PLB ENGINEERING BERHAD

GEOTECHNICAL DESIGN REPORT

PERMOHONAN KEBENARAN MERANCANG UNTUK KERJA-KERJA TEBUSGUNA TANAH BAGI PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIADA), SEKYEN 8, BANDAR GEORGETOWN, PULAU PINANG UNTUK TETUAN PLB ENGINEERING BERHAD

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TABLE OF CONTENTS

Page

1.0 PROJECT INFORMATION 1

2.0 INTRODUCTION 2
2.1 General 2
2.2 Objective and Scope 3
2.3 Limitation on Use and Liability 3

3.0 THE SITE 4
3.1 Location and Site Conditions 4
3.2 General Geology 5

4.0 SUBSURFACE INVESTIGATION 5
4.1 General 5
4.2 Subsoil Condition 6

5.0 WATER LEVEL AND TIDAL RANGE 7

6.0 ENGINEERING PROPERTIES OF SUBSOIL 7
6.1 General 7
6.2 Physical Properties 7
6.3 Chemical Properties 8
6.4 Shear Strength Parameters 9
6.5 Compressibility Parameters 9

7.0 GEOTECHNICAL DESIGN CONSIDERATIONS 10
7.1 General 10
7.2 Settlement Analyses 10
7.3 Reclamation Embankment Stability Analyses 11
7.3.1 Static Condition 11
7.3.2 Seismic Condition 12
7.4 Existing Dumpsite Post Rehabilitation Stability Analyses 12

8.0 GROUND TREATMENT DESIGN 13
8.1 Temporary Surcharging 14

8.2 Prefabricated Vertical Drain (PVD) 14
8.3 Adopted Ground Treatment 14

9.0 PROPOSED CONSTRUCTION SEQUENCE 14

10.0 INSTRUMENTATION SCHEME, MONITORING AND INTERPRETATION 16

11.0 ESTIMATED FILL QUANTITIES FOR RECLAMATION WORKS 16

12.0 ABANDONMENT PLAN 18

13.0 CONCLUSIONS 19

14.0 ENGINEER'S DECLARATION 20

TABLES

List of Tables

Tables

FIGURES

List of Figures

Figures

APPENDICES

Appendices

1.0 PROJECT INFORMATION

Project Title	PERMOHONAN KEBENARAN MERANCANG UNTUK KERJA-KERJA TEBUSGUNA TANAH BAGI PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIADA), SEKSYEN 8, BANDAR GEORGETOWN, PULAU PINANG UNTUK TETUAN PLB ENGINEERING BERHAD
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PM No.	No.PKM: JPBD/PG/P2/PKM-0132

2.0 INTRODUCTION

2.1 General

PLB Engineering Bhd (hereinafter referred to as the 'Project Proponent') has appointed Global Water Consultants Sdn Bhd (hereinafter referred to as the 'Consultant') to conduct maritime and geotechnical study for land reclamation of the proposed project titled

"PERMOHONAN KEBENARAN MERANCANG UNTUK KERJA-KERJA TEBUSGUNA TANAH BAGI PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIADA), SEKSYEN 8, BANDAR GEORGETOWN, PULAU PINANG UNTUK TETUAN PLB ENGINEERING BERHAD"

G&P Geotechnics Sdn Bhd appointed by Global Water Consultants Sdn Bhd as Geotechnical Consultant (hereinafter referred to as the Geotechnical Consultant or 'G&P') and is responsible for conducting geotechnical study. The proposed development consists of two parts namely the rehabilitation of the existing Jelutong dumpsite and reclamation fill adjacent to the dumpsite. The master layout plan for the proposed reclamation and development is shown in Figure 1.

This geotechnical design report presents an assessment of the existing ground conditions at the proposed site. Based on the results of Subsurface Investigation (SI) works and laboratory tests carried out, related geotechnical issues and potential solutions are considered for the land reclamation. The interpretation of field & laboratory tests results and selection of subsoil parameters for geotechnical design are presented together with the geotechnical analyses. This report also includes design considerations of the reclamation platform level and stability of the dumpsite after rehabilitation.

This report shall be read in conjunction with the following supplied documents:

a) Subsurface Investigation (SI) Factual Report prepared by M/S Soil Mechanic Sdn Bhd titled "Soil Investigation Work at Jelutong Dumpsite" (Report Ref.: SM 21 SI (04)-26) dated June 2021, planned by Sri & Sri's Associates Sdn Bhd and submitted to PLB Engineering Bhd.

b) Subsurface Investigation (SI) Factual Report prepared by M/S Geolab (M) Sdn Bhd titled "Subsurface Investigation Works for Jelutong Rehabilitation and Reclamation at Jelutong,

Penang" (Report Ref.: GLSB/SI/3971-155/2022 dated March 2023) planned by G&P Geotechnics Sdn Bhd.

c) Bathymetric survey prepared by Jurukur Perunding Services Sdn Bhd (Drawing No.: JPWS/20/PNG/145/001 dated 1st July 2020).

Note that levels in this report are in National Geodetic Vertical Datum (NGVD) with reference to Standard Port of Kedah Pier, Penang, whereby 0.00m Chart Datum (CD) is equivalent to -1.56m National Geodetic Vertical Datum (NGVD).

2.2 Objective and Scope

The main objectives of this report is to interpret and assess the SI results, address geotechnical issues such as settlement and stability of the proposed reclamation fill, stability of the existing Jelutong dumpsite platform after rehabilitation and to provide geotechnical design for the reclamation works. The selection of the subsoil parameters is based on interpreted field and laboratory test results as well as SI information from nearby reclamation site.

2.3 Limitation on Use and Liability

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties that vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This document may report such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigations were carried out and are believed to be reported accurately (only if SI not supervised by G&P).

Any interpretation or recommendation given in this report shall be understood to be based on judgement and experience and not on greater knowledge of the facts than the reported investigations would imply.

The interpretation and recommendation are therefore opinions provided for our Client's sole use in accordance with the appointment. As such they do not necessarily address all aspects of ground behaviour on the subject site. The responsibility of G&P Geotechnics

Sdn Bhd is solely to its Client, PLB Engineering Bhd and Authorities the report is submitted to on the permanent works designed by G&P in accordance to the scope of works appointed. This report may be disclosed to other professional advisors assisting the Client in respect of the project concerned only. It is not intended for and should not be relied upon by any third party. No liability is undertaken to any third party.

Our recommendation and works are only for the Geotechnical and Maritime Engineering aspects of Permanent Works under our scope of works and excluding Temporary Works by Contractor (Refer to BEM Guideline No: 001 "The Role and Responsibility of Professional Engineers for Temporary Works during Construction Stage"). Our proposals, recommendations and works do not cover works and other aspects of other parties that shall be considered and taken necessary decisions and actions by other respective parties (e.g.: Client, Architect, C&S Engineer, M&E Engineer, Quantity Surveyor, Contractors, Sub-contractor, Suppliers etc.). The environment and potential methane gas analyses and treatment <u>are not</u> within the scope of works of this report.

3.0 THE SITE

3.1 Location and Site Conditions

The proposed project site is located at Jelutong Town, bounded between The Light development and reclamation at the southern side and Sungai Pinang at the northern side. The existing Jelutong dumpsite is located directly adjacent to Tun Dr. Lim Chong Eu Highway, stretches ~820m seaward and is approximately 90 acres. The existing level of the dumpsite is +37m NGVD at its highest closer towards Tun Dr. Lim Chong Eu Highway and is +4m NGVD at its lowest further seaward and slopes into the sea. The dumpsite is to be rehabilitated and dump materials removed to final platform level of +4.35m NGVD (seaward) and +5.35m NGVD (landward) respectively.

The proposed reclamation is approximately 70 acres and is located north of the existing Jelutong dumpsite and adjacent to Karpal Singh Drive. The final platform level of the proposed reclamation development are +4.35m NGVD (seaward) and +5.00m NGVD (landward) respectively. According to the latest bathymetric survey dated July 2020 as shown in Figure 2, the seabed level toward the sea is approximately at -12.2m NGVD at the deepest section. The 3D seabed topographic image of the seabed profile contour is shown in Figures 3. The site key and location plan are shown in Figure 4. The water levels and tidal range affecting the proposed reclamation site is further discussed in Section 5.0.

3.2 General Geology

Based on the Geological Map of Pulau Pinang and Butterworth Area, New Series L7010 Sheet 28, Negeri Pulau Pinang, published in 2014 by Director General, Minerals and Geoscience Department Malaysia, the proposed site location is in Jelutong province and is likely within a previously reclaimed land underlain by Recent Alluvium.

Recent Alluvium is a marine deposit of Quaternary age and younger than Tanjung Bunga Granite which was formed during the Early Jurassic age. The coastal and fluviatile deposits in the main river valleys consists mainly of sand, silt and clay with traces of gravel. The geology underneath this soft alluvium may encounter granitic bedrock with various depths. The geological map of the area is shown in Figure 5.

4.0 SUBSURFACE INVESTIGATION

4.1 General

Subsurface Investigation (SI) works planned by Sri & Sri's Associated Sdn Bhd consisting of nine (9) nos of boreholes (named as OBH series) are carried out at the existing Jelutong dumpsite to provide an indication of the thickness of dump material and the estimated original seabed level. Figure 6 shows the location of the SI works previously carried out at the existing dumpsite.

Additional SI works were carried out overwater (named as BH series) to acquire necessary subsoil parameters for planning and design of the reclamation works. The SI works were carried out in December 2022 by SI contractor, Geolab (M) Sdn Bhd under full-time supervision of G&P's site representative. Figure 7 shows the location of the additional SI works overwater and the following tests (field and laboratory) were carried out to acquire the representative subsoil parameter:

i) Boreholes – A total of nine (9) nos. of boreholes were sunk in to obtain the subsoil information and the necessary subsoil parameters for the design of settlement analyses and embankment stability analyses. Undisturbed soil samples were collected at various depths using thin wall sampler for laboratory tests. Table 1a to 1b summarize the boreholes information.

ii) Piezocones – A total of three (3) nos. of piezocone test including 5 nos. dissipation test were carried out at soft soil areas to investigate the subsoil parameters such as soil type,

soil strength, consolidation parameters (such as coefficient of consolidation in horizontal direction) and to determine sand layers (if any). Table 2 summarize the piezocone information.

iii) Penetration vane shear test – A total of six (6) nos. of penetration vane shear tests were carried out at soft soil area to obtain the undrained shear strength of the subsoil.

iv) Laboratory tests – One dimensional One-dimensional Consolidation test, Isotropic Consolidated Undrained Triaxial Test with pore water pressure measurement (CIU) and Unconfined Compression Test (UCT) were carried out on the collected undisturbed soil samples to acquire the design parameters such as shear strength, compressibility, permeability, etc. Several direct shear box tests were carried out on the various collected disturbed samples for shear strength parameters. In addition, classification tests (i.e., Atterberg Limits, Particle Size Distribution, etc) and chemical tests (i.e., Organic Content, Chloride Content, Total Sulphate Content and pH Value) were carried out on various undisturbed and disturbed samples.

4.2 Subsoil Condition

The simplified borelogs showing the SPT-N values, major/minor classified subsoil components for the boreholes carried out at the existing dumpsite and overwater are presented in Figure 8 and Figure 9 respectively. The soil types at the existing dumpsite and overwater are classified in accordance with the British Soil Classification System for Engineering Purposes (BSCS) obtained from soil laboratory classification tests as shown in Tables 3a to 3b and Table 4a to 4i respectively. Subsoil profiles obtained from the piezocone test are shown in Figure 10.

The borelog results (OBH Series) at the existing dumpsite show that the thickness of the dump material ranges between 15m to 43m thick. On the other hand, the interpreted seabed levels beneath the dumpsite are between -3m NGVD and -24m NGVD. The seabed subsoil stratum here mainly consists of CLAY and sandy SILT/CLAY with SPT-N generally more than 4 blows.

On the other hand, the borelog profile (BH Series) for overwater show that the seabed subsoil stratum mainly consists of CLAY and silty/clayey SAND. Soft compressible materials (SPTN <4) are found to be approximately 3m to 15m thick below the seabed. The piezocone profiles generally confirm the findings from the borelog profiles. Predominantly silty/clayey SAND underlain the soft compressible layers. During borehole drilling, in-situ Standard Penetration Test (SPT) was carried out at every 1.50m interval inside the boreholes as the boring progressed. It should be noted that BH8 encountered granite at 49.8m below the seabed.

5.0 WATER LEVEL AND TIDAL RANGE

Due to the influence of tidal effects in the open sea (near-shore and off-shore), seawater level can vary considerably. As such, it is important to be aware of the seawater levels under the influence of tidal effects. Table 5 summarises the abovementioned tidal levels at Standard Port at Kedah Pier, Penang.

According to the Tide Tables Malaysia 2018, Volume 1 published by the National Hydrographic Centre, Royal Malaysian Navy and the Bathymetric Survey of the proposed site dated July 2020, the seawater level at the outermost region of the proposed reclamation is estimated to range from 9m to 13m above the seabed (based on *Mean High Water Spring – MHWS at +1.13m NGVD*).

6.0 ENGINEERING PROPERTIES OF SUBSOIL

6.1 General

The geotechnical design parameters presented in this section are based on the SI and available laboratory tests results. In the following sections, physical and chemical properties as well as shear strength, compressibility and consolidation parameters of the subsoil that are adopted are discussed.

6.2 Physical Properties

Majority of soil samples obtained for laboratory testing from the existing Jelutong dumpsite is deemed to be recovered from the existing subsoil below the dumping materials which is also evident from the SI borelogs.

Plasticity Chart of the SI information for the Jelutong dumpsite and reclamation site are shown in Figure 11 and Figure 12 respectively. The Liquid Limit (LL) of the soil samples generally range from 30% to 90% and 27% to 136% for samples retrieved from the dumpsite and reclamation respectively. This indicates that samples range from low to extremely high plasticity. It is also observed that majority of the samples are scattered above the “A” line with fine components which are clayey in nature. Besides, some of the samples are found to be scattered below the “A” line with fine components which are silty in nature.

The bulk unit weight of the collected soil samples beneath the Jelutong dumpsite ranges from 14kN/m^3 to 19kN/m^3 as shown in Figure 13. Due to absence of dumping samples, a unit weight of 12kN/m^3 is adopted for dump materials which is within the range stated in literature.

For the reclamation site, bulk unit weight ranges from 10.5kN/m^3 to 15.5kN/m^3 for compressible clayey subsoil and 14kN/m^3 to 21.5kN/m^3 for sandy subsoil as shown in Figures 14 and Figure 15. Unit weight of 13kN/m^3 and 19kN/m^3 are adopted for clay and sand materials respectively.

Bulk unit weight of the subsoil for the proposed reclamation area is based on available SI information as follows:

Reduced Level (RLm)	Adopted Unit Weight (kN/m^3)
0 to -15 (clay material)	13
-15 (sand material)	19

6.3 Chemical Properties

Chemical tests were carried out to ascertain the amount of chloride content, pH value, total sulphate content and organic matter content in the subsoil which will react with construction materials such as concrete and steel. Soil samples from boreholes were tested at varying depths and results for the abovementioned chemical tests are presented in Figure 16 to 19.

The subsoil is slightly acidic to slightly alkaline in nature with pH value range between 4.4 – 7.9. The subsoil also contains organic matter with content ranging from 0.1% to 5.6%. Based on Section 6, clause 41.4.6, BS5930:1999, the subsoil is classified as slightly organic to organic.

Test results show that sulphate content (SO_3) ranges from 0.07% to 0.15% whereas chloride content ranges from 0.08% to 2.7%. The chemical test results for chloride content suggest that the subsoil is aggressive toward construction materials (>0.1% as per BS12:1996) and this has been expected as the influence of seawater and aquatic life have significant effects on the subsoil. As such, appropriate measures due to aggressive subsoil must be taken into consideration as per BRE Special Digest 1:2005 during design stage of building structures.

6.4 Shear Strength Parameters

Generally, based on numerous SI information for reclamation in Penang, marine subsoil consists of weak cohesive material with low permeability. Hence, undrained shear strength (s_u) of the subsoil is an important parameter for embankment stability analyses. s_u values adopted for the proposed reclamation design is based on penetration vane shear test, piezocones, Unconsolidated Undrained Triaxial Test (UU) and Unconfined Compression Test (UCT) carried out at site during the SI works. Figure 20 shows the interpreted undrained shear strength of the subsoil resulting from the abovementioned tests, and the s_u varies from 6kPa to 20kPa for predominantly clayey materials.

The effective stress shear strength parameters are derived from the Consolidated Isotropic Undrained (CIU) Triaxial test with pore pressure measurement and Direct Shear Box test. The interpreted effective stress shear strength parameters are presented in Figures 21 and 22. For design purposes, the effective stress friction angle, ϕ' and effective cohesion, c' of the subsoil are 30° and 1kPa respectively for predominantly sandy materials. For the existing dump materials, the effective shear strength parameters adopted are 26° for effective friction angle (ϕ') and 0kPa for effective cohesion (c'). This is in line with the recommendations stated in Waste Disposal by Landfill by Sarsby, R.W, Institution of Civil Engineers (ICE) Environmental Geotechnics Publishing.

6.5 Compressibility Parameters

Generally, subsoil settlement shall be the main geotechnical issue particularly for the proposed reclamation where consolidation of the soft compressible clay layers is expected. Compressibility parameters adopted for the settlement analysis in this report are derived from the One-Dimensional (1D) Consolidation test using oedometer.

From the tests results, compression ratio (CR) and Recompression ratio (RR) of the subsoil range from 0.045 to 0.38 and 0.01 to 0.07 respectively. The adopted CR and RR value for settlement analyses are shown in Figure 23 and Figure 24. Results for vertical coefficient of consolidation (C_{vo}) are shown in Figure 25a. Local and international literatures have reported that actual field C_{vo} could be 5 to 15 times the C_{vo} obtained through laboratory oedometer tests. As such, a value of 2m^2/year is adopted for C_{vo}. The coefficient of consolidation in the horizontal direction, C_h are obtained from piezocone dissipation tests and the adopted value is 4m^2/year as shown in Figure 25b. Overconsolidation Ratio (OCR) test results suggest that the subsoil is generally overly consolidated and Figure 26 shows the OCR values adopted for the settlement analysis.

7.0 GEOTECHNICAL DESIGN CONSIDERATIONS

7.1 General

The total area of the proposed reclamation is approximately 70 acres. Due to the nature of the subsoil condition (soft clay) at the proposed site, settlement and embankment stability are the two main issues that need to be addressed during and after reclamation works. Therefore, it is imperative that the design of the reclamation works satisfies both settlement and stability criteria. In addition, the existing Jelutong dumpsite of approximately 90 acres will be rehabilitated for future development use therefore, the stability of the platform for post-rehabilitated dumpsite needs to be properly assessed. It should be noted that as rehabilitation of the dumpsite involves removal of dump materials and no significant fill above the existing levels is expected, hence consolidation settlement will not be significant. Critical sections are selected for stability analyses as shown in Figure 27 to 29.

Excessive differential settlement occurring at the building platform and surrounding infrastructure could cause serviceability problems, distress and damages to future structures. If the subsoil is excessively stressed, it may lead to instability of the embankment fill. In addition, uncontrolled and rapid filling during reclamation works over soft ground conditions could result in deep seated slip failure. Therefore, it is evident that settlement (both total and differential), filling rate and embankment stability issues need to be addressed and considered.

7.2 Settlement Analyses

It is necessary to estimate the magnitude of settlement that occurs during construction and waiting period so that the total actual thickness of the fill at site can be designed to ensure stability. An iterative process is required in the estimation of settlement to ensure that the post construction settlement is less than the allowable settlement. The iteration captures the extra fill (more load) required to compensate for settlement which in turn, leads to further settlement of the subsoil. If Prefabricated Vertical Drain (PVD) is adopted as ground treatment method, it shall be designed to achieve 100% degree of primary consolidation of the net fill height.

Design calculation on consolidation settlement is attached in Appendix B which considered 100% of primary consolidation of net fill height. The settlement analyses are carried out by using Terzaghi's 1-D consolidation and the estimated settlement for clay thickness ranging from 3m to 15m thick and maximum actual fill height between 9.34m to 17.92m is presented in Table 6.

7.3 Reclamation Embankment Stability Analyses

Generally, the stability of the reclaimed platform is analysed to determine the safe fill slopes and the required ground treatment during construction. The stability of the reclaimed platform is commonly assessed using limit equilibrium analysis. It is very important to check for the stability of the reclaimed platform with consideration for different potential failure surfaces.

7.3.1 Static Condition

The following stages are taken into consideration in the stability analyses:

a) Construction stage – Short term stability of the reclaimed platform over soft ground, which is generally the most critical, is analysed based on the undrained shear strength (s_u) of the compressible subsoil prior to the commencement of construction works (Total Stress Parameters).

b) Serviceability stage – Long term stability of the reclaimed platform is assessed using drained condition with effective stress parameters to simulate the long-term stability of the reclaimed platform under constant permanent loading during serviceability stage.

