road Lahore. Ph: 042-7510942, Fax: 042-7510944

CONSOLIDATION TEST

Operator	Checked by
Nisar Ahmad	Mahmood

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	BA-3	SAMPLE	BS
SPECIMEN	1	TYPE	REMOULDED
DEPTH m	0.10-1.00	DATE	27.02.2020



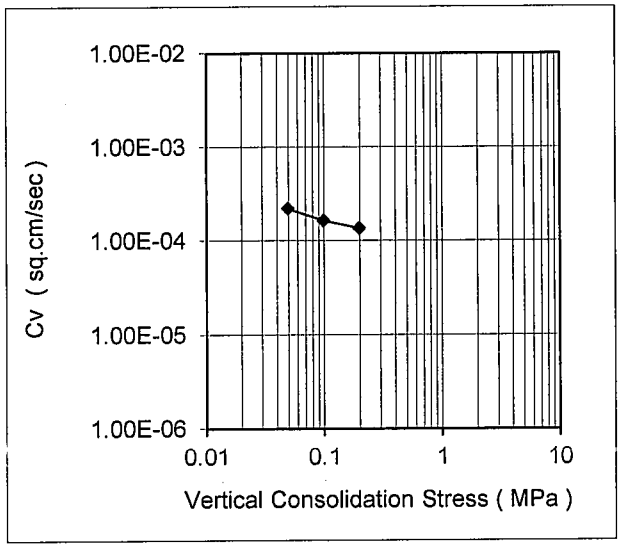
SOIL AND SPECIMEN CHARACTERISTICS

Initial Bulk Density	2149	Kg/m^3
Final Bulk Density	2256	Kg/m^3
Initial Water Content	10.64	%
Final Water Content	13.21	%
Initial Specimen Height	20.00	mm
Specimen Diameter	63.70	mm
Specific Gravity App.	2.712	
Initial Void Ratio	0.396	

TEST CHARACTERISTICS

No. of Loading Steps	3
No. of unloading Steps	

LAB REF.	11/2019



Pressure	Void Ratio	Cv
Mpa		cm^2/sec
0		
0.049	0.389	2.20E-04
0.098	0.378	1.64E-04
0.196	0.361	1.36E-04

REMARKS:

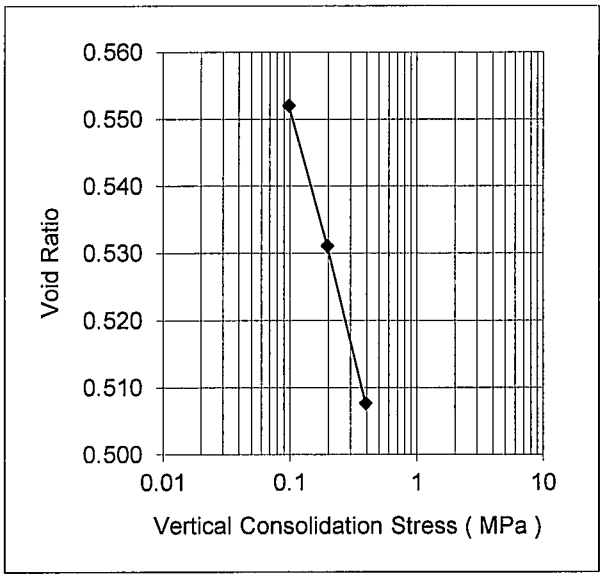
SOILCON

18-Km, Multan Road Lahore. Ph: 042-7510942, Fax: 042-7510944

CONSOLIDATION TEST

Operator	Checked by
Nisar Ahmad	Mahmood

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	BAS-5	SAMPLE	BS
SPECIMEN	1	TYPE	REMOULDED
DEPTH m		DATE	04.03.2020



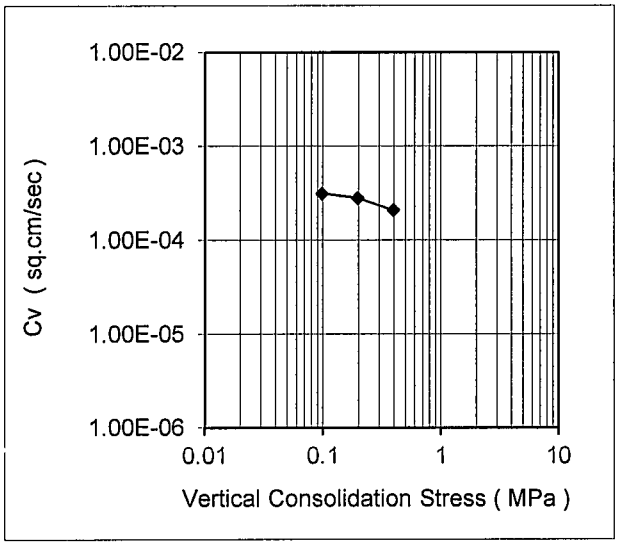
SOIL AND SPECIMEN CHARACTERISTICS

Initial Bulk Density	1924	Kg/m^3
Final Bulk Density	2124	Kg/m^3
Initial Water Content	11.49	%
Final Water Content	18.74	%
Initial Specimen Height	20.00	mm
Specimen Diameter	63.70	mm
Specific Gravity App.	2.697	
Initial Void Ratio	0.563	

TEST CHARACTERISTICS

No. of Loading Steps	3
No. of unloading Steps	

LAB REF.	11/2019



Pressure	Void Ratio	Cv
Mpa		cm^2/sec
0		
0.098	0.552	3.13E-04
0.196	0.531	2.81E-04
0.392	0.508	2.09E-04

REMARKS:

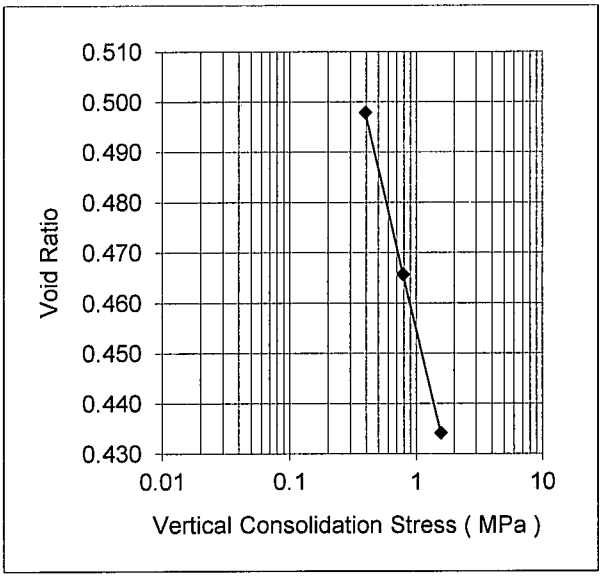
SOILCON

18-Km, Multan Road Lahore. Ph: 042-7510942, Fax: 042-7510944

CONSOLIDATION TEST

Operator	Checked by
Nisar Ahmad	Mahmood

CLIENT	AJK ENGINEERS		
PROJECT	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM		
SITE	TREATMENT PLANTS IN SIALKOT CITY		
BORE HOLE	BAS-7	SAMPLE	BS
SPECIMEN	1	TYPE	REMOULDED
DEPTH m		DATE	27.02.2020



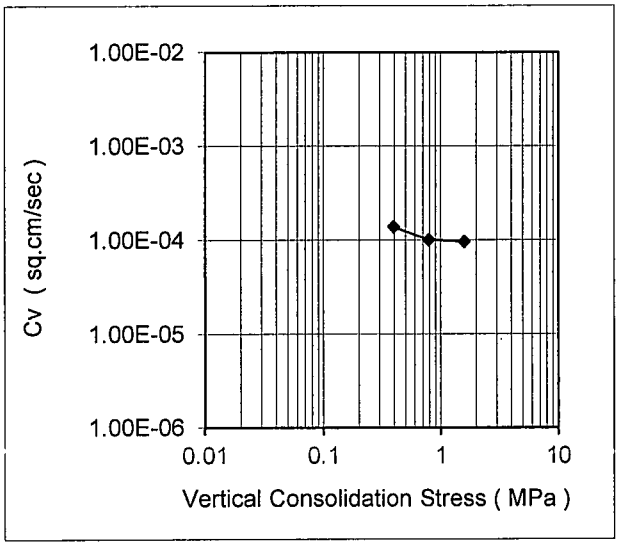
SOIL AND SPECIMEN CHARACTERISTICS

Initial Bulk Density	2070	Kg/m^3
Final Bulk Density	2204	Kg/m^3
Initial Water Content	15.10	%
Final Water Content	15.16	%
Initial Specimen Height	20.00	mm
Specimen Diameter	63.70	mm
Specific Gravity App.	2.745	
Initial Void Ratio	0.526	

TEST CHARACTERISTICS

No. of Loading Steps	3
No. of unloading Steps	

LAB REF.	11/2019



Pressure	Void Ratio	Cv
Mpa		cm^2/sec
0		
0.392	0.498	1.39E-04
0.785	0.466	1.01E-04
1.569	0.434	9.65E-05

REMARKS:

SOILCON
GEOTECHNICAL TESTING LABORATORIES
18-Km, Multan Road, Lahore. Ph: 042-7510942-43 Fax:042-7515267

SUMMARY OF SWELL PRESSURE TEST RESULTS

Project: PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM
Location: TREATMENT PLANTS IN SIALKOT CITY
Client: AJK ENGINEERS
Lab. Ref: 11/20

BH / TP No.	Sample No.	Depth (m)	Location	Free swell %	DENSITY (g/cu.cm)		Swell Pressure (kg/cm^2)	Remarks
					Bulk	Dry		
TP-2	BS-1	0.00-1.00					2.667	
TP-9	BS-1	0.00-1.50					1.804	
BA-3	BS	0.10-1.00					0.314	
BAS-7	BS						2.040	

Tested By: Nisar Ahmad
Checked By: Mahmood
Dated: 27.02.2020

SOILCON
GEOTECHNICAL TESTING LABORATORIES
18-Km, Multan Road, Lahore. Ph: 042-7510942-43 Fax:042-7515267

SUMMARY OF SWELL PRESSURE TEST RESULTS

Project: PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM
Location: TREATMENT PLANTS IN SIALKOT CITY

Client: AJK ENGINEERS
Lab. Ref: 11/20

BH / TP No.	Sample No.	Depth (m)	Location	Free swell %	DENSITY (g/cu.cm)		Swell Pressure (kg/cm^2)	Remarks
					Bulk	Dry		
TP-5	BS-1	0.00-1.50					1.647	
BA-1	BS	0.20-1.20					2.353	
BA-2	BS	0.10-1.20					0.628	
BAS-5	BS						0.706	

Tested By: Nisar Ahmad
Checked By: Mahmood
Dated: 04.03.2020

SOILCON
GEOTECHNICAL TESTING LABORATORIES
18-Km, Multan Road, Lahore. Ph: 042-7510942-43 Fax:042-7515267

SUMMARY OF Mv

Project: PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM
Location: TREATMENT PLANTS IN SIALKOT CITY

Client: AJK ENGINEERS
Lab. Ref: 11/2020

BH #	Sample #	Depth (m)	0.5	1	2	4	8	16	Remarks
TP-2	BS-1	0.00-1.00				1.15E-05	3.25E-05	2.02E-05	
TP-9	BS-1	0.00-1.50			1.15E-05	2.05E-05	1.63E-05		
BA-3	BS	0.10-1.00	1.15E-05	1.55E-04	1.24E-04				
BAS-7	BS	4.00				4.69E-05	5.48E-05	2.75E-05	

Tested By: Nisar Ahmad
Checked By: Mahmood
Dated: 27.02.2020

SOGEC
GEOTECHNICAL TESTING LABORATORIES
18-Km, Multan Road, Lahore. Ph: 042-7510942-43 Fax:042-7515267

SUMMARY OF Mv

Project: PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM
Location: TREATMENT PLANTS IN SIALKOT CITY
Client: AJK ENGINEERS
Lab. Ref: 11/2020

BH #	Sample #	Depth (m)	0.5	1	2	4	8	16	Remarks
TP-5	BS-1	0.00-1.50			1.43E-05	7.57E-05	7.01E-05		
BA-1	BS	0.20-1.20				6.07E-05	5.32E-05	2.64E-05	
BA-2	BS	0.10-1.20		8.36E-05	1.46E-04	9.65E-05			
BAS-5	BS			7.24E-05	1.38E-04	7.81E-05			

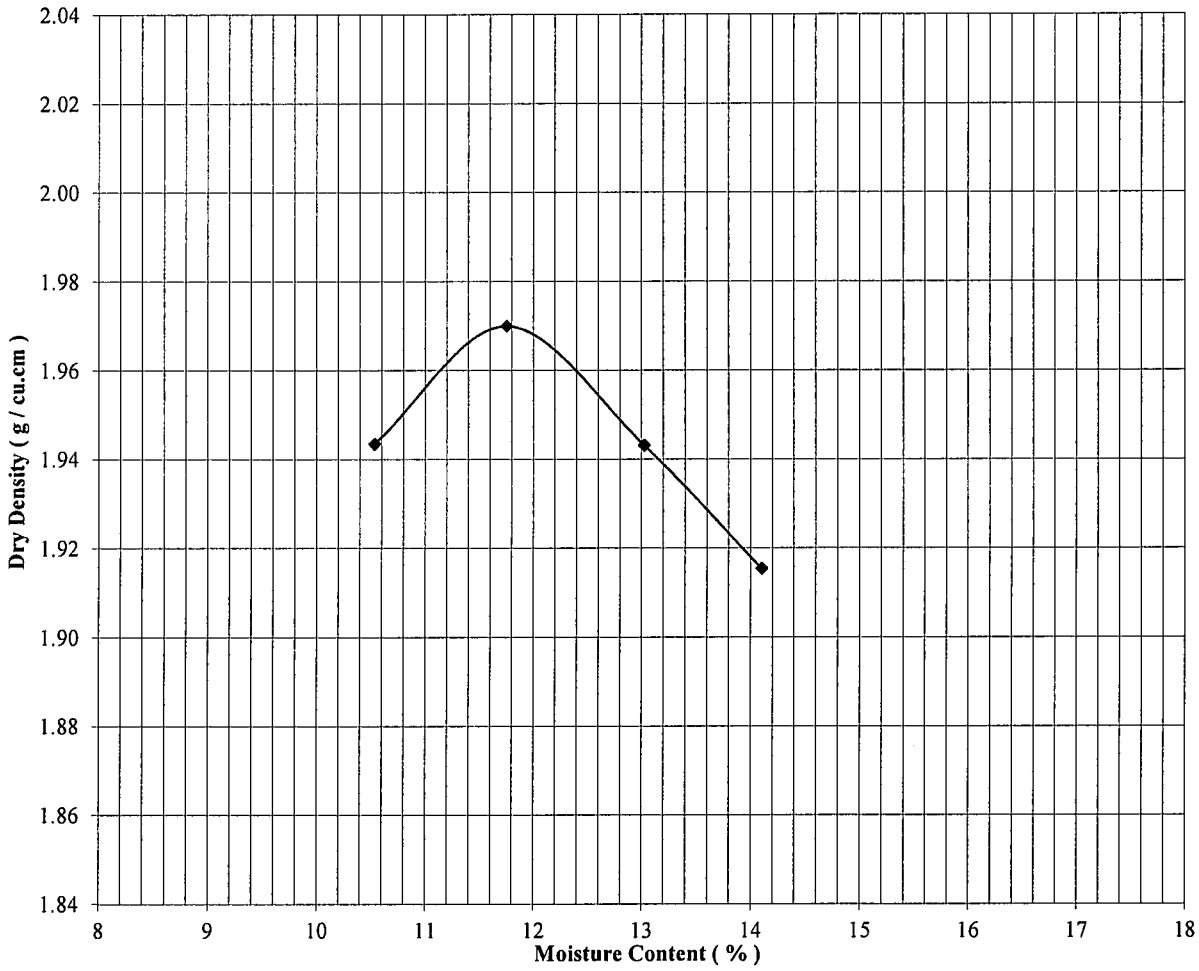
Tested By: Nisar Ahmad
Checked By: Mahmood
Dated: 04.03.2020

SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method :	Modified AASHTO T-180 (Method A)			**Volume of Mould :**	938 cm^3
Dia of Mould :	4.0 inch			**Drop :**	18 inch
No of Blows :	25	**No of Layers**	5	**Wt of Hammer :**	10 lbs
Test Pit No:	TP-1	**Sample No.**	BS-1	**Depth (m):**	0.00-1.40



Optimum Moisture Content (%)		11.75	**Maximum Dry Density**		1.970 g/cm^3
Project:	**PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM**				
Location :	**TREATMENT PLANTS IN SIALKOT CITY**			**Client: AJK ENGINEERS**	
Tested By	**Checked By**			**Dated**	**LAB. REF**
Azmat	**Mahmood**			**22.02.2020**	**11/2020**

REMARKS: _____

SOILCON

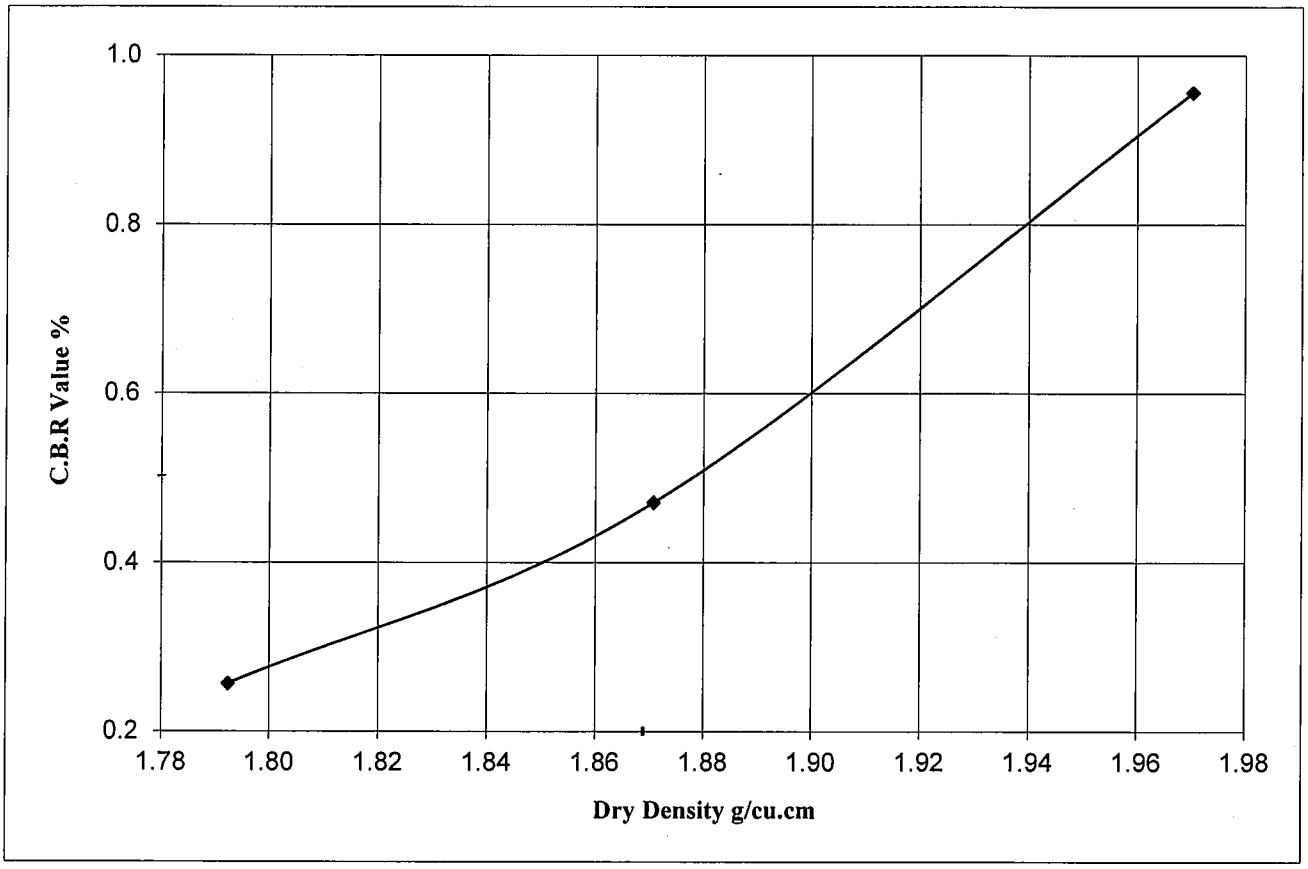
GEOTECHNICAL TESTING LABORATORIES, 18-Km,
MULTAN ROAD, LAHORE

C.B.R. TEST

(AASHTO T-193)

No.of Blows per Layer		65	30	10
CBR Value at 0.1 in	%			
CBR Value at 0.2 in	%	1.0	0.5	0.3
Dry Density	g/ cm ^{3}	1.970	1.871	1.792
Moisture Content	%	11.69	11.69	11.69
Absorption	%	2.28	5.52	7.93
Swelling	%		3.73	

COMPACTION	MODIFIED
M.D.D. g/cu.cm	1.970
O.M.C %	11.75



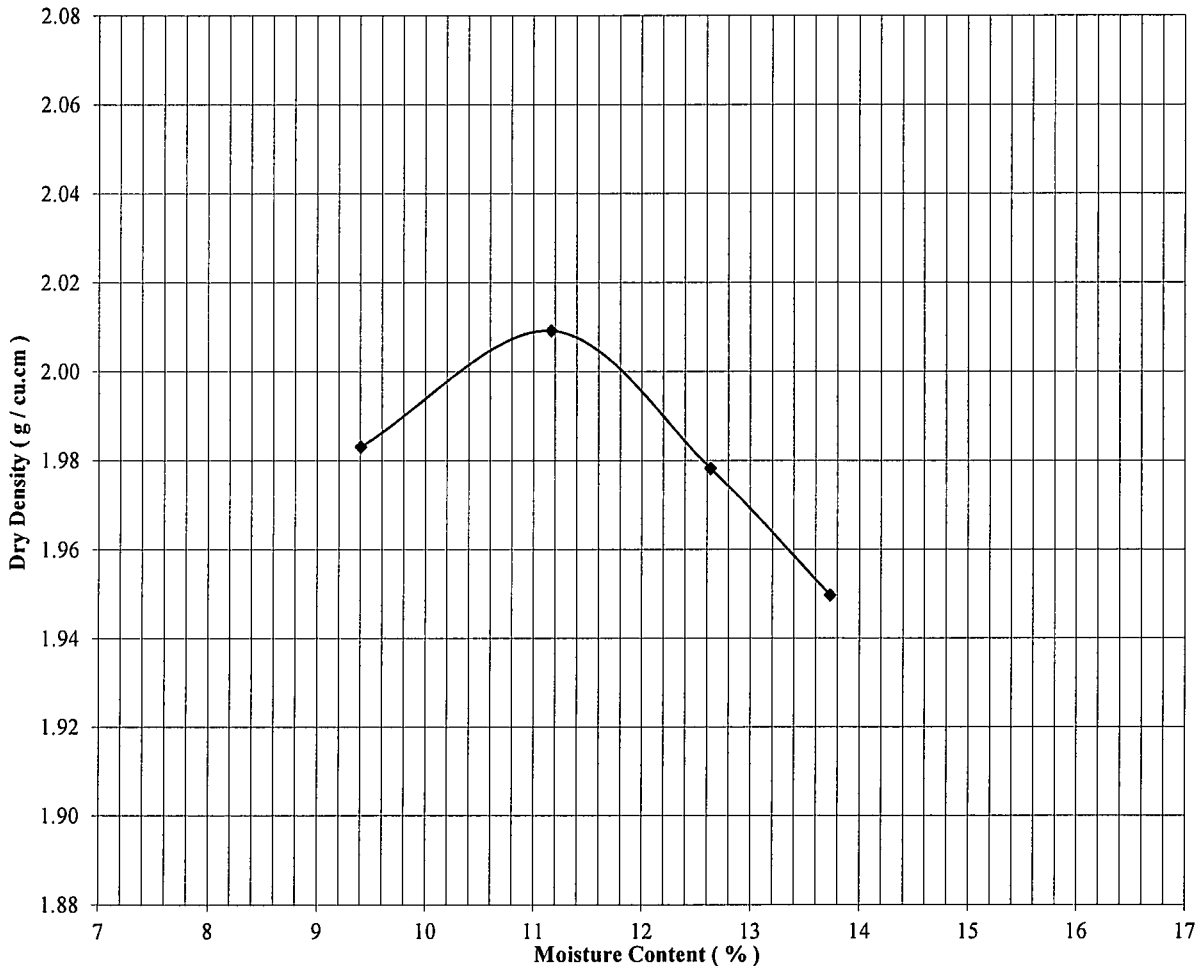
PROJECT:	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION:	TREATMENT PLANTS IN SIALKOT CITY			CLIENT	AJK ENGINEERS
TP/ BH NO:	TP-1	SAMPLE NO:	BS-1	DEPTH (m)	0.00-1.40
LAB REF. NO :	11/2020	DATE :	28.02.2020		
TESTED BY : AZMAT			CHECKED BY: MAHMOOD		

SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method :	Modified AASHTO T-180 (Method A)			**Volume of Mould :**	938 cm^3
Dia of Mould :	4.0 inch			**Drop :**	18 inch
No of Blows :	25	**No of Layers**	5	**Wt of Hammer :**	10 lbs
Test Pit No:	TP-2	**Sample No.**	BS-1	**Depth (m):**	0.00-1.00



Optimum Moisture Content (%)		11.16	**Maximum Dry Density**		2.009 g/cm^3
Project:	**PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM**				
Location :	**TREATMENT PLANTS IN SIALKOT CITY**			**Client: AJK ENGINEERS**	
Tested By	**Checked By**			**Dated**	**LAB. REF**
Azmat	**Mahmood**			**22.02.2020**	**11/2020**

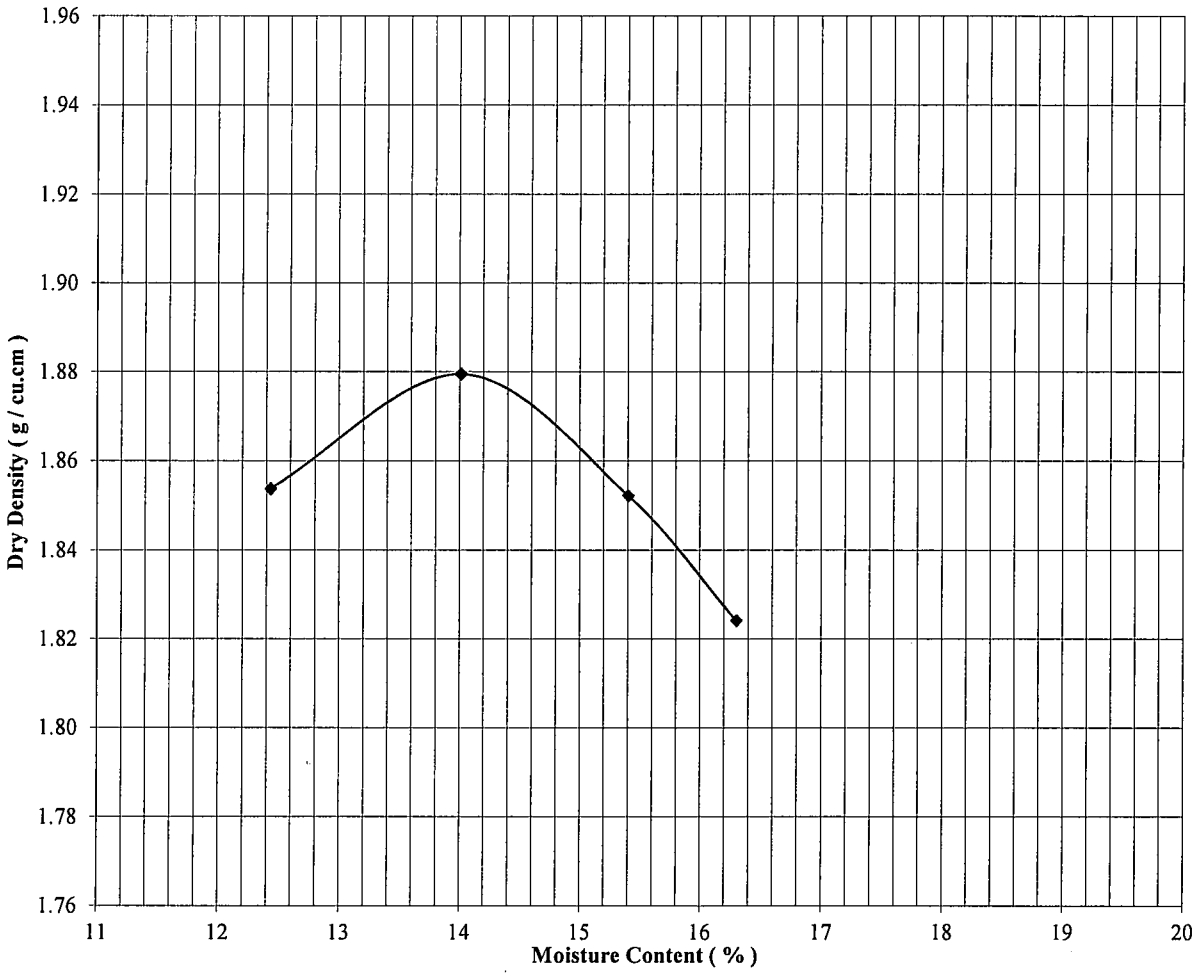
REMARKS: _____

SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method :	Modified AASHTO T-180 (Method A)			**Volume of Mould :**	938 cm^3
Dia of Mould :	4.0 inch			**Drop :**	18 inch
No of Blows :	25	**No of Layers**	5	**Wt of Hammer :**	10 lbs
Test Pit No:	TP-4	**Sample No.**	BS-1	**Depth (m):**	0.00-1.50



Optimum Moisture Content (%)		14.01	**Maximum Dry Density**		1.880 g/cm^3
Project:	**PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM**				
Location :	**TREATMENT PLANTS IN SIALKOT CITY**			**Client: AJK ENGINEERS**	
Tested By	**Checked By**			**Dated**	**LAB. REF**
Azmat	**Mahmood**			**22.02.2020**	**11/2020**

REMARKS: _____

SOILCON

GEOTECHNICAL TESTING LABORATORIES, 18-Km,
MULTAN ROAD, LAHORE

C.B.R. TEST

(AASHTO T-193)

No.of Blows per Layer		65	30	10
CBR Value at 0.1 in	%			
CBR Value at 0.2 in	%	0.6	0.3	0.1
Dry Density	g/ cm ^{3}	1.879	1.784	1.672
Moisture Content	%	13.45	13.45	13.45
Absorption	%	3.56	6.17	9.08
Swelling	%		3.95	

