

MUNICIPAL CORPORATION OF GREATER MUMBAI

**PLANNING, DESIGN AND CONSTRUCTION INCLUDING SUPPLY, DELIVERY, ERECTION, COMMISSIONING OF
MECHANICAL, ELECTRICAL, INSTRUMENTATION AND AUTOMATION WORKS FOLLOWED BY COMPREHENSIVE
OPERATION AND MAINTENANCE OF MOGRA STORM WATER PUMPING STATION (SWPS) IN K/W WARD**

ADDENDA I

Amendments / Modifications / Additions / Deletions in Tender Volumes shall be referred as under.

The following tables and associated attachments represent amendments, modifications, additions and deletions to the Tender Documents associated with the Design-Build and Comprehensive Operation & Maintenance Contract for Mogra Storm Water Pumping Station in K/W ward

Sr. No.	Reference Clause	Existing Description	Addendum
1	Volume 1, Section 1, pg no. 6	l) Contract Deposit – The successful tenderer, here after referred to as the contractor shall pay an amount equal to two (2) percent of the contract sum within thirty days from the date of issue of letter of acceptance.	Add the following at the end of existing description: Contract deposit shall be in the form of an irrevocable bank guarantee bond of any Scheduled Bank.
2	Volume 2, Section 2E, Cl. 2.6, pg. 7 & 8	Table for minimum staff requirement during Operation & Maintenance period to be supplied by contractor	Refer Appendix I.
3	Volume 3, Section 3B, A-5, Schedule of Prices for Operation & Maintenance Works, Pg. 10, Item 5.1 c.	Unit of measurement for Fuel component under column "Per".	Delete and replace with the following: Hrs
4	Volume 2, Section 2B, Cl. 2.7, pt. 3, pg. 24	Geotechnical investigation should be done by the Contractor from MCGM approved soil consultant..... Number of boreholes drilled in Geotechnical investigation shall not be less than 13.	Delete and replace with the following: Geotechnical investigation should be done by the Contractor from MCGM approved soil consultant and the report should be furnished to Client/Consultant and should be approved by MCGM/Consultant prior to start of structural design and drawings. Number of boreholes drilled in Geotechnical investigation shall not be less than 8. Depth of boreholes shall extend up to atleast 15m in hard rock below invert level / plinth level of the structure, whichever is deeper. Permeability of bed rock shall be checked by Packer Permeability Test till minimum depth of 5m below Invert Level. Each Packer Test Section shall not be made more than 1.5m in length.
5	Volume 1, Section 9, Cl. 83, pg. no. 91, Joint Venture / consortium	Technical eligibility criteria: In case of Work involving single discipline, the Lead member of the JV firm shall meet at least 35% requirement of technical capacity as stipulated in tender document. OR In case of composite works (e.g. works involving more than one distinct component such as Civil Engineering works, M&E works, Electrical works, etc. and in the case of major bridges, substructure and superstructure etc.), atleast one member should have satisfactorily completed 35% of the value of any one component of the project work so as to cover all the components of project work or any member having satisfactorily completed 35% of the value of work of each component during last seven financial years.	Delete and replace as follows: Technical eligibility criteria: In case of Work involving single discipline, the Lead member of the JV firm shall meet at least 35% requirement of technical capacity as stipulated in tender document. (NOT APPLICABLE FOR THIS CONTRACT) OR In case of composite works (e.g. works involving more than one distinct component such as Civil Engineering works, M&E Works, Electrical Works, etc.), all JV members shall collectively meet the "Technical Eligibility Criteria" of Clause 2.1, Section 2, Eligibility Criteria.
6	Volume II sec IID page 178 , clause 20.19 sr no 1	Measuring of Pump Motor Speed	Add at the end of existing description: Wherever applicable
7	Volume II sec IID page 178 , clause 20.19 sr no 6	Pressure indicator /Transmitter	Add at the end of existing description: Wherever applicable
8	Volume II sec IID page 179 , clause 20.19 sr no 7	Flow indicator/Transmitter	Add at the end of existing description: Wherever applicable

Sr. No.	Reference Clause	Existing Description	Addendum
9	Volume 2, Section 2E, Cl. 2.6, pg. 7 & 8	Table for minimum staff requirement during Operation & Maintenance period to be supplied by contractor	Refer reply to sr. no. 2.
10	Volume 1, Section 6, Cl. H, pg. 22, Time period of the Project	Entire project should be completed and delivered within 20 months (excluding monsoon) of time from the date of award of contract that excludes Monsoon followed by 84 months (7 Years) of Comprehensive Operation & Maintenance from the date of issue of DB completion certificate.	Add the following at the end of existing description: The date of award of contract is the date to be considered from handover of site to the Contractor by MCGM and accord of clearances by Competent Authorities such as MCZMA, Hon. High Court, Dept. of Fisheries, MoEF / Forest Dept, and any other permissions required prior to start of the work.
11	Volume 1, Section 15, pt. 13, pg. 138	Substantial completion certificate may be issued on achieving above 95% work completion during Part 'A' of the contract including successful commissioning of the pumping station and at the discretion of Ch. E (SWD). Balance works shall be completed within one year from award of such substantial/ deemed completions. Failing which again the delay provisions shall be applicable. This clause supersedes clause no. 8(g) of Standard General Conditions of Contract.	Delete and replace as: If any part of work shall have been substantially completed and shall have satisfactorily passed any final test that may be prescribed under the contract as per the Site conditions, the Engineer may issue certificate of substantial completion in respect of that part of the work along with the list clearly mentioning all the pending works. Upon issue of substantial completion certificate, the contractor shall be deemed to have undertaken to complete any outstanding work within one year from date of substantial completion. This clause supersedes clause no. 8(g) of Standard General Conditions of Contract.
12	Volume 1, Section 15, pt. 13, pg. 138	Balance works shall be completed within one year from award of such substantial/ deemed completions. Failing which again the delay provisions shall be applicable. This clause supersedes clause no. 8(g) of Standard General Conditions of Contract.	Refer reply to pt. 11 above.
13	Volume 2, Section 2A, Cl. 14, pg. 17, Main Electrical & operation house and Administration office	Elevator (Lift) with collapsible gate for access to second and third floor	Add the following at the end of existing description: In case of single storey, lift not required.
14	Volume 2, Section 2A, Cl. 2, pg. 7, pt. 31	Collateral guarantees to be provided for all equipment	Delete and replace as: Provision of collateral warranties for key equipment viz. pumps, DG sets and Screens from respective manufacturers.
15	Volume 2, Section 2A, Cl. 12, Pump bays, Pg.16	The pumping structure shall be provided with a superstructure as indicated on the conceptual section with provision of electrically operated actuators shall be provided for operation (lifting and lowering) of pumps, roller gates. EOT crane shall be provided for operation of grab buckets and stop logs.	Delete & replace as follows: The pumping structure shall be provided with a civil superstructure with suitable electrically operated lifting mechanism for pumps. EOT crane shall be provided for operation of grab buckets and stop logs. Roof of the pump house other than RCC slab shall have a minimum life of 25 years.
16	Volume 2, Section 2A, Cl. 14, pg. 17, Lift	Elevator with Collapsible Gate to be provided	Refer reply to sr. no. 13.
17	Volume 1, Section 9, clause 83, Joint Venture consortium, pg. no. 89, pt. 3	No. of members in a JV firm shall not be more than two.	Delete and replace as: Number of members in a JV firm shall not be more than three.

Sr. No.	Reference Clause	Existing Description	Addendum
18	Volume 1, Section 9, clause 83, Joint Venture consortium, pg. no. 89, pt. 7	One of the members of the JV firm shall be the lead member of the JV firm who shall have a majority (at least 51%) share of interest in the JV firm. The other member shall have a share of not less than 20%. In case of JV firm with foreign member(s), the lead member has to be an Indian firm with a minimum share of 51%.	Delete and replace as: One of the members of the JV firm shall be the lead member of the JV firm who shall have a majority (at least 51%) share of interest in the JV firm. The other members shall have a share of not less than 20% each. In case of JV firm with foreign member(s), the lead member has to be an Indian firm with a minimum share of 51%.
19	Vol II Sec 2C	Sluice gate	Refer Appendix II.
20	Vol II Sec 2C Cl 1.2 Pg no. 1	7. Automatically operated centrally hinged type Flap Gates including control gear box with actuator and manual override.	Add at the end of existing description: MOC of flap gates shall be cast iron.
21	Volume 1, Cl. 79. II), pg. 87	F = Fuel price Mumbai (declared by Indian Oil) applicable to the period under reference	Delete and replace as: F = Fuel price Mumbai (declared by Competent govt. authority) applicable on the 1st day of the billing month
22	Volume 2, Section 2C, Cl. 3.21, pg. 90	List of Recommended Manufacturers / Makes for Mechanical Equipment and Instruments	Add the following in the table: Stop logs - Mahabull EOT Crane / Gantry Crane - Shakti, S Cranes

In addition to above, Bidders had raised queries which were not pertaining to any specific clause in the Tender document. Such queries are clarified below.

CLARIFICATIONS TO QUERIES		
Sr. No.	Bidder's queries	Clarifications
1	The Total project duration is about 29 Months (including monsoon). We presume that the maximum limit of price variation for this project is 10%. Kindly confirm.	Maximum limit of price variation for Part A + Part B of this project is 10%.
2	For Calculating the price variation for material component , we presume that the commodity from whole sale price index to be considered under the component "All Commodities". Please Confirm.	Yes.
3	In this clause both the paragraph or contrary Please confirm the price to be quoted is inclusive of GST or it will be paid extra. Kindly confirm.	Price to be quoted shall be inclusive of GST.
4	Kindly furnish the following details: a. HFL of drain. b. Bed level of drain. c. Scour depth of drain d. FGL (Finished Ground Level)	a. HFL of nallah - 27.5m THD b. Bed level of nallah - varies c. Scour depth of nallah - Bidders are advised to carry out necessary investigation d. FGL - 30.0m THD (Finished Floor Level)
5	Kindly provide topographical survey and Bathymetry datas of the proposed project area.	Bidder to carry out necessary field surveys.
6	The Soil Investigation report was not available in the bid document. Please provide the same.	Refer Appendix IV for soil investigation report of plot adjacent to proposed site for SWPS. This report is for reference purpose only. However, MCGM assumes no responsibility for the correctness and accuracy of the information. The tenderer may carry out further test prior to submitting the tender with the prior permission of the concerned authorities.

