

EMPLOYER :

RAIL INFRASTRUCTURE DEVELOPMENT COMPANY LIMITED



GENERAL CONSULTANT:

AECOM-EGIS-WSP

AECOM



PROOF CONSULTANT:



CONTRACTOR:



L&T CONSTRUCTION

TRANSPORTATION INFRASTRUCTURE IC

DESIGN CONSULTANT:



L&T CONSTRUCTION

TRANSPORTATION INFRASTRUCTURE IC

EDRC RBF - CHENNAI

PROJECT :

BENGALURU SUB-URBAN RAIL PROJECT CORRIDOR - 4

TITLE :Geotechnical factual reports

Doc No.-

DOC-BSRP-CR4-GFR-AG-1006

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1 INTRODUCTION

The Corridor-4 of Bengaluru Sub Urban Railway Project has been awarded tender engineering project, Procurement and Construction contract. The Corridor-4 Package comprises of Design and Construction of Elevated Viaduct of length 8.96 Km (CH: 14.625 Km to 17.950 Km, CH: 22.665 Km to 23.750 Km, 34.450 Km to 36.025 Km & 36.275 Km to 39.250 Km) including ramps and formation in Embankments /Cuttings including Blanketing, Major Bridges, Minor Bridges, RUB, ROB, ROR, Retaining Wall, Sacrificial Retaining Wall and Drains, Utility Diversions of At-Grade section of length 37.92 Km (Ch: -0.635 Km to Ch: 14.625 Km, Ch: 17.950 Km to Ch: 21.925 Km, Ch: 23.750 Km to 34.450 Km, Ch: 36.025 Km to 36.275 Km & Ch: 39.250 Km to 46.985 Km) and other related Infrastructural Works from Heelalige to Rajankunte, excluding station buildings, of Corridor-4 of Bengaluru Suburban Railway Project (BSRP).

The alignment plan of the Corridor-4 is shown in Fig 1-1 Project layout.