COMPACTION	MODIFIED
M.D.D. g/cu.cm	1.880
O.M.C %	14.01

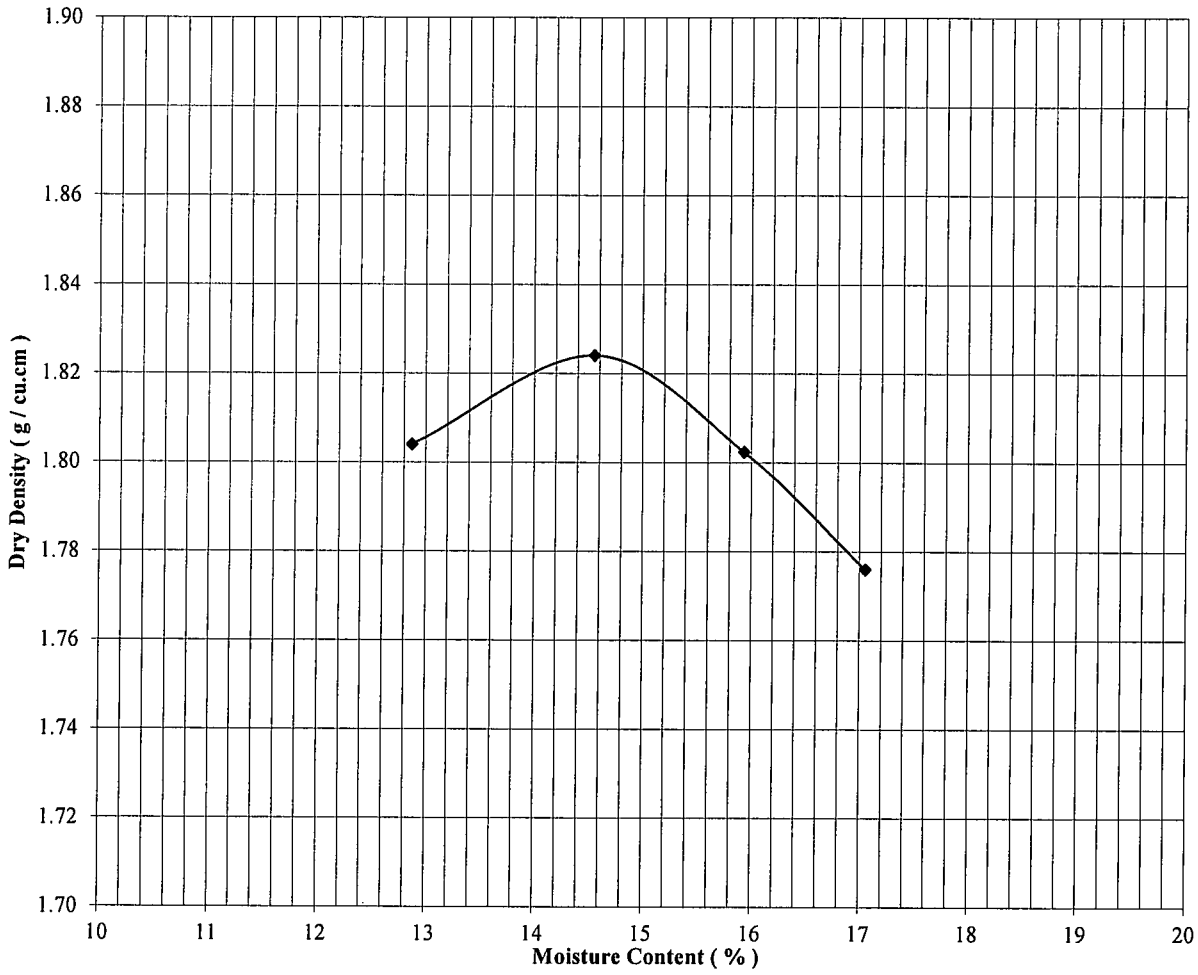
PROJECT:	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION:	TREATMENT PLANTS IN SIALKOT CITY			CLIENT	AJK ENGINEERS
TP/ BH NO:	TP-4	SAMPLE NO:	BS-1	DEPTH (m)	0.00-1.50
LAB REF. NO :	11/2020	DATE :	28.02.2020		
TESTED BY : AZMAT			CHECKED BY: MAHMOOD		

SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method :	Modified AASHTO T-180 (Method A)			**Volume of Mould :**	938 cm^3
Dia of Mould :	4.0 inch			**Drop :**	18 inch
No of Blows :	25	**No of Layers**	5	**Wt of Hammer :**	10 lbs
Test Pit No:	TP-5	**Sample No.**	BS-1	**Depth (m):**	0.00-1.50



Optimum Moisture Content (%)		14.55	**Maximum Dry Density**		1.824 g/cm^3
Project:	**PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM**				
Location :	**TREATMENT PLANTS IN SIALKOT CITY**			**Client: AJK ENGINEERS**	
Tested By		**Checked By**		**Dated**	**LAB. REF**
Azmat		**Mahmood**		**22.02.2020**	**11/2020**

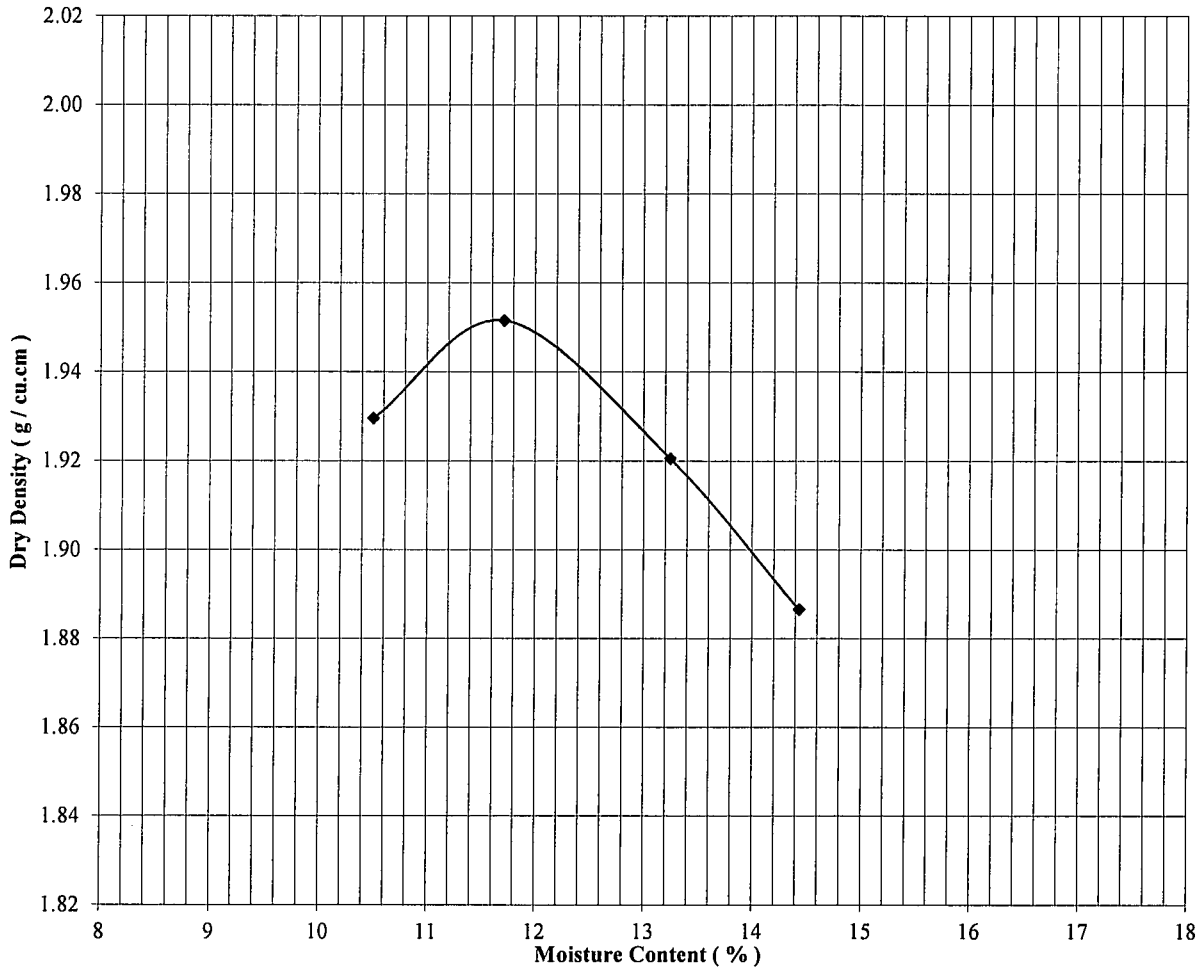
REMARKS: _____

SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method :	Modified AASHTO T-180 (Method A)			**Volume of Mould :**	938 cm^3
Dia of Mould :	4.0 inch			**Drop :**	18 inch
No of Blows :	25	**No of Layers**	5	**Wt of Hammer :**	10 lbs
Test Pit No:	TP-7	**Sample No.**	BS-1	**Depth (m):**	0.00-1.20



Optimum Moisture Content (%)		11.71	**Maximum Dry Density**		1.952 g/cm^3
Project:	**PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM**				
Location :	**TREATMENT PLANTS IN SIALKOT CITY**			**Client: AJK ENGINEERS**	
Tested By	**Checked By**			**Dated**	**LAB. REF**
Azmat	**Mahmood**			**22.02.2020**	**11/2020**

REMARKS: _____

SOILCON

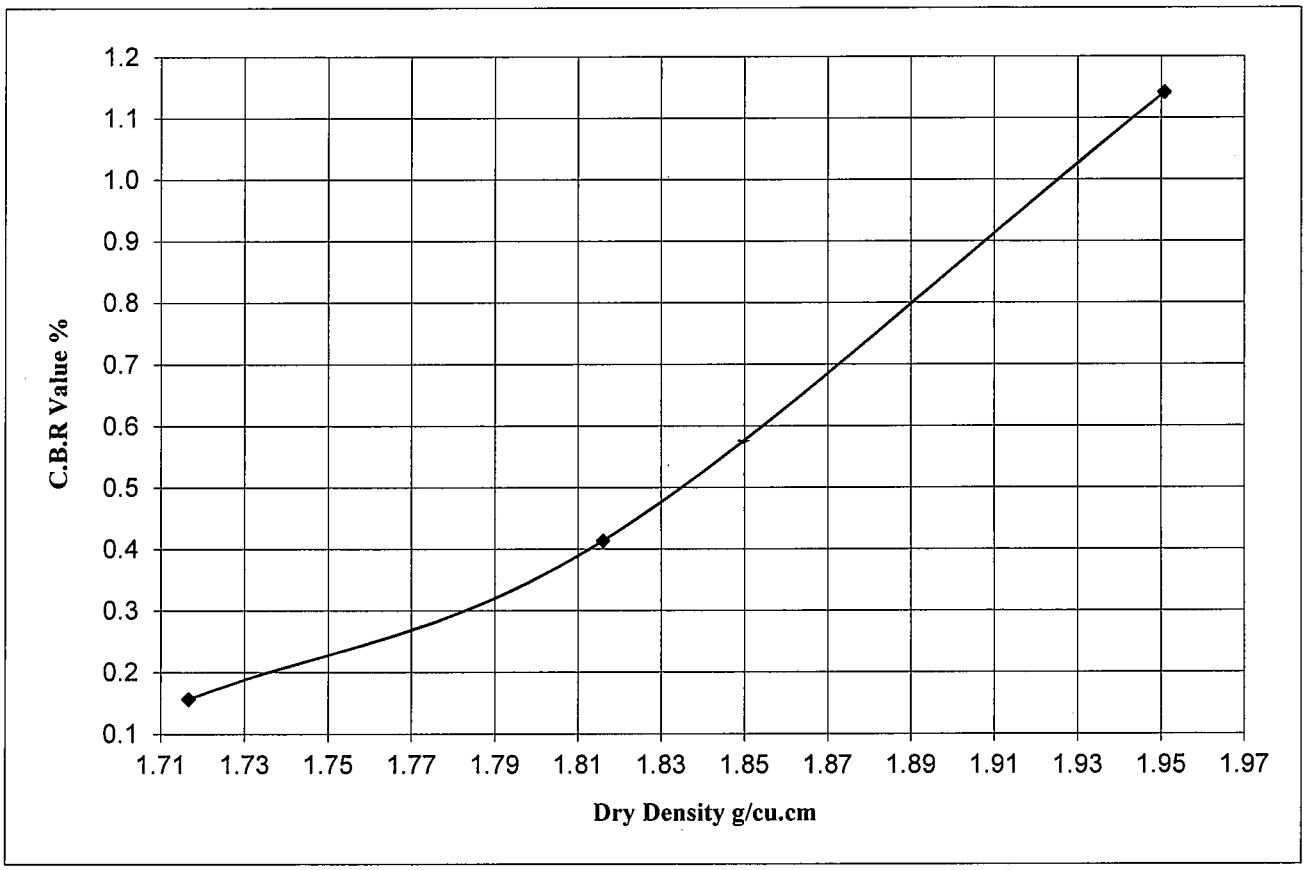
GEOTECHNICAL TESTING LABORATORIES, 18-Km,
MULTAN ROAD, LAHORE

C.B.R. TEST

(AASHTO T-193)

No.of Blows per Layer		65	30	10
CBR Value at 0.1 in	%			
CBR Value at 0.2 in	%	1.1	0.4	0.2
Dry Density	g/ cm ^{3}	1.951	1.816	1.717
Moisture Content	%	11.57	11.57	11.57
Absorption	%	5.62	7.15	9.02
Swelling	%		5.58	

COMPACTION	MODIFIED
M.D.D. g/cu.cm	1.952
O.M.C %	11.71



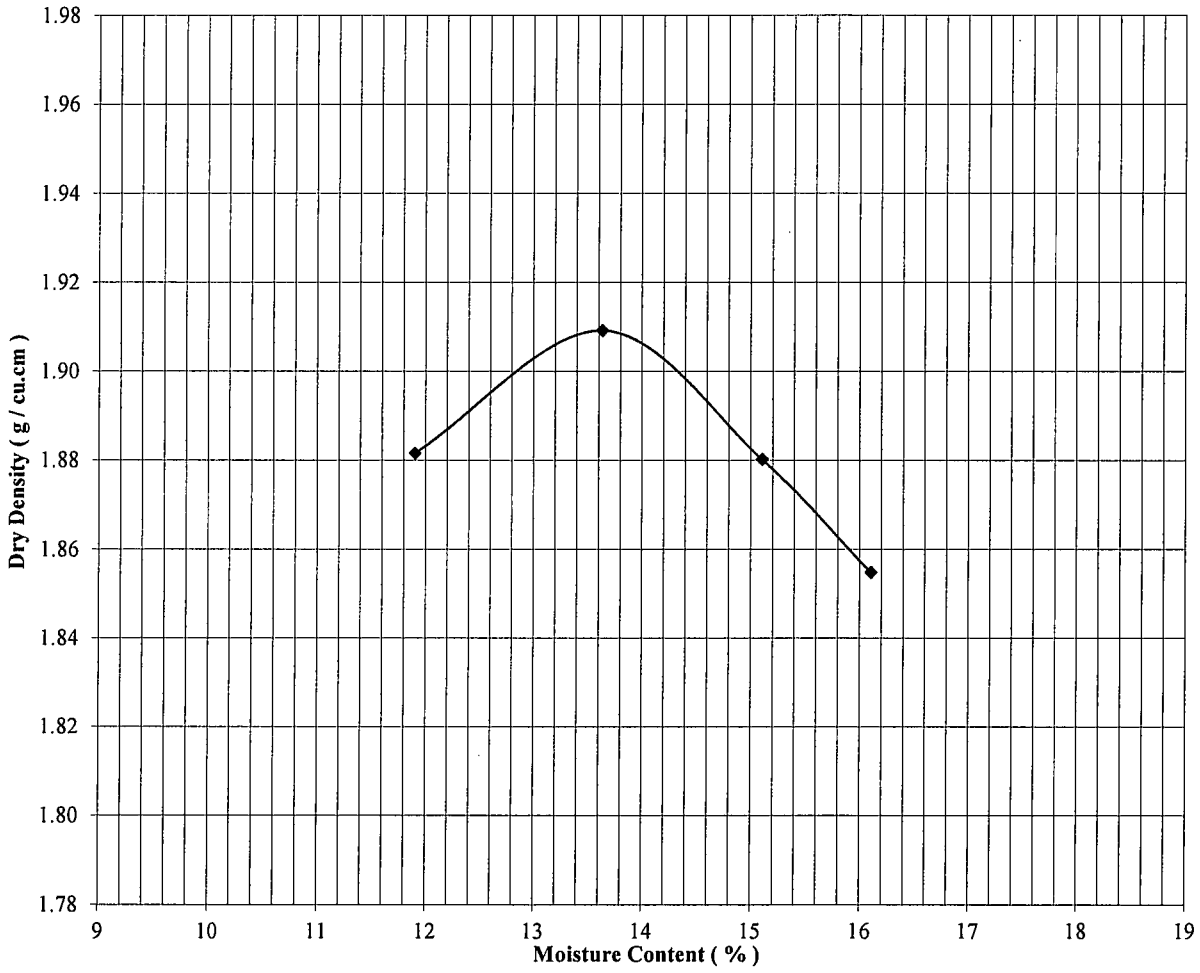
PROJECT:	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION:	TREATMENT PLANTS IN SIALKOT CITY			CLIENT	AJK ENGINEERS
TP/ BH NO:	TP-7	SAMPLE NO:	BS-1	DEPTH (m)	0.00-1.20
LAB REF. NO :	11/2020	DATE :	28.02.2020		
TESTED BY : AZMAT			CHECKED BY: MAHMOOD		

SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method :	Modified AASHTO T-180 (Method A)			**Volume of Mould :**	938 cm^3
Dia of Mould :	4.0 inch			**Drop :**	18 inch
No of Blows :	25	**No of Layers**	5	**Wt of Hammer :**	10 lbs
Test Pit No:	TP-9	**Sample No.**	BS-1	**Depth (m):**	0.00-1.50



Optimum Moisture Content (%)		13.63	**Maximum Dry Density**		1.909 g/cm^3
Project:	**PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM**				
Location :	**TREATMENT PLANTS IN SIALKOT CITY**			**Client: AJK ENGINEERS**	
Tested By		**Checked By**		**Dated**	**LAB. REF**
Azmat		**Mahmood**		**22.02.2020**	**11/2020**

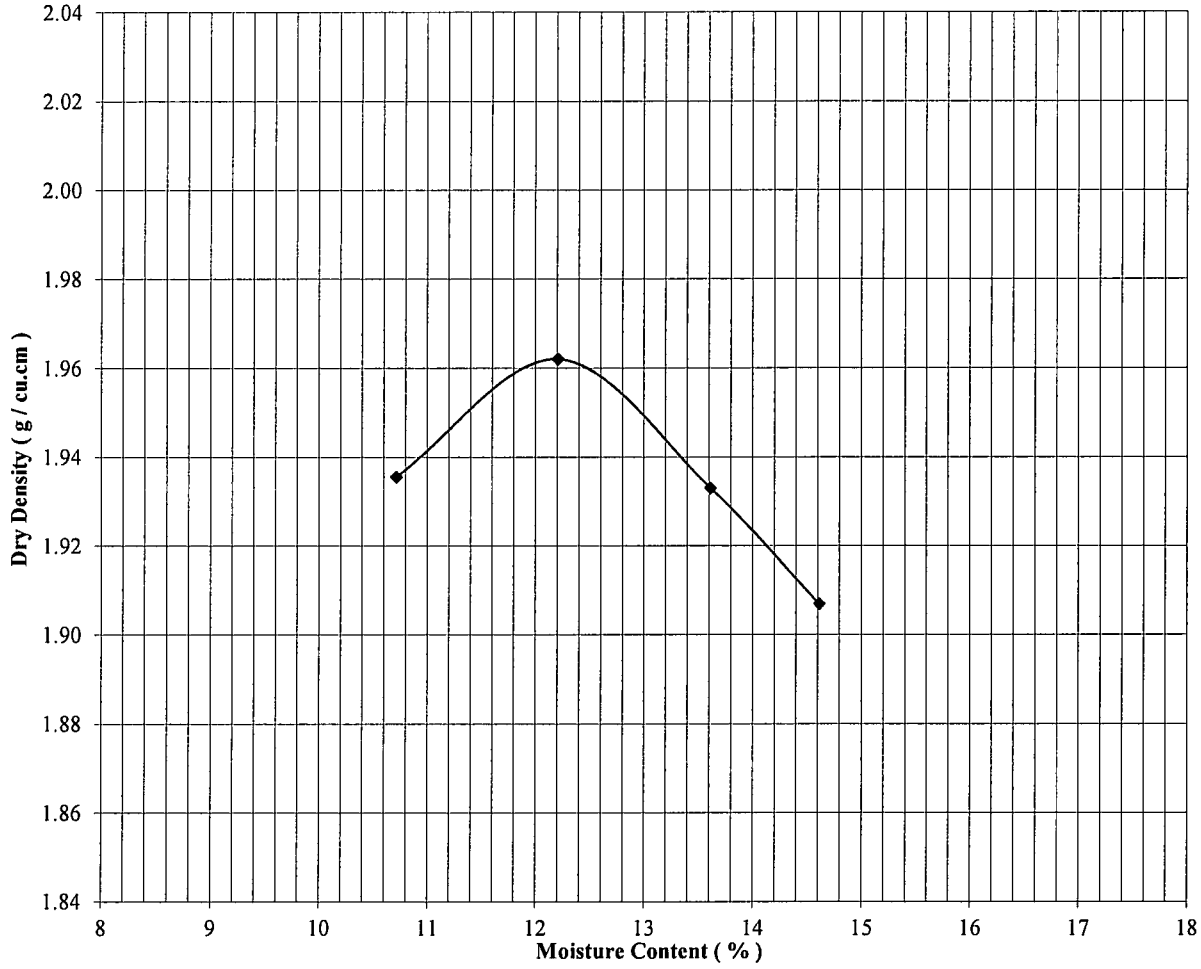
REMARKS: _____

SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method :	Modified AASHTO T-180 (Method A)			**Volume of Mould :**	938 cm^3
Dia of Mould :	4.0 inch			**Drop :**	18 inch
No of Blows :	25	**No of Layers**	5	**Wt of Hammer :**	10 lbs
Test Pit No:	TP-10	**Sample No.**	BS-1	**Depth (m):**	0.00-1.50



Optimum Moisture Content (%)		12.20	**Maximum Dry Density**		1.962 g/cm^3
Project:	**PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM**				
Location :	**TREATMENT PLANTS IN SIALKOT CITY**			**Client: AJK ENGINEERS**	
Tested By	**Checked By**			**Dated**	**LAB. REF**
Azmat	**Mahmood**			**22.02.2020**	**11/2020**

REMARKS: _____

SOILCON

GEOTECHNICAL TESTING LABORATORIES, 18-Km,
MULTAN ROAD, LAHORE

C.B.R. TEST

(AASHTO T-193)

No.of Blows per Layer		65	30	10
CBR Value at 0.1 in	%			
CBR Value at 0.2 in	%	1.2	0.4	0.2
Dry Density	g/ cm ^{3}	1.962	1.864	1.765
Moisture Content	%	11.89	11.89	11.89
Absorption	%	3.40	5.16	7.18
Swelling	%		3.91	

COMPACTION	MODIFIED
M.D.D. g/cu.cm	1.962
O.M.C %	12.20

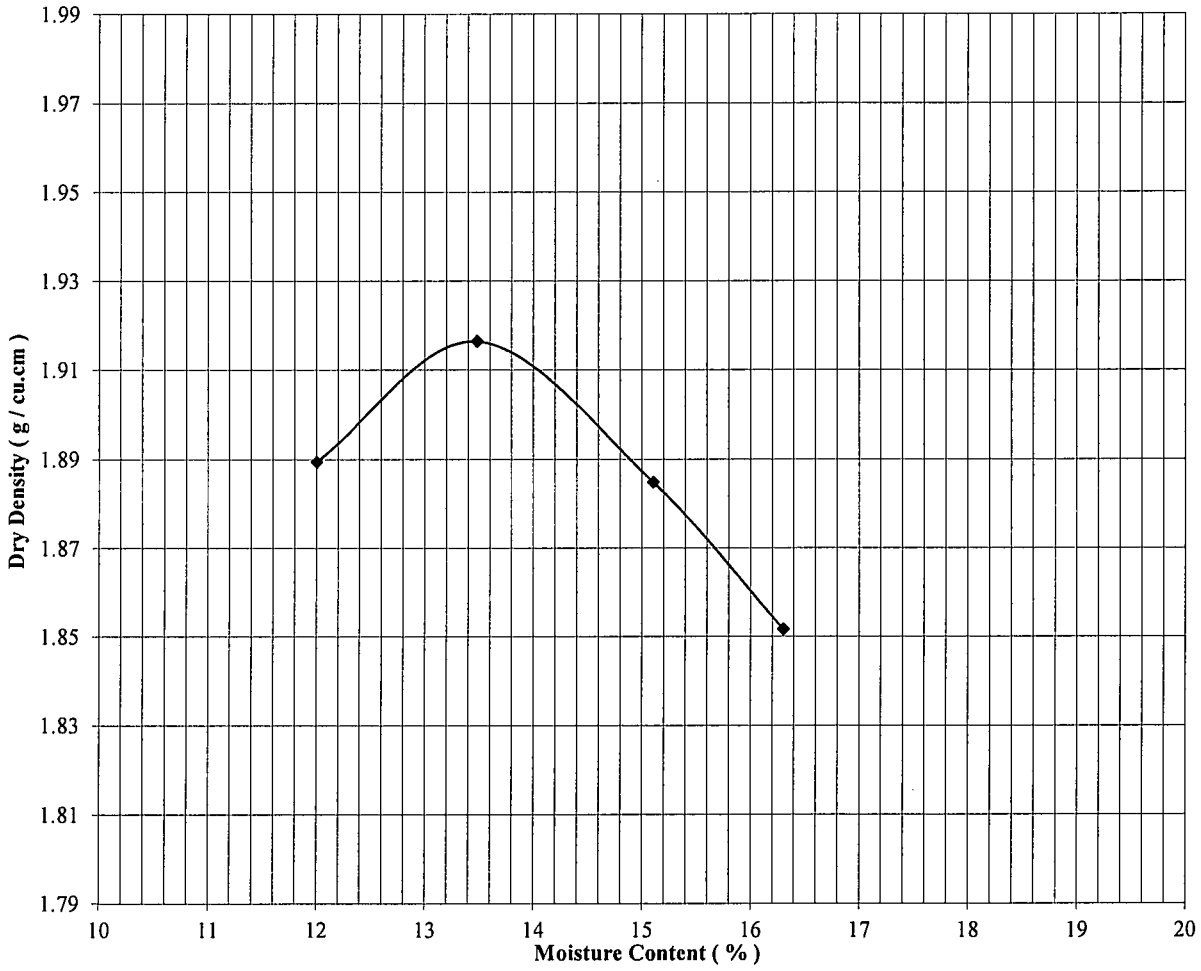
PROJECT:	PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM				
LOCATION:	TREATMENT PLANTS IN SIALKOT CITY			CLIENT	AJK ENGINEERS
TP/ BH NO:	TP-10	SAMPLE NO:	BS-1	DEPTH (m)	0.00-1.50
LAB REF. NO :	11/2020	DATE :	28.02.2020		
TESTED BY : AZMAT			CHECKED BY: MAHMOOD		

SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method :	Modified AASHTO T-180 (Method A)			**Volume of Mould :**	938 cm^3
Dia of Mould :	4.0 inch			**Drop :**	18 inch
No of Blows :	25	**No of Layers**	5	**Wt of Hammer :**	10 lbs
Test Pit No:	BA-1	**Sample No.**	BS	**Depth (m):**	0.20-1.20



Optimum Moisture Content (%)		13.48	**Maximum Dry Density**		1.916 g/cm^3
Project:	**PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM**				
Location :	**TREATMENT PLANTS IN SIALKOT CITY**			**Client: AJK ENGINEERS**	
Tested By		**Checked By**		**Dated**	**LAB. REF**
Azmat		**Mahmood**		**22.02.2020**	**11/2020**

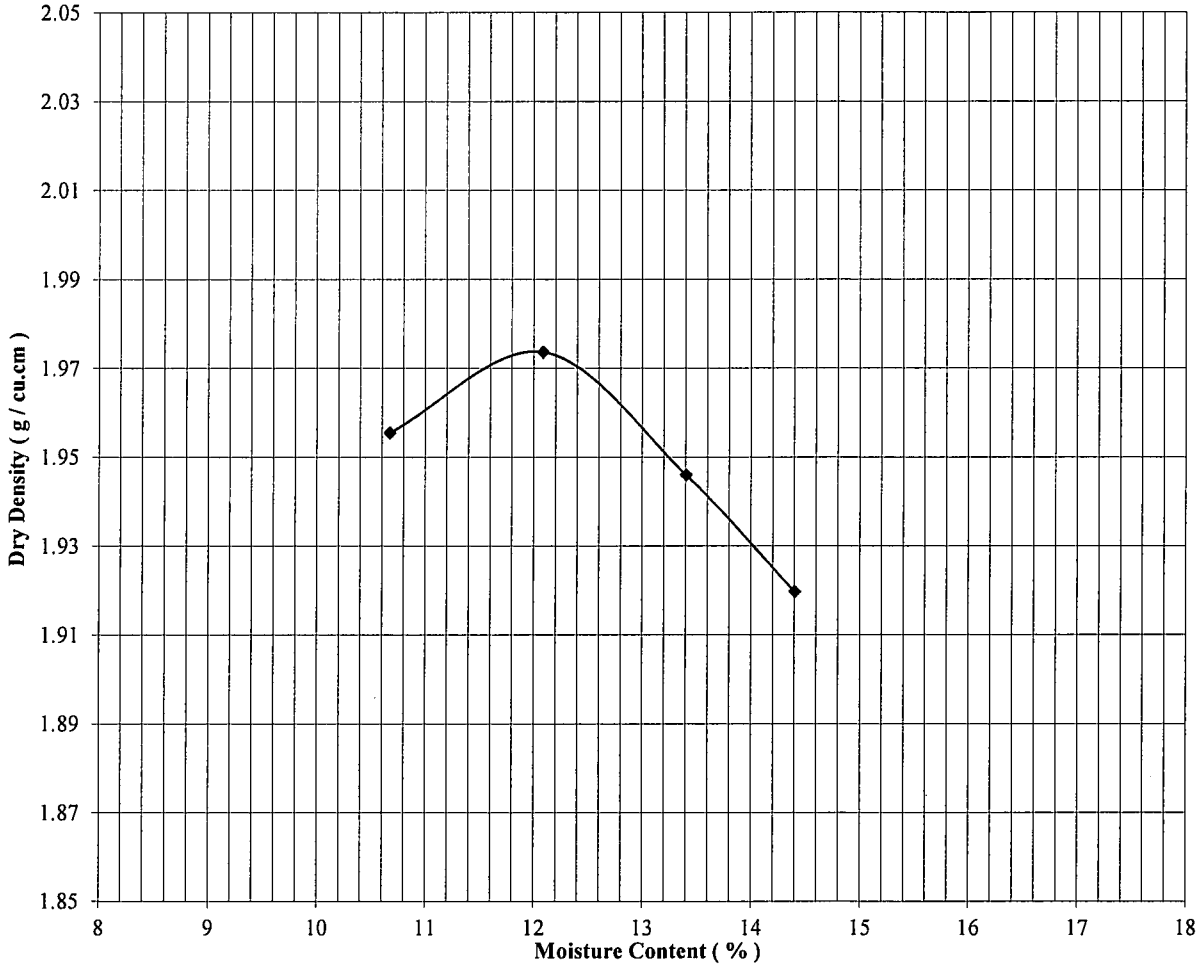
REMARKS: _____

SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method :	Modified AASHTO T-180 (Method A)			**Volume of Mould :**	938 cm^3
Dia of Mould :	4.0 inch			**Drop :**	18 inch
No of Blows :	25	**No of Layers**	5	**Wt of Hammer :**	10 lbs
Test Pit No:	BA-2	**Sample No.**	BS	**Depth (m):**	0.10-1.20



Optimum Moisture Content (%)	12.08		**Maximum Dry Density**	1.974 g/cm^3	
Project:	**PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM**				
Location :	**TREATMENT PLANTS IN SIALKOT CITY**		**Client: AJK ENGINEERS**		
Tested By	**Checked By**		**Dated**	**LAB. REF**	
Azmat	**Mahmood**		**22.02.2020**	**11/2020**	