Sr. No.	Bidder's queries	Clarifications
7	<p>Combined flow of all 7 pumps when running simultaneously shall be 42 m3/sec at design head only. At any other head, the flow will be different from 42 m3/sec. Hence, bidder requests to modify the clause as "The design of pumps and pumping arrangement should be such that combined flow of all 7 pumps when running simultaneously and measured in individual pump channel shall in no case be less than 42 m3/sec at design static head at site. Design head shall be approved by Engineer in charge."</p> <p>Please confirm.</p>	<p>This is a DB and comprehensive O&M contract. Bidders shall carry out design and detailed engineering without compromising on minimum hydraulic requirements specified in the Tender.</p>
8	<p>For the proposed storm water pumping station requirement, fire-fighting systems like foam extinguishers, fire suppression system will be more effective. Bidder assumes that suitable firefighting systems can be proposed as per the requirement instead of water-based firefighting (water storage tank, pumps, hydrants, sprinklers etc.) system and necessary approvals shall be taken from Fire services department.</p> <p>Kindly confirm.</p>	<p>Tender specifications indicate minimum requirements. Bidder shall consider firefighting system suitable for intended application and meeting the necessary permissions and approvals from the Chief Fire officer of MCGM.</p>
9	<p>Since the Shifting of 33kV Overhead lines as per MSEDCL Guidelines is required to be executed by Contractor assigned by the Power Supply Company (Tata Power/BEST/Adani).</p> <p>Hence Please confirm that,</p> <p>a)The Payment towards the 33kV Overhead Line Shifting Works to the Power Supply Company shall be done through Provisional Sum of Contract. The Contractor is responsible for all coordination/ Liaison works between MCGM and Power Supply Company for Shifting of the 33kV Overhead line falling on Pumping Station Site</p>	<p>Provisional amount to be expended is mentioned in Volume 3, pg 24 Schedule A-7</p>
10	<p>Bidder understands that the list of I/O's that have been provided in the tender is the typical list, it may vary during detail engineering stage. Please confirm.</p>	<p>Confirmed. Bidders to consider I/Os as per their design and as necessary for achieving intended performance of the pumping station.</p>
11	<p>We request you to provide Bathymetry, Topographical survey (contour) of Malad creek location.</p>	<p>Bidder to carry out necessary field surveys.</p>
12	<p>Kindly provide the details of the existing utilities (High tension electric line, Existing bridge etc.).</p>	<p>Bidder is advised to visit the site for any additional information and may carry out necessary surveys / assessment after permission from concerned authorities.</p>
13	<p>Kindly confirm whether structural support can be taken from retaining wall for Approach bridge construction.</p>	<p>This is a DB and comprehensive O&M contract. Bidders shall carry out design and detailed engineering without compromising on minimum hydraulic requirements specified in the Tender.</p>

Sr. No.	Bidder's queries	Clarifications
14	By considering the huge volume of works, we request to accept the additional pre bid queries if any in further (Maximum a period of 1 week)	Bidders were allowed to submit pre-bid queries till March 16, 2021 upto 5.00pm.
15	<p>The bidder requests to provide at least one additional cross section perpendicular to the Mogra nallah flow anywhere from existing BMC road up to silt trap in order to clarify the following.</p> <ol style="list-style-type: none"> 1.Approach bridge road level 2.Top of retaining wall. 3.Proposed bed level in nallah 4.RCC base slab requirement in this stretch of 145m. 	<ol style="list-style-type: none"> 1. Approach bridge road level - 30m THD 2. Top of retaining wall. - Not less than 28.0m THD 3. Proposed bed level in nallah - Not more than 21.0m THD 4. RCC base slab requirement in this stretch of 145m. - Shall be as per Bidder's design
16	<p>Request to provide the following data for competitive design & estimation.</p> <ul style="list-style-type: none"> • Hydrological model of the Nallah • Scour depth of the Nallah • Flow velocity and flow depth of the nallah 	Bidder to visit site for any additional information.
17	Requesting to accept the new technology of placing two seals in the cartridge for longer life time , easy servicing and risk of incorrect fitting. Seal faces are SiC vs SiC	This is a DB and comprehensive O&M contract. Bidders shall carry out design and detailed engineering without compromising on minimum hydraulic requirements specified in the Tender.
18	sealing between logs and frame shall be achieved by Lip type EPDM rubberseal mechanically fastened on frame and sealing between logs will be achieved by dual flush bottom seal made of EPDM rubber mechanically fastened /secured in dovetailed grooves and are replaceable	This is a DB and comprehensive O&M contract. Bidders shall carry out design and detailed engineering without compromising on minimum hydraulic requirements specified in the Tender.
19	Kindly accept TC of market broughtout items .	This is a DB and comprehensive O&M contract. Bidders shall carry out design and detailed engineering without compromising on minimum hydraulic requirements specified in the Tender.
20	Lockout Relay shall only have hand reset, Not Protective numerical relays.	This is a DB and comprehensive O&M contract. Bidders shall carry out design and detailed engineering without compromising on minimum hydraulic requirements specified in the Tender.
21	Busbar to be designed as per ambient temperature of 45 Deg Cel?	Busbar to be designed at 45 Deg Cel.
22	Kindly accept 75 microns in place of 100/150 microns	This is a DB and comprehensive O&M contract. Bidders shall carry out design and detailed engineering without compromising on minimum hydraulic requirements specified in the Tender.

Sr. No.	Bidder's queries	Clarifications
23	During Prebid meeting it is informed by MCGM that some of preconstruction NOCs /Approval like obtaining permission/consent for land required for SWPS from the collector(MSD), shifting of high tension line, MCZMA, High court, Department of fisheries, MOEF/Forest department are in the scope of work of consultant. Since the said work is already allotted to consultant which is beyond our control. Hence in this regard authority is requested that in case consultant unable to obtain NOCs/approvals form competent authority within stipulated period of 3 months in that case MCGM may allocate the responsibility of the said works to the contractor at the risk and cost of the consultant. kindly confirm	Obtaining clearances from MCZMA, Hon. High Court, Dept. of Fisheries, MoEF / Forest Dept. is in the scope of consultant. Award of work to contractor shall be effected after obtaining all above clearances. Contractor's scope of work includes obtaining permission / consent from Collector (M.S.D) for designated plot for Mogra SWPS further to award of work.
24	Since the tender is floated on the basis of design, built, operate(DBO) wherein bidder has liberty to design SWPS as per parameters given in the tender documents. While designing the SWPS there might be changes in Bill of quantities like nos of screen, mitre gates, EOT cranes given in tender documents. So authority is requested to allow bidder to modify the Schedule of Bill of quantities as per design/technology proposed for the work.	This is a DB and comprehensive O&M contract. Bidders shall carry out design and detailed engineering without compromising on minimum hydraulic requirements specified in the Tender.
25	As there is various technology/type of pumps are proposed in the tender document. If bidder is proposed technology other than conventional vertical axial flow pumps. In that case whether site visit with MCGM staff is required before bidding to ascertain performance of new technology. kindly confirm	MCGM reserves the right to visit successfully completed work(s) submitted by Bidder / manufacturer if required.
26	Since there is constraint of space, it is upto the contractor to provide number of DG sets of required capacity	This is a DB and comprehensive O&M contract. Bidders shall carry out design and detailed engineering without compromising on minimum hydraulic requirements specified in the Tender.
27	Since the bidders are free to adopt the type of pumps/technology as per said clause. In that case, there will be changes in Bill of quantities vis-à-vis quantities mentioned in the tender BOQ. So authority is requested to clarify whether bidder can upload his own BOQ instead of BOQ gievn in tender document	Refer reply to sr. no. 24.

Sr. No.	Bidder's queries	Clarifications
28	As given in the tender, bidder is allowed to adopt use technology like horizontal/inclined/vertical pumps. Accordingly we planning to deploy screw pumps which works from inclined shaft technology wherein Screw pump has 7 Cumsec discharge capacity at 6 meter head. In this regard kindly note that as the pumps offered in screw type technology is of 7 Cumsec discharge, Hence cumulative discharge of 42 cum/sec shall be achieved by 6 nos pumps instead of 7 pumps as asked in the tender document. So we will deploy 6 pumps of 7 cumsec discharge. kindly confirm. Also, while conducting performance test for 6 Cumsec discharge (in case of screw pump 7 cumsec) for 6 meter head, the desired water depth level is slightly higher than minimum drawn level. Kindly confirm	This is a DB and comprehensive O&M contract. Bidders shall carry out design and detailed engineering without compromising on minimum hydraulic requirements specified in the Tender.
29	As MCGM has proposed design based on gate pump technology. In case, we adopt alternate technology like screw pump then Levels may be subject to change in THD level of bed given in the tender document. However maximum level to be maintained in the nallah will be as prescrib in the tender. kindly confirm	This is a DB and comprehensive O&M contract. Minimum level will be as per design, however maximum level will remain the same.
30	In this regard authority is requested to allow the speed of the screen as per manufacturer recommendation which shall be as per their design	This is a DB and comprehensive O&M contract. Bidders shall carry out design and detailed engineering without compromising on minimum hydraulic requirements specified in the Tender.
31	Allowed to keep as per recommendation of manufacturer	This is a DB and comprehensive O&M contract. Bidders shall carry out design and detailed engineering without compromising on minimum hydraulic requirements specified in the Tender.
32	Allowed to keep rectangular bar in addition to tapered bars.	This is a DB and comprehensive O&M contract. Bidders shall carry out design and detailed engineering without compromising on minimum hydraulic requirements specified in the Tender.
33	The design of rake tine including its engagement with the bars shall be per manufacturer design.	This is a DB and comprehensive O&M contract. Bidders shall carry out design and detailed engineering without compromising on minimum hydraulic requirements specified in the Tender.

APPENDIX I

Sr.	Personnel	Numbers		Main Task of the Personnel
		Monsoon period	Non-Monsoon	
1	Plant Manager (B.E.- Mechanical or Electrical Engineering with 7 years of experience)	1	1	Coordination of activities for satisfactory performance of operation and maintenance and reporting to the Engineer-in-charge and responsible for the proper functioning & maintenance, data collection etc.
2	Assistant Engineer (B.E / Diploma.- Mechanical or Electrical Engineering with 5 years of experience)	1	1	Responsible for daily O&M, electrical and mechanical equipment and data collection.
3	Junior Engineer (Diploma/B.E. - Civil Engineering with 1 year of experience)	1	1	Responsible for daily O&M, civil units and data collection.
4	Junior Engineer (Diploma/B.E. Mechanical or Electrical Engineering with 2 years of experience)	7	2	Responsible for daily O&M, electrical and mechanical equipment and data collection.
5	Operators/Pump attendant (ITI Qualified with 3 years of experience)	7	4	Execution of specific tasks as indicated by the JE(E&M) for operating the different equipment installation
6	Electrician(ITI Qualified with 3 years of experience)	4	1	Responsible for maintenance of electrical equipment.
7	Fitter (Mech.) (ITI Qualified with 3 years of experience)	4	4	Responsible for maintenance of mechanical equipment.
8	Sweeper/Casual labour	14	4	Assistance to operator for cleaning plant premises, structures and equipment
9	Watchman	4	4	To protect the plant from the trespassers, animals etc.
10	Gardener	1	1	To maintain the garden/landscaping of the plant

APPENDIX II

1.1 Sluice gates

Design, manufacture, Supply, inspection at vendor's works, installation, erection, testing & commissioning of Sluice Gates and supply of necessary spare parts.

Sluice gates shall be provided to isolate each of the pump bays whilst maintaining flow to all or any of the others.

General

Design Requirements and Construction Features:

The construction of sluice gates shall be in accordance with the specification and conform to IS: 13349. All sluice gates shall be of Rising Stem type.

Frame:

The frame shall be of the flange back type and shall be machined on the rear face to bolt directly to the machined face of the wall thimble.

Seating Faces:

Seating faces shall be made of full width, solid section, strips of stainless steel. They shall be secured firmly by means of counter sunk fixings in finished grooves in the frame and slide faces in such a way as to ensure that they will remain permanently in place, free from distortion and loosening during the life of the sluice gates.

Wedging Devices:

Sluice gates shall be equipped with adjustable side, top and bottom wedging devices as required to provide contact between the slide and frame facing when the gate is in closed position.

Lifting Mechanism (Headstock):

Sluice gate shall be operated through suitable lifting mechanism, which shall incorporate suitable gearing if required, to keep the torque requirement within 7 kg.m.

Lifting mechanism shall incorporate a strong locking device suitable for use with a padlock or padlock and chain.

Lift mechanism shall be provided with a suitable position indicator to show the position of the gate at all times.

Wall Thimbles:

The wall thimbles shall provide a rigid mounting and the cross section of the thimble shall have the shape of the letter 'F'.

Lifting Lugs:

Lifting lugs shall be provided for all gates.