The required factors of safety (FOS) for each stage are tabulated as follows:

Stage	**Condition**	**Sea Water Condition**	**FOS**
Construction	Undrained (Total Stress Parameters)	Normal – MLWS	1.2
Construction	Undrained (Total Stress Parameters)	Rapid Drawdown ➔ MHWS[a] to MSL[b]	1.1
Serviceability	Drained (Effective Stress Parameters)	Normal – MLWS	1.4
Serviceability	Drained (Effective Stress Parameters)	Rapid Drawdown ➔ MHWS[a] to MSL[b]	1.2

Notes:

i) Normal – Groundwater level and sea level are at the same level at Mean Low Water Spring (MLWS)

ii) Rapid Drawdown – Groundwater level and sea level are not at the same level; Mean High Water Spring (MHWS[a]) to Mean Sea Level to (MSL[b])

iii) [a] – Groundwater level

iv) [b] – Seawater level

Due to the soft clay, the reclamation fill is proposed to be carried out in stages to allow for sufficient gain in strength of the subsoil. Surcharge load of 10kPa is modelled to simulate the machineries load in stability analyses. The construction sequence is further described in

subsequent section. The stability analyses for the critical section for reclamation are carried out for the following sequences:

a. Construct sand containment bund by filling 0.5 m above Mean Sea Level (MSL) (construction stage).

b. Fill 0.5m above Mean High Water Spring (MHWS) then install Prefabricated Vertical Drain (PVD) and additional surcharge thickness of 2m and rest for 3 months (construction stage).

c. Fill up to the designed surcharge level and rest for 5 months (construction stage).

d. Remove temporary surcharge to the designed final platform level (serviceability stage).

7.3.2 Seismic Condition

The history of earthquake event in Malaysia is not well documented due to lack of recorded data, clear guidelines on adopted peak ground acceleration (PGA) is not officially available. However, based on seismic hazard map produced by USGS in April 2008 as shown in Figure 30 (based on the far field seismic impact), the anticipated PGA for project site shall be in the order of 4% to 5% of gravitational acceleration. In addition, the design of Penang 2nd Bridge (Sultan Abdul Halim Muadzam Shah Bridge) has considered PGA of 5.55%. Thus, a PGA value of 5.55% has been adopted in the seismic sensitivity assessment of reclaimed platform stability.

With seismic load considered, the reclaimed platform shall achieve a minimum FOS of 1.2 as suggested by Naval Facilities Engineering Command (NAVFAC) SM 7.01, 1986 for embankment subjected to transient loads, such as earthquake.

The stability analyses for static and seismic conditions of the reclamation fill are shown in Appendix C and a summary of the results are shown in Table 7. Results from the stability analyses show that the minimum factor of safety (FOS) is achieved for each Construction Stage and Serviceability Stage.

7.4 Existing Dumpsite Post Rehabilitation Stability Analyses

Based on the latest survey topography plan, the levels of existing dumpsite currently range between +4m NGVD at its lowest point seaward and +37m NGVD at its highest point closer

towards Tun Dr. Lim Chong Eu Highway. The dumpsite has been in operation since 1992 and has an area of approximately 90 acres. The dump materials have occupied the dumpsite for approximately 30 years and the rehabilitation includes removing dump materials to form a final platform level of +4.35m NGVD (seaward) and +5.35m NGVD (landward) respectively.

Removal of dump materials of around 32m thick effectively reduces the overburden stresses and leads to an increase in stabilising effects of the existing dumpsite. Moreover, the existing shoreline will be reprofiled and protected with rip-rap revetment to further enhance the stability. Nonetheless, to ensure that the dumpsite's final platform level is stable for future top side development, a critical section of the existing dumpsite is selected for stability analyses after removal of the dump materials to final platform level with construction of the revetment (post rehabilitation). The critical section is analysed using limit equilibrium method for serviceability stage under drained condition using normal seawater condition, rapid drawdown condition as well as seismic condition. The design rip-rap revetment surrounding the shoreline of the rehabilitated dump site shall be no steeper than 1V:4H and shall be constructed after the dumpsite has reached the final proposed platform. Results from the analyses shows that the minimum factor of safety is achieved and Appendix D shows the stability analyses whereas Table 8 shows the summary of the results.

Several measures shall be taken during the future top side development. In general, the future top side development shall consist of deep foundations with shaft friction resistance contributed from the original seabed stratum and below only. Where localised soft areas are encountered at the final platform level, ground treatment methods shall be employed such as stone columns, jet grouting, etc. The engineering analyses and design for foundation and ground treatment of the future top side developments shall refer to the appointed engineer for the specific parcels at a later stage. In addition, the environment and potential methane gas analyses and treatment are not within the scope of works of this report.

8.0 GROUND TREATMENT DESIGN

Ground treatment is required when the stability of the reclaimed platform is unable to achieve the required factor of safety (FOS) in the most critical condition during construction stage. In addition, ground treatment also is required to shorten the construction period, especially to expedite the dissipation of excess pore water pressure during construction stage. Basically, the application of ground treatment is to improve the soil strength and reduce the long-term settlement of the soft founding soils. This will allow the subsoil to support the reclaimed platform with the required factor of safety within the serviceability limit stage.

8.1 Temporary Surcharging

Temporary surcharging is to subject the ground to higher pressure than that during the service life to accelerate consolidation settlement and thus reducing long term settlements. The magnitude (thickness of surcharge material) and duration of the surcharging will be controlled by the magnitude of total settlement, permeability of the subsoil and available construction period. Figure 31 shows the concept of temporary surcharging. Usually, temporary surcharging is used together with prefabricated vertical drain (PVD) installed into the low permeability soft compressible layer.

8.2 Prefabricated Vertical Drain (PVD)

Generally, prefabricated vertical drains (PVD) are installed at 0.9m to 1.5m spacing in triangular pattern into very soft to soft clay layer to expedite the consolidation process. The design of PVD was carried out based on Barron's theory and taking into the consideration the effects of smearing and the variation of vertical and radial permeability.

8.3 Adopted Ground Treatment

Based on the subsoil condition, PVD with temporary surcharge are proposed as the ground treatment works to expedite the consolidation settlement and to eliminate long term settlement. The adopted spacing for the PVD design is 1.1m in triangular pattern with estimated length of 18m from installation platform. Design calculation and parameters adopted in the PVD design are shown in Appendix E. The designed surcharge thickness is 2m across the proposed reclamation site and rest period to achieve the final settlement are summarized in Table 9. Figure 32 shows the surcharge layout with required rest period for different net fill heights (with 1.1m PVD spacing) to achieve 100% of primary consolidation.

9.0 PROPOSED CONSTRUCTION SEQUENCE

The following construction stages are proposed for the reclamation works as illustrated in Figure 33:

- Stage 1 – Sand containment bund to be filled 0.5m above Mean Sea Level (MSL) (+0.65m NGVD) and to form slope gradient of not steeper than 1V:7H on both sides. Temporary surface protection shall be provided where necessary.

- Stage 2 – To continue the reclamation filling works at inner area to 0.5m above Mean High Water Spring (MHWS) (+1.63m NGVD).

- Stage 3 – Install Prefabricated Vertical Drains (PVD) with 1.1m c/c spacing as soon as fill has reached 0.5m above MHWS.

- Stage 4 – Install settlement gauges and top up additional 1.0m thick sand blanket with slope gradient not steeper than 1V:4H.

- Stage 5 – Top up additional 1.0m thick surcharge with slope gradient not steeper than 1V:4H and rest for 3 months.

- Stage 6 – After 3 months rest period, carry out subsequent surcharge filling to reach final ground treatment level and install settlement markers. Rest another 5 months.

- Stage 7 – Temporary surcharge shall be removed after resting period or as per Engineer's instruction to the proposed platform level and settlement markers are to be repositioned to the final platform level.

- Stage 8 – Sand containment bund shall be trimmed to construct permanent rip-rap revetment with slope gradient not steeper than 1V:5H.

The following construction stages are proposed for the dumpsite as illustrated in Figure 34:

- Stage 1 – Existing dumpsite shall be excavated to the proposed platform level +3.35m NGVD. Excavation at existing dumpsite area to be carried out layer by layer with every 2m height.

- Stage 2 – Backfill with suitable material to final platform level of +5.35m NGVD. The existing shoreline shall be scarified and reprofiled to slope gradient not steeper than 1V:4H. Temporary surface protection shall be provided where necessary.

- Stage 3 – To construct permanent rip-rap revetment with slope gradient not steeper than 1V:4H.

10.0 INSTRUMENTATION SCHEME, MONITORING AND INTERPRETATION

Instrumentation and monitoring scheme will be proposed in the detailed stage. Nonetheless, in order to confirm the effectiveness of the ground treatment works, timing of surcharge removal and safety, the typical instruments shall include the following:

No.	Item	Description of purpose
1	Deep Settlement Gauges	Measure the settlement at fill close to the original soil interface as practical as possible
2	Surface Settlement Markers	Measure settlement at top of fill
3	Deep Levelling Datum	Establish a datum as reference point
4	Inclinometer	Measure deformation of reclaimed platform
5	Vibrating wire piezometer	Measure the excess pore water pressure of original ground.
6	Standpipe	Measure water level of the reclaimed platform
7	Extensometer	Measure deformation (or settlement) of specific layers within the subsoil stratum

The review of the above measurements will decide the rate of filling for stability, assessing the performance of PVD and timing for surcharge removal. Asaoka plot will be used to determine the degree of consolidation for surcharge removal.

In addition, shoreline monitoring survey shall be carried out in accordance with the specifications stipulated by the Department of Irrigation and Drainage (JPS), Pulau Pinang.

11.0 ESTIMATED FILL QUANTITIES FOR RECLAMATION WORKS

For reclamation works of the proposed site, sand fill is to be used for the filling works. Dump materials from existing dump site shall be processed and tested for its suitability to be used for filling material. Upon the acceptance of the post processed dump materials, the material can be subsequently used for surcharge filling of reclamation works.

The estimated fill quantities for the project (inclusive of reclamation fill up to design ground treatment level and rip-rap revetment) are shown below:

Material	[1] Estimated Volume (m^3)
Reclamation Fill (up to design ground treatment level)	4,920,000
Rip-Rap Revetment	321,000*

Note:

[1] Subjected to detailed estimation at later stage

*For whole site project boundary

The sand fill materials after being placed in the reclamation except for beach areas shall possess the following properties:

a) The minimum permeability coefficient shall be 10^{-3}cm/sec at 20°C and at void ratio equivalent to that obtained at 90% ± 2% of the maximum dry density determined in accordance with BS 1377:1990.

b) The fill material shall be well graded with a smooth grading curve covering a range of particle sizes, falling within the grading limits as tabulated below and shown in Figure 35:

B.S. Sieve Size	Passing by Weight (%)	
	Lower Limit	Upper Limit
20mm	100	100
14mm	94	100
6.3mm	75	100
2mm	30	100
600µm	0	98
300µm	0	80
150µm	0	30
63µm	0	8

The suitable earth fill materials shall possess the following properties:

a) Liquid limit less than 80% or plasticity index less than 55%.

b) Do not contain any topsoil, wood, peat or water-logged substances.

c) Do not contain any bio-degradable or organic material (< 2.5%), etc.

d) Do not contain material which by virtue of its particle size or shape cannot be properly and effectively compacted (e.g., some slate waste, boulders larger than 150mm, etc.)

Rock used for the construction of the coastal / riverbank protection works such as rip-rap revetment shall be hard, durable, angular in shape; resistant to weathering and to water action; free from soft, weathered or decomposed parts, overburden, spoil and organic material. The acceptance properties of rock used for rip-rap revetment are as shown below:

Aggregate Crushing Value	25% maximum
Los Angeles Abrasion	15% maximum
Specific Gravity (saturated surface dry)	2.6 minimum
Water Absorption	2% maximum gain by weight
Sodium Sulphate Soundness	5% maximum loss over 5 cycles

12.0 ABANDONMENT PLAN

Abandonment plan for incomplete reclamation works during possible stages of construction shall be executed as per the following recommendations:

a) Scenario 1: Abandonment plan for incomplete reclamation works during sand filling before ground treatment works.

The sand fills shall be trimmed to gentler slope with slope gradient of not steeper than 1V:12H for slope stability of partial reclaimed land.

b) Scenario 2: Abandonment plan for incomplete reclamation works during installation of prefabricated vertical drain (PVD).

The sand containment bund shall be trimmed to gentler slope with slope gradient of not steeper than 1V:12H for slope stability of reclaimed land.

The sand fills above water level shall be trimmed to gentler slope with slope gradient of not steeper than 1V:5H.

c) Scenario 3: Abandonment plan for incomplete reclamation works upon the completion of necessary ground treatment works before rip-rap revetment construction.

The sand containment bund shall be trimmed to gentler slope with slope gradient not steeper than 1V:12H for slope stability of reclaimed land.

The incomplete reclaimed land may function as a natural beach without rip-rap revetment and no building development shall be allowed on the incomplete reclaimed land until necessary ground treatment measures have been carried out as per design and as agreed by the Engineer.

13.0 CONCLUSIONS

Based on the SI information from OBH boreholes of existing dumpsite, dump material thickness ranges between 15m to 43m thick and the underlying seabed consists of CLAY and sandy SILT/CLAY. The BH boreholes of the reclamation site show that seabed subsoil stratum consists of CLAY with thickness ranging from 3m to 15m thick and subsequently underlain by silty/clayey SAND.

For the proposed reclamation area, ground treatment is required during the reclamation works such that the stability of the fill embankment could achieved the required factor of safety (FOS). In addition, ground treatment also is required to shorten the construction period to expedite the dissipation of excess pore water pressure during construction stage.

The main geotechnical findings and recommendation of the reclamation are as follows:

a. Stage construction is required for the proposed reclamation and commences with sand containment bund to be constructed with slope gradient of not steeper than 1V:7H up to 0.5m above MSL. Subsequent filling works to be carried out to 0.5m above MHWS for installation of PVD and further top up to the design ground treatment level. The temporary surcharge shall be removed after achieving the design rest period and permanent rip-rap revetment with gradient not steeper than 1V:5H to be placed.

b. Stability analyses for the relevant stages of construction are performed and results show that the minimum required FOS is achieved for static conditions in construction and serviceability stages as well as for seismic condition.

Assessment of the stability of the existing Jelutong dumpsite post rehabilitation has also been carried out and the main findings are as follows:

i. Rehabilitation of the existing dumpsite involves removing of the existing dump materials of up to 32m thick to achieve the design platform level. As no additional fill is expected, consolidation settlement is not significant.

ii. Removal of the existing dump materials reduces the overburden stresses and increases the stabilising effects of the existing site.

iii. Stability analyses for the critical section under serviceability stage is carried out and the minimum required FOS is achieved. The design rip-rap revetment surrounding the shoreline of the rehabilitated dump site shall be no steeper than 1V:4H.

iv. The excavated dump materials from the existing dumpsite shall be tested for its suitability to be used as surcharge fill for the reclamation works.

14.0 ENGINEER'S DECLARATION

I hereby certify that these works have been designed by me in accordance with sound engineering practice and that I take full responsibility for the design, and proper performance of the same.

Professional Engineer Endorsement

Name: **Ir. Dr. Tan Yean Chin**

Designation: **Project Director (Geotechnical)**

Company: **Global Water Consultants Sdn Bhd**

TABLES

LIST OF TABLES

TABLE	TITLE OF TABLE
1a to 1b	Summary of Borehole
2	Summary of Piezocone
3a to 3b	Soil Classification in accordance with the British Soil Classification System (BSCS) – Subsurface Investigation by M/S Soil Mechanic Sdn Bhd (2021) (by Others)
4a to 4i	Soil Classification in accordance with the British Soil Classification System (BSCS) – Subsurface Investigation by Geolab (M) Sdn Bhd (2023)
5	Tidal Chart
6	Settlement Analyses Summary (Reclamation)
7	Stability Analyses Summary (Reclamation)
8	Stability Analyses Summary (Dumpsite)
9	Temporary Surcharge Design

Borehole	Reduced Level (mNGVD)	Termination Depth (m.b.g.l.)	Remarks
OBH1	16.74	30.45	Dumping material at 0-20.7mbgl, no hard layer/rock encountered
OBH2	36.75	51.45	Dumping material at 0-41.7mbgl, no hard layer/rock encountered
OBH3	11.18	24.45	Dumping material at 0-14.7mbgl, no hard layer/rock encountered
OBH4	5.58	42.45	Dumping material at 0-29.7mbgl, no hard layer/rock encountered
OBH5	35.44	52.95	Dumping material at 0-43.2mbgl, no hard layer/rock encountered
OBH6	11.50	28.95	Dumping material at 0-19.2mbg, no hard layer/rock encountered
OBH7	0.79	27.45	Dumping material at 0-16.2mbgl, no hard layer/rock encountered
OBH8	20.83	45.45	Dumping material at 0-36mbgl, no hard layer/rock encountered
OBH9	5.65	40.95	Dumping material at 0-19.2mbgl, no hard layer/rock encountered

Summary of Borehole – Subsurface Investigation by M/S Soil Mechanic Sdn Bhd (by Others)

TABLE 1a

Borehole	Reduced Level (mNGVD)	Termination Depth (m.b.g.l.)	Remarks
BH1	-11.49	60.45	No hard layer/rock encountered
BH2	-12.27	60.45	Intermediate hard layer at 49.5-54mbgl
BH3	-6.64	60.45	Encountered hard layer at 60mbgl
BH4	-12.50	60.45	No hard layer/rock encountered
BH5	-0.74	60.45	No hard layer/rock encountered
BH6	-14.15	60.45	Encountered hard layer at 58.5mbgl
BH7	-11.15	60.45	Intermediate hard layer at 58.5mbgl
BH8	-0.60	52.80	Encountered hard layer at 48m and rock at 49.8mbgl
BH9	-14.19	60.45	No hard layer/rock encountered

Summary of Borehole – Subsurface Investigation by Geolab (M) Sdn Bhd

TABLE 1b

Borehole	Reduced Level (mNGVD)	Termination Depth (m.b.g.l.)
PZ-1	-6.16	7.45
PZ-3	-6.48	9.88
PZ-4	-13.25	2.61

Summary of Piezocone **TABLE 2**

BH No.	SAMPLE No.	Depth (m)		ATTERBERG LIMIT			PARTICLE SIZE DISTRIBUTION				SOIL DESCRIPTION	
				L.L. (%)	P.L. (%)	P.I. (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)		
OBH1	UD1	21.59	22.00	45	30	15	8	43	49	0	MIS	Sandy SILT of Intermediate Plasticity
	P17	25.50	25.95				14	23	56	7	FS	Sandy SILTS/CLAYS
	P19	28.50	28.95	57	27	30	29	23	41	7	CHS	Sandy CLAY of High Plasticity
OBH2	P26	42.00	42.45				8	0	64	28	S-F	Silty/Clayey SAND
	P28	45.00	45.45				17	0	59	24	S-F	Silty/Clayey SAND
	P31	49.50	49.95	50	30	20	21	33	46	0	MHS	Sandy SILT of High Plasticity
OBH3	UD1	15.50	16.00	52	30	22	21	71	8	0	MH	SILT of High Plasticity
	UD2	20.00	20.50	43	30	13	10	73	17	0	MI	SILT of Intermediate Plasticity
	P15	22.50	22.95	31	25	6	12	30	49	9	MLS	Sandy SILT of Low Plasticity
OBH4	P21	33.00	33.45				25	0	67	8	SF	Very Silty/Clayey SAND
	UD2	36.50	37.00	85	36	49	50	49	1	0	CV	CLAY of Very High Plasticity
	P25	39.00	39.45	66	30	36	31	47	22	0	CH	CLAY of High Plasticity
OBH5	UD1	44.00	44.50	46	30	16	12	66	21	1	MI	SILT of Intermediate Plasticity
	P32	48.00	48.45				23	0	69	8	SF	Very Silty/Clayey SAND
	UD2	51.50	52.00	64	31	33	39	48	13	0	CH	CLAY of High Plasticity
OBH6	UD1	20.00	20.50	60	32	28	24	47	27	2	MH	SILT of High Plasticity
	UD2	24.50	25.00				22	27	50	1	FS	Sandy SILTS/CLAYS
	P17	25.50	25.95				18	0	69	13	S-F	Silty/Clayey SAND
OBH7	UD1	18.50	19.00				25	24	51	0	FS	Sandy SILTS/CLAYS
	P14	21.00	21.45	48	24	24	21	31	48	0	CIS	Sandy CLAY of Intermediate Plasticity
	UD2	24.50	24.95	36	23	13	24	13	53	10	CIS	Sandy CLAY of Intermediate Plasticity

Soil Classification in accordance with the British Soil Classification System (BSCS) – Subsurface Investigation by M/S Soil Mechanic Sdn Bhd (2021) (by Others)

TABLE 3a

BH No.	SAMPLE No.	Depth (m)		ATTERBERG LIMIT			PARTICLE SIZE DISTRIBUTION				SOIL DESCRIPTION	
				L.L. (%)	P.L. (%)	P.I. (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)		
OBH8	P25	37.50	37.95				20	0	79	1	SF	Very Silty/Clayey SAND
	P27	40.50	40.95	42	24	18	21	28	45	6	CIS	Sandy CLAY of Intermediate Plasticity
	P29	43.50	43.95	44	24	20	23	28	43	6	CIS	Sandy CLAY of Intermediate Plasticity
OBH9	UD1	20.00	20.50	55	28	27	28	32	29	11	CHS	Sandy CLAY of High Plasticity
	P15	22.50	22.95				10	0	77	13	S-F	Silty/Clayey SAND
	UD2	26.00	26.50	49	25	24	20	34	42	4	CIS	Sandy CLAY of Intermediate Plasticity

Soil Classification in accordance with the British Soil Classification System (BSCS) – Subsurface Investigation by M/S Soil Mechanic Sdn Bhd (2021) (by Others)