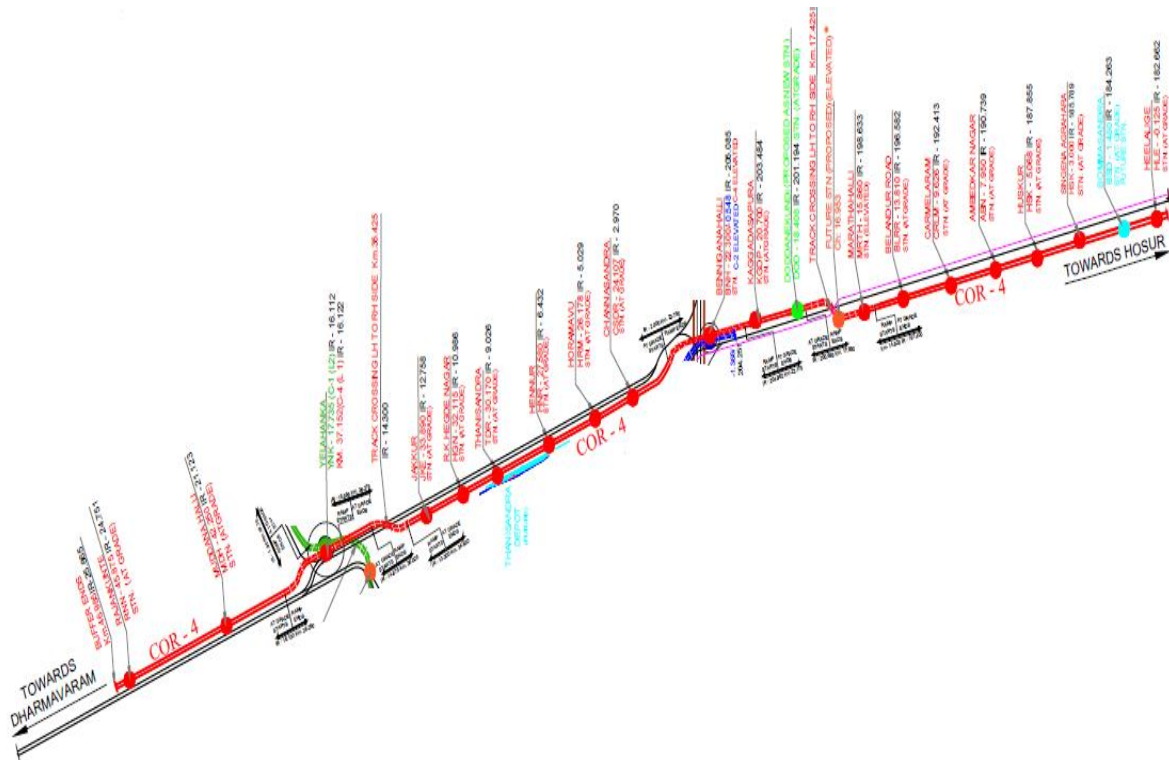


Fig 1-1 Project layout.

2 SCOPE OF THE WORK

The project includes total 103 structures between CH. 0+000 to CH. 46+985 that includes 83 Minor Bridges, 14 RUBs, 2 ROBs and 4 Major Bridges.

A detailed geotechnical investigation is conducted by drilling boreholes at 115 locations to obtain physical and engineering properties of sub soil strata. Boreholes are drilled up to the required depth below existing ground level. Soil conditions/strata are identified, and laboratory tests are conducted on collected samples of soil and rock.

The scope of the report forms the geotechnical investigation and factual report for the boreholes carried out.

3 LOCATION OF THE BOREHOLES

The location of the boreholes with reference to respective section is tabulated below.

Table 3-1 Details of Proposed structure

S. No	BH ID	Section number	Structure
1	BH MI 13/59	1	MIB
2	BH RU 13-66	1	RUB
3	BH RU 13-67	1	RUB
4	BH F 13+900	1	Formation
5	BH MI 14/10	1	MIB
6	BH MI 25/62	3	MIB
7	BH MI 25/79	3	MIB
8	BH F 25+300	3	Formation
9	BH MI 25/92	3	MIB
10	BH RU 25/94	3	RUB

4 GEOTECHNICAL INVESTIGATION

Geotechnical investigation for the above tabulated structure is conducted as per the codal provisions. The geotechnical field investigation consists of drilling, sampling, field tests and collection of disturbed and undisturbed soil and rock core samples, preserving the samples at site before dispatching them to the laboratory. Laboratory testing includes carrying out all the necessary tests on soil samples (both disturbed and undisturbed) as per relevant IS codes.

The borelog and lab test results, which describe the details of the investigation, laboratory tests and results on soil and rock samples, is attached herewith.

5 GEOLOGY AND GEOMORPHOLOGY

Bangalore city is situated on a latitude of 12° 58' North and longitude of 77° 36' East and is at an average altitude of around 910 m above mean sea level (MSL). The city is the principal administrative, industrial, commercial, educational, and cultural capital of Karnataka state and lies in the South-Western part of India.

Geology of Bangalore comprises of dominant presence of 'Archaean' crystalline formation. The formation is of Peninsular Gneissic complex with small patch of hornblende schist in the northern part and intrusive Closepet Granites all along the western part of the district. These young gneissic complexes are in the age of 2.6 to 3.0 billion years. They are essentially granodioritic and granitic formed due to several thermal-tectonic movements with large influx of sialic materials representing remobilized parts of an older crust with abundant additions of granitic materials. These gneissic complexes act as basement for belt of schist, largely basaltic and characterized by gold mineralization which is noticed in nearby Kolar. Small stretch comprising unconsolidated sediments are also noticed in Channapatna and Devanahalli. The soil overburden generally is dominated by Silty SAND /residual SILT and shows presence of clay as a nominal interstitial binder. Overburden in upper layers is generally in loose to medium compact condition especially in areas with high ground water table. The overburden thickness is variable and is reflective of typical differential weathering that has occurred over a prolonged period. This is followed by completely weathered to highly weathered rock. The geological map also shows presence of large number of dolerite/gabbro/norite bodies and quartz veins in Bangalore area. The Regional Geological Map of Bangalore is shown in Fig 5-1