Flush Bottom Seal:

When sluice gates are provided with flush bottom seals, the wedging device and facing along the bottom edge of the slide and frame shall be omitted.

A solid square cornered resilient EPDM seal shall be provided on the bottom facing of slide. The seal shall be securely fastened to the bottom face of the slide by a stainless steel retainer flat and fasteners of ASTM A276 type 316. The top surface of the bottom facing of frame shall be flush with invert of the gate opening. Bottom facing of the slide shall be accurately machined to make contact with the seal when the slide is closed.

APPENDIX II

When flush bottom sluice gates are provided the recess in the bottom of sump shall be filled with asphalt after installation of the gate.

Materials of Construction

The materials of construction of different parts shall be as follows:

Sr. No.	Component	Material
1	Wall Thimble	Cast Iron: IS 210 Gr. FG 200
2	Frame and Slide	Cast Iron: IS 210 Gr. FG 200
3	Seating faces	Stainless Steel : ASTM Countersunk fixing A276 type 316
4	Wedge	Stainless Steel : ASTM A743 CF8M or SS316
5	Stem	Stainless Steel: ASTM extension A276 type 316
6	Stem nut	Stainless Steel : ASTM A743 CF8M
7	Stem Coupling	Stainless Steel : ASTM A276 type 316
8	Fasteners, anchor	Stainless Steel : ASTM bolts and nuts A276 type 316
8	Lifting mechanism Pedestal gear house cover and stem guide	Cast Iron : IS 210 Grade FG 200
10	Lift nut	Bronze: ASTM B 148 (CA952, CA954 or CA958)

Note - Material test certificates shall be furnished for all the above parts.

Note: Use of equivalent standards of other countries or organisations may be permitted.

APPENDIX III

APPENDIX IV

**MUNICIPAL CORPORATION OF GREATER
MUMBAI**

CONSULTANTS

M/s NJS ENGINEERS (I) PVT. LTD.

**GEO TECHNICAL INVESTIGATIONS
REPORT
FOR
PROPOSED STORM WATER PUMPING
STATION AT MOGRA NALA**

Report No.: GSL-851

OCTOBER 2019

BY

GEO SCIENCE

FOR

**NAZIMAH SABIR MUJAWAR
(UNIQUE GEOSOLUTIONS AND SURVEYS)**

**MUNICIPAL CORPORATION OF GREATER
MUMBAI**
CONSULTANTS
M/s NJS ENGINEERS (I) PVT. LTD.

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2	Oct 24, 2019	Final Report
1	Oct 22, 2019	Final Report
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1. INTRODUCTION

Municipal Corporation of Greater Mumbai, has proposed to construct storm water pumping station at Mogra. For the design of foundations for the proposed facility, geotechnical investigations were planned which are necessary for deciding the type of foundation system and to decide their design parameters. This report covers the borelogs and lab test results for the subsoil at proposed building.

M/s NJS Engineers (I) Pvt Ltd are the project consultants of the proposed project. Consultants decided to carry out geotechnical investigation work to determine foundation design parameters. The work of Geotechnical Investigations was awarded to M/s Unique Geosolutions and Surveys. M/s Unique Geosolutions and Surveys carried out the fieldwork in the months of October 2019. Laboratory testing on the selected soil and rock samples was also carried out and the foundation design report is prepared.

This report has been prepared by the undersigned for M/s Unique Geosolutions and Surveys. Report covers data collected in fieldwork of three investigation boreholes and analysis of field and laboratory test results.

2. SCOPE OF WORK

Mobilization of machinery and manpower along with drilling rigs, water pump, testing tools, accessories, etc. to carry out Geotechnical investigation work comprising

- Boring / Drilling three boreholes in soil and rock up to a maximum termination depth below existing ground level / finished ground level as per the instruction of Engineer In-charge.
- Conducting Standard Penetration Tests.
- Collection of disturbed and undisturbed soil samples from the boreholes.
- Packing, labeling and dispatching the soil and rock samples to carry out various laboratory tests as per the technical specification.
- Preparation and submission of the Geotechnical report.

3. MOBILISATION

3.1 Positioning Equipment

3.2 Geotechnical Equipment

- Calyx Drilling Rig
- Drill Pipes
- NX casings
- Drill Rods
- NX single tube core barrels
- NX Rock Coring Bits
- SPT system
- Core Boxes
- Other Tools & Tackles as required

4. METHODOLOGY OF INVESTIGATION

The boreholes are carried out at the locations proposed by M/s NJS Engineers (I) Pvt. Ltd. The investigation was planned to obtain subsurface stratification and collect soil, rock and ground water samples for laboratory testing to decide the foundation design parameters. Bore holes were planned to penetrate through the overburden soils and go into the hard strata / rock strata.

A brief methodology of geotechnical investigation is as follows:

- Geotechnical investigation was planned to obtain the subsoil stratification in the proposed project area and collect soil, rock and ground water samples for laboratory testing to determine the engineering properties such as shear strength, compressibility, along with basic engineering classification of the subsurface stratum as well as the pile capacities and safe bearing capacities (SBC) for shallow foundations. This information will be used to decide the foundation design parameters.
- Location of boreholes were selected in consultation with client. Data and results obtained from this investigation will be used in the design of the proposed Storm Water Drainage Pumping Station and ancillary structures.
- For geotechnical investigation work, standard rotary type drilling rig was used. This rig is coupled with diesel engine and has tripod and all drilling accessories. Drilling rig deployed is suitable for and has arrangement for driving as well as extracting

casing, boring drilling by mud circulation method, conducting Standard Penetration Test (SPT) collection of Undisturbed Soil Sample (UDS) and Disturbed or wash Soil Sample (DS) including obtaining rock cores.

- Drilling rig was installed at the specified bore hole location. Rig was stabilised by making level ground. Initially casing of adequate diameter to suit boring of 100 mm hole was lowered and boring was commenced.
- Sampling in the bore hole was carried out generally as per the guidelines given in the IS 1892 code. Disturbed soil samples were to be collected and SPTs were conducted at regular intervals.
- Standard Penetration Tests (SPT) were conducted in bore holes to obtain the 'N' values i.e. no. of blows of 63.5 kg hammer falling through 75 cm, required to penetrate 30 cm of SPT split spoon. This test was conducted as per IS-2131. The 'N' values are correlated with the relative density of non-cohesive soils and consistency of saturated cohesive soils. The test also collected samples in the split spoon assembly, which are treated as disturbed samples. SPTs were taken at 1.50 m interval.
- When the rock was encountered, size of bore hole was changed to Nx. i.e. 76mm diameter. A core barrel and Nx sized diamond bit fitted to double tube core barrel was used for drilling and recovering rock cores. The recovered rock cores were numbered serially and preserved in wooden core boxes. The core recovery and Rock Quality Designation (RQD) were computed for every run length drilled. Rock samples have been selected based on the probable founding elevation of the proposed structure.
- Generally bore holes are terminated after drilling in rock for about 4 meter in rock in order to check continuity of rock mass. In bore hole, consistent rock recovery was observed and the bore hole was terminated after penetrating minimum 4.0 meter in in to the rock. The depth of borehole termination is 12.0m. On completion of bore hole selected rock samples were taken to the laboratory for testing.

Three numbers of boreholes were decided to drill in order to investigate the subsurface conditions at the site. The details of the boreholes are given in table 1.

Table 1 Borehole details

Sr. No.	Bore Hole No.	Depth of Borehole, m	Ground R.L.	Rock depth, m	Ground water table, m
1	BH-1	12.0	27.4	5.5	0.5
2	BH-2	12.0	27.5	5.0	1.1
3	BH-3	12.0	27.5	5.4	0.9

Wherever weathered rock / hard strata was encountered, rotary core drilling was carried out using single tube NX core barrel. The coring in rock strata was advanced using diamond core bits and tungsten carbide bits. The data obtained from coring has been used for foundation design, geotechnical investigation and geological correlation purposes. The rock specimen were restored in aluminium core boxes (as per IS Standard) with core no., run no. and depth marked. The core samples thus obtained were logged, preserved properly and carefully transported to the laboratory for testing.

The drill run was generally restricted to 1.5m. Core recovery and RQD (Rock Quality Designation) were computed based on the cores retrieved. Typical rock cores from the weathered and hard rock strata were selected for strength, water absorption, porosity and density tests. Logs of these bore holes are presented in Annexure II.

4.1 Rock Core Measurements

The quantitative description of natural fracture state of rock masses are indicated on the borehole logs using a number of indices as determined from the borehole cores. These indices are described as CR and RQD.

Core Recovery (CR) is the percentage ratio of core recovered (whether solid, intact with full diameter, or non-intact) to the total length of core run.

Rock Quality Designation (RQD) is a quantitative index based on core recovery procedure that incorporates only those pieces of core which are 100mm or more in length. It is the total length of solid core pieces, each greater than 100mm between

natural fractures, expressed as a percentage of the total length of core run. It is also a measure of drill core quality and it disregards the influence of orientation, continuity, joint thickness and gauge.

Fracture State (IS 11315-Part 11)	
RQD (%)	Core Quality
0 - 25	Very Poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

4.2 In-situ Testing

4.2.1 Standard Penetration Test (SPT)

Conventional SPTs were carried out in the soil stratification. The split spoon sampler was lowered with the help of SPT / 'A' rods to the bottom of the bore hole and seated 15cm by giving blows using the hammer of 63.5kg weight falling through 75cm. Thereafter, the split spoon sampler was further driven by 30cm. The number of blows to effect each 15cm of penetration was recorded. The total number blows required for the last 30 cm of penetration is termed as the penetration resistance, denoted by 'N'.

4.2.2 Borehole logging

Borehole logging was done as per the IS-1892 standards and was done by an experienced Geotechnical Engineer. Bore logs were prepared indicating location co-ordinates, in-situ test results, strata description, etc.

4.2.3 Water depth measurements

The depth of the water table has been observed to be varied from 0.5m to 1.1m below the existing ground level.

4.2.4 Preserving and Protection of samples

On recovery of cores, the samples were extruded for logging. Selected samples were sealed and sent for laboratory testing. Samples and cores were protected from direct sunlight and were stored in a place suggested by the client representative.

4.3 Laboratory Testing

The selected soil/rock samples sent to the laboratory were tested to determine the properties to supplement the information obtained in the field to determine the soil/rock parameters for engineering recommendations on foundation. The following tests were conducted in the laboratory:

Soil:

- Grain Size Analysis (Sieve analysis)
- Liquid and Plastic Limit of soil

Rock:

- Uniaxial compressive strength
- Point Load Index
- Unit Weight
- Water Absorption
- Porosity

4.4 Laboratory Test Procedure for Soil Specimen

4.4.1 Grain size analysis by sieving:

Take oven dried representative sample and weigh it to 100 grams (or any weight, if sufficient quantity of sample is not available). Arrange the standard sizes of sieves in increasing order upward one over the other. Put the dry soil in top sieve; fix the set of sieves and shake the sieves. Carefully weigh the soil retained in each sieve and an to 0.01 g, enter the values in tabular form. Calculate the percent passing through each sieve.

4.4.2 Liquid limit of soil:

Take about 120 gm of oven dried sample passing through 425 micron sieve. Add some water in the sample to make a paste. A paste is then placed in a cup of liquid Limit apparatus and spread into the position. The soil in the cup is then divided using a

suitable type of grooving tool. The cup is then dropped by turning the crank at the rate of two revolutions per second until the two halves of the soil cake come in contact with bottom of the groove along a distance of about 12 mm. The no. of drops required to cause the groove close are recorded. The test is repeated with some addition of water for at least five trials. The moisture content of soil in each trial is determined using oven dry method. The semi-logarithmic plot of moisture content Vs no of blows in each trial is plotted. The moisture content corresponding to 25 blows is read from the plot and is reported as the liquid limit of that soil. Some soil samples show non-plastic behaviour initially and such samples shall be soaked in water for 24 hour and tried again for liquid limit test.