TABLE 3b

BH No.	SAMPLE No.	Depth (m)		ATTERBERG LIMIT			PARTICLE SIZE DISTRIBUTION				SOIL DESCRIPTION	
				L.L. (%)	P.L. (%)	P.I. (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)		
BH1	P1/D1	1.50	1.95				11	0	59	30	S-F	Silty/Clayey SAND
BH1	P2/D2	3.00		29	15	14	31	0	58	11	SCL	Very CLayey SAND of Low Plasticity
BH1	UD1	4.50	4.95				19	0	71	10	S-F	Silty/Clayey SAND
BH1	UD1-S1	4.50	4.95	36	23	13	32	0	54	14	SCI	Very Clayey SAND of Intermediate Plasticity
BH1	UD1-S2	4.50	4.95	36	22	14	32	2	49	17	SCI	Very Clayey SAND of Intermediate Plasticity
BH1	UD1-S3	4.50	4.95				20	0	64	16	SF	Very Silty/Clayey SAND
BH1	P6/D5	10.50		28	16	12	33	0	60	7	SCL	Very CLayey SAND of Low Plasticity
BH1	UD2	14.50		37	18	19	49	3	46	2	CIS	Sandy CLAY of Intermediate Plasticity
BH1	UD2-S1	14.50		38	19	19	47	3	47	3	CIS	Sandy CLAY of Intermediate Plasticity
BH1	P11/D10	18.00		28	13	15	34	2	57	7	CLS	Sandy CLAY of Low Plasticity
BH1	P15/D14	24.00		31	18	13	39	3	49	9	CLS	Sandy CLAY of Low Plasticity
BH1	P18/D17	28.50		28	18	10	30	0	46	24	SCL	Very CLayey SAND of Low Plasticity
BH1	P22/D21	34.50		39	19	20	56	5	39	0	CIS	Sandy CLAY of Intermediate Plasticity
BH1	P27/D26	42.00					21	0	79	0	SF	Very Silty/Clayey SAND
BH1	P34/D33	52.50					3	0	59	38	SW/SP	Slightly Silty/Clayey SAND

Soil Classification in accordance with the British Soil Classification System (BSCS) – Subsurface Investigation by Geolab (M) Sdn Bhd (2023)

TABLE 4a

BH No.	SAMPLE No.	Depth (m)		ATTERBERG LIMIT			PARTICLE SIZE DISTRIBUTION				SOIL DESCRIPTION	
				L.L. (%)	P.L. (%)	P.I. (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)		
BH2	P1/D1	1.50					22	0	63	15	SF	Very Silty/Clayey SAND
BH2	P3/D3	4.50					22	0	59	19	SF	Very Silty/Clayey SAND
BH2	P7/D7	10.50		30	20	10	38	3	35	24	CLS	Sandy CLAY of Low Plasticity
BH2	P11/D11	16.50		42	22	20	50	6	41	3	CIS	Sandy CLAY of Intermediate Plasticity
BH2	P16/D16	24.00		30	17	13	42	2	45	11	CLS	Sandy CLAY of Low Plasticity
BH2	P24/D24	37.50		33	14	19	64	24	11	1	CL	CLAY of Low Plasticity
BH2	P29/D29	45.00					24	0	76	0	SF	Very Silty/Clayey SAND
BH2	P33/D33	51.00					12	0	66	22	S-F	Silty/Clayey SAND
BH2	P37/D37	57.00		30	16	14	2	41	53	4	CLS	Sandy CLAY of Low Plasticity

Soil Classification in accordance with the British Soil Classification System (BSCS) – Subsurface Investigation by Geolab (M) Sdn Bhd (2023)

TABLE 4b

BH No.	SAMPLE No.	Depth (m)		ATTERBERG LIMIT			PARTICLE SIZE DISTRIBUTION				SOIL DESCRIPTION	
				L.L. (%)	P.L. (%)	P.I. (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)		
BH3	P1/D1	1.50		94	40	54	13	64	20	3	ME	SILT of Extremely High Plasticity
BH3	UD1	3.00		108	41	67	23	48	27	2	CE	CLAY of Extremely High Plasticity
BH3	P2/D2	4.50					17	0	69	14	S-F	Silty/Clayey SAND
BH3	UD2	8.50					17	0	76	7	S-F	Silty/Clayey SAND
BH3	UD2-S1	8.50					16	0	64	20	S-F	Silty/Clayey SAND
BH3	UD2-S2	8.50					13	0	55	32	S-F	Silty/Clayey SAND
BH3	UD2-S3	8.50					15	0	62	23	S-F	Silty/Clayey SAND
BH3	P10/D9	18.00		31	18	13	3	47	48	2	CLS	Sandy CLAY of Low Plasticity
BH3	P15/D14	25.50		35	19	16	37	0	50	13	CIS	Sandy CLAY of Intermediate Plasticity
BH3	P20/D19	33.00					23	0	50	27	SF	Very Silty/Clayey SAND
BH3	P25/D24	40.50		37	17	20	32	50	16	2	CI	CLAY of Intermediate Plasticity
BH3	P30/D29	48.00					29	0	71	0	SF	Very Silty/Clayey SAND
BH3	P35/D34	55.50					11	0	52	37	S-F	Silty/Clayey SAND

Soil Classification in accordance with the British Soil Classification System (BSCS) – Subsurface Investigation by Geolab (M) Sdn Bhd (2023)

TABLE 4c

BH No.	SAMPLE No.	Depth (m)		ATTERBERG LIMIT			PARTICLE SIZE DISTRIBUTION				SOIL DESCRIPTION	
				L.L. (%)	P.L. (%)	P.I. (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)		
BH4	P1/D1	1.50		33	17	16	36	0	51	13	CLS	Sandy CLAY of Low Plasticity
BH4	P5/D5	7.50		28	16	12	2	39	44	15	CLS	Sandy CLAY of Low Plasticity
BH4	UD1	11.50		40	21	19	4	44	45	7	CIS	Sandy CLAY of Intermediate Plasticity
BH4	UD1-S1	11.50		40	22	18	16	53	30	1	CI	CLAY of Intermediate Plasticity
BH4	UD1-S2	11.50		43	23	20	6	54	38	2	CIS	Sandy CLAY of Intermediate Plasticity
BH4	UD1-S3	11.50		36	18	18	3	48	47	2	CIS	Sandy CLAY of Intermediate Plasticity
BH4	P11/D11	18.00		27	13	14	32	0	50	18	SCL	Very CLayey SAND of Low Plasticity
BH4	P15/D15	21.00					18	0	53	29	S-F	Silty/Clayey SAND
BH4	P19/D19	30.00		34	18	16	3	43	50	4	CLS	Sandy CLAY of Low Plasticity
BH4	P22/D22	34.50		41	20	21	25	48	23	4	CI	CLAY of Intermediate Plasticity
BH4	P23/D23	36.00		39	20	19	5	58	33	4	CIS	Sandy CLAY of Intermediate Plasticity
BH4	P29/D29	45.00					26	0	74	0	SF	Very Silty/Clayey SAND
BH4	P36/D35	55.50					17	0	64	19	S-F	Silty/Clayey SAND

Soil Classification in accordance with the British Soil Classification System (BSCS) – Subsurface Investigation by Geolab (M) Sdn Bhd (2023)

TABLE 4d

BH No.	SAMPLE No.	Depth (m)		ATTERBERG LIMIT			PARTICLE SIZE DISTRIBUTION				SOIL DESCRIPTION	
				L.L. (%)	P.L. (%)	P.I. (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)		
BH5	UD1	3.50		135	46	89	2	79	18	1	C	CLAY
BH5	UD2	9.00		136	44	92	4	85	10	1	C	CLAY
BH5	UD2-S1	9.00		118	41	77	7	75	18	0	CE	CLAY of Extremely High Plasticity
BH5	UD2-S2	9.00		120	41	79	7	77	15	1	CE	CLAY of Extremely High Plasticity
BH5	UD2-S3	9.00		124	43	81	2	75	22	1	CE	CLAY of Extremely High Plasticity
BH5	P6/D6	13.50		0	0	0	8	0	74	18	S-F	Silty/Clayey SAND
BH5	P11/D11	21.00		32	22	10	5	39	49	7	CLS	Sandy CLAY of Low Plasticity
BH5	P16/D16	28.50		0	0	0	24	0	50	26	SF	Very Silty/Clayey SAND
BH5	P24/D24	40.50		34	21	13	8	48	40	4	CLS	Sandy CLAY of Low Plasticity
BH5	P26/D26	43.50		0	0	0	27	0	53	20	SF	Very Silty/Clayey SAND
BH5	P29/D29	48.00		38	21	17	38	55	7	0	CI	CLAY of Intermediate Plasticity
BH5	P32/D32	52.50		0	0	0	26	0	74	0	SF	Very Silty/Clayey SAND

Soil Classification in accordance with the British Soil Classification System (BSCS) – Subsurface Investigation by Geolab (M) Sdn Bhd (2023)

TABLE 4e

BH No.	SAMPLE No.	Depth (m)		ATTERBERG LIMIT			PARTICLE SIZE DISTRIBUTION				SOIL DESCRIPTION	
				L.L. (%)	P.L. (%)	P.I. (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)		
BH6	P4/D3	6.00		0	0	0	28	0	56	16	SF	Very Silty/Clayey SAND
BH6	P10/D9	15.00		30	17	13	38	0	56	6	CLS	Sandy CLAY of Low Plasticity
BH6	P14/D13	21.00		31	18	13	36	0	45	19	CLS	Sandy CLAY of Low Plasticity
BH6	P18/D17	27.00		36	20	16	37	0	48	15	CIS	Sandy CLAY of Intermediate Plasticity
BH6	P23/D22	34.50		34	22	12	3	50	47	0	CLS	Sandy CLAY of Low Plasticity
BH6	P26/D25	39.00		0	0	0	25	0	75	0	SF	Very Silty/Clayey SAND
BH6	P31/D30	46.50		0	0	0	17	0	65	18	S-F	Silty/Clayey SAND
BH6	P38/D36	57.00		41	22	19	38	0	44	18	CIS	Sandy CLAY of Intermediate Plasticity

Soil Classification in accordance with the British Soil Classification System (BSCS) – Subsurface Investigation by Geolab (M) Sdn Bhd (2023)

TABLE 4f

BH No.	SAMPLE No.	Depth (m)		ATTERBERG LIMIT			PARTICLE SIZE DISTRIBUTION				SOIL DESCRIPTION	
				L.L. (%)	P.L. (%)	P.I. (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)		
BH7	UD1	3.00		87	33	54	34	55	11	0	CV	CLAY of Very High Plasticity
BH7	UD1-S1	3.00		77	34	43	10	71	17	2	CV	CLAY of Very High Plasticity
BH7	UD1-S2	3.00		67	33	34	24	50	24	2	MH	SILT of High Plasticity
BH7	UD1-S3	3.00		70	34	36	24	57	18	1	MV	SILT of Very High Plasticity
BH7	UD2	6.00		46	26	20	2	36	42	20	CIS	Sandy CLAY of Intermediate Plasticity
BH7	UD2-UCT	6.00		39	23	16	3	31	50	16	SCI	Very Clayey SAND of Intermediate Plasticity
BH7	P8/D8	15.00		35	22	13	2	31	51	16	SCI	Very Clayey SAND of Intermediate Plasticity
BH7	P11/D11	19.50		31	21	10	5	45	43	7	CLS	Sandy CLAY of Low Plasticity
BH7	P19/D19	31.50		28	18	10	2	39	52	7	CLS	Sandy CLAY of Low Plasticity
BH7	P22/D22	36.00		27	17	10	31	0	41	28	SCL	Very CLayey SAND of Low Plasticity
BH7	P26/D26	42.00		32	21	11	48	0	52	0	CLS	Sandy CLAY of Low Plasticity
BH7	P30/D30	48.00		30	20	10	41	0	59	0	CLS	Sandy CLAY of Low Plasticity
BH7	P33/D33	52.50					18	0	74	8	S-F	Silty/Clayey SAND
BH7	P35/D35	57.00					6	0	37	57	G-F	Silty/Clayey GRAVEL

Soil Classification in accordance with the British Soil Classification System (BSCS) – Subsurface Investigation by Geolab (M) Sdn Bhd (2023)

TABLE 4g

BH No.	SAMPLE No.	Depth (m)		ATTERBERG LIMIT			PARTICLE SIZE DISTRIBUTION				SOIL DESCRIPTION	
				L.L. (%)	P.L. (%)	P.I. (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)		
BH8	UD1	2.00		121	45	76	6	60	32	2	CE	CLAY of Extremely High Plasticity
BH8	UD1-S1	2.00		120	45	75	11	65	24	0	CE	CLAY of Extremely High Plasticity
BH8	UD1-S2	2.00		122	45	77	8	61	31	0	CE	CLAY of Extremely High Plasticity
BH8	UD1-S3	2.00		122	43	79	11	52	37	0	CES	Sandy CLAY of Extremely High Plasticity
BH8	UD2	6.50		124	45	79	2	50	48	0	CES	Sandy CLAY of Extremely High Plasticity
BH8	UD2-S1	6.50		122	44	78	39	59	2	0	CE	CLAY of Extremely High Plasticity
BH8	UD2-S2	6.50		126	44	82	18	57	25	0	CE	CLAY of Extremely High Plasticity
BH8	UD2-S3	6.50		114	43	71	11	64	25	0	CE	CLAY of Extremely High Plasticity
BH8	P4/D4	12.00		30	17	13	4	32	47	17	CLS	Sandy CLAY of Low Plasticity
BH8	P6/D6	15.00		35	20	15	5	44	45	6	CIS	Sandy CLAY of Intermediate Plasticity
BH8	P10/D10	21.00					26	0	52	22	SF	Very Silty/Clayey SAND
BH8	P16/D16	30.00		37	20	17	4	45	50	1	CIS	Sandy CLAY of Intermediate Plasticity
BH8	P21/D21	37.50		32	16	16	40	0	56	4	CLS	Sandy CLAY of Low Plasticity
BH8	P24/D24	42.00					25	0	56	19	SF	Very Silty/Clayey SAND
BH8	P26/D26	45.00		35	20	15	31	51	10	8	CI	CLAY of Intermediate Plasticity
BH8	C1	49.80										
BH8	C2	51.30										

Soil Classification in accordance with the British Soil Classification System (BSCS) – Subsurface Investigation by Geolab (M) Sdn Bhd (2023)

TABLE 4h

BH No.	SAMPLE No.	Depth (m)		ATTERBERG LIMIT			PARTICLE SIZE DISTRIBUTION				SOIL DESCRIPTION	
				L.L. (%)	P.L. (%)	P.I. (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)		
BH9	P1/D1	1.50					2	42	46	10	FS	Sandy SILTS/CLAYS
BH9	UD1	7.50		35	20	15	37	0	45	18	CIS	Sandy CLAY of Intermediate Plasticity
BH9	UD1-S1	7.50		39	24	15	5	52	39	4	CIS	Sandy CLAY of Intermediate Plasticity
BH9	UD1-S2	7.50		34	19	15	2	40	48	10	CLS	Sandy CLAY of Low Plasticity
BH9	UD1-S3	7.50		34	17	17	4	44	47	5	CLS	Sandy CLAY of Low Plasticity
BH9	P9/D9	15.00		32	19	13	37	0	44	19	CLS	Sandy CLAY of Low Plasticity
BH9	P14/D14	22.50		35	18	17	3	50	44	3	CIS	Sandy CLAY of Intermediate Plasticity
BH9	P19/D19	30.00		35	19	16	5	50	31	14	CIS	Sandy CLAY of Intermediate Plasticity
BH9	P21/D21	33.00					19	0	79	2	S-F	Silty/Clayey SAND
BH9	P24/D24	37.50		28	15	13	31	0	69	0	SCL	Very CLayey SAND of Low Plasticity
BH9	P30/D30	46.50					9	0	53	38	S-F	Silty/Clayey SAND
BH9	P35/D35	54.00					8	0	63	29	S-F	Silty/Clayey SAND

Soil Classification in accordance with the British Soil Classification System (BSCS) – Subsurface Investigation by Geolab (M) Sdn Bhd (2023)

TABLE 4i

Tides	Chart Datum Level (CDm)	National Geodetic Vertical Datum Level (NGVDm)
Lowest Astronomical Tide (LAT)	0.00	-1.56
Mean Low Water Spring (MLWS)	0.72	-0.84
Mean Low Water Neap (MLWN)	1.45	-0.11
Mean Sea Level (MSL)	1.71	0.15
Mean High Water Neap (MHWN)	1.96	0.40
Mean High Water Spring (MHWS)	2.69	1.13
Highest Astronomical Tide (HAT)	3.09	1.53
Proposed Platform Level	5.91	4.35 - 5.35

Note: Tidal Levels above are referenced to the Standard Port at Kedah Pier, Penang.

Tidal Chart

TABLE 5

Zone	Estimated Soft Clay Thickness (m)	Net Fill Height (m)	Estimated Settlement (m)	Actual Fill Thickness (m)
A1	15	5.00	4.34	9.34
A2	15	4.35	4.11	8.46
B1	10	10.00	3.68	13.68
B2	10	9.35	3.57	12.92
C	5	14.35	2.29	16.64
D	3	16.35	1.57	17.92

Note: Zoning A1 & A2, B1 & B2, C, and D are based on seabed level of ~0m, -5m, -10m, -12m NGVD respectively.

Settlement Analyses Summary (Reclamation)

TABLE 6

Filling Stage	Sea Water Condition	Circular FOS	Wedge FOS	Remarks
Sand Containment Bund (Undrained)	MLWS	2.124	1.651	FOS≥1.2, achieved minimum safety factor
	MHWS to MSL	2.211	1.788	FOS≥1.1, achieved minimum safety factor
1st Fill (2.0m fill above PVD Platform Level, Undrained)	MLWS	1.844	1.313	FOS≥1.2, achieved minimum safety factor
	MHWS to MSL	1.870	1.355	FOS≥1.1, achieved minimum safety factor
2nd Fill (Fill until Final Fill Height for each zone, Undrained)	MLWS	1.741	1.492	FOS≥1.2, achieved minimum safety factor
	MHWS to MSL	1.737	1.468	FOS≥1.1, achieved minimum safety factor
Final Platform Level (Undrained)	MLWS	1.996	1.789	FOS≥1.2, achieved minimum safety factor
	MHWS to MSL	1.969	1.783	FOS≥1.1, achieved minimum safety factor
Final Platform Level (Undrained, Seismic: 5.55%g)	MLWS	1.356	1.220	FOS≥1.2, achieved minimum safety factor
	MHWS to MSL	1.292	1.200	FOS≥1.2, achieved minimum safety factor
Final Platform Level (Drained)	MLWS	2.431	2.478	FOS≥1.4, achieved minimum safety factor
	MHWS to MSL	2.405	2.458	FOS≥1.2, achieved minimum safety factor
Final Platform Level (Drained, Seismic: 5.55%g)	MLWS	1.728	1.817	FOS≥1.2, achieved minimum safety factor
	MHWS to MSL	1.694	1.792	FOS≥1.2, achieved minimum safety factor

Stability Analyses Summary (Reclamation)

TABLE 7

Filling Stage	Sea Water Condition	Circular FOS	Wedge FOS	Remarks
Final Platform Level (Drained)	MLWS	1.767	1.742	FOS≥1.4, achieved minimum safety factor
	MHWS to MSL	1.608	1.641	FOS≥1.2, achieved minimum safety factor
Final Platform Level (Drained, Seismic: 5.55%g)	MLWS	1.308	1.322	FOS≥1.2, achieved minimum safety factor
	MHWS to MSL	1.259	1.243	FOS≥1.2, achieved minimum safety factor

Stability Analyses Summary (Dumpsite)

TABLE 8

Contour	Net Fill Height	Actual Fill Height	Surcharge Thickness	Gross Fill Height + Surcharge	Final Settlement	Total Settlement (% / mm) for Rest Period of					
	m	m	m	m	m	1 Month	2 Month	3 Month	4 Month	5 Month	6 Month
Using PVD at 1.1m spacing will give degree of consolidation ==>						43.86	67.33	80.87	88.77	93.39	96.11
A1	5.00	9.34	0.0	9.34	4.34	1.9019	2.9196	3.5071	3.8495	4.0500	4.1677
			2.0	11.34	4.82	2.1130	3.2438	3.8964	4.2768	4.4996	4.6304
Using PVD at 1.1m spacing will give degree of consolidation ==>						43.86	67.33	80.87	88.77	93.39	96.11
A2	4.35	8.46	0.0	8.46	4.11	1.8020	2.7664	3.3230	3.6474	3.8374	3.9489
			2.0	10.46	4.64	2.0336	3.1219	3.7501	4.1162	4.3306	4.4564
Using PVD at 1.1m spacing will give degree of consolidation ==>						45.69	68.88	82.01	89.56	93.92	96.45
B1	10.00	13.68	0.0	13.68	3.68	1.6815	2.5348	3.0180	3.2956	3.4561	3.5493
			2.0	15.68	3.95	1.8064	2.7230	3.2421	3.5403	3.7128	3.8129
Using PVD at 1.1m spacing will give degree of consolidation ==>						51.21	73.54	85.43	91.92	95.50	97.49
B2	9.35	12.92	0.0	12.92	3.57	1.6277	2.4537	2.9214	3.1901	3.3455	3.4358
			2.0	14.92	3.86	1.7620	2.6561	3.1625	3.4533	3.6216	3.7193