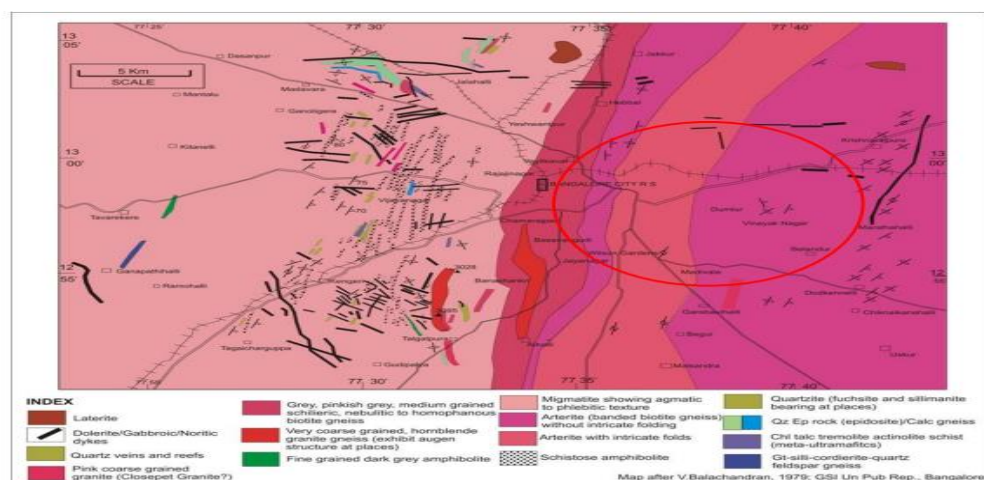


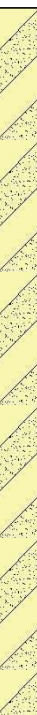








Fig 5-1 The Regional Geological Map of Bangalore (Ref. Geological Survey of India, 1979)

				BOREHOLE LOG										Borehole ID: BH-MI-13-59																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
Project Name : Geotechnical investigation for "K-RIDE Bangalore Suburban Rail Project (BSRP) - Corridor-4" Bangalore, Karnataka																								Project Number : S-2612																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
Client : Larsen & Toubro Limited Transportation Infra I.C.								Project Location : Bangalore, Karnataka								Logged By: DK						Checked By: VSM						Approved By: ANS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
Rig ID : NE-06						Energy Transfer Ratio (%) :						Started Date : 21 Jun 2024										Completed Date : 22 Jun 2024																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
Equipment: Hydraulic								Termination Depth						Northing: 1431529.000m						Easting: 793752.000m						Ground Water Table : 1.80 m																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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 		BOREHOLE LOG					Borehole ID: BH-RU-13-66								
Project Name : Geotechnical investigation for "K-RIDE Bangalore Suburban Rail Project (BSRP) - Corridor-4" Bangalore, Karnataka										Project Number : S-2612					
Client : Larsen & Toubro Limited Transportation Infra I.C.			Project Location : Bangalore, Karnataka			Logged By: DK		Checked By: VSM		Approved By: ANS					
Rig ID : NE-06		Energy Transfer Ratio (%) :			Started Date : 24 Jun 2024			Completed Date : 26 Jun 2024							
Equipment: Hydraulic			Termination Depth		Northing: 1431605.000m		Easting: 793774.000m		Ground Water Table : 18.24 m						
Drilling Method: Rotary Drilling			35.00 m		Ground Elevation : 868.514 m			BSRP Chainage (km) : 13+665							
Elevation (m)	Depth	Legend	Material Description	Sample Type	Blow Counts (N Value)	C (kPa)	φ (°)	Coring (%)		Strength Parameters		Index Properties		SPT N Value ▲ MC ● LL ● PL ▼ Fines Content	
								CR	RQD	UCS (Mpa) 40 80 120 160 2 4 6 8 Point Load (MPa)	SG Bulk Density Dry Density 5 10 15 20	10 20 30 40 50 60 70 80 90			
33			Completely weathered, completely fractured, fine to medium grained, yellowish brown, Granulite	RC-9				46	8						
34			RC-10						53	9					
834.01 833.51			RC-11	Moderately weathered, moderately fractured, fine to medium grained, whitish brown, Granulite End of Borehole at 35.00m					96	64					
35															
36															
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Abbreviation