4.5 Lab Test Procedure for Rock Specimen:

4.5.1 Uniaxial Compressive Test:

The unconfined compression test is the most commonly used strength test on rocks. For accurate results, the test should be performed carefully. The specimen should be in the form of a cylinder of length to width ratio varying from 2 to 3. The ends of the specimen should be flat, smooth and parallel. The ends should be exactly perpendicular to the axis of the cylinder. Cores obtained during explorations are usually trimmed for this purpose. The specimen is subjected to compression between the cross-head and the platen of a compression testing machine. The specimen should preferably have a diameter of 45 mm. In no case, the diameter should be less than 35mm. The load should be applied continuously with a stress rate of 0.5 to 1.0 MPa per second. The compressive strength (q_u) is determined from the relation

$$q_u = P / A$$

Where “P” is the peak load and “A” is the initial cross-sectional area of the specimen.

4.5.2 Point Load Strength:

The point load strength is frequently used to estimate the strength of the rock. In this test, a rock specimen is loaded between hardened steel cones till failure occurs by the development of tensile cracks parallel to the axis of loading. The point load strength or point load index (I_s) is given by :

$$I_s(50) = P / D^2$$

where P is the failure load, D is the core diameter

4.5.3 Unit Weight:

The mass density (ρ) of a rock is the mass per unit volume. It is expressed as kg/m^3 . In rock mechanics, the term unit weight is commonly used. The unit weight (γ) is the weight per unit volume. It is expressed as gm/cc . Sometimes, the term density is also used for unit weight.

4.5.4 Porosity:

The porosity (n) of a rock is defined as the ratio of the void space to the total volume in the rock. It is expressed as a percentage. Thus

$$n = (V_a / V) \times 100$$

where V_a is the volume of voids (of pores) and V is the total volume.

5. GEOTECHNICAL APPRAISAL

The borehole data obtained in these geotechnical investigations for the proposed residential building were reviewed and the results of laboratory tests on selected rock samples were also studied. Based on the outcome of geotechnical investigation work subsurface strata have been broadly divided into three layers as mentioned below;

Layer I: Backfilled material

Layer II: Greyish soft marine clay

Layer III: Highly weathered rock

Layer IV: Greyish / brownish Breccia / Amygdaloidal Basalt

Layer I: Backfilled material

First layer of subsoil stratification is Backfilled material. This layer is present in all the boreholes. The thickness of this layer is varying from 0.8m to 1.5m. No standard penetration test (SPT) has been carried out in this layer.

Layer II: Greyish soft marine clay

This layer of subsoil stratification is Greyish soft marine clay. This layer is present in all the boreholes. The thickness of this layer is varying from 3.5m to 4.6m. The standard penetration test (SPT) has been carried out in this layer with field N values ranging from 0 to 4. Laboratory testing has also been carried out on sample from this layer.

Layer III: Highly weathered rock

This layer of stratification consists of Highly weathered rock. This layer is present in all the boreholes. The thickness of this layer is varying from 1.0m to 2.5m. The standard penetration test (SPT) has been carried out in this layer with field N values showing refusal ($N > 50$).

Layer IV: Greyish / brownish Breccia / Amygdaloidal Basalt

This layer of stratification consists of Greyish / brownish Breccia / Amygdaloidal Basalt. This layer is present in all the boreholes. The thickness of this layer is varying from 4.0m to 6.0m which is limited by the depth of the borehole. Rock core recovery obtained in this layer is varying from 35% to 100%. The rock quality designation (RQD) in this layer is varying from 25% to 100%. The variation in other physical properties is as mentioned in the table below:

Table 2

Material Property	Value
Uniaxial compressive strength, kg/cm^2	146-364
Point Load Strength Index, kg/cm^2	8.06-50.23
Dry density, gm/cc	1.85-2.55
Water Absorption, %	0.75-8.19
Porosity, %	1.73-15.01

6. CHEMICAL ANALYSIS OF SOIL AND GROUND WATER

The chemical composition of soil indicates that it falls under class 2 and ground water falls under class 4 as per table 4 of IS: 456.

7. DISCUSSIONS AND RECOMMENDATIONS

- After considering the variation in sub surface stratification at different borehole locations, deep pile foundations are recommended for the structure at all the borehole locations. The foundations can rest on the recommended founding strata as per this report.
- The recommended pile capacity values as obtained from the calculations are mentioned in tables 3 and 5.

- The pile capacity is calculated considering varying pile diameters. It is recommended to socket the pile well within the rock strata with socket length of 3 times the diameter of pile from the depth of occurrence of Layer IV i.e. Greyish / brownish Breccia / Amygdaloidal Basalt

Table 3

Pile Dia., mm	Recommended Safe compression Pile Capacity, T
500	126
600	153
750	283

The approximate pile lengths corresponding to each pile diameter as tabulated in table 4.

Table 4

Pile Dia., mm	Pile diameter, mm	500	600	750
	Rock depth, m	Minimum Pile Length (m) from Existing Ground Level		
BH-1	8.0	9.5	9.8	10.3
BH-2	6.0	7.5	7.8	8.3
BH-3	6.5	8.0	8.3	8.8

- The recommended Pile Capacity values as mentioned above are based on the strength of the founding rock. The safe working loading load shall be governed by the structural capacity of the pile.
- Proper cleaning of pile shaft after boring, after lowering the reinforcement and before concreting shall be done to achieve the above mentioned pile capacities. On completion of pile bore up to required depth, the bottom of the pile bore shall be cleaned to remove rock debris, pile bore soil etc.

- The safe lateral pile capacities are determined considering pile cut off level as 2.0m below the existing ground level. The permissible lateral deflection is considered as 5mm. The pile lateral capacities are summarised in table 4;

Table 5

Pile Dia., mm	Type of fixity	Depth of fixity, m	Shear Capacity, T
500	Fix Head	8.37	0.85
600	Fix Head	10.05	1.00
750	Fix Head	12.56	1.25

- All the mentioned pile capacities must be confirmed by carrying out the pile load testing as per IS 2911 (Part-4).
- If shallow foundations have to adopted, the net SBC at 1.5m to 2.5m founding depth from EGL can be considered as 2 T/m² for footing size of 2m x 2m and 1 T/m² for raft foundation with size 5m x 5m. These net SBC are based on consideration of 50mm permissible settlement.
- In order to increase the net SBC, it is recommended remove the soft clay layer up to the depth of 5m and replace the same with structural fill or murum soil. The replaced soil shall be placed in layers with maximum thickness of 300mm, each layer being duly compacted to achieve 95% of proctor density. Net SBC for foundations resting on structural fill can be considered as 10 T/m².
- Proper cleaning of loose soil and rock particles at founding level shall be carried out before concreting operation. It is advisable to inform M/s Geo Science for site inspection of founding strata and for reconfirmation of bearing capacities before laying the foundations.
- Suitable dewatering arrangement shall be adopted to keep the ground water level temporarily below the depth of the excavation. The ground water level shall be considered at finished grade level or existing ground level whichever is shallower during structural designing of the foundations considering the full effect of buoyancy.

BORED CAST IN SITU PILE CAPACITY SAMPLE CALCULATIONS

I) Safe vertical pile capacity founded on Layer IV

a) Based on uniaxial compressive strength as per IS14593

$$\text{Safe pile load capacity } (Q_s) = q_c N_j N_d A_p + q_c \pi D l_s \alpha \beta$$

q_c = UCS of rock, T/sqm = 1460 T/sqm (considering lowest value from lab test results)

N_d = depth factor = $0.8 + 0.2 l_s/D$, limited to 2

A_p = Area of pile, sqm = 0.28 for 600mm dia. pile

D = diameter of pile, m = 0.6 m

l_s = socket length, m = 1.8m

α = rock socket slide resistance reduction factor = 0.05 for relatively homogenous rock as per clause 6.5.1.1

β = rock socket correction factor = 0.5 (from fig. 2 assuming ratio of $E_{\text{rock mass}} / E_{\text{intact rock}} = 0.2$)

N_j = 0.20 for relatively homogenous rock as per clause 6.5.1.1

End Bearing = 147.1 T for 600mm dia. pile

Socket Friction = 96.3 T for 600mm dia. pile

$$\text{Safe pile load capacity } (Q_s) = 147.1 + 96.3 = 243.4 \text{ T}$$

b) Based on uniaxial compressive strength as per Clause 3.5.7, Dr. N V Nayak (Similar approach is adopted by Canadian Foundation Engineering Manual- CFEM)

$$\text{Safe pile load capacity } (Q_{ap}) = A_p q_a$$

Where $q_a = q_u K_{sp} K_{dp}$

q_u = UCS of rock, T/sqm = 1460 T/sqm

K_{sp} = empirical factor = 0.1 as per table 2.10.2 for moderately close spacing of discontinuity

K_{dp} = depth factor = $0.8 + 0.2 l_s/D = 1.4$

A_p = Area of pile, sqm = 0.28 for 600mm dia. pile

D = diameter of pile, m = 0.6

l_s = socket length, m = 1.8m

End Bearing = Q_{ap} = 57.23 T for 600mm dia. Pile

$$\text{Safe pile load capacity } (Q_s) = 57.23 + 96.3 = 153.53 \text{ T}$$

II) Safe lateral pile capacity in CLAY with pile cutoff level assumed at 2.0m below existing ground level

N value = 1

Grade of Concrete assumed = M30

Unconfined Compressive strength of Clay from co-relations = $1/0.75 = 1.33$ t/sqm say 13 kPa

$$R = \sqrt[4]{EI/KB}$$

R = Stiffness factor for preloaded clay

E = Modulus of Elasticity of pile material = 2.74×10^4 MN/m²

I = Moment of Inertia of pile cross section = 0.006359 m⁴

B = width of pile shaft

K = $k_1/1.5 \times 0.3/B$

$k_1 = 2$ (kN/m³ × 10³)

considering very low N
value

$$\begin{aligned} \text{Deflection, } y &= \frac{H (e + z_f)^3}{12 EI} && \text{for fixed head pile} \\ \text{Deflection, } y &= \frac{H (e + z_f)^3}{3 EI} && \text{for free head pile} \end{aligned}$$

H = Lateral Load

e = Cantilever length above ground

z_f = Depth of point of fixity

y = deflection of pile head,

Z_f/T = 1.9 for free head condition

= 2.2 for fixed head condition

Depth of fixity, z_f (m) = 10.05 for fixed head condition for 600 dia. pile

Safe lateral capacity (T) = 1.03 for fixed head condition 600 dia. pile

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MIGS, MISSMGE

OCTOBER 2019

8. REFERENCES

10.1 Codes

- IS 456: Plain and reinforced concrete-Code of Practice
- IS 1498: Classification and Identification of Soils for General Engineering Purposes
- IS 1892: Code of Practice for Site Investigations for Foundations
- IS 1904: Code of Practice for Design and Construction of Foundations in Soils: General Requirements.
- IS 2131: Method of Standard Penetration Test for Soils
- IS 2720: Method of Test for Soil (relevant Parts)
- IS 2911 (Part 1 / sec 2) Design and construction of pile foundations-Code of practice part 1 concrete piles, section 2-Bored cast In-situ concrete piles
- IS 5313: Guide for Core Drilling Observations
- IS 6926: Code of practice for Diamond Core Drilling for Site Investigations
- IS 8764: Method for the determination of point load strength index of rocks
- IS 9143: Method for the determination of unconfined compressive strength of rock materials
- IS 13030: Method of test for laboratory determination of water content, porosity, density and related properties of rock material
- IS 13365 (Part-I) : Quantitative classification system of rock mass - Guidelines, Part 1: RMR for predicting of engineering properties
- IRC; 78-2000 Standard specifications and code of practice for road bridges, sec VII Foundations and Substructure

10.2 Manuals/Books

- Canadian Foundation Engineering Manual, 4th Edition (2006). Canadian Geotechnical Society.