Temporary Surcharge Design

TABLE 9a

Contour	Net Fill Height	Actual Fill Height	Surcharge Thickness	Gross Fill Height + Surcharge	Final Settlement	Total Settlement (% / mm) for Rest Period of					
	m	m	m	m	m	1 Month	2 Month	3 Month	4 Month	5 Month	6 Month
Using PVD at 1.1m spacing will give degree of consolidation ==>						51.21	73.54	85.43	91.92	95.50	97.49
C	14.35	16.64	0.0	16.64	2.29	1.1720	1.6833	1.9553	2.1038	2.1858	2.2313
			2.0	18.64	2.42	1.2386	1.7790	2.0665	2.2234	2.3100	2.3582
Using PVD at 1.1m spacing will give degree of consolidation ==>						58.55	79.76	89.98	95.00	97.51	98.76
D	16.35	17.92	0.0	17.92	1.57	0.9184	1.2510	1.4113	1.4901	1.5294	1.5490
			2.0	19.92	1.64	0.9625	1.3111	1.4791	1.5617	1.6029	1.6234

Temporary Surcharge Design

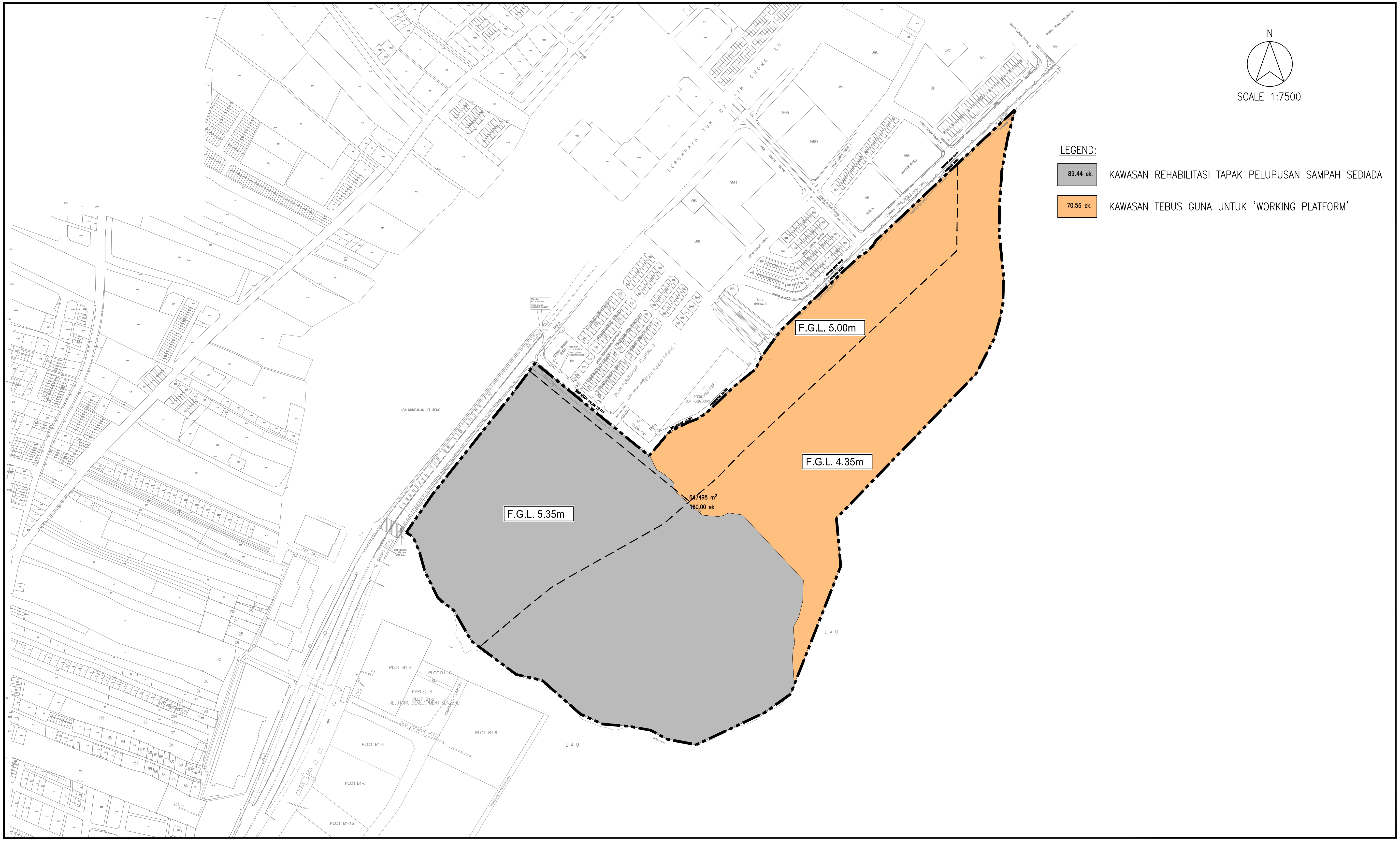
TABLE 9b

FIGURES

LIST OF FIGURES

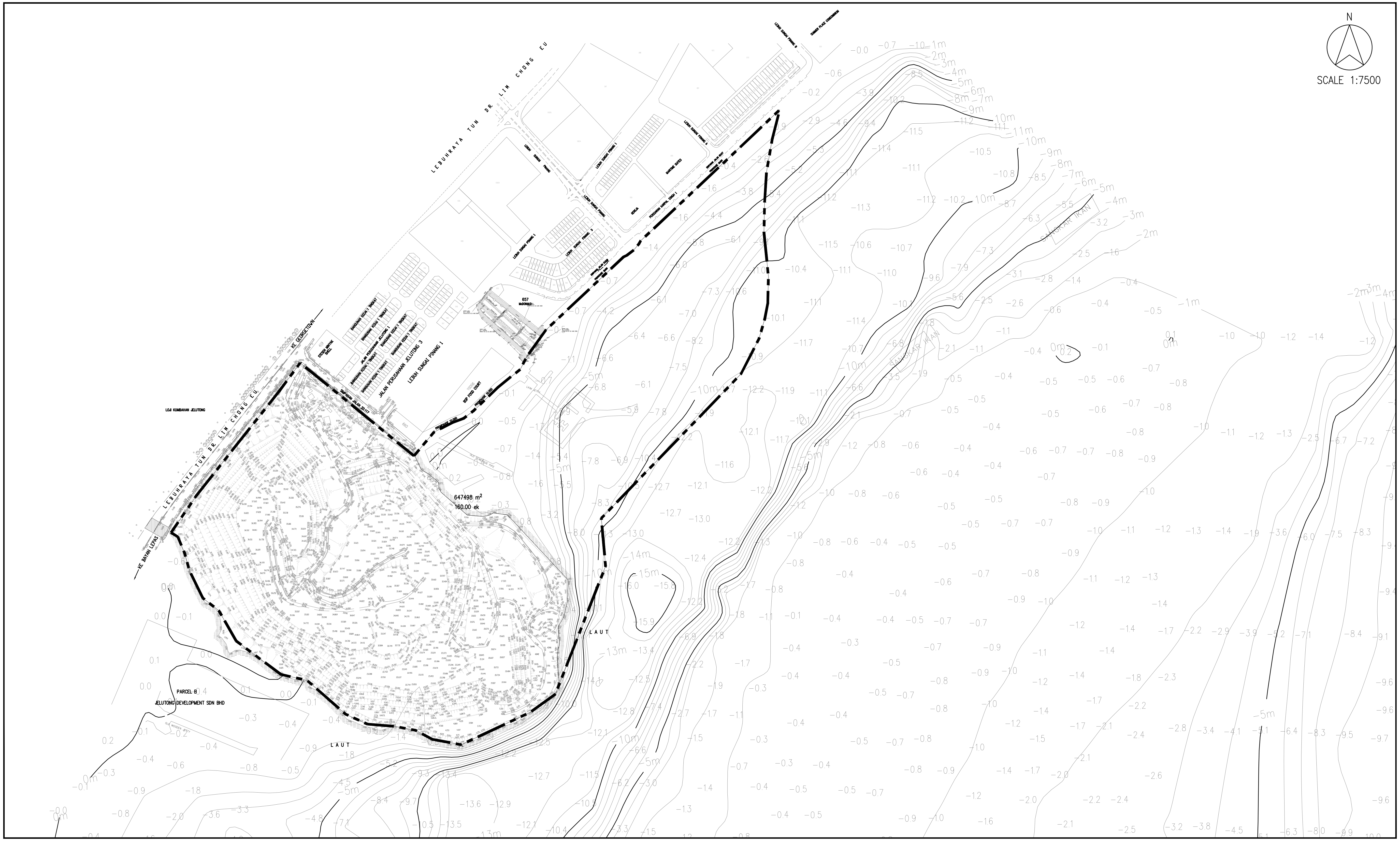
FIGURE	TITLE OF FIGURES
1	Master Layout Plan
2	Bathymetric Survey Plan
3	3D Seabed Topography
4	Key Plan and Location Plan
5	Geological Map
6	Subsurface Investigation (S.I.) Layout Plan (Dumpsite) (by Others)
7	Subsurface Investigation (S.I.) Layout Plan (Overwater)
8	Simplified Borelog (Dumpsite) (by Others)
9	Simplified Borelog (Overwater)
10	Simplified Piezocone
11	Plasticity Chart (Dumpsite) (by Others)
12	Plasticity Chart (Reclamation)
13	Unit Weight (Dumpsite)
14	Unit Weight of Clay (Reclamation)
15	Unit Weight of Sand (Reclamation)
16	Chloride Content (Reclamation)
17	pH Value (Reclamation)
18	Total Sulphate Content (Reclamation)
19	Organic Content (Reclamation)
20	Undrained Shear Strength (Reclamation)
21	Consolidated Isotropic Undrained (CIU) Triaxial Test (t-s plot) (Reclamation)
22	Direct Shear Box Test (Reclamation)
23	Compression Ratio (CR) (Reclamation)
24	Recompression ratio (RR) (Reclamation)
25a to 25b	Coefficient of Consolidation (Reclamation)
26	Over-consolidation Ratio (OCR) (Reclamation)
27	Cross Section Layout
28	Section A-A
29	Section B-B
30	Seismic Hazard Map by US Geological Survey (USGS)
31	Concept of Temporary Surcharge

32	Surcharge Layout
33	Proposed Construction Sequence (Reclamation)
34	Proposed Construction Sequence (Dumpsite)
35	Grading Limits for Fill Material