SPT: Standard Penetration Test	C: Cohesion	UCS-Unconfined Compressive Strength
UD: Undisturbed Sample	φ: Angle of Internal Friction	LL : Liquid Limit
MC: Moisture Content	SG: Specific Gravity	PL: Plastic Limit
CR : Core Recovery	RQD: Rock Quality Designation	Bulk & Dry Density in kN/cu.m

				BOREHOLE LOG										Borehole ID: BH-RU-13-67																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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Rig ID : NE-05					Energy Transfer Ratio (%) :					Started Date : 21 Jun 2024					Completed Date : 22 Jun 2024					Equipment:																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
Hydraulic					Termination Depth					Northing: 1431627.000m					Easting: 793761.000m					Ground Water Table :Notmet																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
Drilling Method: Rotary Drilling					15.00 m					Ground Elevation : 867.530 m					BSRP Chainage (km) : 13+678																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
Elevation (m)	Depth	Legend	Material Description	Sample Type	Blow Counts (N Value)	C (kPa)	φ (°)	Coring (%)		Strength Parameters				Index Properties				▲ SPT N Value ▲ MC ● LL ● PL ▽ Fines Content																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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Borehole ID: BH-F-13+900

Sheet 1 of 1

Project Number : S-2612

Approved By: ANS

Completed Date : 24 Jun 2024

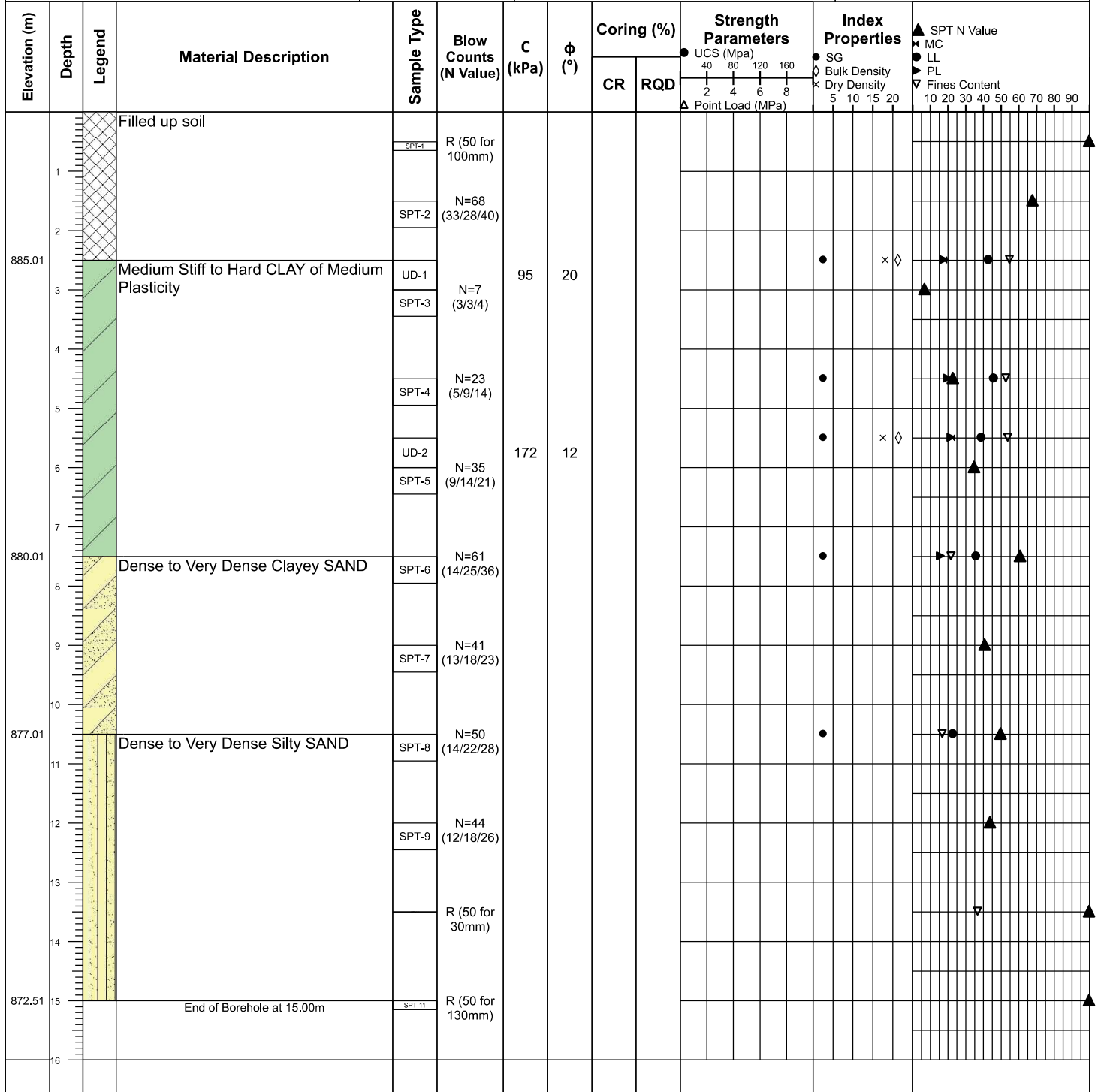
Ground Water Table : 7.40 m

BSRP Chainage (km) : 13+900

[illegible]

UCS-Unconfined Compressive Strength
LL : Liquid Limit PL: Plastic Limit
Bulk & Dry Density in kN/cu.m

Project Name : Geotechnical investigation for "K-RIDE Bangalore Suburban Rail Project (BSRP) - Corridor-4" Bangalore, Karnataka							Project Number : S-2612			
Client : Larsen & Toubro Limited Transportation Infra I.C.			Project Location : Bangalore, Karnataka		Logged By: DK		Checked By: VSM		Approved By: ANS	
Rig ID : NE-05		Energy Transfer Ratio (%) :			Started Date : 26 Jun 2024			Completed Date : 26 Jun 2024		
Equipment: Hydraulic			Termination Depth 15.00 m		Northing: 1432033.000m		Easting: 793678.000m		Ground Water Table : 5.10 m	
Drilling Method: Rotary Drilling					Ground Elevation : 887.510 m			BSRP Chainage (km) : 14+101		



Abbreviation			
SPT: Standard Penetration Test	C: Cohesion	UCS-Unconfined Compressive Strength	
UD: Undisturbed Sample	ϕ : Angle of Internal Friction	LL : Liquid Limit	PL: Plastic Limit
MC: Moisture Content	SG: Specific Gravity	Bulk & Dry Density in kN/cu.m	
CR : Core Recovery	RQD: Rock Quality Designation		

APPENDIX-B

Plate No.1: Summary of Test Results (SOTR)

Plate No.2: Rock Mass Rating (RMR)

APPENDIX-B

Plate No.1: Summary of Test Result (SOTR)