Relative Density of Cohesionless Soils

SPT ' N ' Values	Relative Density
0 – 4	Very Loose
5 – 10	Loose
11 – 30	Medium Dense
31 – 50	Dense
> 50	Very Dense

Consistency of Cohesive Soil

SPT ' N ' Values	Consistency of Cohesive Soil
0 – 2	Very Soft
2 – 4	Soft
5 – 8	Medium Stiff
9 – 16	Stiff
17 – 31	Very Stiff
> 32	Hard

Classification of Rock with respect to Strength

Rock Classification	Compressive Strength of Rock
Very High Strength	> 2200 Kg/cm ²
High Strength	550 - 2200 Kg/cm ²
Medium Strength	140 – 550 Kg/cm ²
Low Strength	35 - 140 Kg/cm ²
Very Low Strength	9 – 35 Kg/cm ²

Rock Quality Designation (RQD) of Rock

Rock Quality Designation (RQD)	Diagnostic Description of Rock
Exceeding 90%	Excellent
90 % - 75 %	Good
75 % - 50 %	Fair
50 % - 25 %	Poor
Less Than 25 %	Very Poor

Rock Recovery : Length of Core / Length of Run %

Rock Quality Designation : Sum of Length of Core Pieces greater than 4 inch / Length of Run

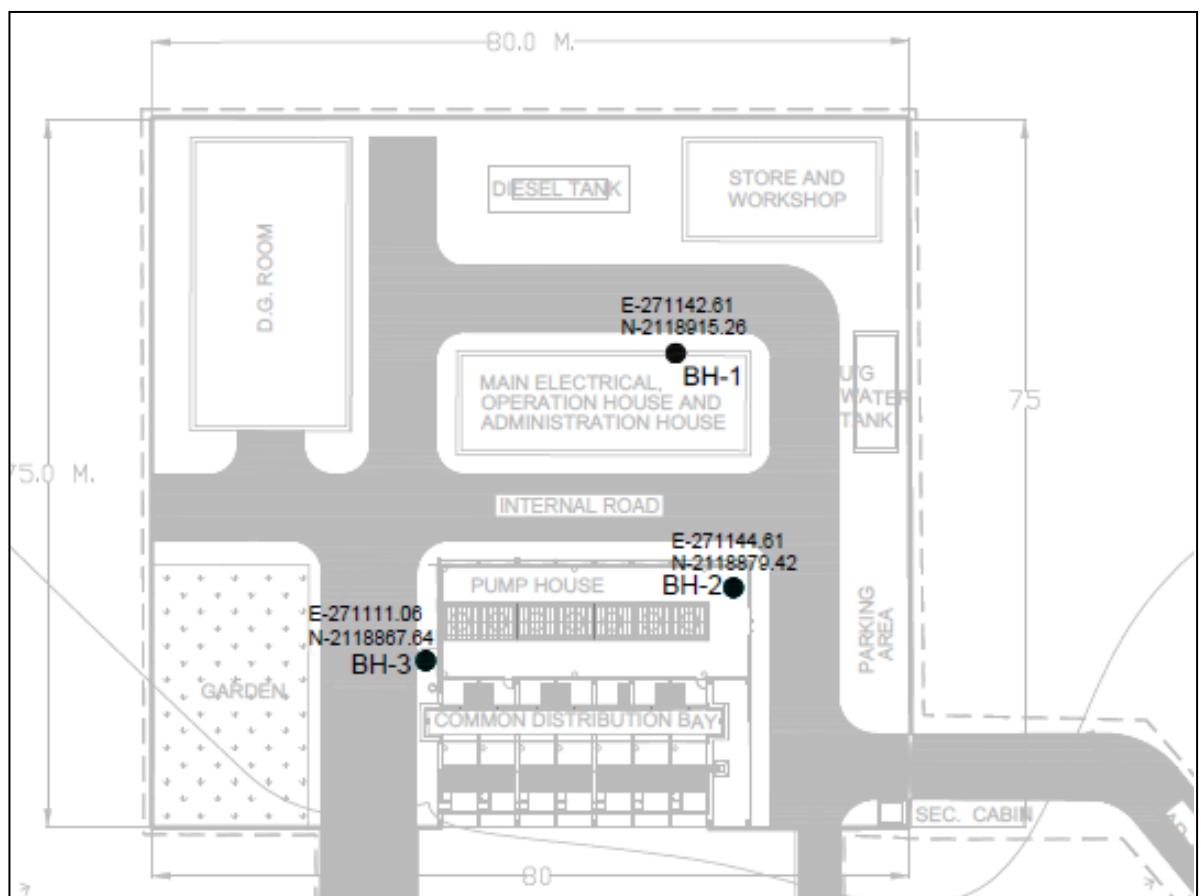
SCALE OF WEATHERING GRADES OF ROCK MASS

Terms	Description	Grade	Interpretation
Fresh	No visible sign of rock material weathering; perhaps slight discoloration on major discontinuity surfaces.	I	CR > 90 %
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discoloured by weathering.	II	CR between 70 % to 90 %
Moderately Weathered	Less than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as core stones.	III	CR between 51 % to 70 %
Highly Weathered	More than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as core stones	IV	CR between 11 % to 50 %
Completely Weathered	All rock material is decomposed and / or disintegrated to soil. The original mass structure is still largely intact.	V	CR between zero to 10 %
Residual Soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI	CR = Zero % But N > 50

ANNEXURE – I



BOREHOLE LOCATION


PLAN



ANNEXURE – II



BORELOGS


		<h2 style="margin: 0;">BORE LOG</h2>										Page: 1 of 1 Job No.: GSL-851 Date: 19/10/2019				
Client: MUNICIPAL CORPORATION OF GREATER MUMBAI																
Project: Proposed construction of storm water pumping station at Mogra Nalla																
Bore Hole No.: BH-1 Depth of Bore Hole: 12.00 m Diameter of Bore Hole: 100mm/NX Bore Hole co-ordinates: ---				Date Commenced: 07/10/2019 Date Completed: 09/10/2019 Depth of GWT: 0.50m												
Penetration	Depth	R.L., m	Soil Profile	Description	Sample No.	Sample Type	Depth, m		Blows/15 cm					CR, %	RQD, %	Remarks
							From	To	15	30	45	60	Valu			
1	1.5			Backfilled material												 GWT
2				Grayish soft marine clay	1	SPT	1.50	2.10	0	1	1	---	2			
3																
4																
5	5.0															
6	5.5			Yellowish stiff clay												
7				Yellowish greyish highly weathered rock	3	SPT	6.00	6.05	36/3cm	50/5cm	---	---	R			
8	8.0															
9																
10	10.0			Greyish / brownish Breccia	4	SPT	7.50	7.54	40/3cm	52/4cm	---	---	R			
					1	CR	7.54	9.00						75	25	
					2	CR	9.00	10.50						83	45	

SPT: Standard Penetration Test	CR: Core Recovery	NE: Not Encountered
DS: Disturbed Sample	RQD: Rock Quality Designation	 Ground Water Table
UDS: Undisturbed Sample	R: Refusal	DR: Drill Run
WS: Wash Sample	GWT: Ground Water Table	

UNIQUE GEOSOLUTIONS AND SURVEYS




		BORE LOG										Page: 2 of 2					
		Job No.: GSL-851															
		Date: 19/10/2019															
Client: MUNICIPAL CORPORATION OF GREATER MUMBAI																	
Project: Proposed construction of storm water pumping station at Mogra Nalla																	
<div style="display: flex; justify-content: space-between;"> <div> Bore Hole No.: BH-1 Depth of Bore Hole: 12.00 m Diameter of Bore Hole: 100mm/NX </div> <div> Date Commenced: 07/10/2019 Date Completed: 09/10/2019 Depth of GWT: 0.50m </div> </div>																	
Penetration	Depth	R.L., m	Soil Profile	Description	Sample No.	Sample Type	Depth, m		Blows/15 cm					CR, %	RQD, %	Remarks	
							From	To	15	30	45	60	Valu				
11				Greyish brownish Breccia	3	CR	10.50	12.00						80	42		
12																	
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	
BORE HOLE TERMINATED AT 12.00 M BELOW EGL																	
<div style="display: flex; justify-content: space-between;"> <div> SPT: Standard Penetration Test DS: Disturbed Sample UDS: Undisturbed Sample WS: Wash Sample </div> <div> CR: Core Recovery RQD: Rock Quality Designation R: Refusal GWT: Ground Water Table </div> <div> NE: Not Encountered Ground Water Level DR: Drill Run </div> </div>																	
UNIQUE GEOSOLUTIONS AND SURVEYS																	

		<h2 style="margin: 0;">BORE LOG</h2>										Page: 1 of 1 Job No.: GSL-851 Date: 19/10/2019				
Client: MUNICIPAL CORPORATION OF GREATER MUMBAI																
Project: Proposed construction of storm water pumping station at Mogra Nalla																
Bore Hole No.: BH-2 Depth of Bore Hole: 12.00 m Diameter of Bore Hole: 100mm/NX Bore Hole co-ordinates: ---				Date Commenced: 09/10/2019 Date Completed: 12/10/2019 Depth of GWT: 1.10m												
Penetration	Depth	R.L., m	Soil Profile	Description	Sample No.	Sample Type	Depth, m		Blows/15 cm					CR, %	RQD, %	Remarks
							From	To	15	30	45	60	Valu			
1	1.5			Backfilled material												 GWT
2				Grayish soft marine clay	1	SPT	1.50	2.10	0	0	1	---	1			
3																
4					1	UDS										
5	5.0				2	SPT	4.50	5.10	1	1	2	---	3			
6	6.0			Yellowish greyish highly weathered rock												
7				Greyish / brownish Amygdaloidal Basalt	3	SPT	6.00	6.15	33/5cm	63/10cm	---	---	R			
8					1	CR	6.15	7.50						84	84	
9					2	CR	7.50	8.00						100	100	
10					3	CR	8.00	9.50						91	85	
					4	CR	9.50	10.50						95	86	

SPT: Standard Penetration Test	CR: Core Recovery	NE: Not Encountered
DS: Disturbed Sample	RQD: Rock Quality Designation	 Ground Water Table
UDS: Undisturbed Sample	R: Refusal	DR: Drill Run
WS: Wash Sample	GWT: Ground Water Table	

UNIQUE GEOSOLUTIONS AND SURVEYS

		BORE LOG										Page: 2 of 2					
		Job No.: GSL-851															
		Date: 19/10/2019															
Client: MUNICIPAL CORPORATION OF GREATER MUMBAI																	
Project: Proposed construction of storm water pumping station at Mogra Nalla																	
<div style="display: flex; justify-content: space-between;"> <div> Bore Hole No.: BH-2 Depth of Bore Hole: 12.00 m Diameter of Bore Hole: 100mm/NX </div> <div> Date Commenced: 09/10/2019 Date Completed: 12/10/2019 Depth of GWT: 1.10m </div> </div>																	
Penetration	Depth	R.L., m	Soil Profile	Description	Sample No.	Sample Type	Depth, m		Blows/15 cm					CR, %	RQD, %	Remarks	
							From	To	15	30	45	60	Valu				
11				Greyish / brownish Amygdaloidal Basalt	5	CR	10.50	12.00						96	87		
12																	
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	
BORE HOLE TERMINATED AT 12.00 M BELOW EGL																	
<div style="display: flex; justify-content: space-between; font-size: 0.8em;"> <div> SPT: Standard Penetration Test DS: Disturbed Sample UDS: Undisturbed Sample WS: Wash Sample </div> <div> CR: Core Recovery RQD: Rock Quality Designation R: Refusal GWT: Ground Water Table </div> <div> NE: Not Encountered Ground Water Level DR: Drill Run </div> </div>																	
UNIQUE GEOSOLUTIONS AND SURVEYS																	