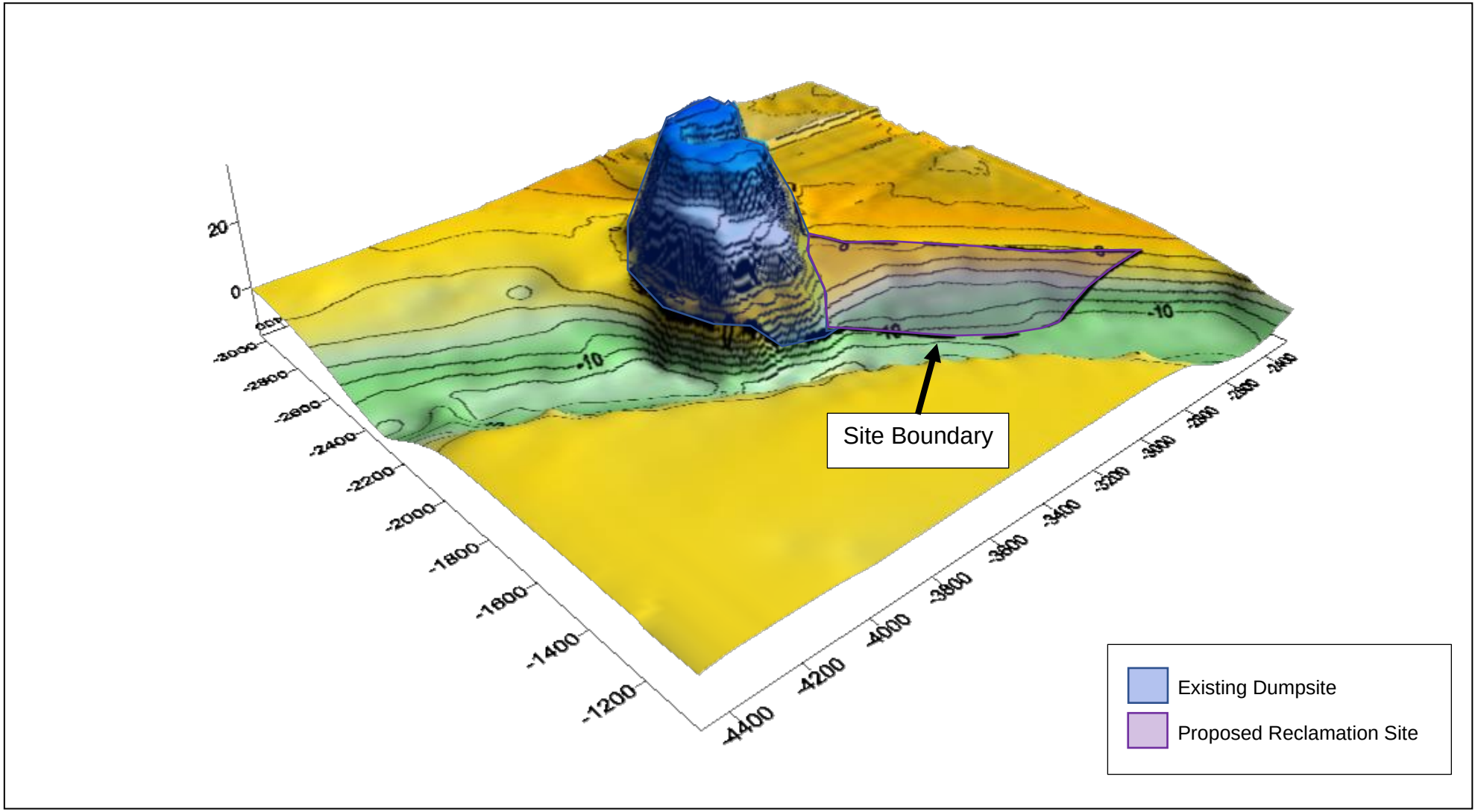
Master Layout Plan

FIGURE 1



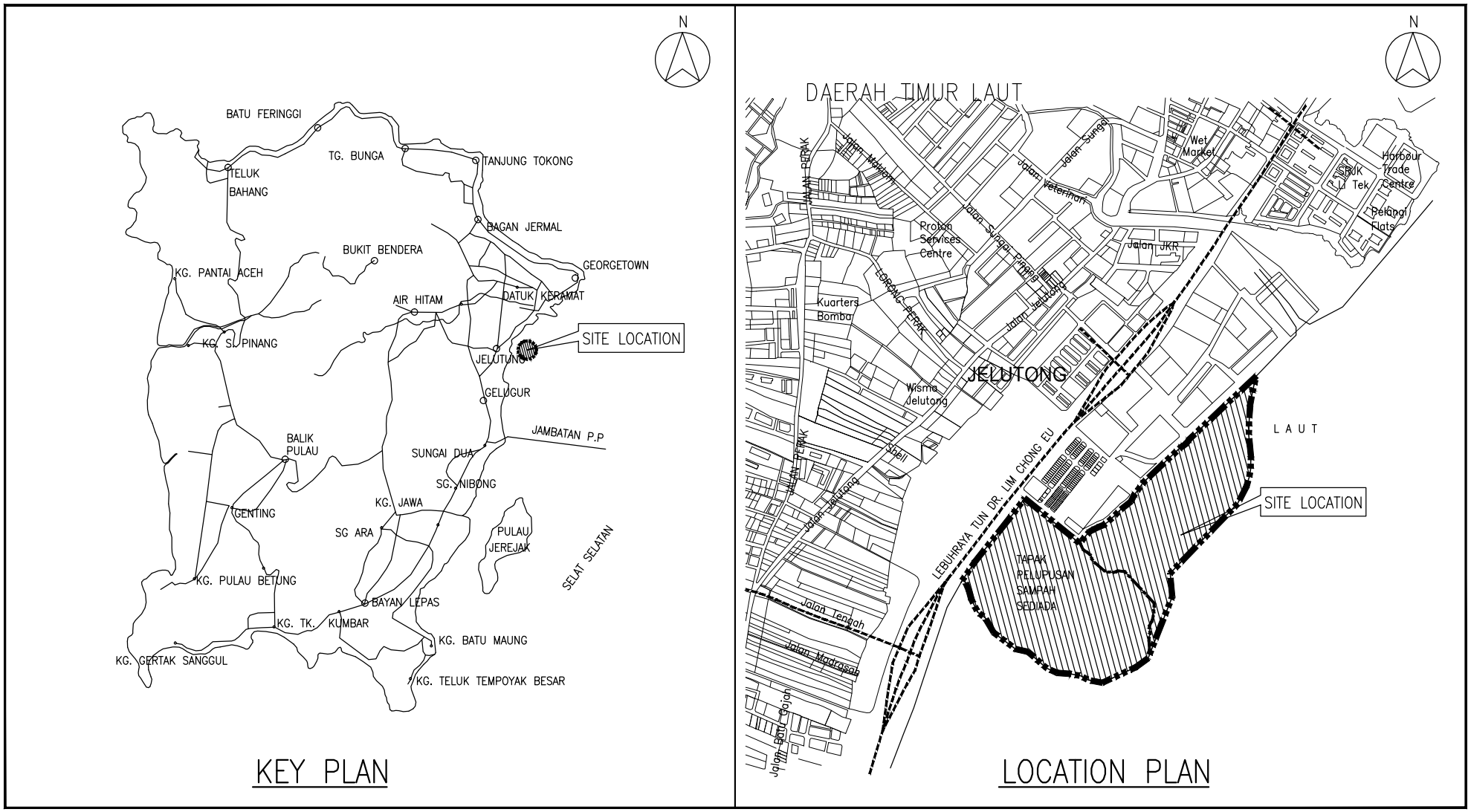
Bathymetric Survey Plan

FIGURE 2



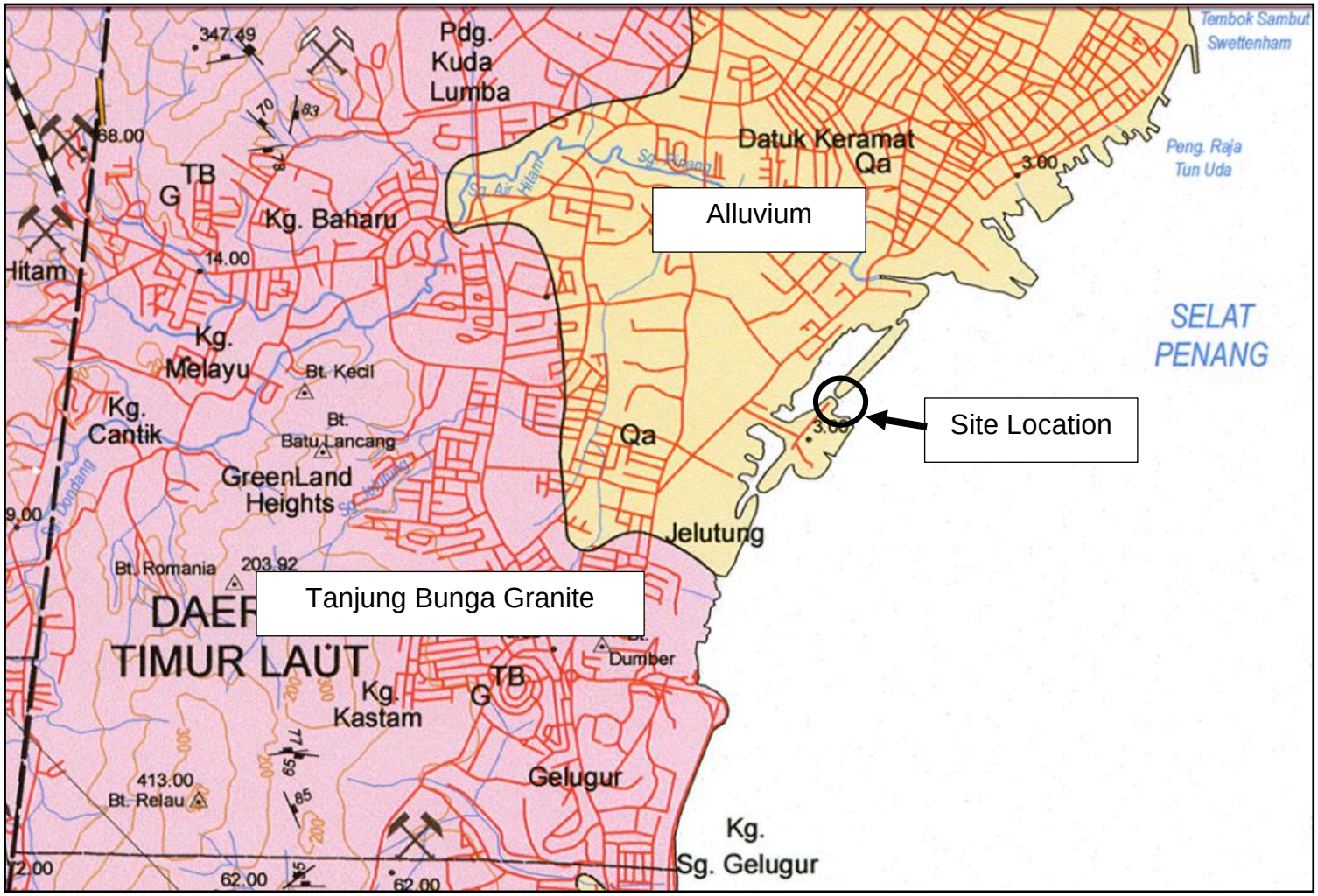
3D Seabed Topography

FIGURE 3



Key Plan and Location Plan

FIGURE 4



Geological Map

FIGURE 5

N

SCALE 1:7500

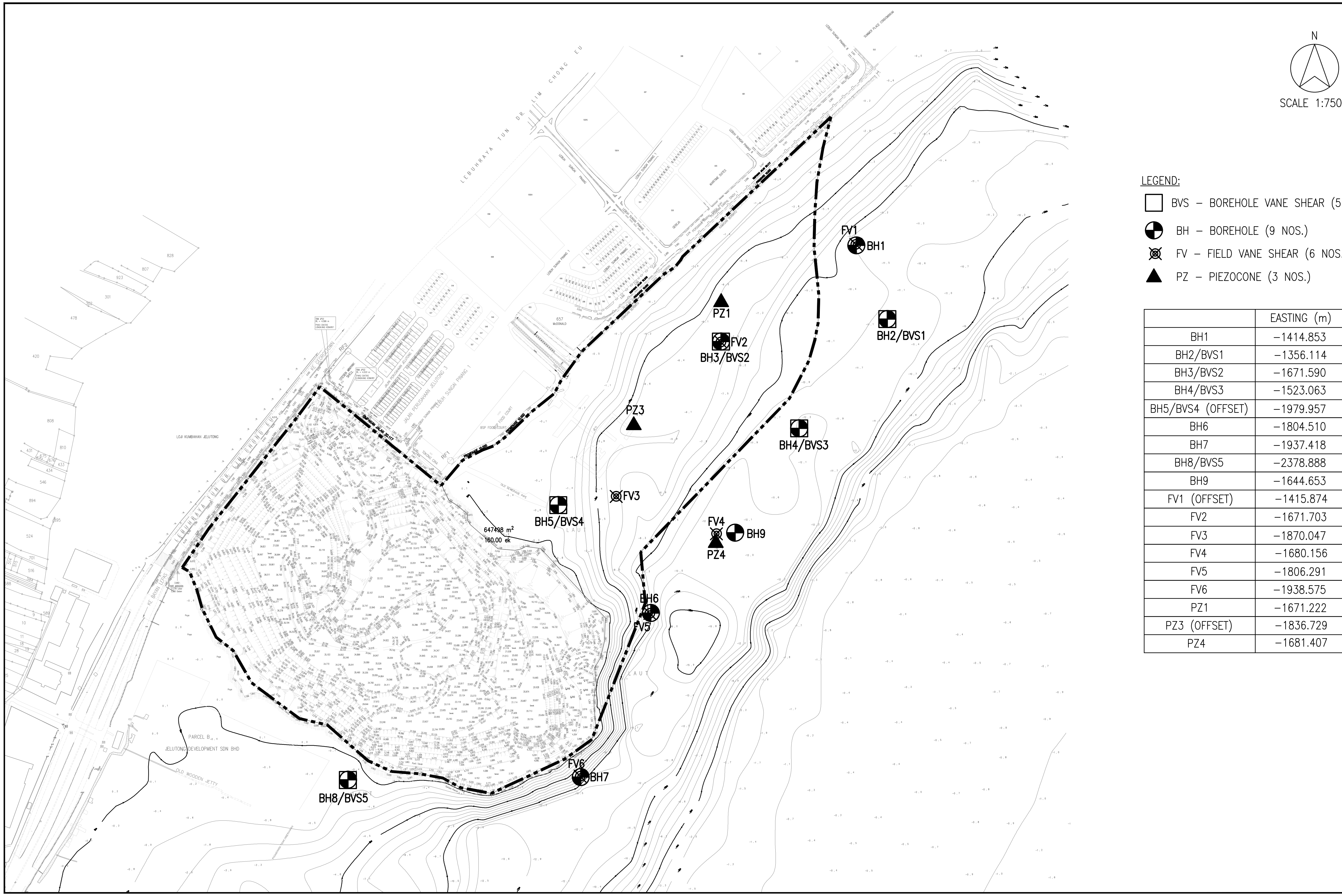
LEGEND:

OBH – BOREHOLE (9 NOS.)

	EASTING (M)	NORTHING (M)
OBH1	−2597.181	−3327.487
OBH2	−2515.022	−3187.891
OBH3	−2432.863	−3048.296
OBH4	−2395.779	−3562.533
OBH5	−2278.830	−3373.957
OBH6	−2165.637	−3206.640
OBH7	−2126.880	−3677.127
OBH8	−2053.333	−3551.598
OBH9	−1943.529	−3373.957

Subsurface Investigation (S.I.) Layout Plan (Dumpsite)
(by Others)

FIGURE 6



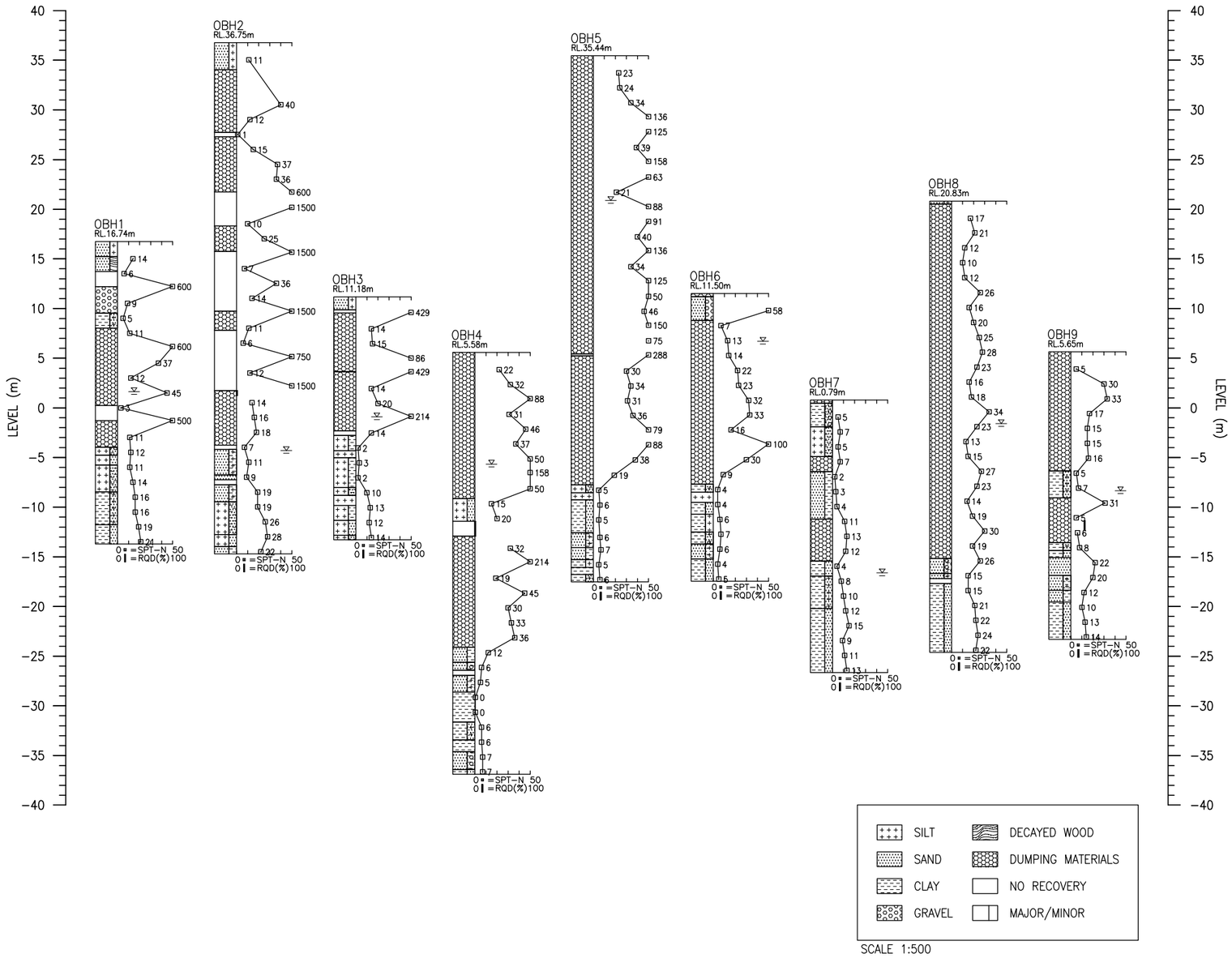
LEGEND:

- BVS – BOREHOLE VANE SHEAR (5 NOS.)
- BH – BOREHOLE (9 NOS.)
- FV – FIELD VANE SHEAR (6 NOS.)
- PZ – PIEZOCONE (3 NOS.)

	EASTING (m)	NORTHING (m)
BH1	-1414.853	-2644.089
BH2/BVS1	-1356.114	-2783.828
BH3/BVS2	-1671.590	-2826.274
BH4/BVS3	-1523.063	-2991.038
BH5/BVS4 (OFFSET)	-1979.957	-3136.463
BH6	-1804.510	-3341.071
BH7	-1937.418	-3652.294
BH8/BVS5	-2378.888	-3657.462
BH9	-1644.653	-3188.772
FV1 (OFFSET)	-1415.874	-2642.123
FV2	-1671.703	-2827.365
FV3	-1870.047	-3119.975
FV4	-1680.156	-3190.795
FV5	-1806.291	-3341.921
FV6	-1938.575	-3650.660
PZ1	-1671.222	-2751.898
PZ3 (OFFSET)	-1836.729	-2985.466
PZ4	-1681.407	-3208.341

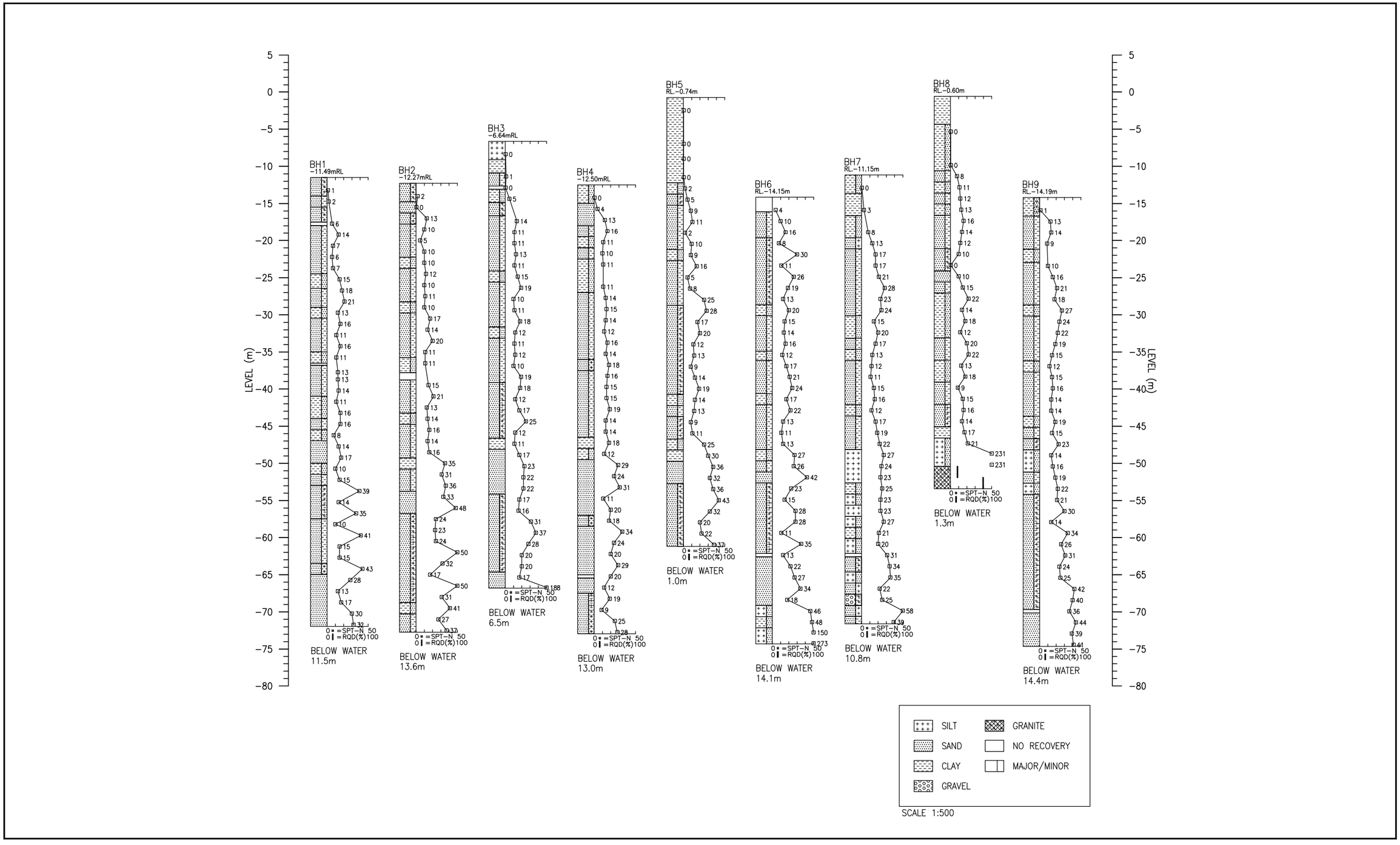
Subsurface Investigation (S.I.) Layout (Overwater)

FIGURE 7



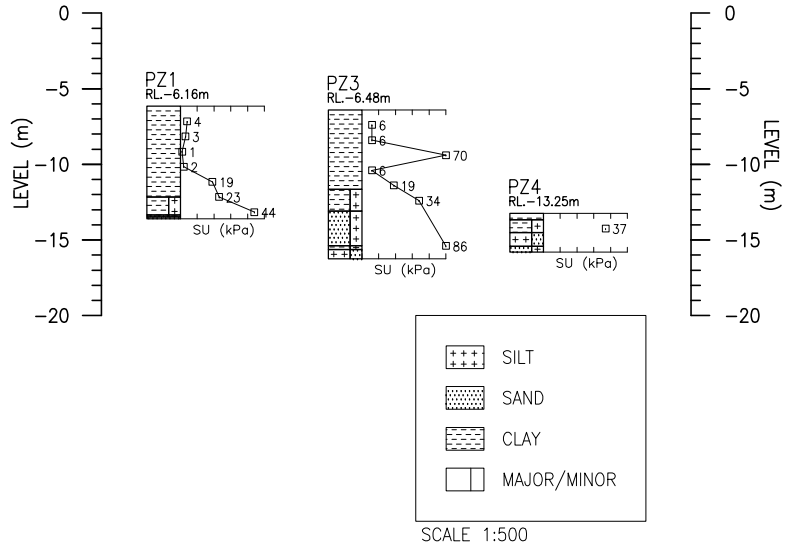
Simplified Borelog (Dumpsite)
(by Others)

FIGURE 8



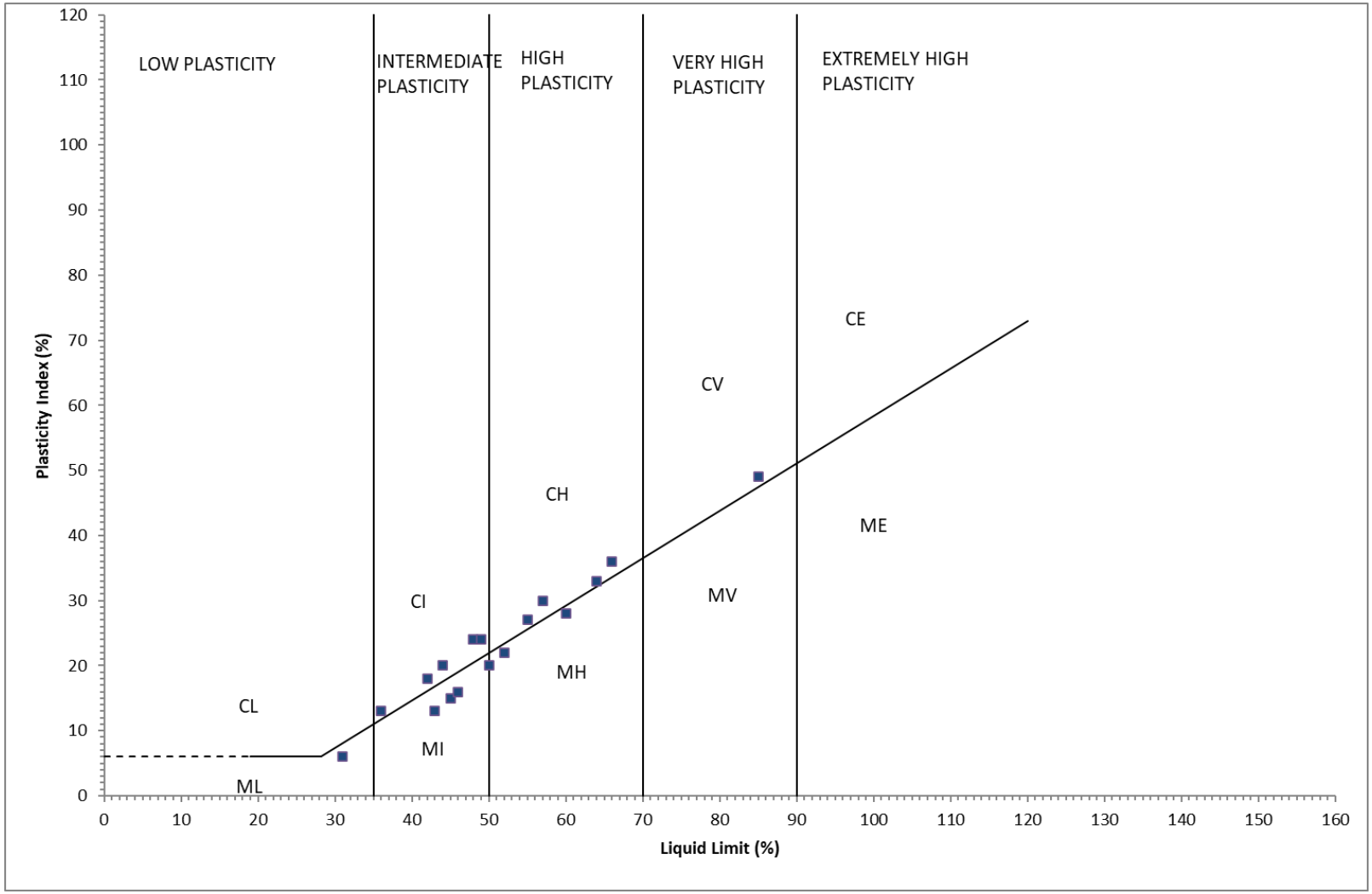
Simplified Borelog (Overwater)