TEST REPORT

BOREHOLE ID: BH-MI-13/59

Test Report No: SRTL/2024-25/TRN-42

Date: 9-Jul-24

U/LR- TC6007240000002702P

U/LR- TC6007240000002702P

Sample ID		Depth in meter (m)	Sample Description	SPT N value	IS Classification	SOIL PARAMETERS										ROCK PARAMETERS					CHEMICAL PARAMETERS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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						Water Content (%) IS 2720 - 2 :1973, RA 2020		Liquid Limit (%)	Plastic Limit (%)		Plasticity Index (%)	Shrinkage Limit (%) IS: 2720-Part 6:1972, RA 2021		* Bulk Unit weight kN/m3		* Dry Density kN/m3		Specific Gravity IS: 2720-Part 3, Section 1 :1980, RA 2021		Gravel %		Coarse Sand %	Medium Sand %	Fine Sand %	% passing 75 micron	Silt %	Clay %	Hydromet er Analysis IS: 2720 - Part 4 :1985, (RA - 2021)	Free swell Index (%) IS: 2720 -Part 40:1977 (RA - 2021)		Angle of Internal Friction deg Φ (RA - 2021)		Cohesion C kPa (RA - 2021)	Unconfined Compressive Strength, kPa IS 2720 - Part10:1991 (RA - 2021)		Angle of Internal Friction deg Φ (RA-2021)		Cohesion C kPa (RA-2021)	Angle of Internal Friction deg Φ (RA-2021)	CU Triaxial Test IS 2720 - Part11 : 1986 (RA-2021)	Pre Consolidation Pressure (kPa) IS 2720-Part 15:1986 (RA - 2021)	Consolidation IS: 2720-Part 15:1986 (RA - 2021)	STRENGTH PARAMETERS					PHYSICAL PROPERTIES IS 13030:1991, RA - 2021					*Chemical Testing(Soil)					*Chemical Testing(Water)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
Water Content (%)		Plastic Limit (%)	Plasticity Index (%)		Shrinkage Limit (%)	* Bulk Unit weight		* Dry Density		Specific Gravity		Gravel		Coarse Sand	Medium Sand	Fine Sand	% passing 75	Silt	Clay	Hydromet er Analysis	Free swell Index (%)		Angle of Internal		Cohesion C kPa	Unconfined Compressive		Angle of Internal		Cohesion C kPa	Angle of Internal	CU Triaxial	Pre Consolidation Pressure (kPa)	Consolidation	STRENGTH PARAMETERS					PHYSICAL PROPERTIES					*Chemical Testing(Soil)					*Chemical Testing(Water)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
Sample ID		Depth in meter (m)	Sample Description	SPT N value	IS Classification	Water Content (%)		Plastic Limit (%)	Plasticity Index (%)		Shrinkage Limit (%)	* Bulk Unit weight		* Dry Density		Specific Gravity		Gravel		Coarse Sand	Medium Sand	Fine Sand	% passing 75	Silt	Clay	Hydromet er Analysis	Free swell Index (%)		Angle of Internal		Cohesion C kPa	Unconfined Compressive		Angle of Internal		Cohesion C kPa	Angle of Internal	CU Triaxial	Pre Consolidation Pressure (kPa)	Consolidation	STRENGTH PARAMETERS					PHYSICAL PROPERTIES					*Chemical Testing(Soil)					*Chemical Testing(Water)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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BOREHOLE ID: BH-RU-13/66

Date: 9-Jul-24

Report No.: S-2612(P)/2024-25/GFR/Ver.01	Approved By: 42
Checked By: CT	Prashanth T
Chikenna T	



BOREHOLE ID: BH-RU-13/67

Date: 9-Jul-24

Date: 9-Jul-24

Date: 0-0-00

PARAMETERS	*Chemical Testing (W)	ph value	Sulphate (mg/l)	TDS (mg/l)				

Approved By: _____

PT

Prashanth Talwar



TEST REPORT

BOREHOLE ID: BH-F-13+900

Test Report No: SRTL/2024-25/TRN-42

Date: 9-Jul-24

ULR- TC600724000002702P

[illegible]