		<h2 style="margin: 0;">BORE LOG</h2>										Page: 1 of 1 Job No.: GSL-851 Date: 19/10/2019				
Client: MUNICIPAL CORPORATION OF GREATER MUMBAI																
Project: Proposed construction of storm water pumping station at Mogra Nalla																
Bore Hole No.: BH-3 Depth of Bore Hole: 12.00 m Diameter of Bore Hole: 100mm/NX Bore Hole co-ordinates: ---				Date Commenced: 13/10/2019 Date Completed: 15/10/2019 Depth of GWT: 0.9m												
Penetration	Depth	R.L., m	Soil Profile	Description	Sample No.	Sample Type	Depth, m		Blows/15 cm					CR, %	RQD, %	Remarks
							From	To	15	30	45	60	Valu			
1	0.8			Backfilled material												 GWT
2				Grayish soft marine clay	1	SPT	1.50	2.10	0	0	1	---	1			
3																
4					1	UDS										
5					2	SPT	4.50	5.10	1	1	2	---	3			
6	5.4			Greyish brownish highly weathered rock												
7	6.5				1	CR	5.50	6.50						35	0	
8				Greyish / brownish Amygdaloidal Basalt	2	CR	6.50	7.50						57	38	
9					3	CR	7.50	9.00						82	76	
10																
					4	CR	9.00	10.50						83	58	
<div style="display: flex; justify-content: space-between;"> <div> <p>SPT: Standard Penetration Test</p> <p>DS: Disturbed Sample</p> <p>UDS: Undisturbed Sample</p> <p>WS: Wash Sample</p> </div> <div> <p>CR: Core Recovery</p> <p>RQD: Rock Quality Designation</p> <p>R: Refusal</p> <p>GWT: Ground Water Table</p> </div> <div> <p>NE: Not Encountered</p> <p> Ground Water Table</p> <p>DR: Drill Run</p> </div> </div>																
UNIQUE GEOSOLUTIONS AND SURVEYS																

		BORE LOG										Page: 2 of 2					
		Job No.: GSL-851															
		Date: 19/10/2019															
Client: MUNICIPAL CORPORATION OF GREATER MUMBAI																	
Project: Proposed construction of storm water pumping station at Mogra Nalla																	
<div style="display: flex; justify-content: space-between;"> <div> Bore Hole No.: BH-3 Depth of Bore Hole: 12.00 m Diameter of Bore Hole: 100mm/NX </div> <div> Date Commenced: 13/10/2019 Date Completed: 15/10/2019 Depth of GWT: 0.9m </div> </div>																	
Penetration	Depth	R.L., m	Soil Profile	Description	Sample No.	Sample Type	Depth, m		Blows/15 cm					CR, %	RQD, %	Remarks	
							From	To	15	30	45	60	Valu				
11				Greyish Amygdaloidal Basalt	5	CR	10.50	12.00						90	74		
12																	
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	
BORE HOLE TERMINATED AT 12.00 M BELOW EGL																	
<div style="display: flex; justify-content: space-between;"> <div> SPT: Standard Penetration Test DS: Disturbed Sample UDS: Undisturbed Sample WS: Wash Sample </div> <div> CR: Core Recovery RQD: Rock Quality Designation R: Refusal GWT: Ground Water Table </div> <div> NE: Not Encountered Ground Water Level DR: Drill Run </div> </div>																	
UNIQUE GEOSOLUTIONS AND SURVEYS																	

ANNEXURE – III


LABORATORY TEST

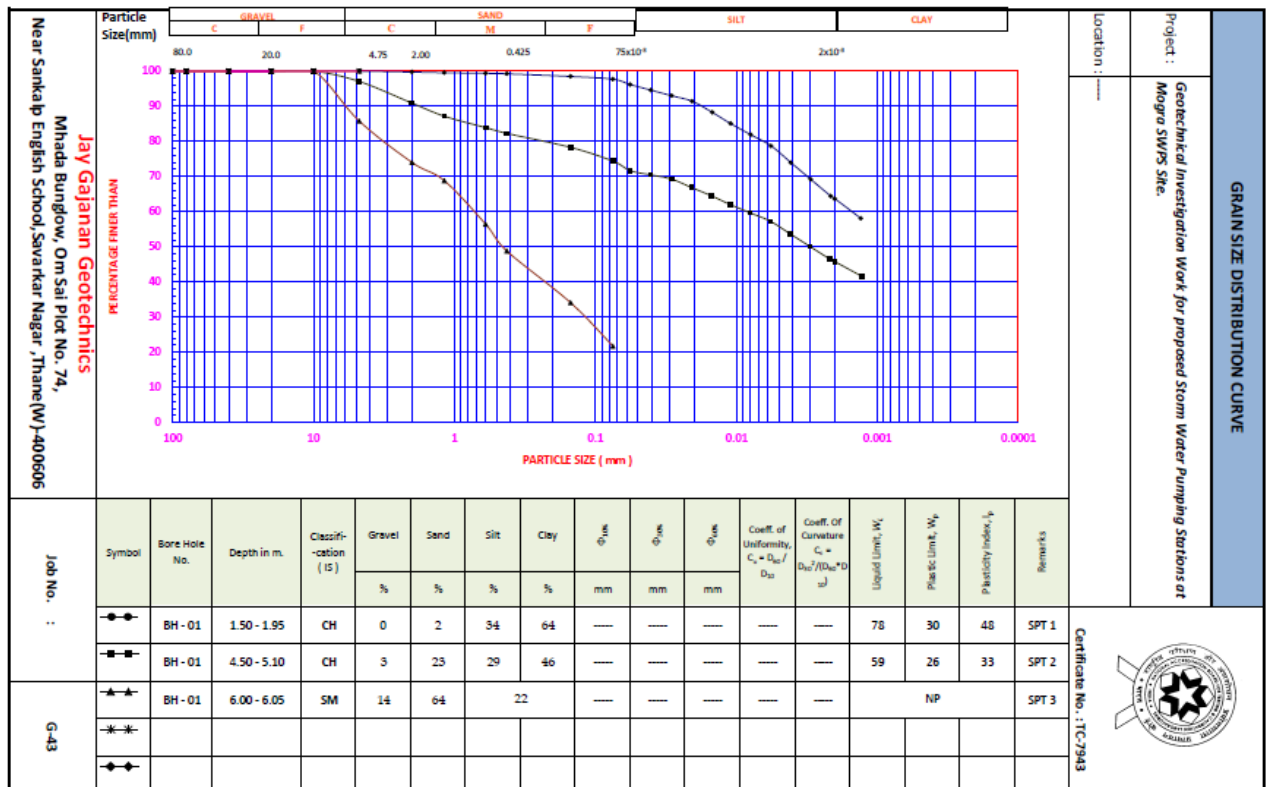
RESULTS



JGG		JAY GAJANAN GEOTECHNICS										TEST REPORT		 NABL ACCREDITED LAB Certificate No.: TC-7943											
U.I.R. : TC79431900000310F		REPORT DATE : 18.10.2019		CLIENT : MCGM		REPORT NUMBER : JGG/2019-20/G-43/01/001		PROJECT : Geotechnical Investigation Work for proposed Storm Water Pumping Stations at Mogra SWPS Site.																	
SAMPLE RECEIVED ON : 14.10.2019		TESTING DURATION : 14.10.2019 to 18.10.2019		CONDITION OF SAMPLES : ACCEPTABLE		TYPE & NUMBER OF SAMPLES RECEIVED :																			
MECHANICAL TEST RESULTS (SOIL)																									
Bore Hole No.	Depth in m.	Sample Type	Lab Id	Soil Classification (IS)	Tests Performed and References																			Remarks	
					IS 2720 P-7,8 Density gm/cm ³		IS 2720 P-2 Natural Moisture Content, w %	IS 2720 P-4 Mechanical Analysis				IS 2720 P-5 Consistency Limits		IS 2720 P-20 Linear Shrinkage %	IS 2720 P-6 Shrinkage Limit %	IS 2720 P-14 *Relative Density %	IS 2720 P-11/12/13 Shear Test		IS 2720 P-10 Unconfined Compression Test kg/cm ²	IS 2720 P-41 *Swelling Pressure kg/cm ²	IS 2720 P-40 Free swell index %	IS 2720 P-15 Vertical Consolidation			IS 2720 P-3(51) Specific Gravity
					Wet	Dry		Gravel %	Sand %	Silt %	Clay %	Liquid %	Plastic %				Plasticity Index, I _p %	Type				Cohesion C _u kg/cm ²	Degree of C _u kg/cm ²		
BH - 01	1.50 - 1.95	SPT 1	S-24	CH	1.47	0.86	71.16	0	2	34	64	78	30	48	---	---	---	---	---	---	---	---	---	---	2.60
BH - 01	4.50 - 5.10	SPT 2	S-25	CH	1.68	1.22	37.78	3	23	29	46	59	26	33	---	---	---	---	---	---	---	---	---	---	2.62
BH - 01	6.00 - 6.05	SPT 3	S-26	SM	---	####	---	14	64	22	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2.66


NOTE:

- The above results refer / relate only to the sample submitted for testing.
- No report shall be reproduced in part or full without written approval of this laboratory.
- Any query regarding report may be reported immediately.
- Any correction invalidates this report.
- Tests performed under controlled room temperature / humidity.
- * Not under NABL Scope.