FIGURE 9



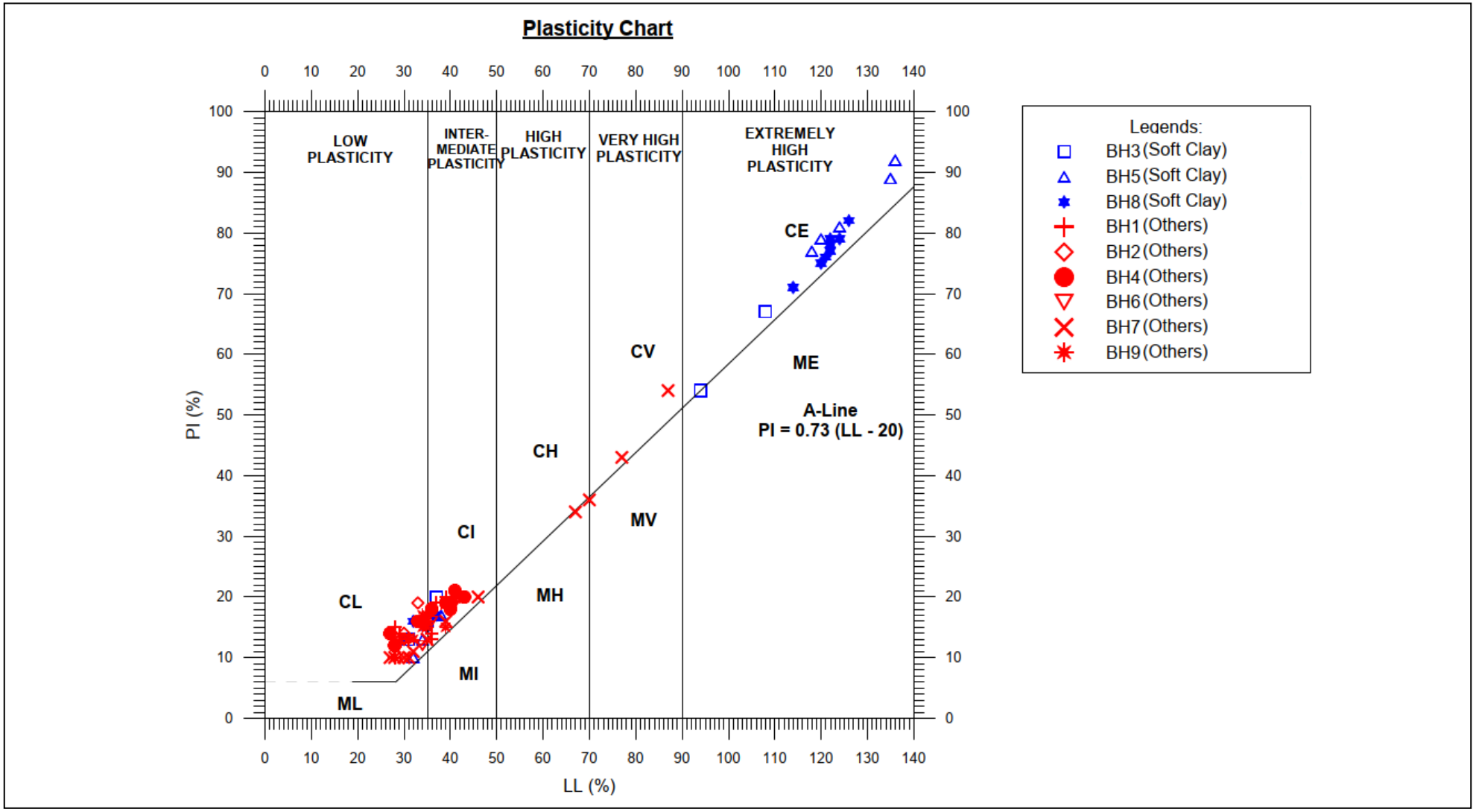
Simplified Piezocone

FIGURE 10



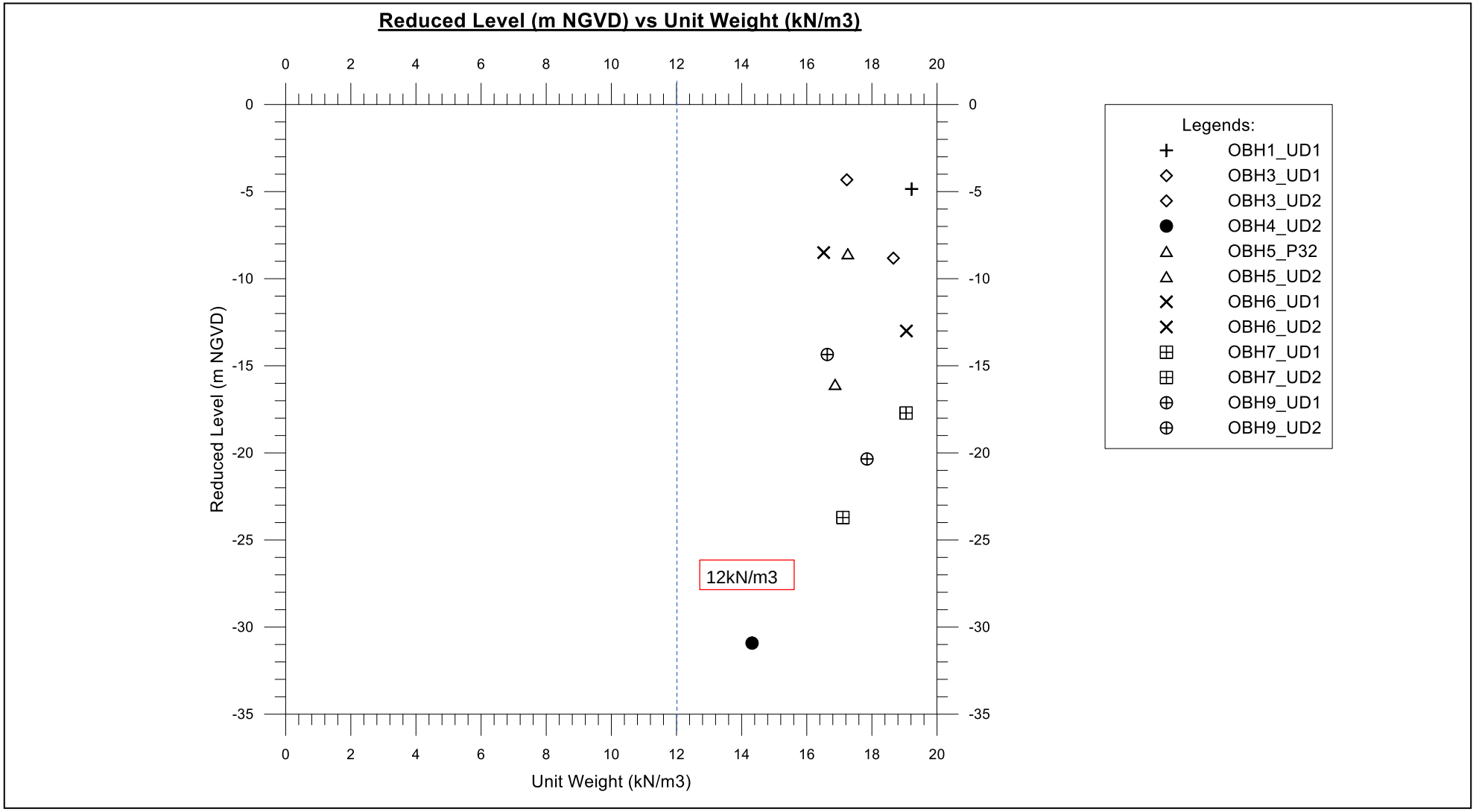
Plasticity Chart (Dumpsite)
(by Others)

FIGURE 11



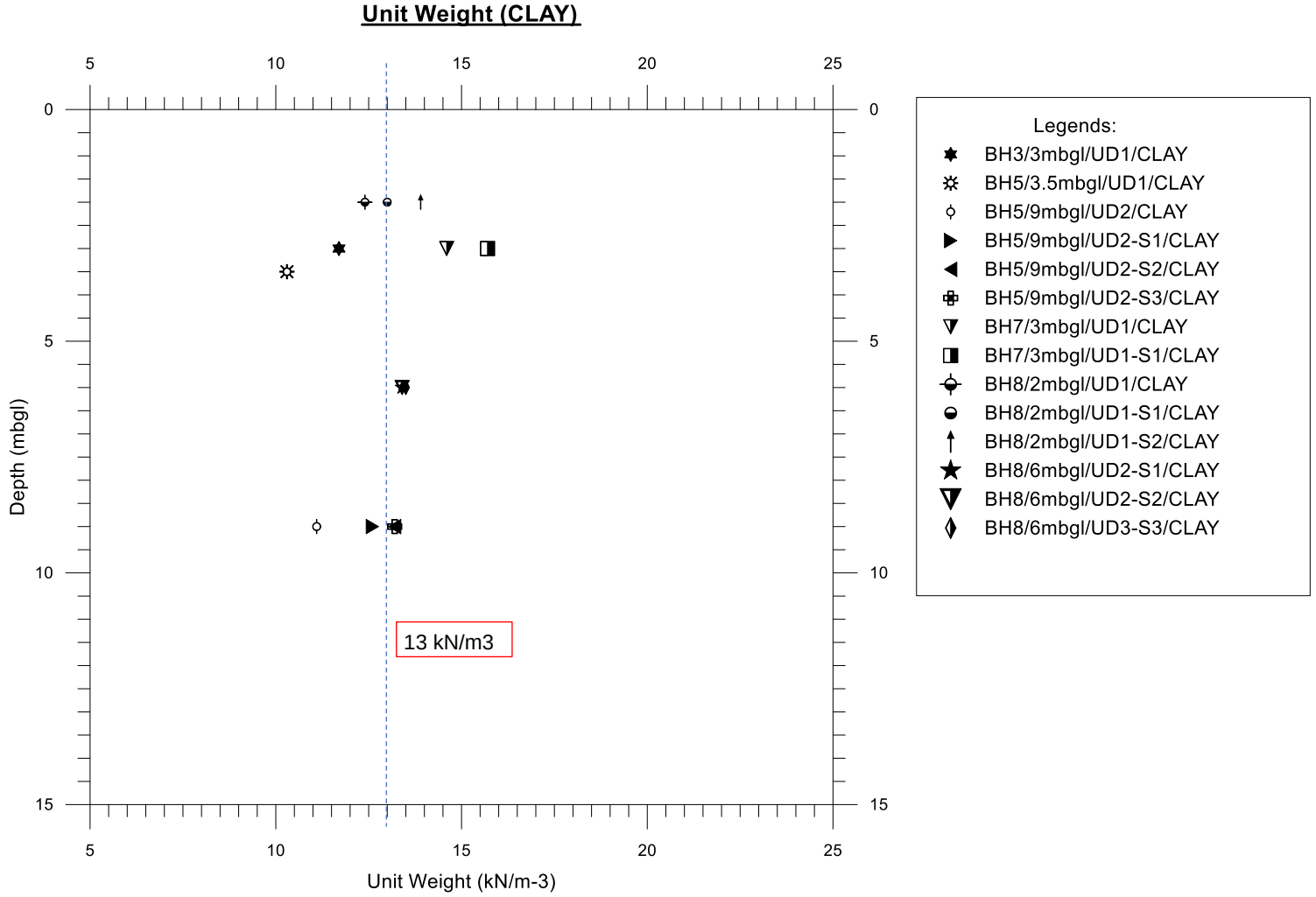
Plasticity Chart (Reclamation)

FIGURE 12



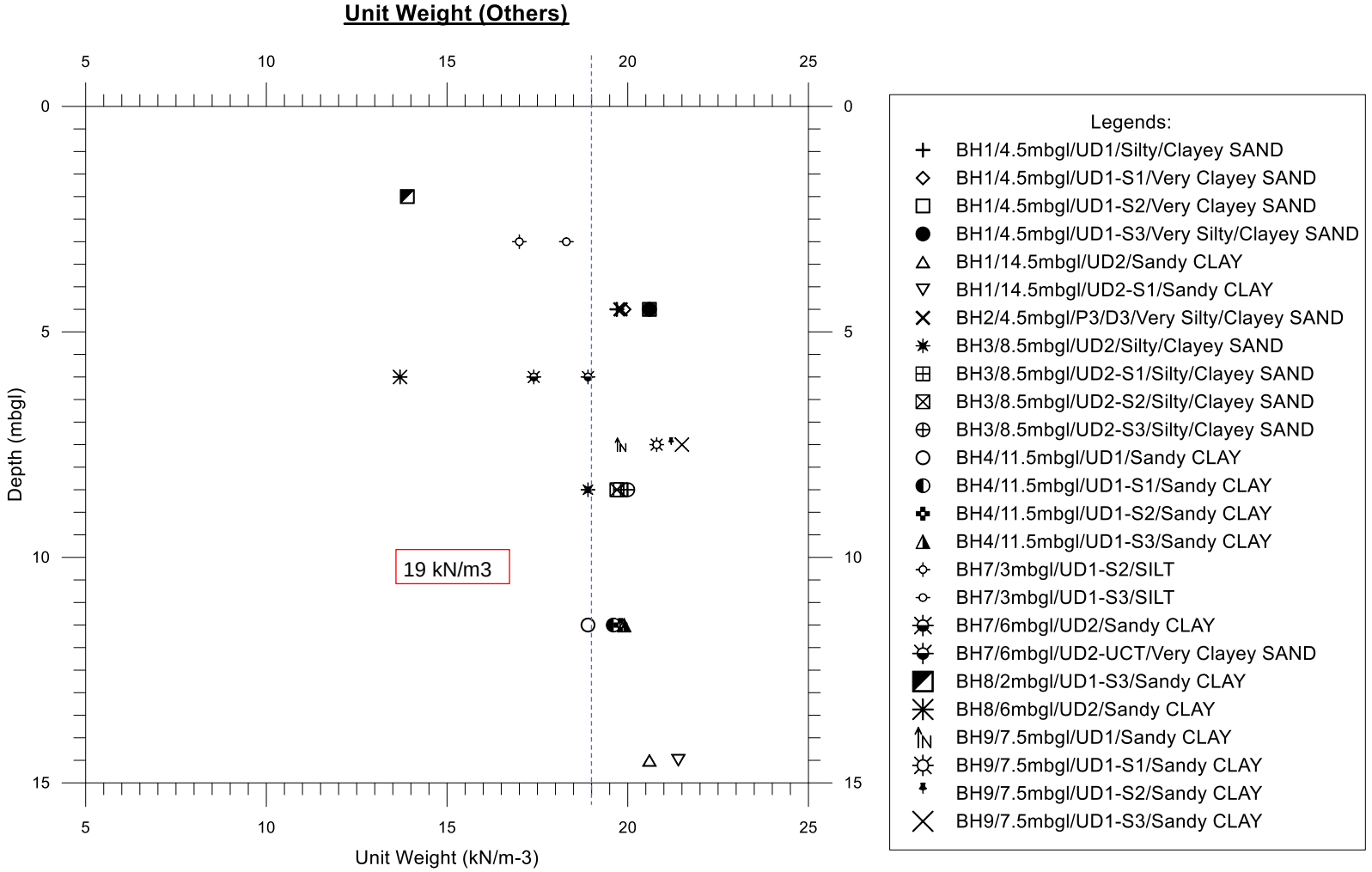
Unit Weight (Dumpsite)
(by Others)

FIGURE 13



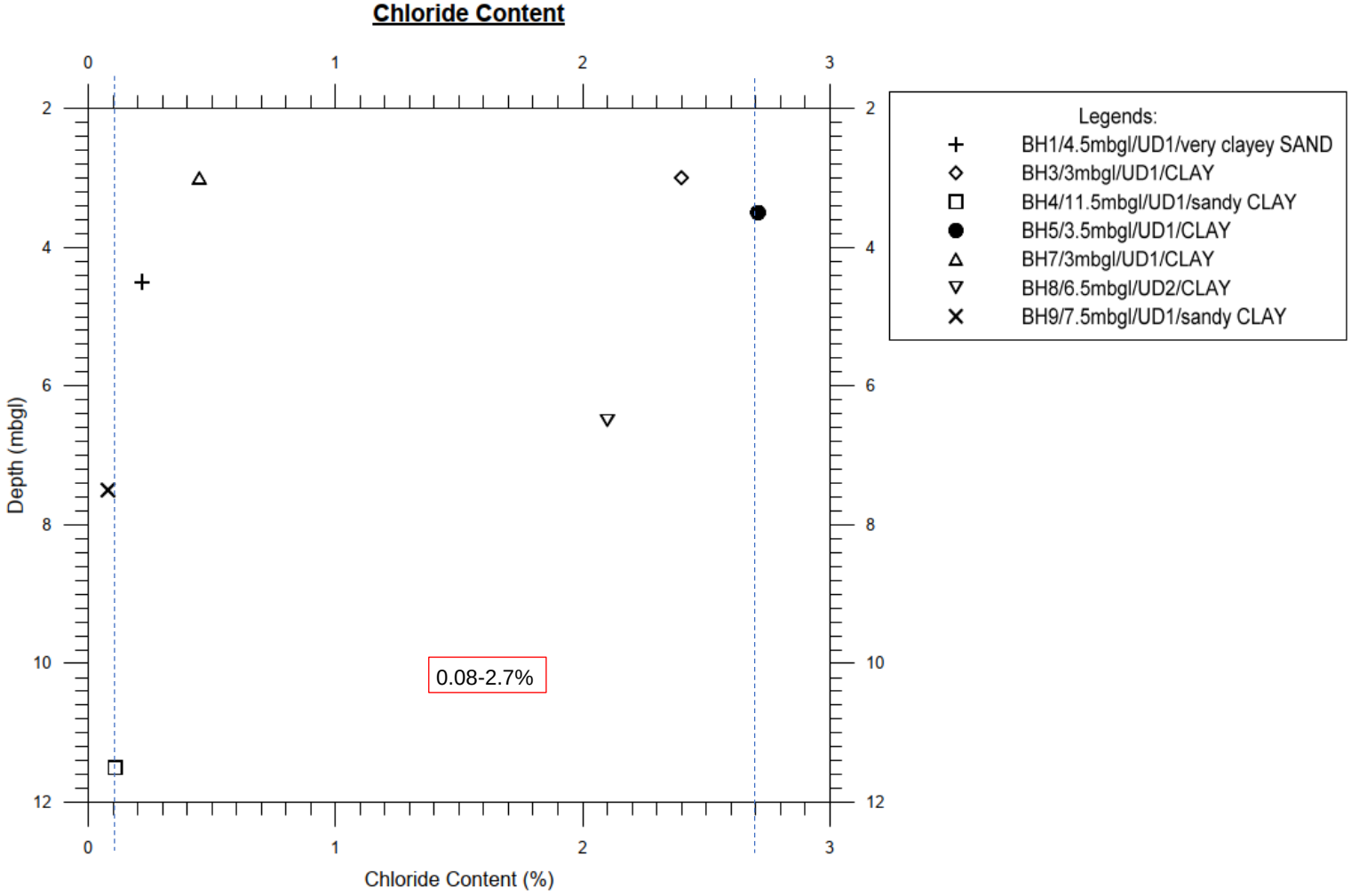
Unit Weight of Clay (Reclamation)

FIGURE 14



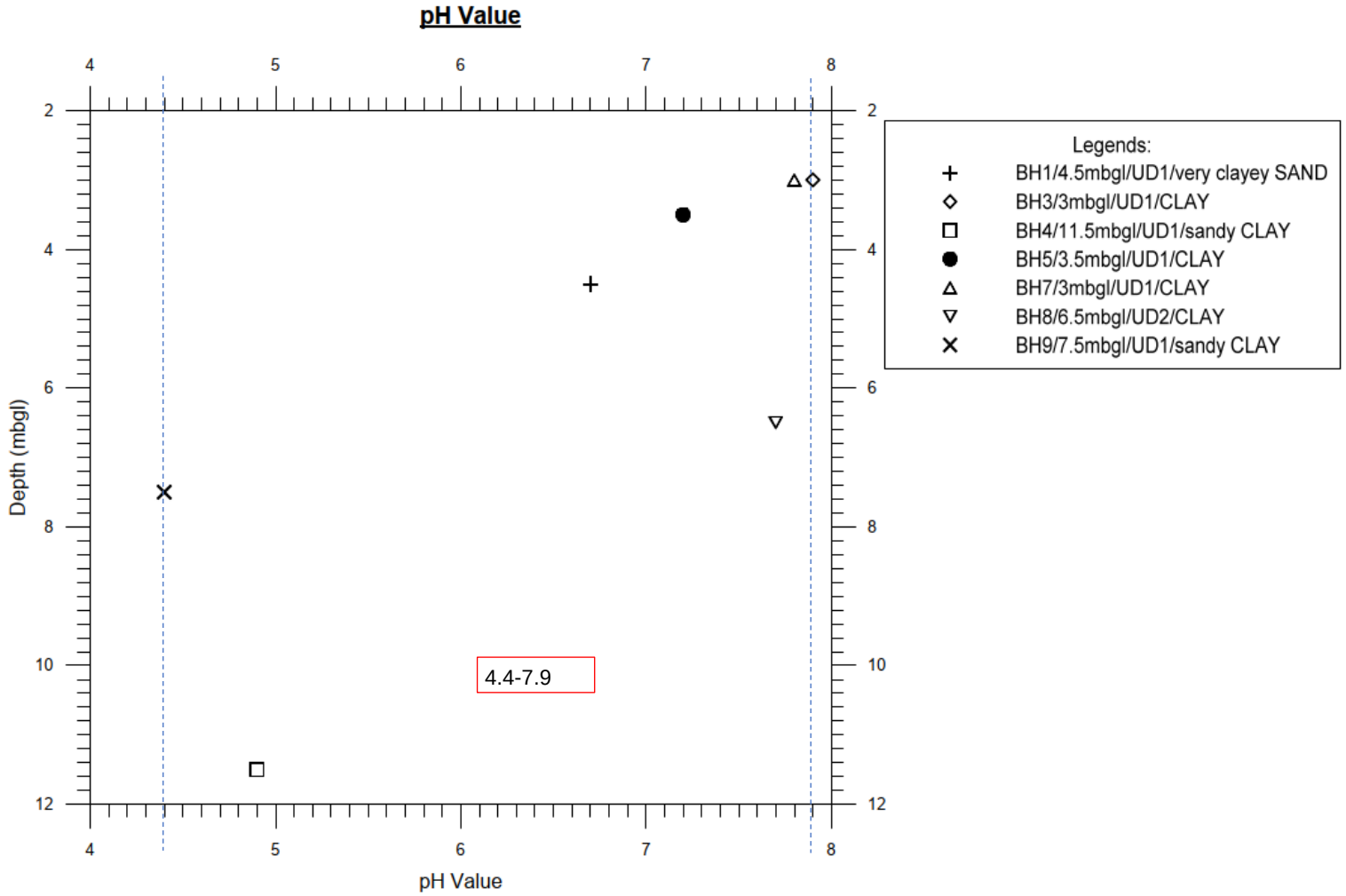
Unit Weight of Sand (Reclamation)