BOREHOLE ID: BH-MI-14 /10

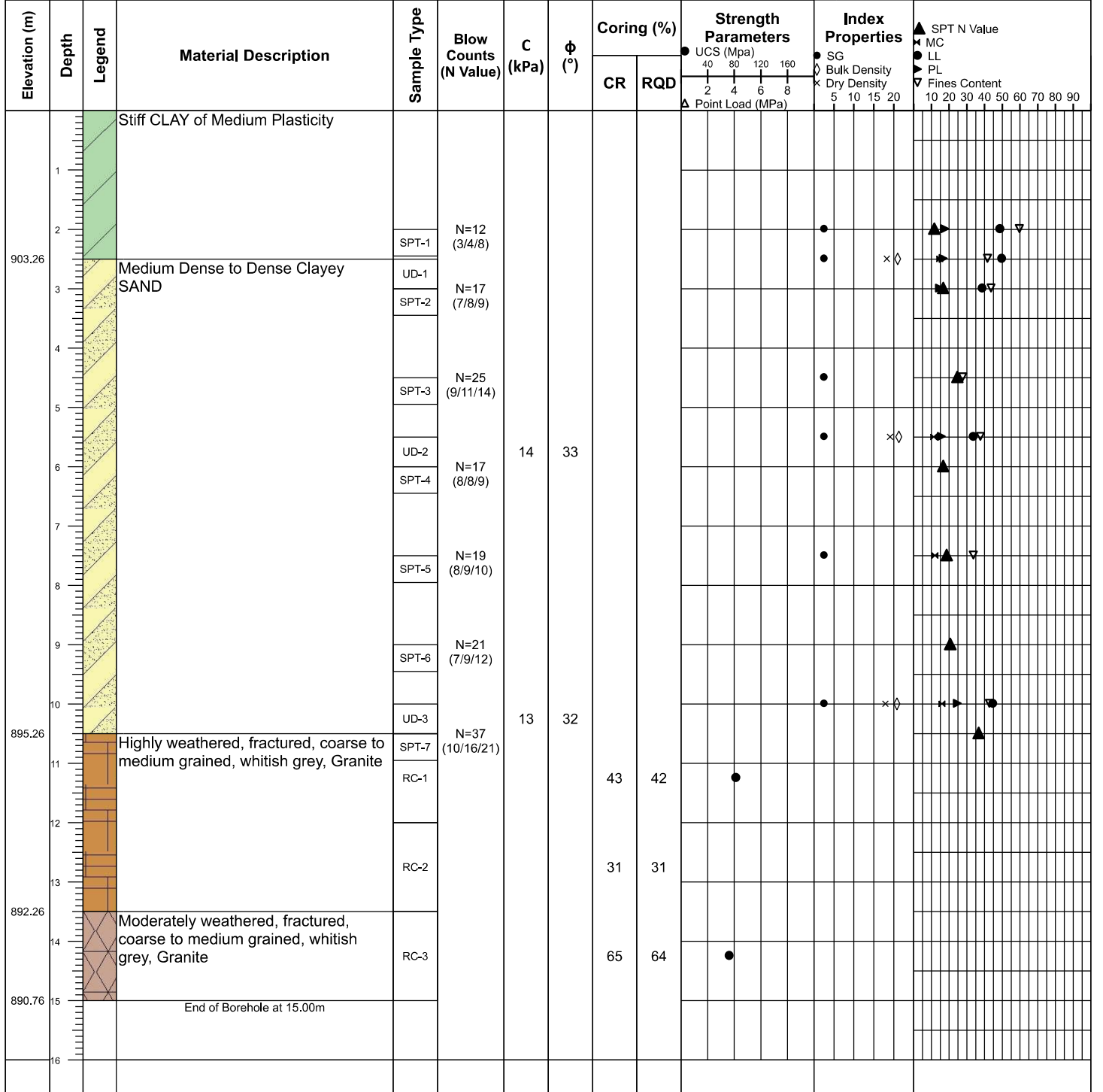
Date: 9-Jul-24

Test Report No: SRTL/2024-25/TRN-42



Test Report No: SRTL/2024-25/TRN-42

[illegible]

Project Name : Geotechnical investigation for "K-RIDE Bangalore Suburban Rail Project (BSRP) - Corridor-4" Bangalore, Karnataka					Project Number : S-2612	
Client : Larsen & Toubro Limited Transportation Infra I.C.		Project Location : Bangalore, Karnataka		Logged By: VSM		Checked By: VSM
				Approved By: ANS		
Rig ID : SH-07		Energy Transfer Ratio (%) :		Started Date : 27 Jun 2024		Completed Date : 28 Jun 2024
Equipment: Hydraulic		Termination Depth		Northing: 1441147.000m		Easting: 788664.000m
		15.00 m		Ground Elevation : 905.759 m		BSRP Chainage (km) : 25+627
Drilling Method: Rotary Drilling						