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 (SIDDHI SAWANT)
 Technical Manager




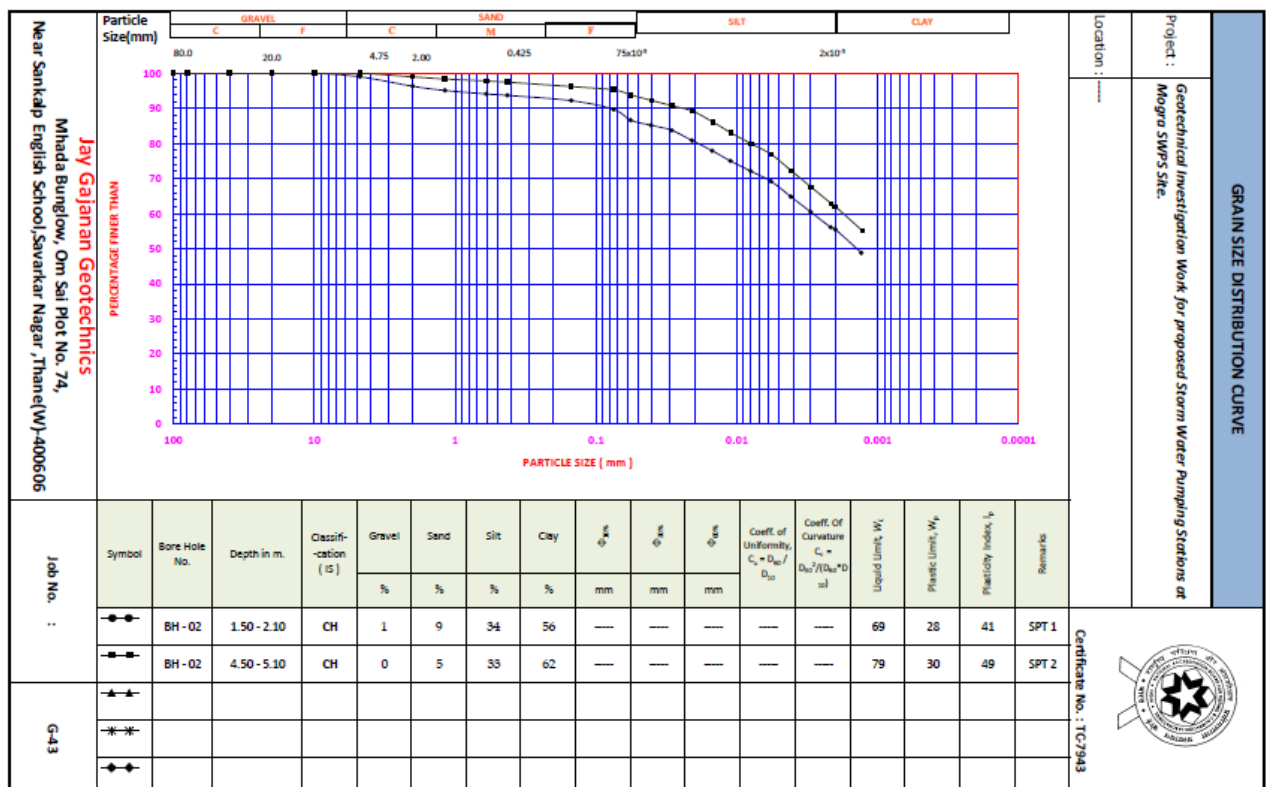
JGG		IAY GAJANAN GEOTECHNICS										 NABL ACCREDITED LAB Certificate No.:TC-7943							
TEST REPORT																			
URL :		TC794319000000310F					REPORT DATE :		18.10.2019										
CLIENT :		MCGM					REPORT NUMBER :		JGG/2019-20/G-43/01/001										
PROJECT :		Geotechnical Investigation Work for proposed Storm Water Pumping Stations at Mogra SWPS Site.																	
SAMPLES RECEIVED ON :		14.10.2019					TESTING DURATION :		14.10.2019 to 18.10.2019										
CONDITION OF SAMPLES :		ACCEPTABLE					TYPE & NUMBER OF SAMPLES RECEIVED :												
MECHANICAL TEST RESULTS (ROCK)																			
Test Method Reference:						IS 9143	IS 9221	IS 13047	IS 8704	IS 10082	IS 10050	IS 13090							
Sr. No.	Bore Hole No.	Core No.	Depth (RL) m	Lab Id	Condition of Test	Uniaxial Compressive Strength	Modulus of Elasticity	*Poisson's Ratio (α)	*Tribial Compressive Strength Test		Point Load Index	Uniaxial Test	Slake Durability Index	Porosity	Water Absorption	Dry Density	Bulk Density	Specific Gravity	Remarks
						kg/cm ²	GPa		Cube/cm ³	kg/cm ²	kg/cm ²	kg/cm ²	kg/cm ²	%	%	%	gm/cm ³		
1	BH - 01	2	7.50 - 9.00	R-173	Soaked	-----	-----	-----	-----	-----	8.06	-----	-----	15.01	8.19	1.83	-----	1.85	
2	BH - 01	9	9.00 - 10.50	R-174	Soaked	146	-----	-----	-----	-----	-----	-----	-----	10.89	5.29	2.06	-----	2.09	
3	BH - 01	25	9.00 - 10.50	R-175	Soaked	-----	-----	-----	-----	-----	14.52	-----	-----	3.76	1.75	2.15	-----	2.17	
4	BH - 01	30	10.50 - 12.00	R-176	Soaked	289	-----	-----	-----	-----	-----	-----	-----	5.58	2.73	2.05	-----	2.09	
NOTE: 1 The above results refer/ relate only to the sample submitted for testing. 2 No report shall be reproduced in part or full without written approval of this laboratory. 3 Any query regarding report may be reported immediately. 4 Any correction invalidates this report. 5 Tests performed under controlled room temperature/ humidity. 6 * Not under NABL Scope.																			
																		 Authorised Signatory (Siddhi Sawant) Technical Manager	



JGG																				JAY GAJANAN GEOTECHNICS										 NABL ACCREDITED LAB Certificate No. TC-7943	
TEST REPORT																															
ULR : TC794319000000311F										REPORT DATE : 18.10.2019																					
CLIENT : MCGM										REPORT NUMBER : JGG/2019-20/G-43/01/001																					
PROJECT : Geotechnical Investigation Work for proposed Storm Water Pumping Stations at Mogra SWPS Site.																															
SAMPLE RECEIVED ON : 14.10.2019										TESTING DURATION : 14.10.2019 to 18.10.2019																					
CONDITION OF SAMPLES : ACCEPTABLE										TYPE & NUMBER OF SAMPLES RECEIVED :																					
MECHANICAL TEST RESULTS (SOIL)																															
Bore Hole No.	Depth in m.	Sample Type	Lab Id	Soil Classification (IS)	Tests Performed and References															Remarks											
					IS 2720 P-7		IS 2720 P-2	IS 2720 P-4				IS 2720 P-5			IS 2720 P-20	IS 2720 P-6	IS 2720 P-14	IS 2720 P-11/12/13			IS 2720 P-10	IS 2720 P-41	IS 2720 P-40	IS 2720 P-15	IS 2720 P-9(S1)						
					Density g_m/cm^3	Dry Density g_m/cm^3		Natural Moisture Content, w %	Gravel %	Sand %	Silt %	Clay %	Liquid %	Plastic %				Plasticity Index, I _p %	Linear Shrinkage %							Shrinkage Limit %	*Relative Density %	Shear Test			
					Wet Density	Dry Density																						Cohesion C_u kg/cm ²	Degree ϕ		
BH - 02	1.50 - 2.10	SPT 1	S-27	CH	1.64	1.13	45.12	1	9	34	56	69	28	41	---	---	---	---	---	---	---	---	---	2.61	0						
BH - 02	4.50 - 5.10	SPT 2	S-28	CH	1.51	0.90	67.50	0	5	33	62	79	30	49	---	---	---	---	---	---	---	---	---	2.60	0						



NOTE:

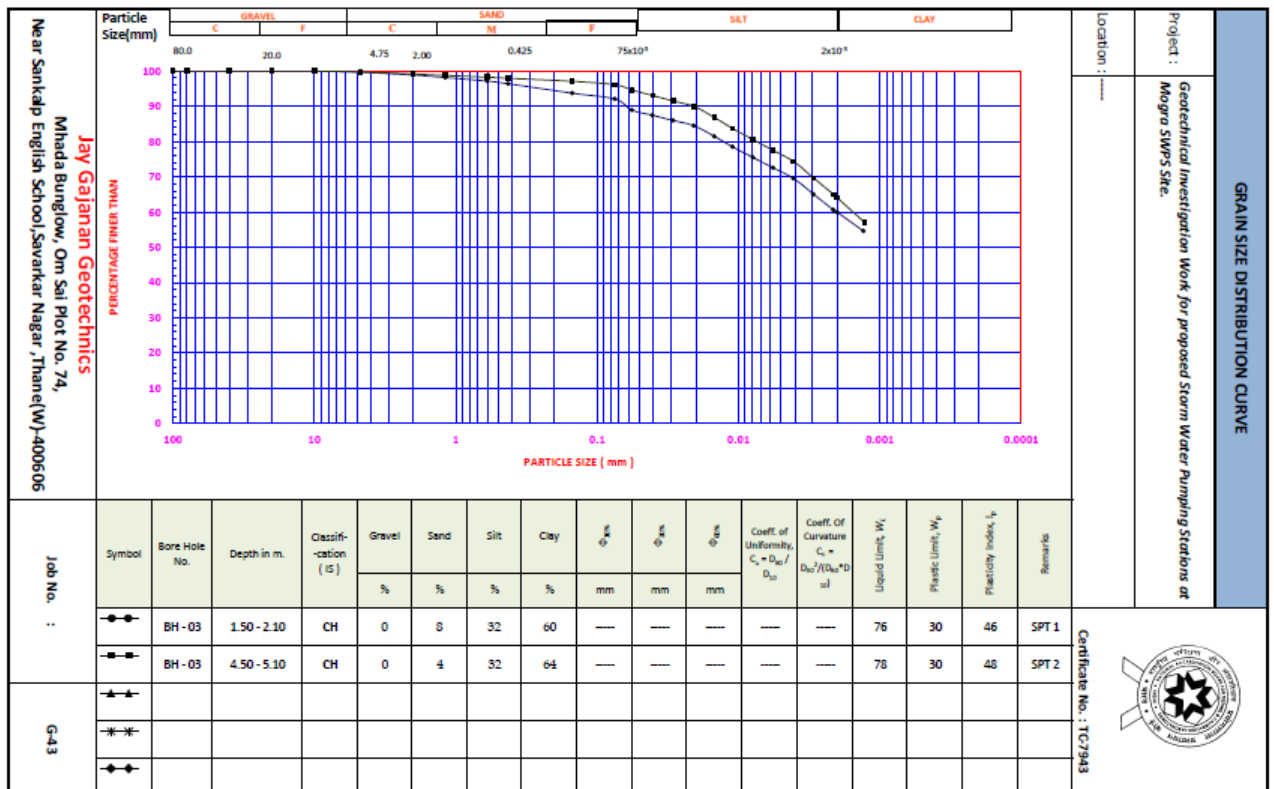
- The above results refer/ relate only to the sample submitted for testing.
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- Any query regarding report may be reported immediately.
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(SIDDHI SAWANT)
Technical Manager





JGG		JAY GAJANAN GEOTECHNICS										 NABL ACCREDITED LAB Certificate No.: TC-7943							
TEST REPORT																			
URL :		TC794319000000311F				REPORT DATE :		18.10.2019											
CLIENT :		MCGM				REPORT NUMBER :		JGG/2019-20/G-43/01/001											
PROJECT :		Geotechnical Investigation Work for proposed Storm Water Pumping Stations at Mogra SWPS Site.																	
SAMPLES RECEIVED ON :		14.10.2019				TESTING DURATION :		14.10.2019 to 18.10.2019											
CONDITION OF SAMPLES :		ACCEPTABLE				TYPE & NUMBER OF SAMPLES RECEIVED :													
MECHANICAL TEST RESULTS (ROCK)																			
Test Method Reference:						IS 9143	IS 9221	IS 13047	IS 8704	IS 10082	IS 10050	IS 13080							
Sr. No.	Bore Hole No.	Core No.	Depth (RL) m	Lab Id	Condition of Test	Uniaxial Compressive Strength	Modulus of Elasticity	*Poisson's Ratio (μ)	*Triaxial Compressive Strength Test		Point Load Index	*Brazilian Tensile	Slake Durability Index	Porosity	Water Absorption	Dry Density	Bulk Density	Specific Gravity	Remarks
						kg/cm ²	GPa		Cohesion (kN/m ²)	Angle of Friction (°)	kg/cm ²	kg/cm ²	%	%	%	g/cm ³	g/cm ³		
1	BH - 02	5	6.30 - 7.50	R-177	Soaked	251	-----	-----	-----	-----	-----	-----	-----	6.73	3.01	2.24	-----	2.26	
2	BH - 02	10	7.50 - 8.00	R-178	Soaked	266	-----	-----	-----	-----	-----	-----	-----	3.27	1.32	2.47	-----	2.50	
3	BH - 02	15	9.00 - 10.50	R-179	Soaked	-----	-----	-----	-----	50.23	-----	-----	-----	3.14	1.40	2.24	-----	2.26	
4	BH - 02	25	10.50 - 12.00	R-180	Soaked	150	-----	-----	-----	-----	-----	-----	-----	11.31	4.70	2.40	-----	2.43	
NOTE: 1 The above results refer/ relate only to the sample submitted for testing. 2 No report shall be reproduced in part or full without written approval of this laboratory. 3 Any query regarding report may be reported immediately. 4 Any correction invalidates this report. 5 Tests performed under controlled room temperature/ humidity. 6 * Not under NABL Scope.																			
																		 Authorized Signatory (Siddhi Sawant) Technical Manager	