FIGURE 15



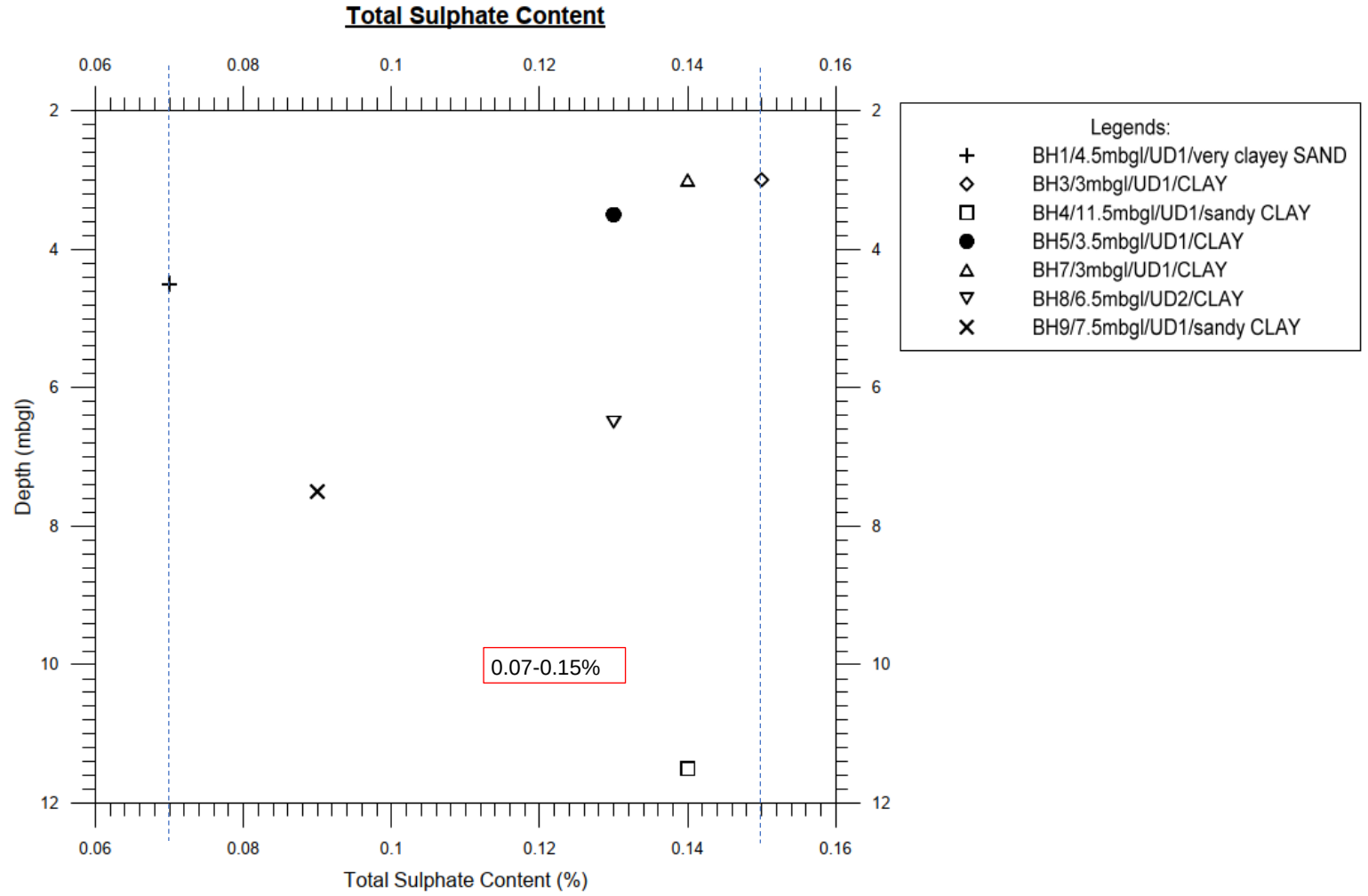
Chloride Content (Reclamation)

FIGURE 16



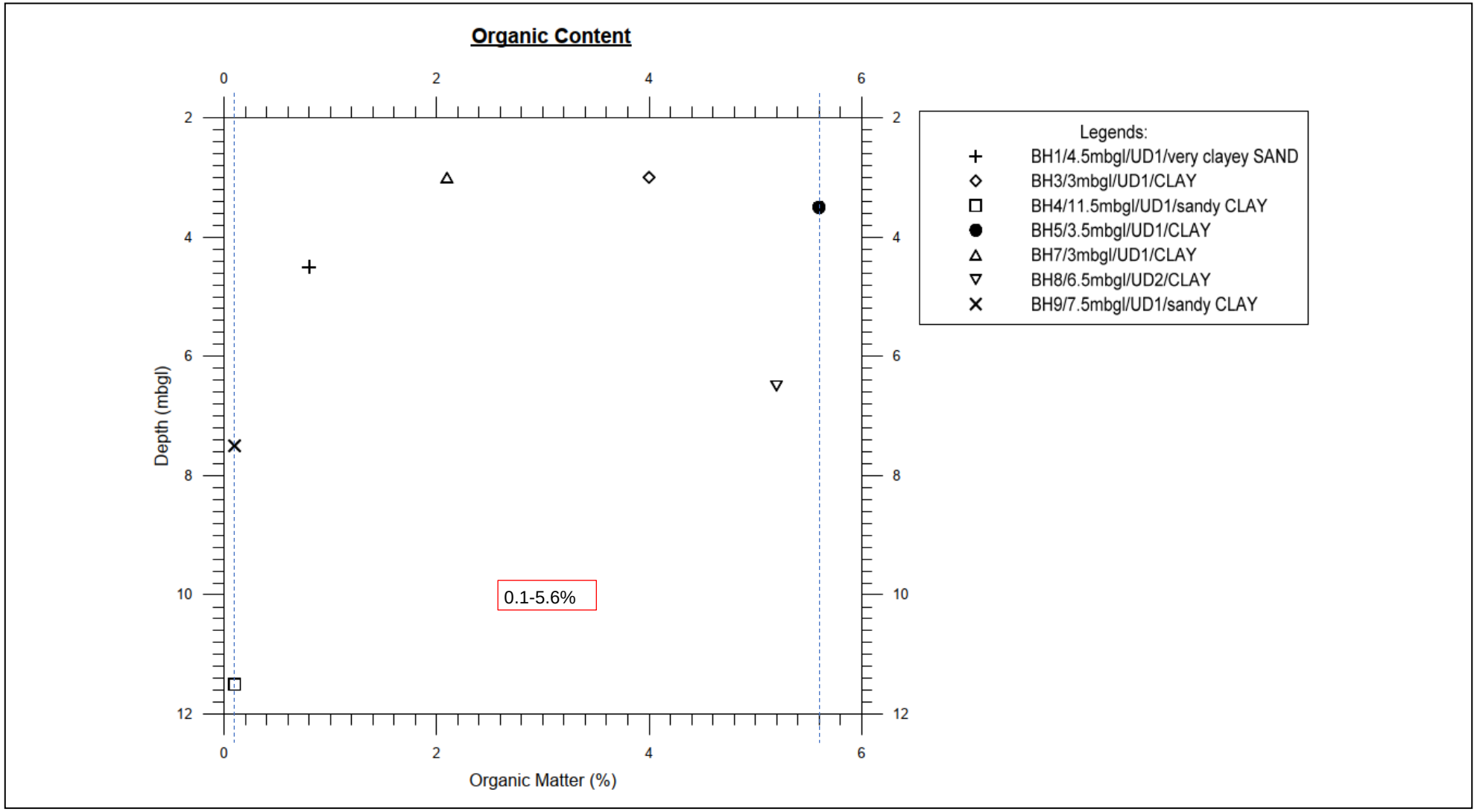
pH Value (Reclamation)

FIGURE 17



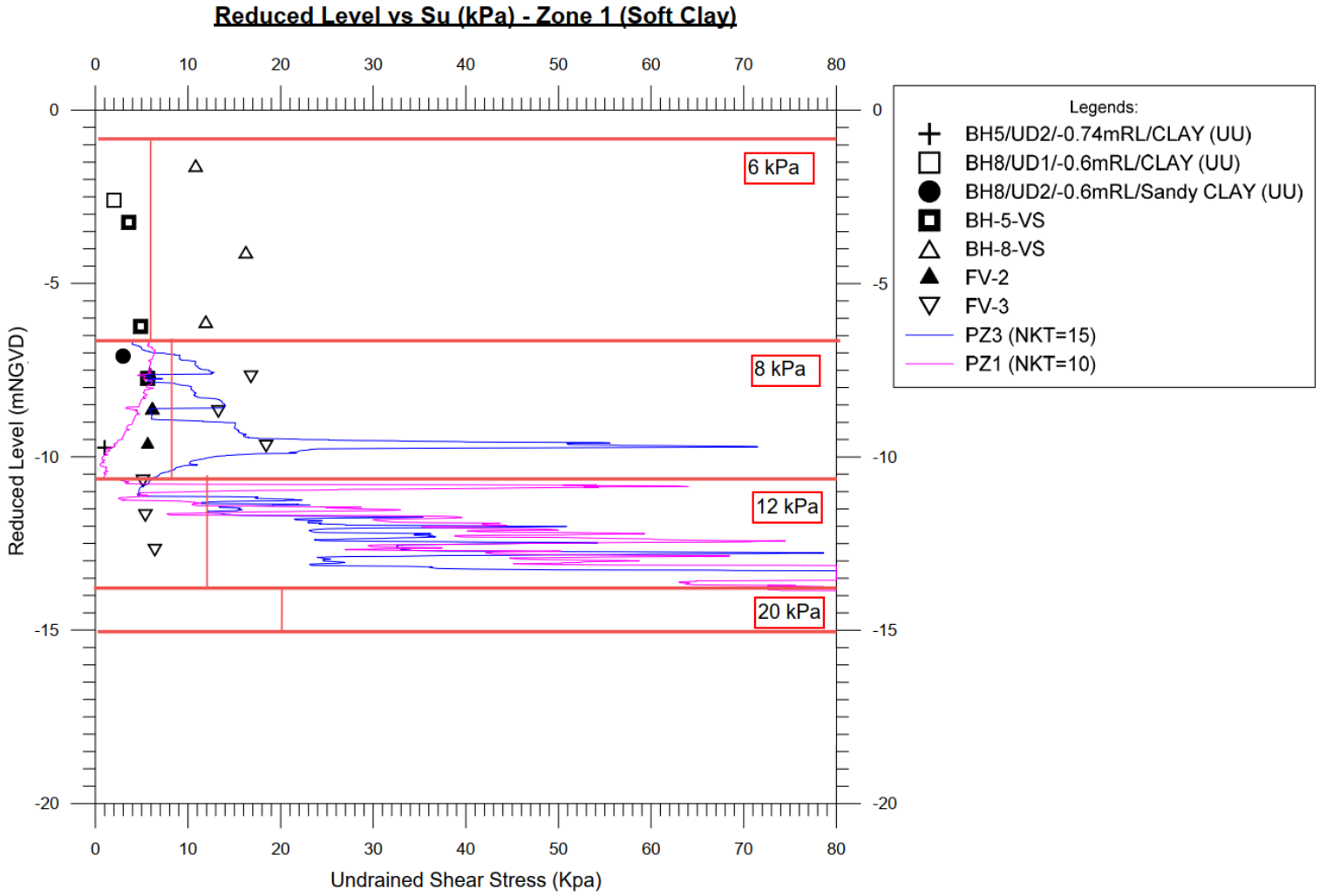
Total Sulphate Content (Reclamation)

FIGURE 18



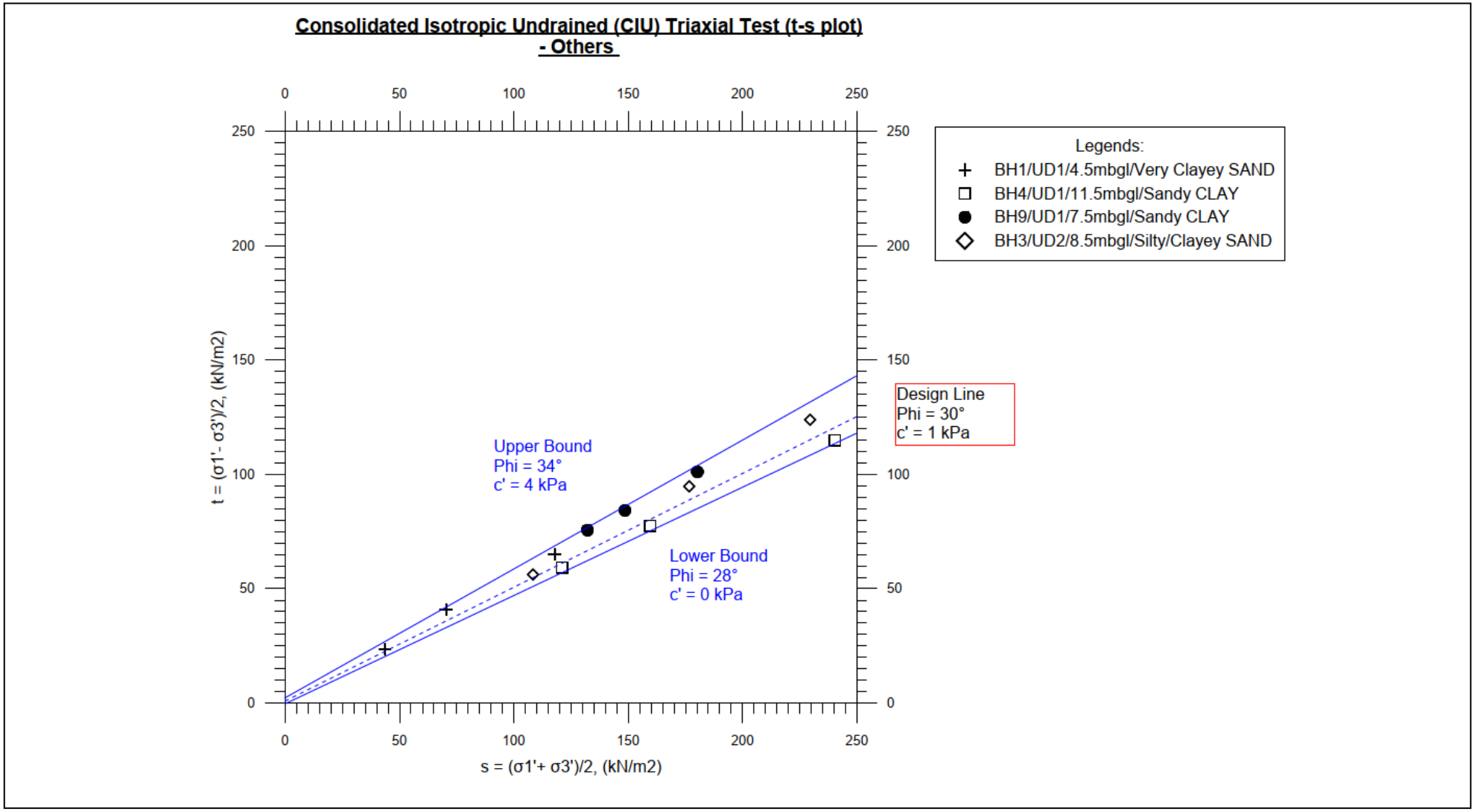
Organic Content (Reclamation)

FIGURE 19



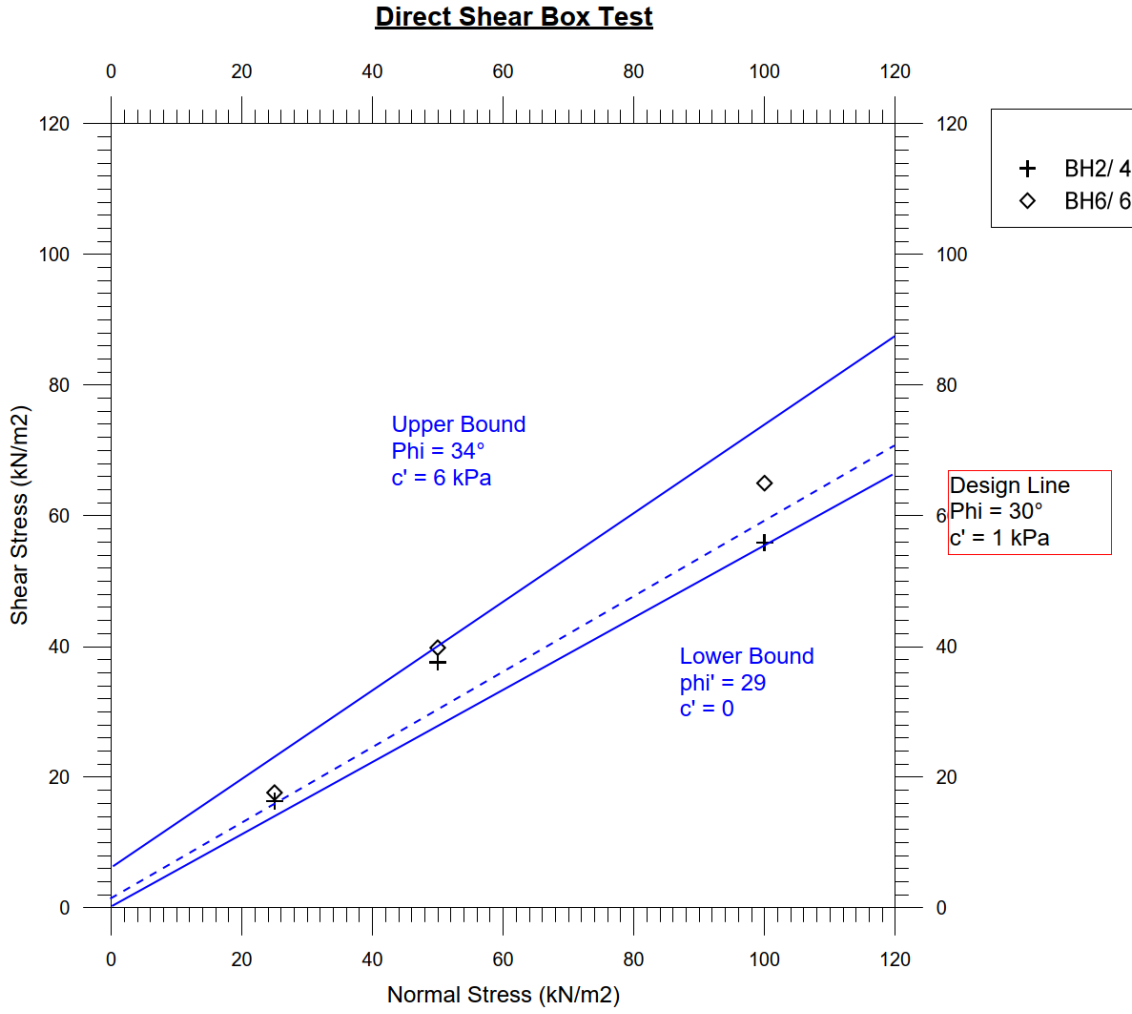
Undrained Shear Strength (Reclamation)

FIGURE 20



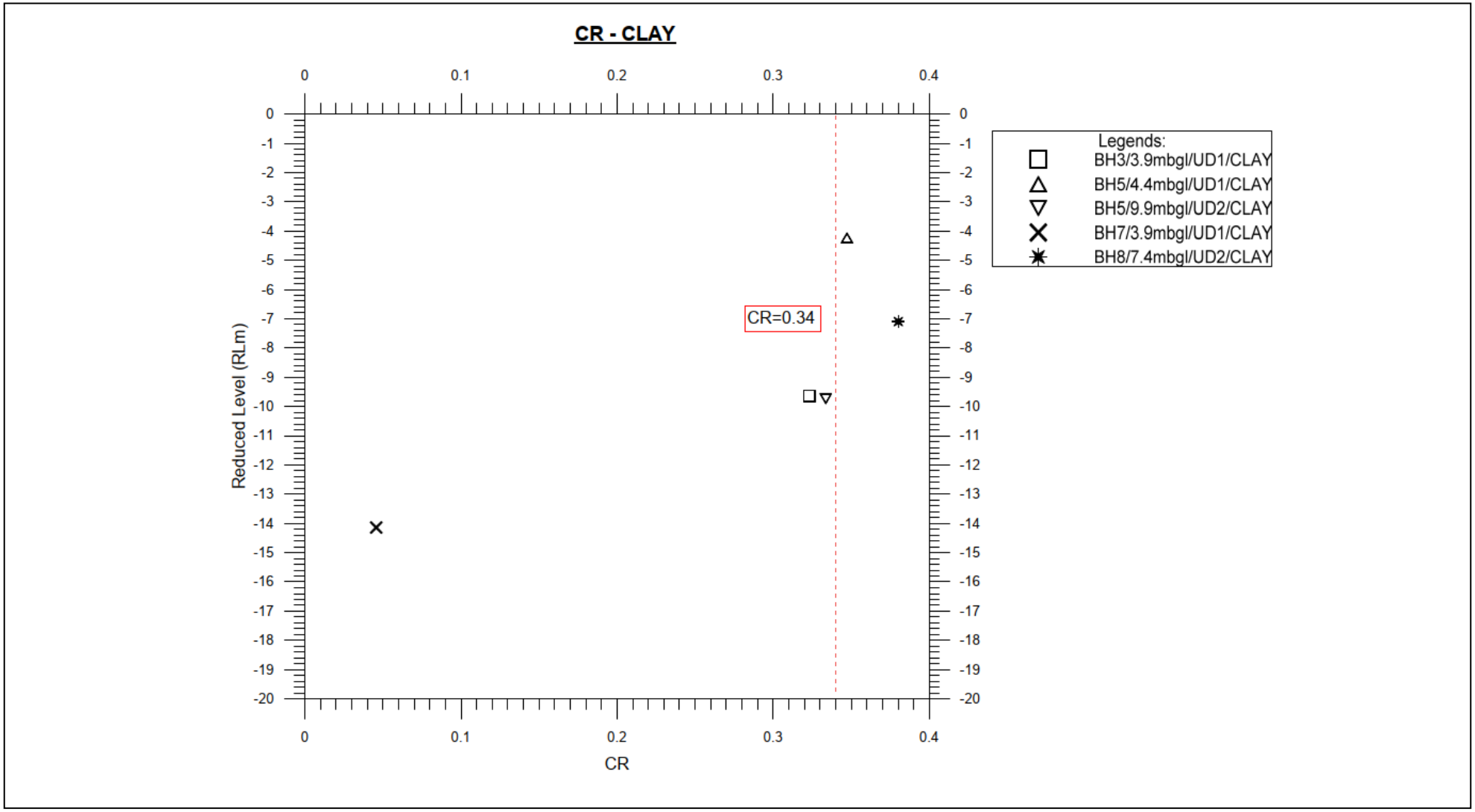
Consolidated Isotropic Undrained (CIU) Triaxial Test (t-s plot) (Reclamation)