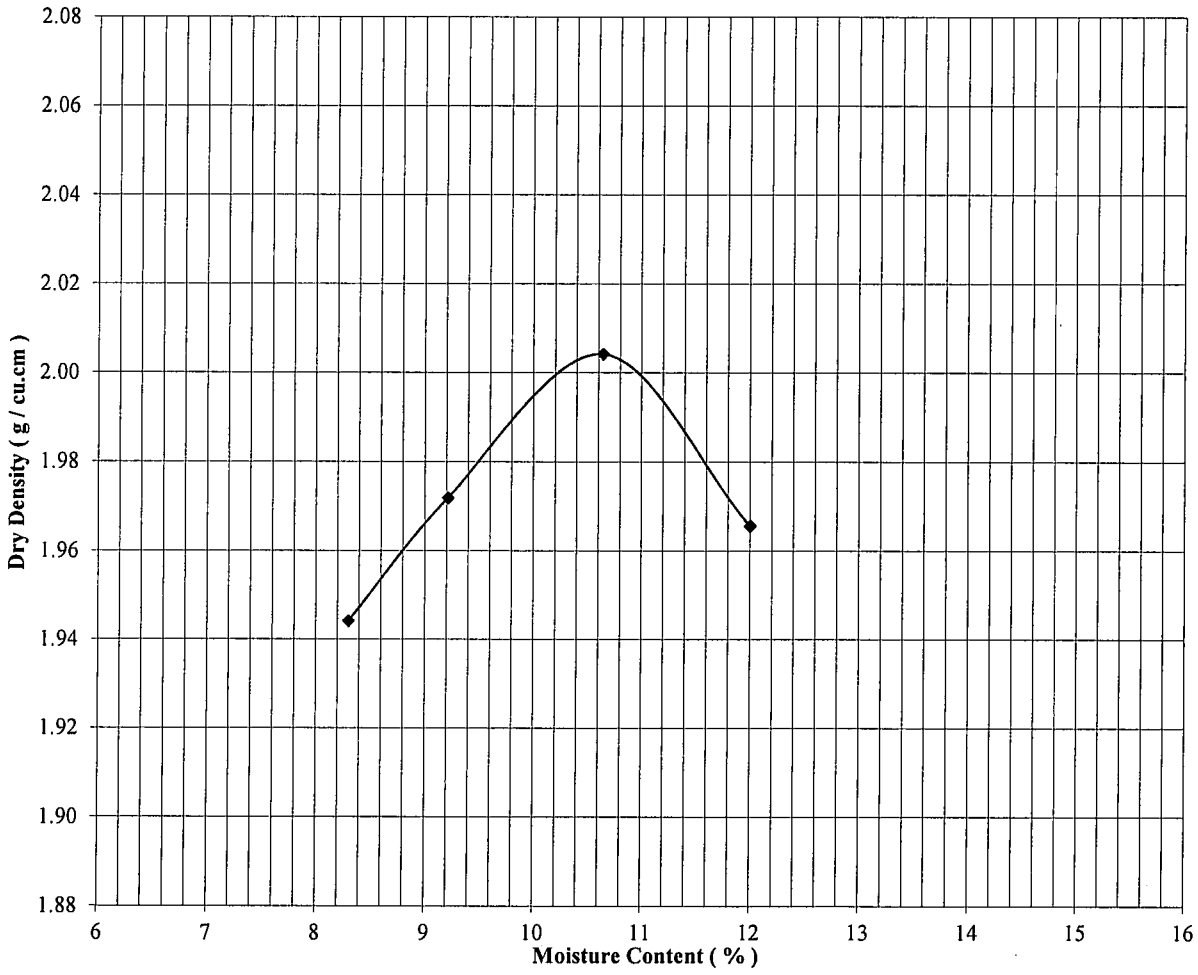
REMARKS: _____

SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method :	Modified AASHTO T-180 (Method A)			**Volume of Mould :**	938 cm^3
Dia of Mould :	4.0 inch			**Drop :**	18 inch
No of Blows :	25	**No of Layers**	5	**Wt of Hammer :**	10 lbs
Test Pit No:	BA-3	**Sample No.**	BS	**Depth (m):**	0.10-1.00



Optimum Moisture Content (%)		10.64	**Maximum Dry Density**		2.004 g/cm^3
Project:	**PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM**				
Location :	**TREATMENT PLANTS IN SIALKOT CITY**			**Client: AJK ENGINEERS**	
Tested By		**Checked By**		**Dated**	**LAB. REF**
Azmat		**Mahmood**		**22.02.2020**	**11/2020**

REMARKS: _____

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**decon** Soil and Concrete Testing Laboratroy Pvt (Ltd)
Location	Sialkot City	

BH / TP No.	BAS-01	**Job No.**	-
Sample No.	CS	**Lab No.**	603
Sample Depth (m)	0.00-1.50	**Test Started**	14-Feb-20
Sampling Date	-	**Test Completed**	16-Feb-20

MOISTURE DENSITY RELATIONSHIP (AASHTO T 180)

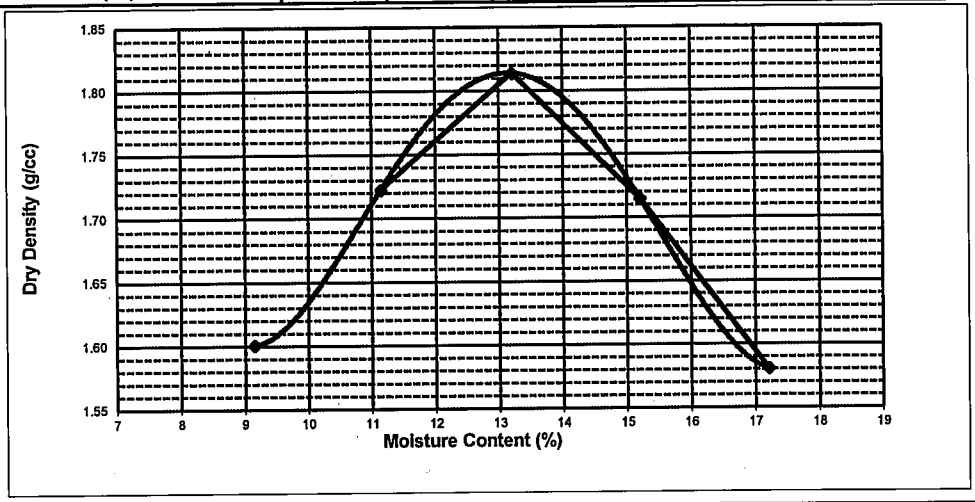
Mould No.	1		**Weight of Rammer**	4.54 kg	**Dia of Mould**		15.24 cm
Number of Blows	~~25~~	56	**Fall of Rammer**	45.72 cm	**Height of Mould**		11.643 cm
Number of Layers	5				**Volume of Mould**		2123.9 cm^3

Unit Weight Determination

Trial No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Weight of Mould (g)	2220	2220	2220	2220	2220		
Weight of Mould and Wet Soil (g)	5930	6285	6580	6415	6154		
Weight of Wet Soil (g)	3710	4065	4360	4195	3934		
Wet Density of Soil (g/cm^3)	1.747	1.914	2.053	1.975	1.852		
Dry Density of Soil (g/cm^3)	1.600	1.722	1.813	1.714	1.580		

Moisture Content Determination

Container No.	**C-30**	**C-74**	**C-71**	**C-36**	**C-80**	**6**	**7**
Wt. of Container (g)	22.47	24.28	22.33	23.64	25.18		
Wt. of Container + Wet Sample (g)	198.52	188.26	177.52	185.28	194.52		
Wt. of Container + Dry Sample (g)	183.76	171.81	159.41	163.94	169.66		
Wt. of Water (g)	14.76	16.45	18.11	21.34	24.86		
Wt. of Dry Soil (g)	161.29	147.53	137.08	140.30	144.48		
Moistrure Content (%)	9.15	11.15	13.21	15.21	17.21		



Maximum Dry Density	**1.813** g/cm^3	Optimum Moisture Content	**13.10 %**

Tested By	**Checked By**	**Approved By**
Faryad Ali	M.Ramzan	Muhammad Daniyal

Engineers & Constructors decon Drillers

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	Job No.	-
Location	Sialkot City	Lab No.	603
BH / TP No.	BAS-01	Sampled Date	-
Sample No.	CS	Test Started	16-Feb-20
Sample Depth (m)	0.00-1.50	Test Completed	21-Feb-20

decon
Soil and Concrete Testing Laboratory (Pvt) Ltd

CALIFORNIA BEARING RATIO TEST (AASHTO T 193)

Dia of Mould	15.24 cm	Height of Mould	12.70 cm	No. of Blows	10, 30, 65	No. of Layers	5	Rammer Weight	4.536 kg	Rammer Fall	45.72 cm

Moisture Content of Soil

Description	Before Soaking						After Soaking					
	10 Blows		30 Blows		65 Blows		10 Blows		30 Blows		65 Blows	
Container No.	C-83	C-39	C-40	C-174	C-129	C-87	C-85	C-18	C-59	C-121	C-75	C-101
Wt. of Container (g)	20.48	24.97	22.82	19.73	24.91	25.09	21.35	28.97	25.03	29.06	23.53	21.89
Wt. of Container + Soil (g)	168.7	181.3	188.5	196.3	159.5	188.8	181.5	185.2	187.6	191.4	182.3	190.6
Wt. of Container + Dry Soil (g)	151.4	163.0	169.1	175.9	143.8	169.7	160.3	164.2	167.3	170.8	162.8	169.9
Wt. of Water (g)	17.22	18.25	19.40	20.38	15.68	19.11	21.20	20.99	20.28	20.58	19.43	20.71
Wt. of Dry Soil (g)	131.0	138.0	146.3	156.2	118.9	144.6	138.9	135.3	142.3	141.7	139.3	148.0
Moistrure Content (%)	13.15	13.22	13.26	13.05	13.18	13.22	15.26	15.52	14.25	14.52	13.95	13.99

Unit Weight of Soil

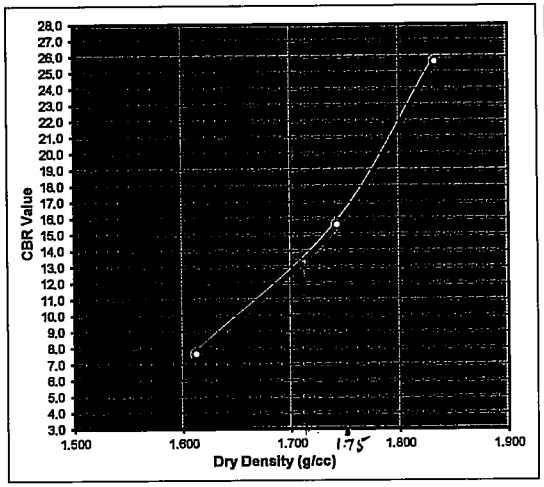
Description	10 Blows	30 Blows	65 Blows
Mould No.	28	1	15
Wt.Mould + Base Plate	3936	3886	3928
Wt.Mould+Soil (g)	8162	8453	8735
Weight of Wet Soil (g)	4226	4567	4807
Volume of Mould (cm^3)	2317	2317	2317
Wet Density of Soil (g/cm^3)	1.824	1.972	2.075
Dry Density of Soil (g/cm^3)	1.612	1.742	1.833

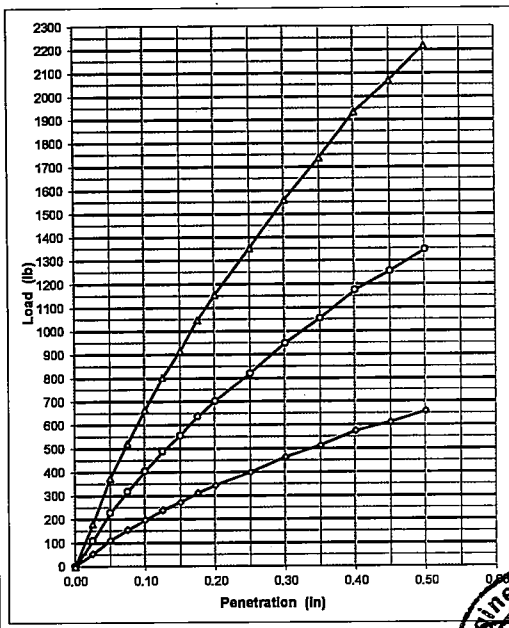
O.M.C 13.10 % | Max Dry Density 1.813 g/cm^3

CBR TEST DATA

Ring Factor 0.89

Penetration (in)	10 Blows		30 Blows		65 Blows	
	Dial Reading	Load (lb)	Dial Reading	Load (lb)	Dial Reading	Load (lb)
0.000	0	0	0	0	0	0
0.025	60	53	122	109	201	179
0.050	124	111	255	227	420	373
0.075	174	155	356	316	586	521
0.100	222	197	454	404	747	665
0.125	267	238	547	486	900	801
0.150	305	271	624	555	1027	914
0.175	349	310	714	635	1176	1046
0.200	385	343	788	701	1298	1155
0.250	447	398	921	820	1520	1353
0.300	520	463	1064	947	1753	1560
0.350	576	512	1184	1053	1953	1738
0.400	644	573	1319	1174	2172	1933
0.450	686	610	1409	1254	2324	2069
0.500	739	658	1512	1346	2491	2217





CBR DATA	CBR at 0.1 in	CBR at 0.2 in
10 Blows	6.58	7.61
30 Blows	13.46	15.58
65 Blows	22.17	25.67

Dry Density (g/cm^3)
1.612
1.742
1.833

Swell		
Initail	Final	%
0	0.0	0.00
0	0.0	0.00
0	0.0	0.00

Max Dry Density at	
90%	= 1.632 g/cc
95%	= 1.722 g/cc
100%	= 1.813 g/cc

CBR Value at 0.20 in penetration	
90 % Max Dry Density	= 8.6
95 % Max Dry Density	= 14.0
100 % Max Dry Density	= 23.0

Tested By	Faryad Ali	Checked By	M.Ramzan	Approved By	Muhammad Danlyal

Engineers & Constructors * Drillers
decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**decon** Soil and Concrete Testing Laboratroy Pvt (Ltd)
Location	Sialkot City	

BH / TP No.	BAS-02	**Job No.**	-
Sample No.	CS	**Lab No.**	603
Sample Depth (m)	0.00-1.50	**Test Started**	14-Feb-20
Sampling Date	-	**Test Completed**	16-Feb-20

MOISTURE DENSITY RELATIONSHIP (AASHTO T 180)

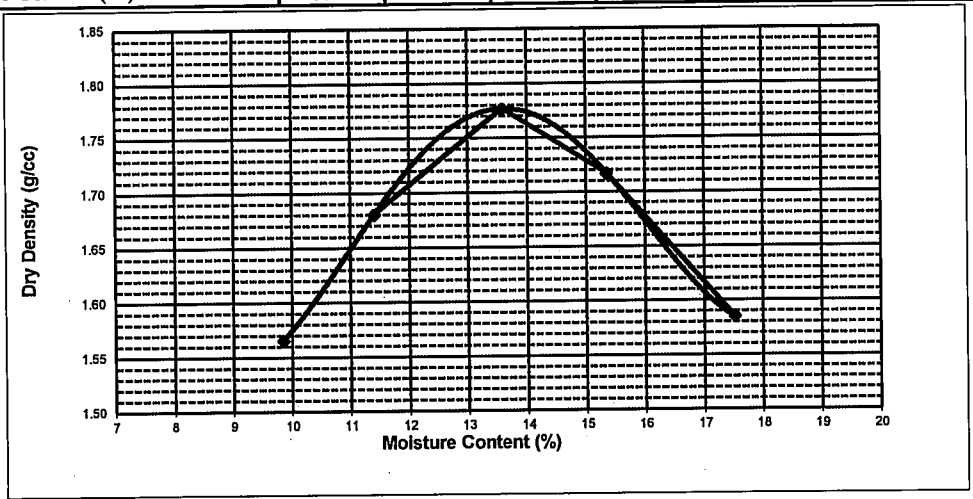
Mould No.	1	**Weight of Rammer**	4.54 kg	**Dia of Mould**		15.24 cm
Number of Blows	~~25~~ 56	**Fall of Rammer**	45.72 cm	**Height of Mould**		11.643 cm
Number of Layers	5			**Volume of Mould**		2123.9 cm^3