JGG		JAY GAJANAN GEOTECHNICS										 NABL ACCREDITED LAB Certificate No: TC-7943															
TEST REPORT																											
URL : TC79431900000312F						REPORT DATE : 18.10.2019																					
CLIENT : MCGM						REPORT NUMBER : JGG/2019-20/G-43/01/001																					
PROJECT : Geotechnical Investigation Work for proposed Storm Water Pumping Stations at Mogra SWPS Site.																											
SAMPLE RECEIVED ON : 14.10.2019						TESTING DURATION : 14.10.2019 to 18.10.2019																					
CONDITION OF SAMPLES : ACCEPTABLE						TYPE & NUMBER OF SAMPLES RECEIVED :																					
MECHANICAL TEST RESULTS (SOIL)																											
Bore Hole No.	Depth in m.	Sample Type	Lab Id	Soil Classification (IS)	Tests Performed and References:																			Remarks			
					IS 2720 P-7.8		IS 2720 P-2	IS 2720 P-4				IS 2720 P-5			IS 2720 P-20	IS 2720 P-6	IS 2720 P-14	IS 2720 P-11/12/13		IS 2720 P-10	IS 2720 P-41	IS 2720 P-40	IS 2720 P-15		IS 2720 P-3(S1)		
					Density		Natural Moisture Content, w %	Mechanical Analysis				Consistency Limits			Linear Shrinkage %	Shrinkage Limit %	*Relative Density %	Shear Test		C _u from Unconsolidated Compression Test kN/m ²	*Swelling Pressure kN/m ²	Free swell index %	Vertical Consolidation				
					Wet Density g/cm ³	Dry Density g/cm ³		Gravel %	Sand %	Silt %	Clay %	Liquid %	Plastic %	Plasticity Index, I _p %				Type	Cohesion C _u kg/cm ²				Degree φ		Comp. Index C _{cr} (Lab)	Initial Void Ratio	Specific Gravity
BH - 03	1.50 - 2.10	SPT 1	S-29	CH	1.52	0.94	61.02	0	8	32	60	76	30	46	---	---	---	---	---	---	---	---	---	---	---	2.61	
BH - 03	4.50 - 5.10	SPT 2	S-30	CH	1.53	0.91	67.37	0	4	32	64	78	30	48	---	---	---	---	---	---	---	---	---	---	---	2.60	
NOTE: 1 The above results refer/ relate only to the sample submitted for testing. 2 No report shall be reproduced in part or full without written approval of this laboratory. 3 Any query regarding report may be reported immediately. 4 Any correction invalidates this report. 5 Tests performed under controlled room temperature/ humidity. 6 * Not under NABL Scope.														 Authorised Signatory (SIDDHI SAWANT) Technical Manager													



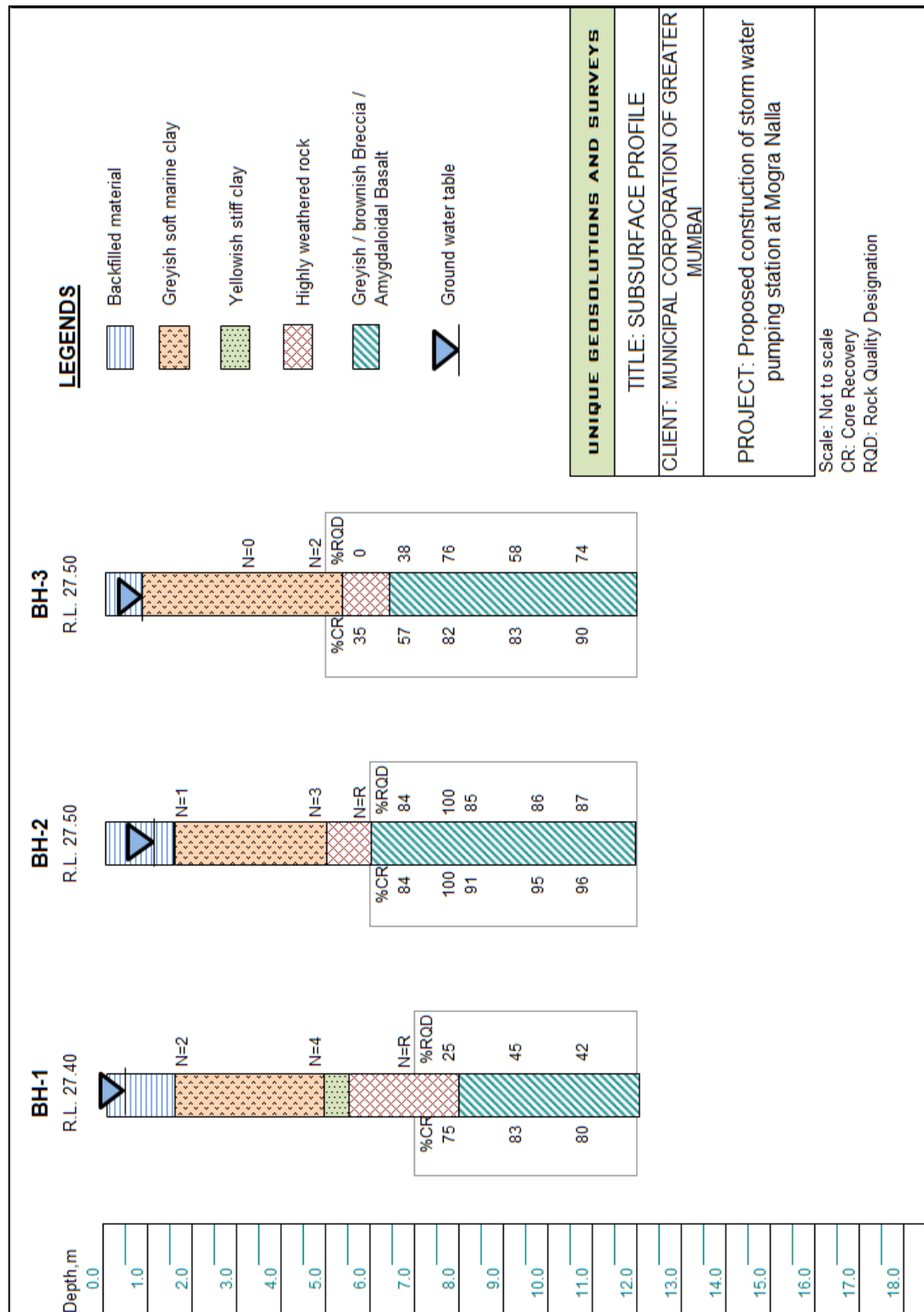
JGG		JAY GAJANAN GEOTECHNICS										 NABL ACCREDITED LAB Certificate No.: TC-7943							
TEST REPORT																			
URL :	TC79431900000312F					REPORT DATE :	18.10.2019												
CLIENT :	MCGM					REPORT NUMBER :	JGG/2019-20/G-43/01/001												
PROJECT :	Geotechnical Investigation Work for proposed Storm Water Pumping Stations at Mogra SWPS Site.																		
SAMPLES RECEIVED ON :	14.10.2019					TESTING DURATION :	14.10.2019 to 18.10.2019												
CONDITION OF SAMPLES :	ACCEPTABLE					TYPE & NUMBER OF SAMPLES RECEIVED :													
MECHANICAL TEST RESULTS (ROCK)																			
Test Method References:						IS 9143	IS 9221	IS 13047	IS 8704	IS 10082	IS 10050	IS 13030							
Sr. No.	Bore Hole No.	Core No.	Depth (RL) m	Lab Id	Condition of Test	Uniaxial Compressive Strength	Modulus of Elasticity	*Poisson's Ratio (μ)	*Triaxial Compressive Strength Test		Point Load Index	*Brazilian Test	Slake Durability Index	Porosity	Water Absorption	Dry Density	Bulk Density	Specific Gravity	Remarks
						kg/cm ²	GPa		Cohesion (c) kg/cm ²	Angle of (φ) Degree									
1	BH - 03	10	6.00 - 7.50	R-181	Soaked	364	-----	-----	-----	-----	-----	-----	-----	5.57	2.22	2.52	-----	2.55	
2	BH - 03	18	7.50 - 9.00	R-182	Soaked	-----	-----	-----	-----	11.46	-----	-----	-----	1.73	0.75	2.29	-----	2.31	
3	BH - 03	27	9.00 - 10.50	R-183	Soaked	172	-----	-----	-----	-----	-----	-----	-----	7.07	2.86	2.47	-----	2.49	VEIN
4	BH - 03	36	10.50 - 12.00	R-184	Soaked	216	-----	-----	-----	-----	-----	-----	-----	10.20	4.28	2.38	-----	2.40	
NOTE: 1 The above results refer/ relate only to the sample submitted for testing. 2 No report shall be reproduced in part or full without written approval of this laboratory. 3 Any query regarding report may be reported immediately. 4 Any correction invalidates this report. 5 Tests performed under controlled room temperature/ humidity. 6 *Not under NABL Scope.																			
																		 Authorized Signatory (Siddhi Sawant) Technical Manager	

JGG		JAY GAJANAN GEOTECHNICS							
SITE :		Geotechnical Investigation Work for proposed Storm Water Pumping Stations at Mogra SWPS Site.							
CLIENT:		MCGM						Date: 19.10.2019	
 Certificate No. : TC-7943									
CHEMICAL TEST RESULT OF SOIL SAMPLES									
Sr. No.	Bore Hole No.	URL NO	Lab ID	Depth in m	Type of Sample	pH Value	Sulphate as SO ₃ (%)	Chloride as Cl (%)	Remark
1	1	TC794319000000310F	S - 24	1.50-2.10	SPT-1	7.35	0.366	0.121	
2	2	TC794319000000311F	S - 28	4.50-5.10	SPT-2	7.85	0.420	0.093	
3	3	TC794319000000312F	S - 30	4.50-5.10	SPT-2	7.79	0.469	0.144	
JAY GAJANAN GEOTECHNICS								Job No.	G43

JGG		JAY GAJANAN GEOTECHNICS					
SITE :		Geotechnical Investigation Work for proposed Storm Water Pumping Stations at Mogra SWPS Site.					
CLIENT:		MCGM				Date: 19.10.2019	
 Certificate No. : TC-7943							
CHEMICAL TEST RESULT OF WATER SAMPLES							
Sr. No.	Bore Hole No.	ULR No	Lab ID	pH Value	Sulphate as SO ₄ (ppm)	Chloride as Cl (ppm)	Remark
1	BH - 1	TC794319000000310F	W - 18	7.00	3902.666	21743.612	
2	BH - 2	TC794319000000311F	W - 19	7.00	4125.699	21550.764	
3	BH - 3	TC794319000000312F	W - 20	7.00	4003.895	22273.944	
JAY GAJANAN GEOTECHNICS						Job No.	G-43

ANNEXURE – IV

SUBSURFACE PROFILE



ANNEXURE – V

PHOTOGRAPHS

BH-1



BH-2



BH-3