Abbreviation			
SPT: Standard Penetration Test	C: Cohesion	UCS-Unconfined Compressive Strength	
UD: Undisturbed Sample	ϕ : Angle of Internal Friction	LL : Liquid Limit	PL: Plastic Limit
MC: Moisture Content	SG: Specific Gravity	Bulk & Dry Density in kN/cu.m	
CR : Core Recovery	RQD: Rock Quality Designation		

				BOREHOLE LOG										Borehole ID: BH-F-25+300																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
Project Name : Geotechnical investigation for "K-RIDE Bangalore Suburban Rail Project (BSRP) - Corridor-4" Bangalore, Karnataka																				Project Number : S-2612																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
Client : Larsen & Toubro Limited Transportation Infra I.C.					Project Location : Bangalore, Karnataka					Logged By: VSM					Checked By: VSM					Approved By: ANS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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Elevation (m)	Depth	Legend	Material Description	Sample Type	Blow Counts (N Value)	C (kPa)	φ (°)	Coring (%)		Strength Parameters				Index Properties				<div>▲ SPT N Value</div> <div>▲ MC</div> <div>● LL</div> <div>● PL</div> <div>▼ Fines Content</div> <div>10 20 30 40 50 60 70 80 90</div>																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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APPENDIX-B

Plate No.1: Summary of Test Results (SOTR)

Plate No.2: Rock Mass Rating (RMR)

APPENDIX-B

Plate No.1: Summary of Test Result (SOTR)



BOREHOLE ID: BH-MI-25/62

TEST REPORT

Test Report No: SRTL/2024-25/IRN-44
ULR-TC6007240000002704P
Date: 10-Jul-24

[illegible]

Checked By:	Approved By:
CT	PT
Chitkanna T	Prashanth Talkad



TEST REPORT

Date: 10-Jul-24

Date: 10-Jul-24

PARAMETERS		Chemical Testing (Water)	
		pH value	
		Sulphate (mg/l)	
		Chlorides (mg/l)	

Approved By:

PT

Prashanth Talakad



TEST REPORT



BOREHOLE ID: BH-F-25+300





Test Report No: SRTL/2024-25/TRN-44

Date: 10-Jul-24

ULR- TC6007240000002704P

[illegible]

				BOREHOLE LOG										Borehole ID: BH-MI-25-92																					
Project Name : Geotechnical investigation for "K-RIDE Bangalore Suburban Rail Project (BSRP) - Corridor-4" Bangalore, Karnataka																								Project Number : S-2612											
Client : Larsen & Toubro Limited Transportation Infra I.C.								Project Location : Bangalore, Karnataka								Logged By: SM						Checked By: VSM						Approved By: ANS							
Rig ID : SG-07						Energy Transfer Ratio (%) :						Started Date : 03 Jul 2024										Completed Date : 04 Jul 2024													
Equipment: Hydraulic								Termination Depth						Northing: 1441378.000m						Easting: 788480.000m						Ground Water Table : 9.40 m									
Drilling Method: Rotary Drilling								15.00 m						Ground Elevation : 903.137 m										BSRP Chainage (km) : 25+923											
Elevation (m)	Depth	Legend	Material Description						Sample Type	Blow Counts (N Value)	C (kPa)	ϕ (°)	Coring (%)		Strength Parameters				Index Properties				▲ SPT N Value ▲ MC ● LL ▲ PL ▼ Fines Content												
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				BOREHOLE LOG										Borehole ID: BH-RU-25-94																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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APPENDIX-B

Plate No.1: Summary of Test Results (SOTR)

Plate No.2: Rock Mass Rating (RMR)

APPENDIX-B

Plate No.1: Summary of Test Result (SOTR)



Date: 19-Jul-24

Date: 19-Jul-24

Date: 19-Jul-24

Date: 19-Jul-24

[illegible]

Approved By:

PT

Prashanth Talkad

Prashanth Talkad

Prashanth Talkad



11-24

11-24

11-24

Chemical g(Water)	Chlorides (mg/l)	
	Organic Solids	