Unit Weight Determination

Trial No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Weight of Mould (g)	2060	2060	2060	2060	2060		
Weight of Mould and Wet Soil (g)	5711	6035	6345	6265	6015		
Weight of Wet Soil (g)	3651	3975	4285	4205	3955		
Wet Density of Soil (g/cm^3)	1.719	1.872	2.018	1.980	1.862		
Dry Density of Soil (g/cm^3)	1.565	1.680	1.776	1.716	1.585		

Moisture Content Determination

Container No.	**C-24**	**C-65**	**C-68**	**C-124**	**C-77**	**6**	**7**
Wt. of Container (g)	21.41	22.16	24.06	22.66	22.57		
Wt. of Container + Wet Sample (g)	187.59	194.58	188.74	192.28	178.52		
Wt. of Container + Dry Sample (g)	172.69	176.92	169.04	169.71	155.27		
Wt. of Water (g)	14.90	17.66	19.70	22.57	23.25		
Wt. of Dry Soil (g)	151.28	154.76	144.98	147.05	132.70		
Moistrure Content (%)	9.85	11.41	13.59	15.35	17.52		



Maximum Dry Density	**1.778** g/cm^3	Optimum Moisture Content	**13.60 %**

Tested By	**Checked By**	**Approved By**
Nasrullha Khan	M.Ramzan	Muhammad Daniyal

Drillers, Engineers & Constructors

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	Job No.	-
Location	Sialkot City	Lab No.	603
BH / TP No.	BAS-02	Sampled Date	-
Sample No.	CS	Test Started	16-Feb-20
Sample Depth (m)	0.00-1.50	Test Completed	21-Feb-20

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CALIFORNIA BEARING RATIO TEST (AASHTO T 193)

Dia of Mould	15.24 cm	Height of Mould	12.70 cm	No. of Blows	10, 30, 65	No. of Layers	5	Rammer Weight	4.536 kg	Rammer Fall	45.72 cm

Moisture Content of Soil

Description	Before Soaking						After Soaking					
	10 Blows		30 Blows		65 Blows		10 Blows		30 Blows		65 Blows	
Container No.	C-12	C-06	C-03	C-02	C-55	C-13	C-17	C-63	C-70	C-32	C-79	C-34
Wt. of Container (g)	25.00	28.22	28.65	30.33	24.29	24.71	22.59	32.08	23.39	24.71	23.23	21.62
Wt. of Container + Soil (g)	170.0	199.7	191.5	158.6	167.6	188.7	194.2	188.7	179.0	185.6	194.3	191.7
Wt. of Container + Dry Soil (g)	152.6	179.1	172.0	143.2	150.5	169.3	171.4	167.7	159.5	165.2	173.7	171.0
Wt. of Water (g)	17.33	20.64	19.43	15.39	17.09	19.43	22.76	21.05	19.40	20.40	20.58	20.73
Wt. of Dry Soil (g)	127.6	150.9	143.4	112.9	126.2	144.6	148.8	135.6	136.2	140.5	150.4	149.4
Moistrure Content (%)	13.58	13.68	13.55	13.64	13.54	13.44	15.29	15.52	14.25	14.52	13.68	13.88

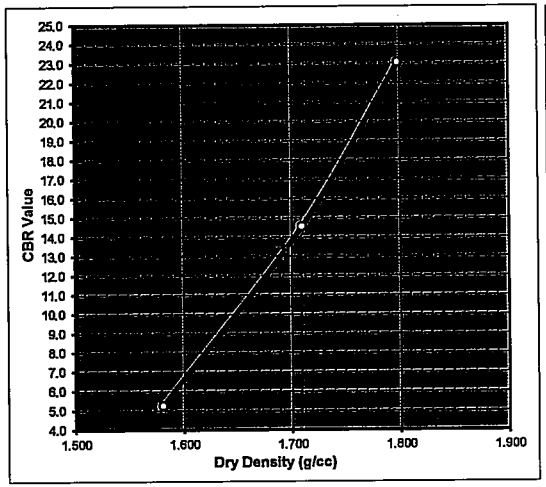
Unit Weight of Soil

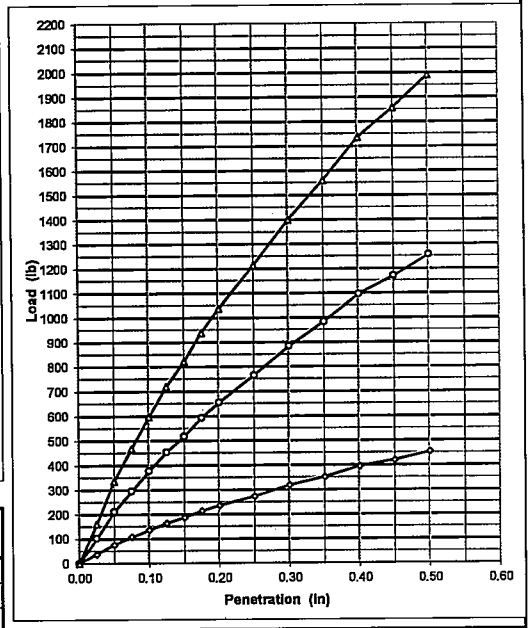
Description	10 Blows	30 Blows	65 Blows
Mould No.	36	5	14
Wt.Mould + Base Plate	3872	3400	3972
Wt.Mould+Soil (g)	8032	7898	8699
Weight of Wet Soil (g)	4160	4498	4727
Volume of Mould (cm^3)	2317	2317	2317
Wet Density of Soil (g/cm^3)	1.796	1.941	2.041
Dry Density of Soil (g/cm^3)	1.580	1.709	1.798
O.M.C 13.60 %	Max Dry Density		1.778 g/cm^3

CBR TEST DATA

Ring Factor 0.89

Penetration (In)	10 Blows		30 Blows		65 Blows	
	Dial Reading	Load (lb)	Dial Reading	Load (lb)	Dial Reading	Load (lb)
0.000	0	0	0	0	0	0
0.025	41	37	114	101	180	161
0.050	86	76	238	211	377	335
0.075	120	106	332	295	526	468
0.100	153	136	423	377	671	597
0.125	184	164	510	454	808	719
0.150	210	187	582	518	922	820
0.175	240	214	666	592	1055	939
0.200	265	236	735	654	1165	1037
0.250	306	273	859	764	1364	1214
0.300	358	318	992	883	1573	1400
0.350	395	351	1104	982	1752	1560
0.400	443	395	1230	1095	1950	1735
0.450	471	419	1314	1169	2086	1856
0.500	509	453	1411	1255	2236	1990





CBR DATA	CBR at 0.1 In	CBR at 0.2 In
10 Blows	4.53	5.24
30 Blows	12.55	14.54
65 Blows	19.90	23.04

Dry Density (g/cm^3)
1.580
1.709
1.798

Swell		
Initail	Final	%
0	0.0	0.00
0	0.0	0.00
0	0.0	0.00

Max Dry Density at	
90%	= 1.600 g/cc
95%	= 1.689 g/cc
100%	= 1.778 g/cc

CBR Value at 0.20 In penetration	
90 % Max Dry Density	= 6.5
95 % Max Dry Density	= 13.0
100 % Max Dry Density	= 20.8

Tested By	Nasrullha Khan	Checked By	M.Ramzan	Approved By	Muhammad Danlyal

Drillers, Engineers & Constructors * decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System
Location	Sialkot City

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Testing Laboratroy Pvt (Ltd)

BH / TP No.	BAS-03	**Job No.**	-
Sample No.	CS	**Lab No.**	603
Sample Depth (m)	0.00-1.50	**Test Started**	14-Feb-20
Sampling Date	-	**Test Completed**	16-Feb-20

MOISTURE DENSITY RELATIONSHIP (AASHTO T 180)

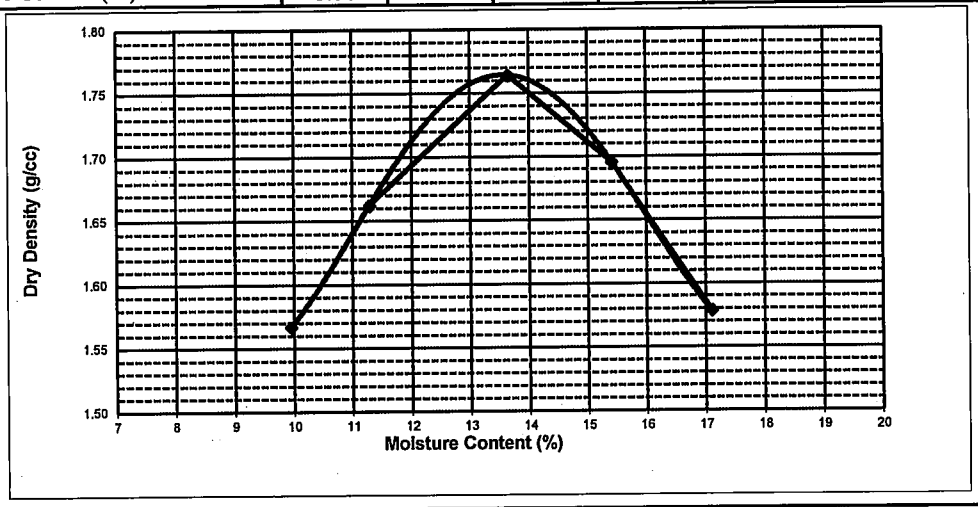
Mould No.	1		**Weight of Rammer**	4.54 kg	**Dia of Mould**		15.24 cm
Number of Blows	~~25~~	56	**Fall of Rammer**	45.72 cm	**Height of Mould**		11.643 cm
Number of Layers	5				**Volume of Mould**		2123.9 cm^3

Unit Weight Determination

Trial No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Weight of Mould (g)	2220	2220	2220	2220	2220		
Weight of Mould and Wet Soil (g)	5878	6148	6477	6375	6145		
Weight of Wet Soil (g)	3658	3928	4257	4155	3925		
Wet Density of Soil (g/cm^3)	1.722	1.849	2.004	1.956	1.848		
Dry Density of Soil (g/cm^3)	1.566	1.662	1.764	1.695	1.578		

Moisture Content Determination

Container No.	**C-22**	**C-28**	**C-72**	**C-117**	**C-58**	**6**	**7**
Wt. of Container (g)	25.53	29.93	28.61	25.77	29.20		
Wt. of Container + Wet Sample (g)	193.52	194.48	188.59	191.41	187.52		
Wt. of Container + Dry Sample (g)	178.32	177.79	169.38	169.29	164.39		
Wt. of Water (g)	15.20	16.69	19.21	22.12	23.13		
Wt. of Dry Soil (g)	152.79	147.86	140.77	143.52	135.19		
Moistrure Content (%)	9.95	11.29	13.65	15.41	17.11		



Maximum Dry Density	**1.763** g/cm^3	Optimum Moisture Content	**13.60 %**

Tested By	**Checked By**	**Approved By**
Faryad Ali	M.Ramzan	Muhammad Daniyal

Engineers & Constructors * Drillers
decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	Job No.	-
Location	Sialkot City	Lab No.	603
BH / TP No.	BAS-03	Sampled Date	-
Sample No.	CS	Test Started	16-Feb-20
Sample Depth (m)	0.00-1.50	Test Completed	21-Feb-20

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Soil and Concrete Testing Laboratory (Pvt) Ltd

CALIFORNIA BEARING RATIO TEST (AASHTO T 193)

Dia of Mould	15.24 cm	Height of Mould	12.70 cm	No. of Blows	10, 30, 65	No. of Layers	5	Rammer Weight	4.536 kg	Rammer Fall	45.72 cm

Moisture Content of Soil

Description	Before Soaking						After Soaking					
	10 Blows		30 Blows		65 Blows		10 Blows		30 Blows		65 Blows	
Container No.	C-119	C-81	C-88	C-60	C-99	C-107	C-53	C-07	C-78	C-66	C-44	C-91
Wt. of Container (g)	29.66	23.00	24.42	23.99	21.93	23.37	23.68	22.61	23.86	25.66	31.58	24.37
Wt. of Container + Soil (g)	164.5	166.5	178.5	188.3	191.5	188.6	178.9	188.3	191.5	188.6	178.3	185.5
Wt. of Container + Dry Soil (g)	148.3	149.4	160.2	168.6	171.3	169.3	157.6	166.1	170.7	167.9	160.4	166.4
Wt. of Water (g)	16.19	17.13	18.31	19.73	20.20	19.39	21.25	22.16	20.78	20.70	17.88	19.14
Wt. of Dry Soil (g)	118.6	126.4	135.8	144.6	149.4	145.9	133.9	143.5	146.8	142.3	128.8	142.0
Moistrure Content (%)	13.65	13.55	13.48	13.65	13.52	13.29	15.87	15.44	14.15	14.55	13.88	13.48

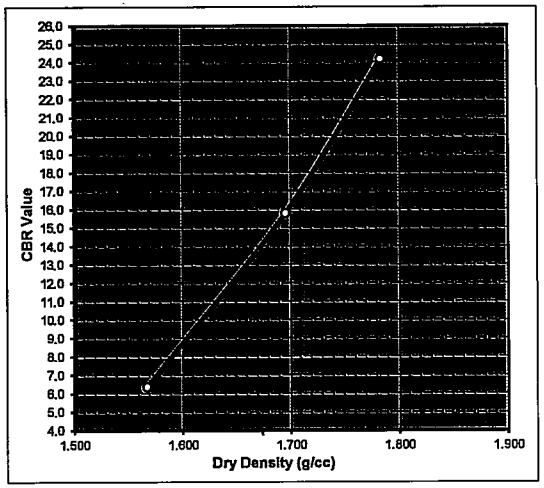
Unit Weight of Soil

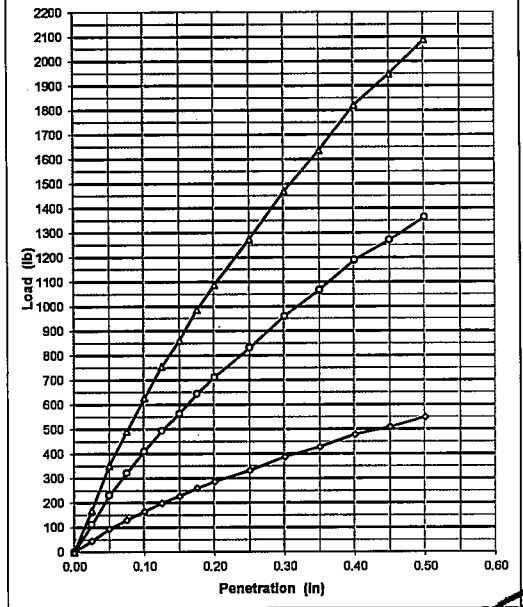
Description	10 Blows	30 Blows	65 Blows
Mould No.	37	6	29
Wt.Mould + Base Plate	3956	3884	3458
Wt.Mould+Soil (g)	8079	8343	8142
Weight of Wet Soil (g)	4123	4459	4684
Volume of Mould (cm^3)	2317	2317	2317
Wet Density of Soil (g/cm^3)	1.780	1.925	2.022
Dry Density of Soil (g/cm^3)	1.567	1.695	1.783
O.M.C 13.60 %	Max Dry Density		1.763 g/cm^3

CBR TEST DATA

Ring Factor 0.89

Penetration (in)	10 Blows		30 Blows		65 Blows	
	Dial Reading	Load (lb)	Dial Reading	Load (lb)	Dial Reading	Load (lb)
0.000	0	0	0	0	0	0
0.025	50	44	124	110	189	168
0.050	104	92	258	230	395	352
0.075	145	129	360	320	551	491
0.100	185	164	459	409	704	626
0.125	223	198	553	493	848	754
0.150	254	226	631	562	967	861
0.175	291	259	723	643	1107	985
0.200	321	286	798	710	1222	1088
0.250	372	331	933	830	1431	1274
0.300	433	386	1077	959	1650	1468
0.350	479	426	1199	1067	1838	1636
0.400	537	478	1335	1188	2045	1820
0.450	571	508	1427	1270	2188	1947
0.500	616	548	1532	1363	2345	2087





CBR DATA	CBR at 0.1 in	CBR at 0.2 in
10 Blows	5.48	6.35
30 Blows	13.63	15.78
65 Blows	20.87	24.17

Dry Density (g/cm^3)
1.567
1.695
1.783

Swell		
Initail	Final	%
0	0.0	0.00
0	0.0	0.00
0	0.0	0.00

Max Dry Density at	
90%	= 1.587 g/cc
95%	= 1.675 g/cc
100%	= 1.763 g/cc

CBR Value at 0.20 in penetration	
90 % Max Dry Density	= 7.6
95 % Max Dry Density	= 14.0
100 % Max Dry Density	= 22.1

Tested By	Jawad Nasir	Checked By	M.Ramzan	Approved By	Muhammad Danlyal

Drillers, Engineers & Constructors

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	**decon** Soil and Concrete Testing Laboratroy Pvt (Ltd)
Location	Sialkot City	

BH / TP No.	BAS-04	**Job No.**	-
Sample No.	CS	**Lab No.**	603
Sample Depth (m)	0.00-1.50	**Test Started**	14-Feb-20
Sampling Date	-	**Test Completed**	16-Feb-20

MOISTURE DENSITY RELATIONSHIP (AASHTO T 180)

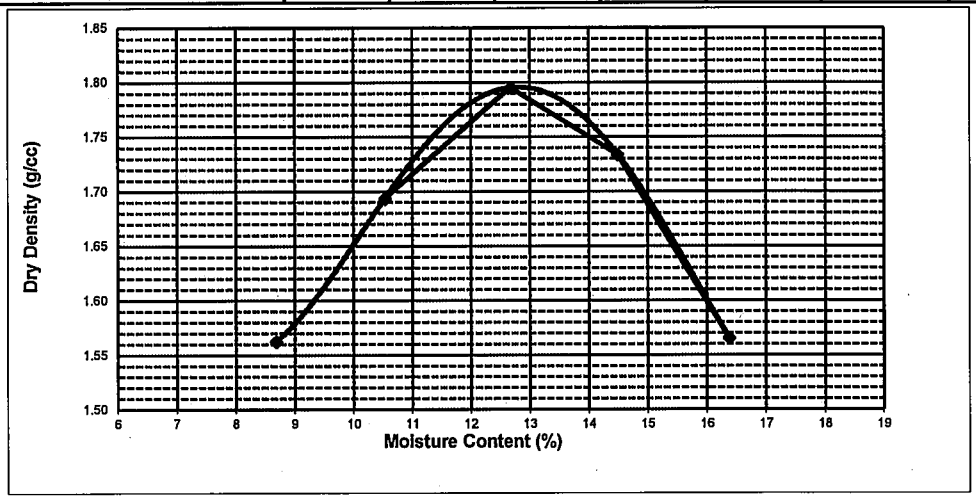
Mould No.	1		**Weight of Rammer**	4.54 kg	**Dia of Mould**		15.24 cm
Number of Blows	~~25~~	56	**Fall of Rammer**	45.72 cm	**Height of Mould**		11.643 cm
Number of Layers	5				**Volume of Mould**		2123.9 cm^3

Unit Weight Determination

Trial No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Weight of Mould (g)	2060	2060	2060	2060	2060		
Weight of Mould and Wet Soil (g)	5665	6035	6355	6275	5928		
Weight of Wet Soil (g)	3605	3975	4295	4215	3868		
Wet Density of Soil (g/cm^3)	1.697	1.872	2.022	1.985	1.821		
Dry Density of Soil (g/cm^3)	1.562	1.693	1.795	1.733	1.565		

Moisture Content Determination

Container No.	**C-15**	**C-09**	**C-26**	**C-51**	**C-62**	**6**	**7**
Wt. of Container (g)	30.41	23.82	23.25	24.09	30.36		
Wt. of Container + Wet Sample (g)	169.85	178.84	188.59	167.94	185.28		
Wt. of Container + Dry Sample (g)	158.71	164.06	169.98	149.73	163.48		
Wt. of Water (g)	11.14	14.78	18.61	18.21	21.80		
Wt. of Dry Soil (g)	128.30	140.24	146.73	125.64	133.12		
Moistrure Content (%)	8.68	10.54	12.68	14.49	16.38		



Maximum Dry Density	**1.795** g/cm^3	Optimum Moisture Content	**12.90 %**

Tested By	**Checked By**	**Approved By**
Nasruallha Khan	M.Ramzan	Muhammad Daniyal

Engineers & Constructors * Drillers * decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System	Job No.	-
Location	Sialkot City	Lab No.	603
BH / TP No.	BAS-04	Sampled Date	-
Sample No.	CS	Test Started	16-Feb-20
Sample Depth (m)	0.00-1.50	Test Completed	21-Feb-20

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Soil and Concrete Testing Laboratory (Pvt) Ltd

CALIFORNIA BEARING RATIO TEST (AASHTO T 193)

Dia of Mould	15.24 cm	Height of Mould	12.70 cm	No. of Blows	10, 30, 65	No. of Layers	5	Rammer Weight	4.536 kg	Rammer Fall	45.72 cm

Moisture Content of Soil

Description	Before Soaking						After Soaking					
	10 Blows		30 Blows		65 Blows		10 Blows		30 Blows		65 Blows	
Container No.	C-90	C-93	C-29	C-73	C-43	C-92	C-177	C-137	C-46	C-89	C-123	C-113
Wt. of Container (g)	23.46	23.29	23.25	21.70	28.25	23.32	20.03	23.10	23.39	24.42	22.37	20.64
Wt. of Container + Soil (g)	178.8	177.5	187.4	179.7	161.5	158.6	197.6	178.9	155.6	164.6	185.6	164.3
Wt. of Container + Dry Soil (g)	161.4	160.1	168.8	161.7	146.8	143.5	172.8	156.2	138.8	146.8	166.1	146.7
Wt. of Water (g)	17.49	17.44	18.60	17.94	14.69	15.12	24.77	22.61	16.75	17.84	19.47	17.58
Wt. of Dry Soil (g)	137.9	136.8	145.6	140.0	118.6	120.2	152.8	133.1	115.4	122.3	143.7	126.1
Moistrure Content (%)	12.68	12.75	12.78	12.81	12.39	12.58	16.21	16.98	14.51	14.58	13.55	13.94

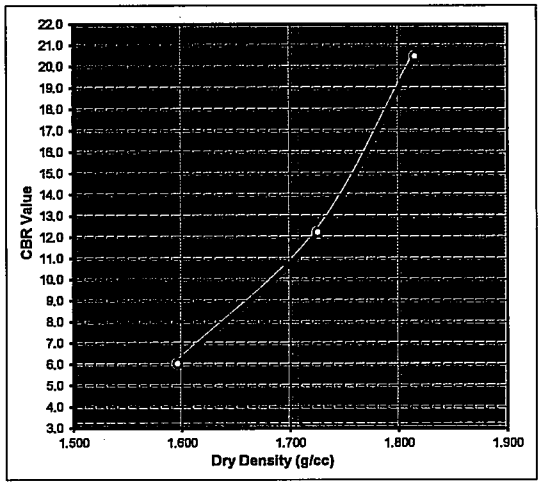
Unit Weight of Soil

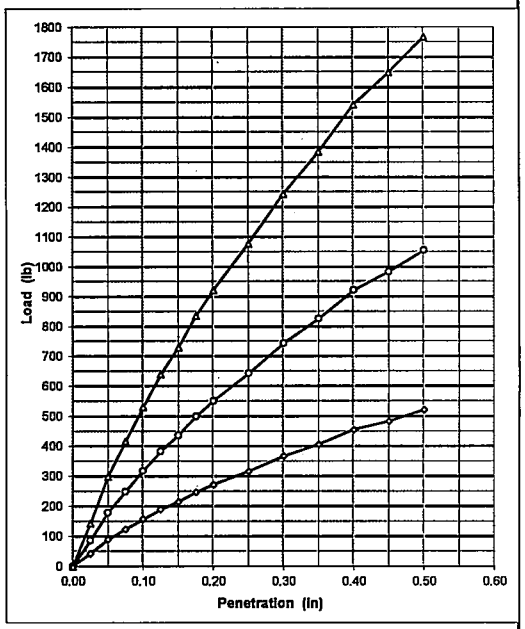
Description	10 Blows	30 Blows	65 Blows
Mould No.	34	11	40
Wt.Mould + Base Plate	3864	3862	3366
Wt.Mould+Soil (g)	8030	8370	8096
Weight of Wet Soil (g)	4166	4508	4730
Volume of Mould (cm^3)	2317	2317	2317
Wet Density of Soil (g/cm^3)	1.798	1.946	2.042
Dry Density of Soil (g/cm^3)	1.596	1.725	1.815
O.M.C 12.90 %	Max Dry Density		1.795 g/cm^3

CBR TEST DATA

Ring Factor 0.89

Penetration (In)	10 Blows		30 Blows		65 Blows	
	Dial Reading	Load (lb)	Dial Reading	Load (lb)	Dial Reading	Load (lb)
0.000	0	0	0	0	0	0
0.025	47	42	96	85	160	143
0.050	99	88	200	178	335	298
0.075	138	122	279	248	467	416
0.100	176	156	356	317	596	530
0.125	212	188	429	381	718	639
0.150	241	215	489	435	819	729
0.175	276	246	560	498	937	834
0.200	305	271	618	550	1035	921
0.250	353	315	721	642	1211	1078
0.300	412	367	834	743	1397	1244
0.350	455	405	927	825	1556	1385
0.400	510	454	1034	920	1732	1541
0.450	542	483	1104	983	1852	1649
0.500	585	521	1186	1056	1986	1768





CBR DATA	CBR at 0.1 In	CBR at 0.2 In
10 Blows	5.21	6.03
30 Blows	10.56	12.22
65 Blows	17.68	20.47

Dry Density (g/cm^3)
1.596
1.725
1.815

Swell		
Initail	Final	%
0	0.0	0.00
0	0.0	0.00
0	0.0	0.00

Max Dry Density at	
90%	= 1.616 g/cc
95%	= 1.705 g/cc
100%	= 1.795 g/cc

CBR Value at 0.20 In penetration	
90 % Max Dry Density	= 6.8
95 % Max Dry Density	= 11.0
100 % Max Dry Density	= 18.5

Tested By	Nasrullha Khan	Checked By	M.Ramzan	Approved By	Muhammad Daniyal

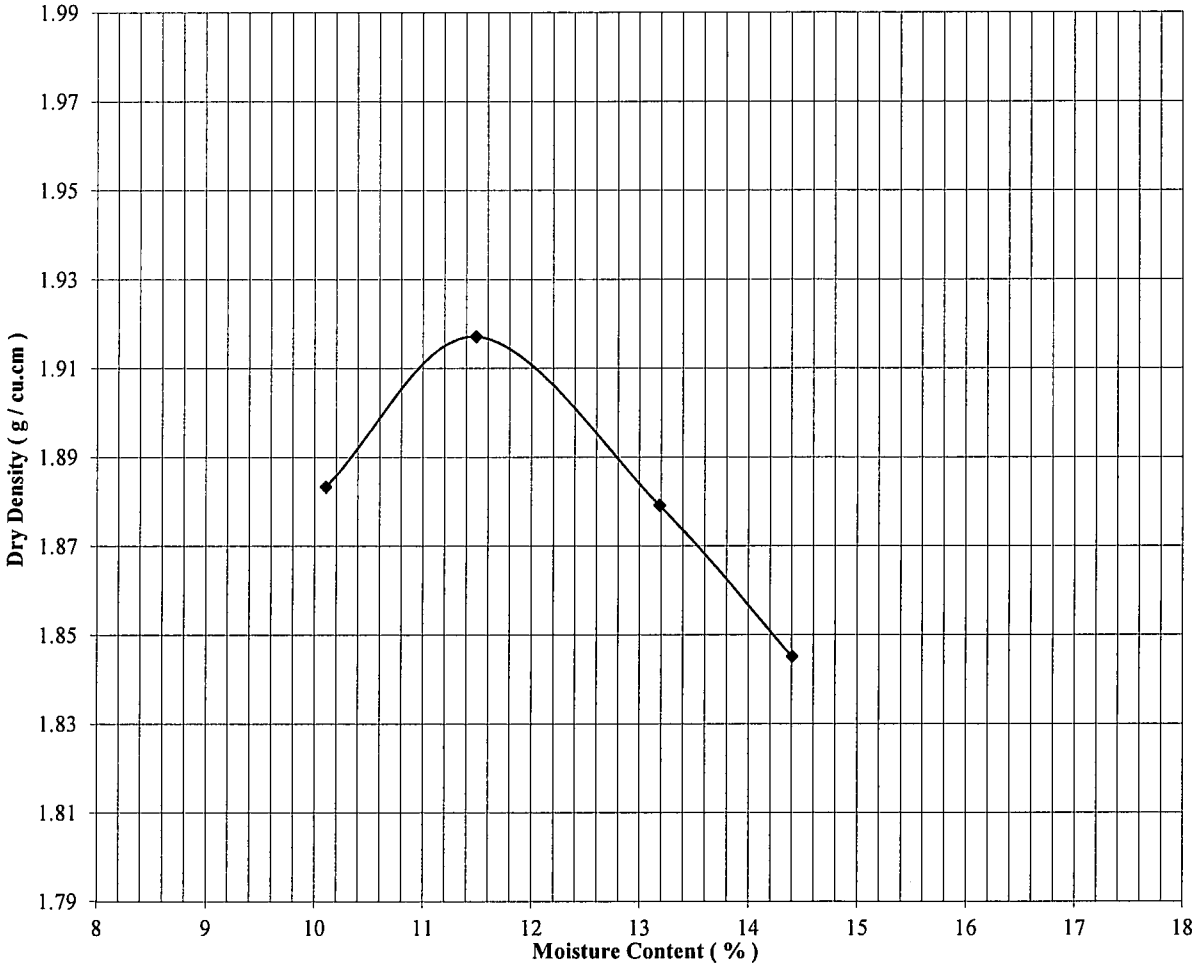
Drillers, Engineers & Constructors * decon

SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method :	Modified AASHTO T-180 (Method A)			**Volume of Mould :**	938 cm^3
Dia of Mould :	4.0 inch			**Drop :**	18 inch
No of Blows :	25	**No of Layers**	5	**Wt of Hammer :**	10 lbs
Test Pit No:	BAS-5	**Sample No.**	BS	**Depth (m):**	



Optimum Moisture Content (%)	11.49	**Maximum Dry Density**	1.917 g/cm^3
Project:	**PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM**		
Location :	**TREATMENT PLANTS IN SIALKOT CITY**	**Client: AJK ENGINEERS**	
Tested By	**Checked By**	**Dated**	**LAB. REF**
Azmat	**Mahmood**	**22.02.2020**	**11/2020**

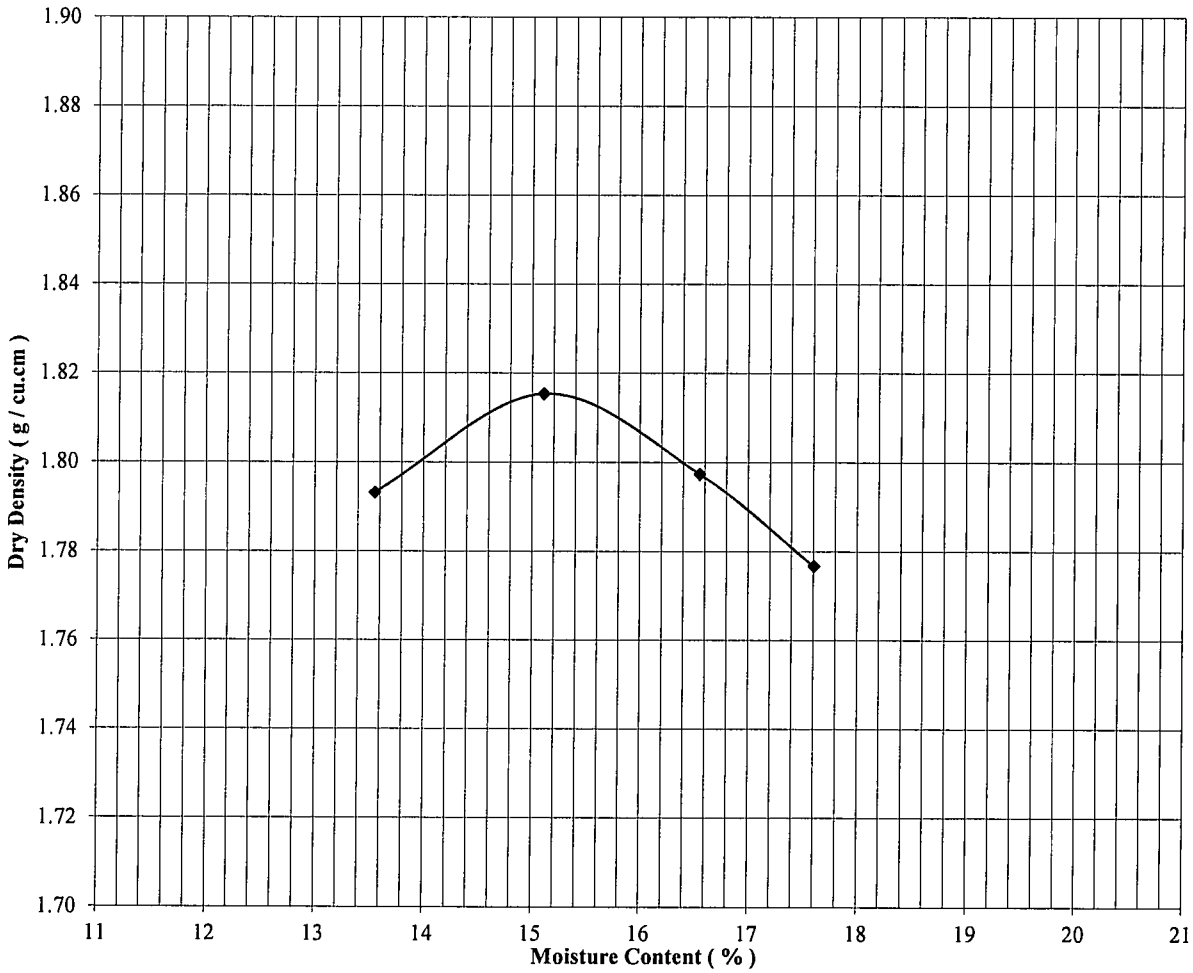
REMARKS:

SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method :	Modified AASHTO T-180 (Method A)			**Volume of Mould :**	938 cm^3
Dia of Mould :	4.0 inch			**Drop :**	18 inch
No of Blows :	25	**No of Layers**	5	**Wt of Hammer :**	10 lbs
Test Pit No:	BAS-7	**Sample No.**	BS	**Depth (m):**	



Optimum Moisture Content (%)		15.10	**Maximum Dry Density**		1.815 g/cm^3
Project:	**PUNJAB INTERMEDIATE CITIES INVESTMENT PROGRAM**				
Location :	**TREATMENT PLANTS IN SIALKOT CITY**			**Client: AJK ENGINEERS**	
Tested By		**Checked By**		**Dated**	**LAB. REF**
Azmat		**Mahmood**		**22.02.2020**	**11/2020**

REMARKS: _____

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System in Sialkot City.		**decon** Soil and Concrete Testing Laboratory
Location	Sialkot		
Lab No	603	**Test Started**	February 11, 2020
Sampled Date	-	**Test Completed**	February 13, 2020

Chemical Analysis of Soil

Sr No	BH / TP No	Sample Detail	Sample Depth (m)		Location	Sulphates (%)	Chlorides (%)	Oraganic Matter (%)	TDS (ppm)	pH
			From	To						
1	BH-33	SPT-02	2.00	2.45		0.07	0.07	0.29	-	-
2	BH-35	SPT-04	4.00	4.45		0.08	0.05	0.31	-	-
3	BH-39	SPT-01	1.00	1.45		0.08	0.05	0.32	-	-

Drillers, Engineers & Constructors
decon

CLIENT	CONSULTANT	CONTRACTOR
-	NES PAK	AJK Engineers (Pvt.) Ltd.

Project	Construction of Water Supply & Sewerage System		**decon** Soil and Concrete Testing Laboratory
Location	Sialkot City		
Lab No	603	**Test Started**	February 11, 2020
Sampled Date	-	**Test Completed**	February 13, 2020

Chemical Analysis of Water

Sr No	BH / TP No	Sample Detail	Sample Depth (m)		Location	Sulphates (ppm)	Chlorides (ppm)	Oraganic Matter (%)	TDS (ppm)	pH
			From	To						
1	BH-32	W/S	-			123	85	-	400	7.3
2	BH-35	W/S	-			165	390	-	300	7.8
3	BH-43	W/S	-			247	250	-	600	7.7
4	BH-48	W/S	-			247	195	-	600	7.8

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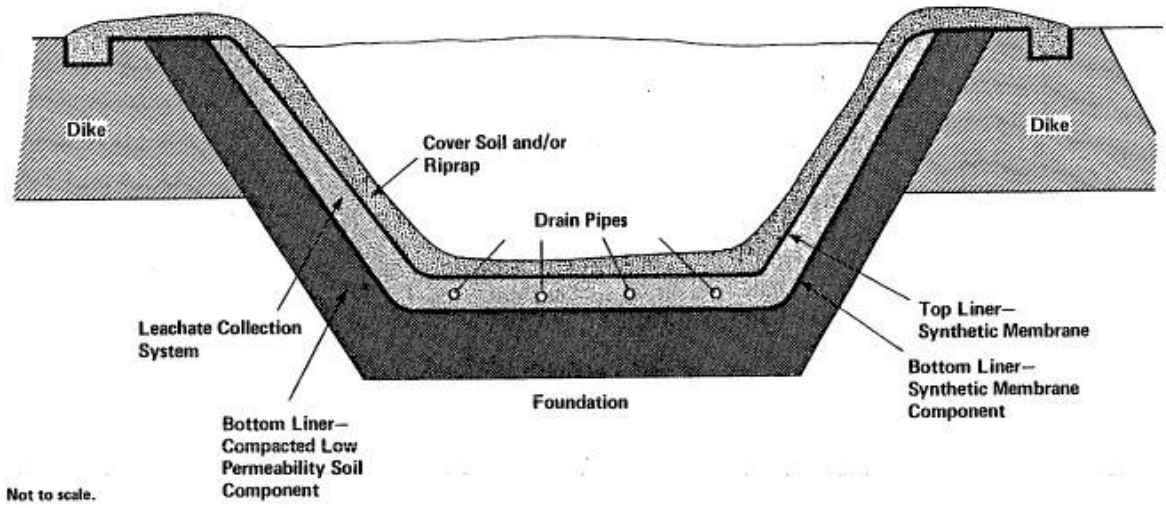
APPENDIX-D

REFERENCE FOR LINING MATERIAL

STATE OF MICHIGAN

Department of Environment, Great Lakes and Energy (EGLE)
(www.michigan.gov)



Cross section of an idealized clay liner system.

WASTEWATER TREATMENT AND STORAGE LAGOONS

(GUIDE SHEET IV)

GUIDESHEET IV

Wastewater Treatment and Storage Lagoons

Unless otherwise approved by the Department of Environmental Quality (DEQ) all wastewater treatment and storage lagoons associated with a discharge to the groundwaters of the State must meet the requirements specified in Rule 2237.

Dike Walls
For above-grade construction or if the lagoon liner base does not extend to the ground surface, perimeter dike walls are required to be constructed using a soil that is keyed to the natural soil base and meets the following criteria:

The relationship between hydraulic conductivity, moisture, and density is to be established with laboratory testing for the source of clay that will serve as the compacted clay portion of the composite liner. The relationship is to be determined using either the modified proctor test, ASTM D1557-91, or the standard proctor test, ASTM D698-91. And

Each lift is required to be thoroughly and uniformly compacted to achieve a hydraulic conductivity of not more than 1×10^{-7} centimeters per second based upon the density and moisture content determined as described above. The hydraulic conductivity of the soil is to be determined using ASTM method D5084-90 as modified by the department**.** If flexible wall permeameters are used, then confining pressures are required to be equivalent to the minimum pressure expected after the lagoon is placed in service. Soil is not be compacted at a moisture content that is less than optimum and is not to be compacted to less than either of the following densities:

Ninety percent of the maximum dry density, as determined by the modified proctor test, ASTM D1557-91. and

Ninety-five percent of the maximum dry density, as determined by the standard proctor test, ASTM D698-91.

Composite liners and Base
Each lagoon must have a composite liner with a base that meets the following requirements as specified in subrule (2) of Rule 2237:

The base of the composite liner is required to be a natural soil barrier, a compacted soil barrier or a geocomposite clay liner that meets the specific criteria for each of these technologies.

Natural Soil Barrier Requirements

A natural soil barrier used as a base in a composite liner system is required to meet all of the following requirements:

The natural soil shall be free of sand lenses and not less than 10 feet thick.

The soil shall have a saturated vertical hydraulic conductivity of not more than 1×10^{-7} centimeters per second.

Note: The hydraulic conductivity of the soil is required to be determined using ASTM method D5084-90, If flexible wall permeameters are used, then confining pressures are required to be equivalent to the minimum pressure expected after the lagoon is placed into service.

The natural soil liner surface is required to be properly prepared for placement of the flexible membrane liner (FML) to remove the potential for failures to the FML.

An engineer licensed under Act No. 299 of the Public Acts of 1980, as amended, otherwise known as the "Occupational Code," is required to certify to the department, that the requirements of the rule were met during installation of the natural soil base of the composite liner. The certification is to be accomplished through spatially random testing and measurements. At least 1 soil test is required to be conducted and an additional test is required for every 5,000 cubic yards placed and when the texture of the soil changes.

Compacted Soil Barrier

A compacted soil liner used as a segment of the composite liner system is required to meet all of the following:

The compacted soil liner shall have a minimum thickness of 2 feet.

The relationship between hydraulic conductivity, moisture, and density must be established with laboratory testing for the source of clay that will serve as the compacted clay portion of the composite liner. The relationship is to be determined using either the modified proctor test, ASTM D1557-91, or the standard proctor test, ASTM D698-91.

Each lift shall be thoroughly and uniformly compacted to achieve a hydraulic conductivity of not more than 1×10^{-7} centimeters per second based upon the density and moisture content determined as described above. The hydraulic conductivity of the soil is to be determined using ASTM method D5084-90, as modified by the department in R 299.4920. If flexible wall permeameters are used, then confining pressures are required to be equivalent to the minimum pressure expected after the lagoon is placed in

service. Soil shall not be compacted at a moisture content that is less than optimum and are not to be compacted to less than either of the following densities:

Ninety percent of the maximum dry density, as determined by the modified proctor test, ASTM D1557-91. And,

Ninety-five percent of the maximum dry density, as determined by the standard proctor test, ASTM D698-91.

The soil is to be placed so that each lift is not more than 6 inches after compaction.

The compacted soil liner surface is to be prepared for placement of the FML to remove the potential for failures of the FML.

The department may approve alternative test and investigative methods.

An engineer licensed under Act No. 299 of the Public Acts of 1980, as amended, otherwise known as the "Occupational Code," shall certify to the department, that the requirements of this rule were met during installation of the compacted soil base of the composite liner. The certification is to be accomplished through spatially random testing and measurements. At least 1 soil test of the compacted soil is required to be conducted and an additional test shall be conducted for every 5,000 cubic yards placed and when the texture of the soil changes.

Geocomposite Clay Liners

A geocomposite clay liner (GCL) used as a segment of a composite liner must meet all of the following requirements:

The GCL must be a factory-manufactured hydraulic barrier consisting of sodium bentonite clay supported by geotextiles that are held together by needling, stitching, or adhesives.

The GCL must be seamed according to the manufacturer's specifications to prevent leakage at the seams.

The GCL must not be laid during a precipitation event and is to be covered immediately by a flexible membrane liner or by another protective cover until the flexible membrane liner can be laid directly over the GCL.

The GCL must be installed according to the manufacturer's specifications and quality assurance and quality control plans. The installation is required to be certified by an engineer licensed under Act No. 299 of the Public Acts

of 1980, as amended, otherwise known as the “Occupational Code,” overseeing the installation of the composite liner.

Flexible Membrane Liners

A flexible membrane liner (FML) required by this rule is to be placed directly over a natural soil barrier, compacted soil barrier or geocomposite clay liner to form what is referred to as the "composite liner." The FML and its installation must meet all of the following requirements:

The liner must be a minimum of 40 mils thick polyvinyl chloride (PVC) or 60 mils thick high-density polyethylene (HDPE). Other materials and thickness may be used if the department determines before installation, that the proposed material and thickness are sufficient to ensure that the integrity of the liner is not compromised due to contact with the soil base, wastewater, climatic conditions, or the stress of installation or daily operation.

An FML is required to be covered immediately after placement. The FML is to be covered by an adequate thickness of soil or other material approved by the department to prevent puncture by equipment and to protect the exposed portion of the FML from degradation by ultraviolet light.

The FML is to be placed upon a foundation or base capable of providing support to the liner and resistance to pressure gradients above and below the liner to prevent slope failure and failure of the liner due to settlement, compression, or uplift.

The FML must cover the entire area of earth material that would be in contact with the treated or stored effluent.

The slopes over which an FML is to be placed may not exceed a grade of 25 percent unless the owner and operator can demonstrate slope stability for slopes with steeper grades.

FML Seams

The field seams of an FML shall meet all of the following requirements:

Seaming is to be done in accordance with the minimum industry standards. The shear strength and peel strength of the seams must be adequate to maintain the integrity of the seam under all operating conditions.

Horizontal seams are not to occur on side slopes.

Horizontal seams are to be located not less than 5 feet from the toe of the slope.

Field seams are to be installed parallel to the line of maximum slope.

The seam area shall be free of moisture, dust, dirt, debris, and foreign material of any kind before seaming.

No field seaming is to be done in weather conditions that would adversely affect the integrity of the seam.

An engineer licensed under Act No. 299 of the Public Acts of 1980, as amended, otherwise known as the "Occupational Code," must certify to the department that all necessary quality assurance testing was conducted to ensure that the FML was installed appropriately.

Quality Assurance Reporting

As indicated previously, the owner and operator of a facility must ensure that a properly licensed engineer certifies in a report to the Water Resources Division of the DEQ that the installation of the natural soil base barriers, compacted soil base, GCL and FML were completed in accordance with approved plans and that all necessary quality assurance testing was completed. The report must include:

A narrative of the results of the quality assurance tests.

Construction records for each component of the composite liner, including all field notes and results of all quality assurance tests. Drawings should be prepared which reference the location of each test to the respective result.

A summary of the testing methods used in determining quality assurance.

For quality assurance test results that did not meet specifications contained in the approved engineering plans, the methods for bringing the components of the composite liner into compliance with approved specifications.

A set of as built plans, signed and sealed by the properly licensed engineer. As a minimum, the as built plans should include the following:

- Dimensions, location, and elevation of the base of the excavation.
- Elevations of the surface and the base of the clay liner(s).
- Elevations of the surface of the protective layer.
- Cross sections of the lagoon(s), including dike locations, keying details and FLM anchor trench details.

All elevations are to be $\pm$ 0.5 feet, United States Geological Survey Datum.

A membrane panel layout drawing showing; panel and seam locations, repair locations, slope directions and slope toe locations.

Alternative Lagoon Standards

The department may approve a storage or treatment lagoon liner that does not meet 1 or more of the requirements specified in the rules if the applicant demonstrates that the requirements of either of the following provisions are met:

The lagoon holds only wastewater that meets the standards of Rule 2222.

The existing system or the proposed design provides equal or greater environmental protection to protection provided by a lagoon liner constructed according to the rules. For an existing system, the demonstration can be made by either of the following:

Through an exfiltration test that demonstrates, to the department's satisfaction, that the lagoon is not leaking at a rate likely to impact groundwater. or

Through monitoring of the groundwater and a demonstration approved by the department that the lagoon has not impacted, and is not likely to impact, groundwater**.**