FIGURE 21



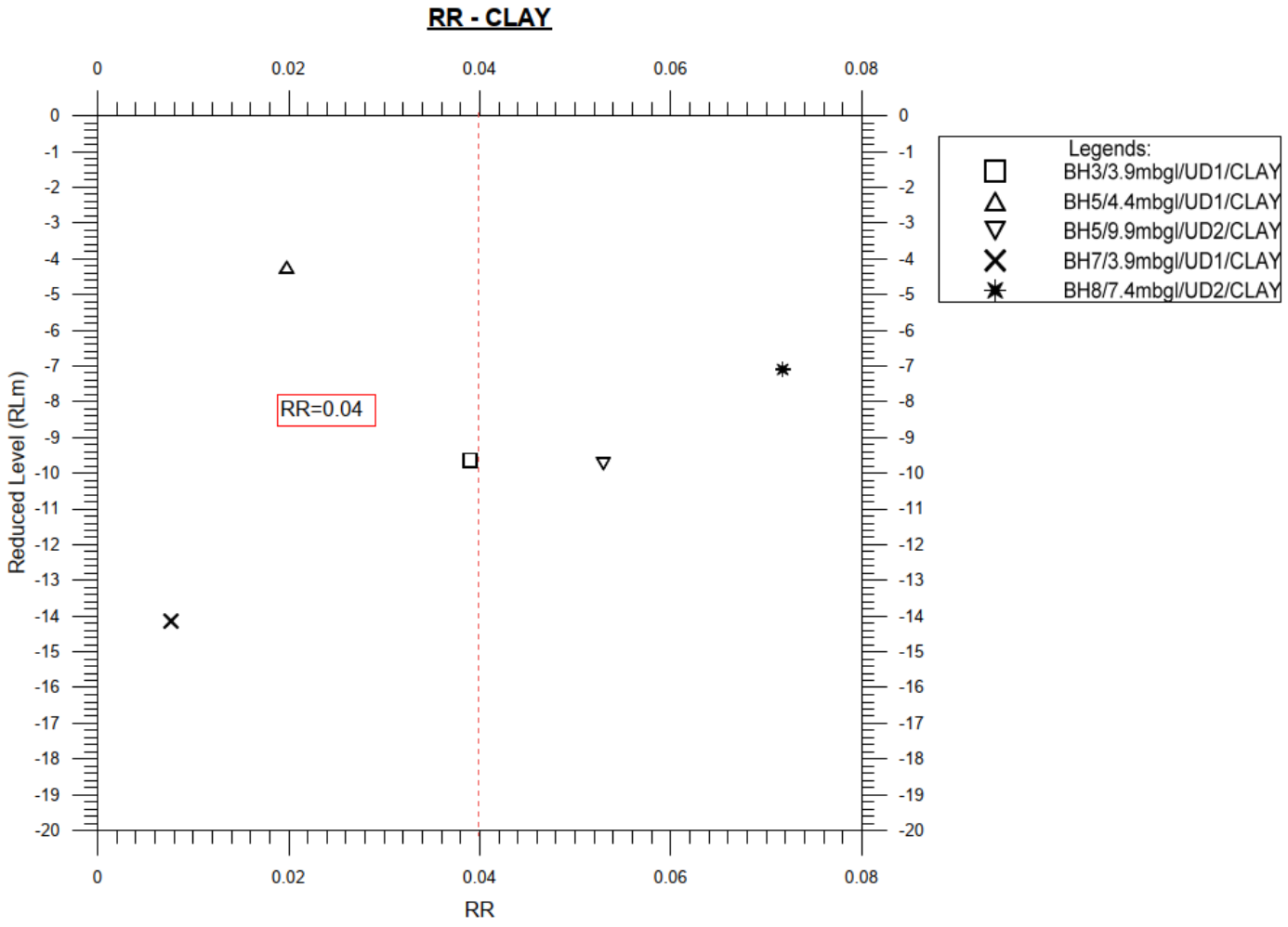
Direct Shear Box Test (Reclamation)

FIGURE 22



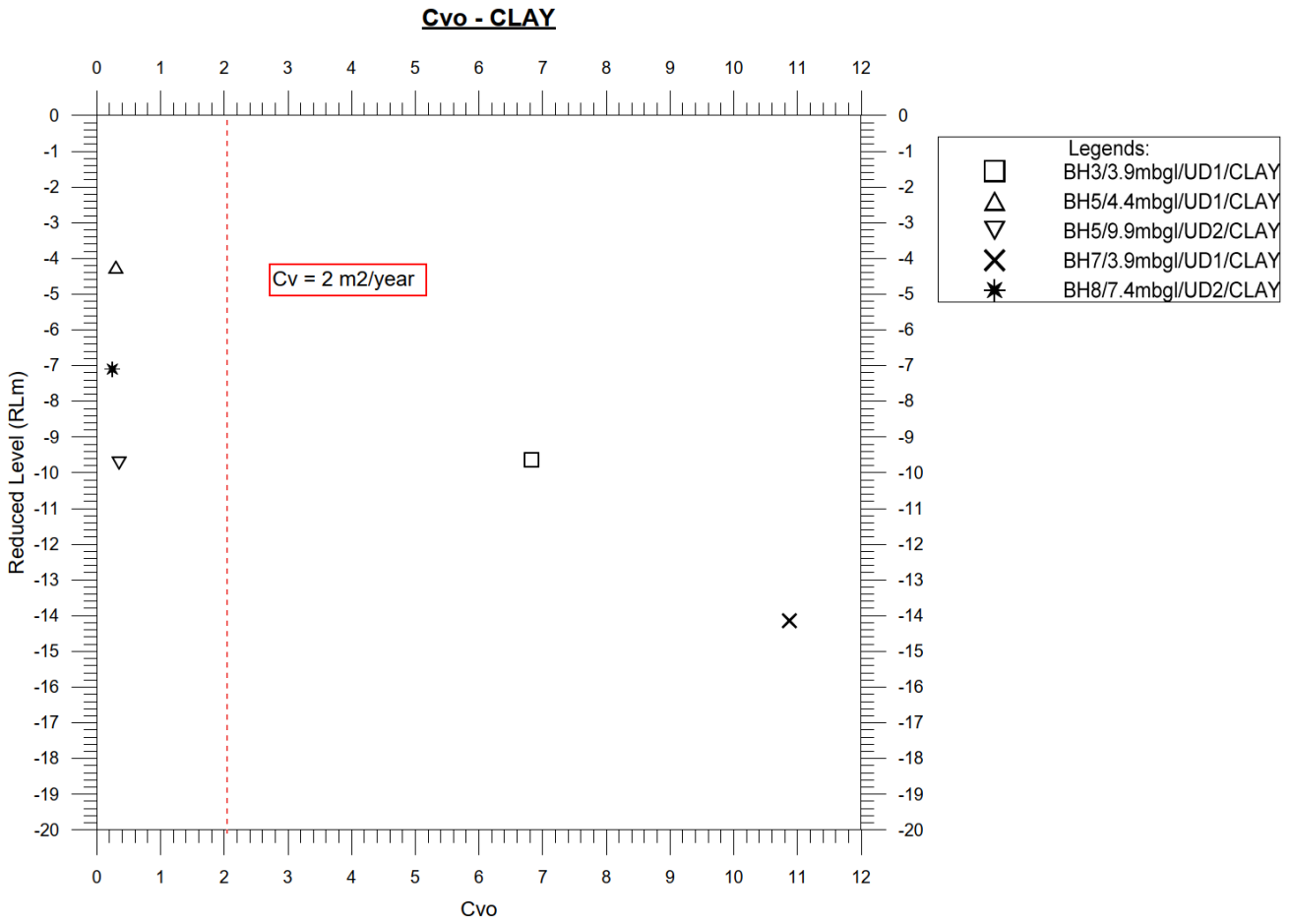
Compression Ratio (CR) (Reclamation)

FIGURE 23



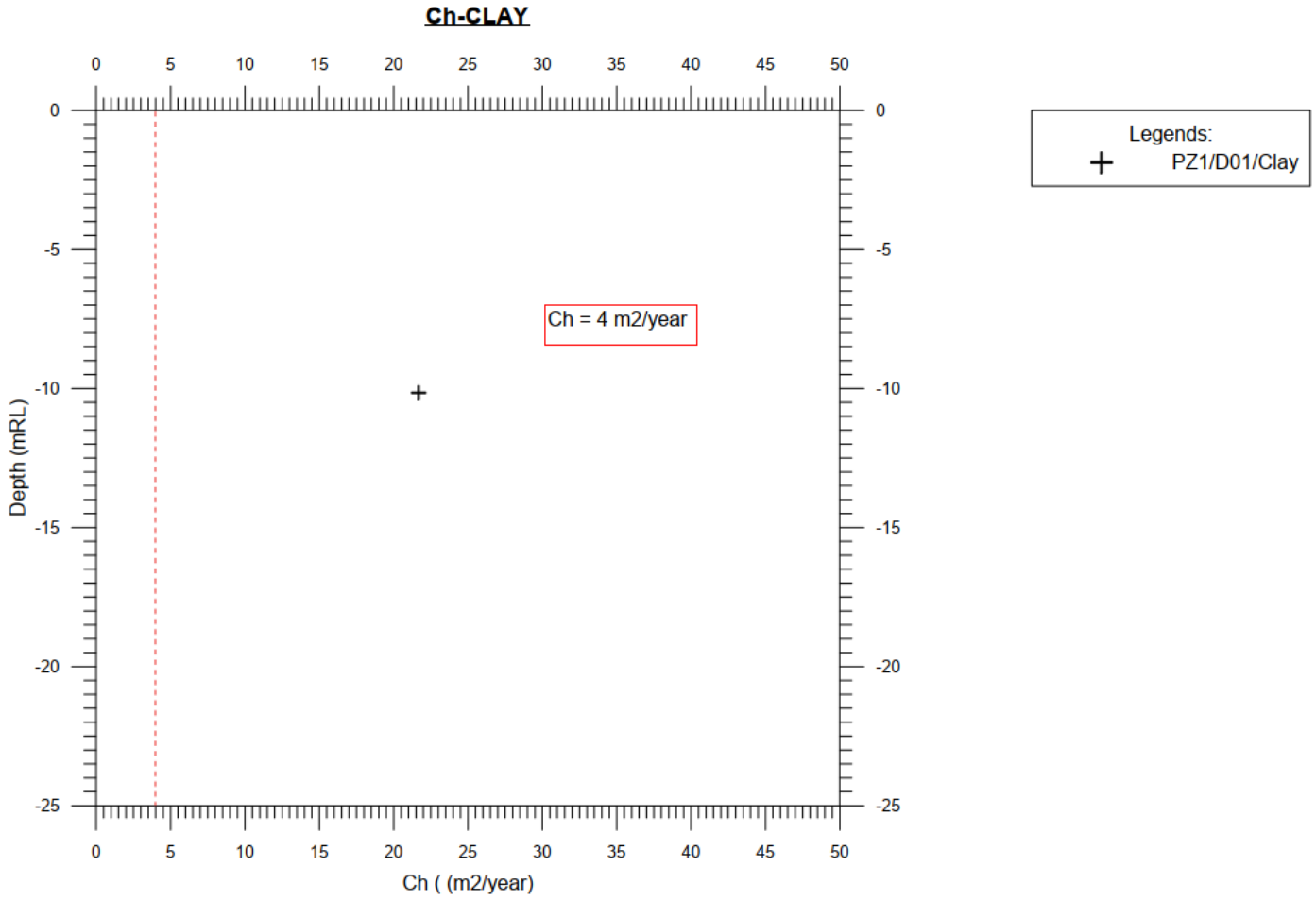
Recompression ratio (RR) (Reclamation)

FIGURE 24



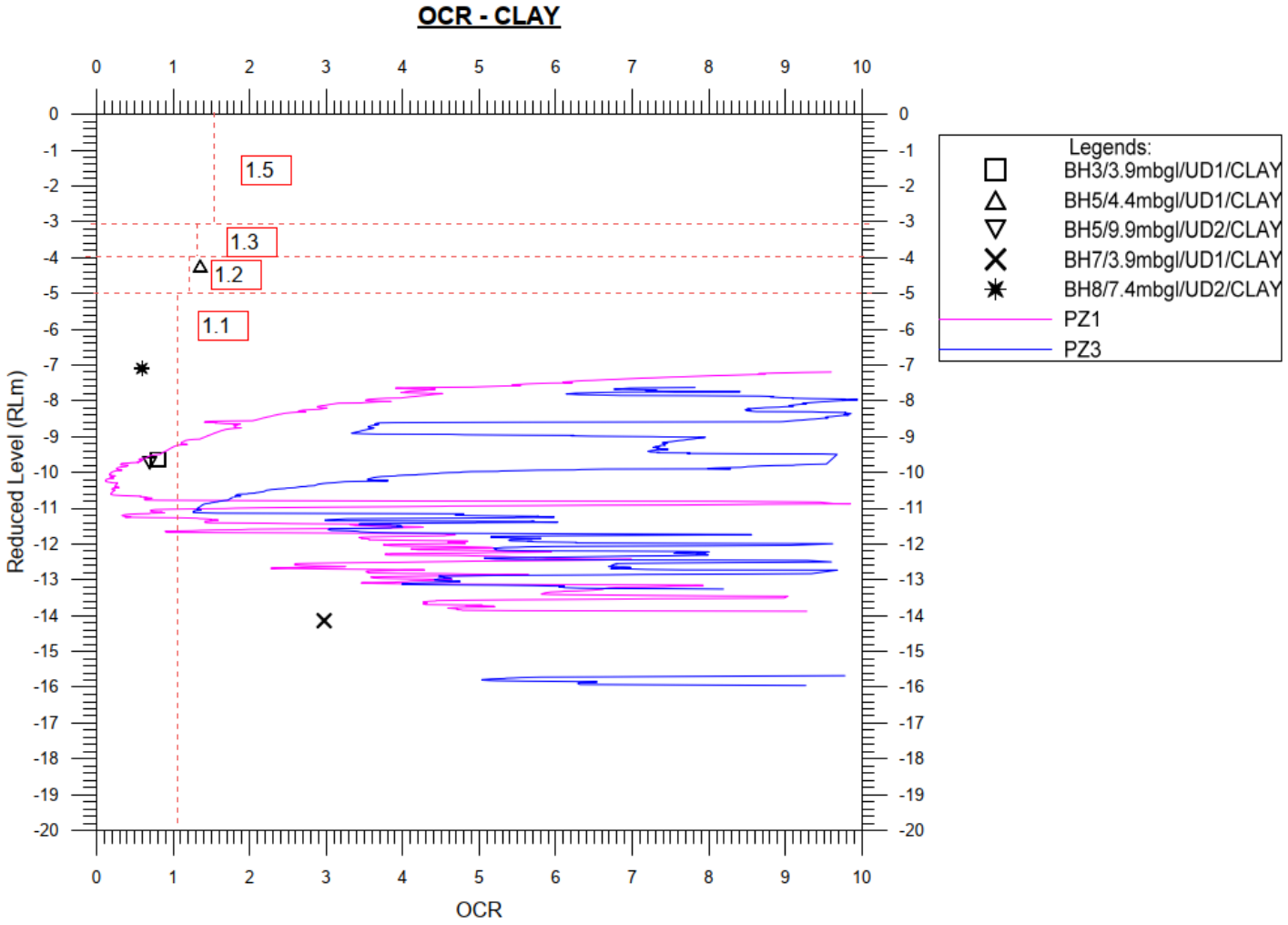
Coefficient of Consolidation (Cv) (Reclamation)

FIGURE 25a



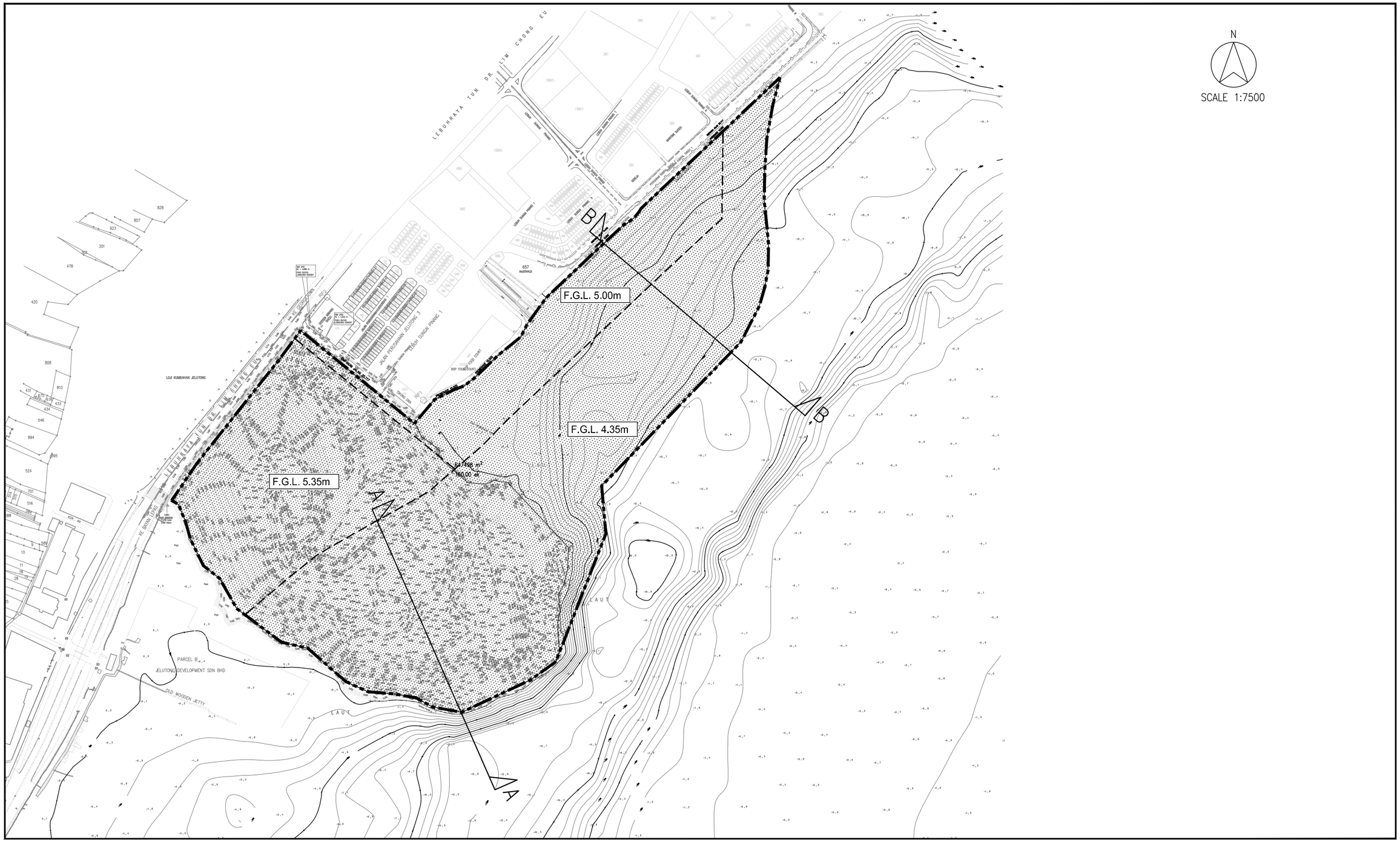
Coefficient of Consolidation (Ch) (Reclamation)

FIGURE 25b



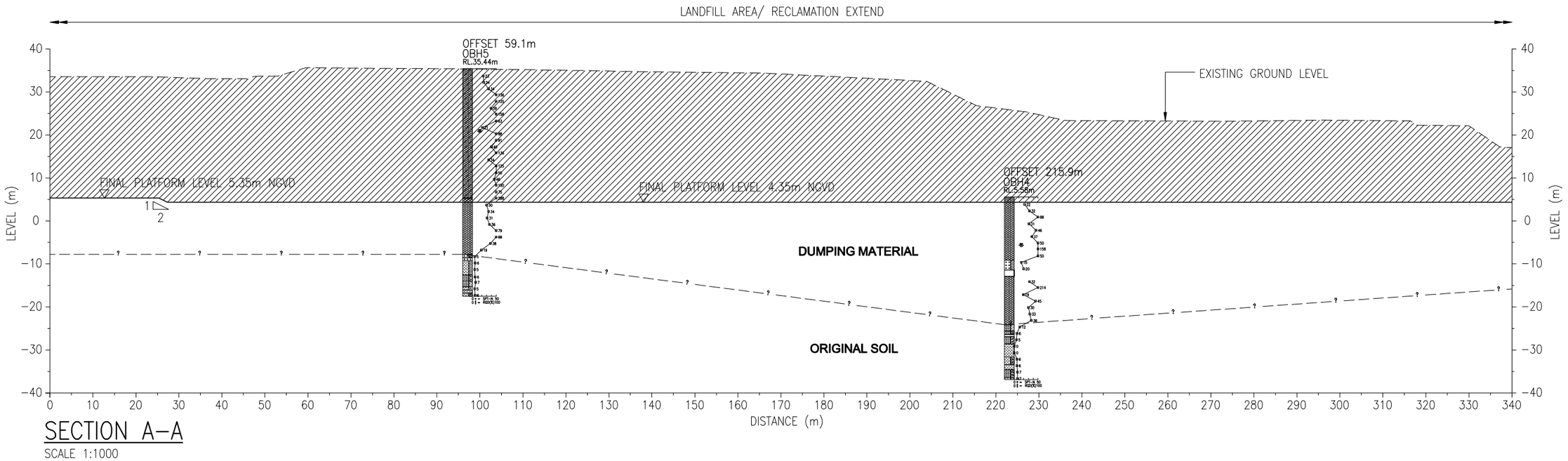
Over-consolidation Ratio (OCR) (Reclamation)

FIGURE 26

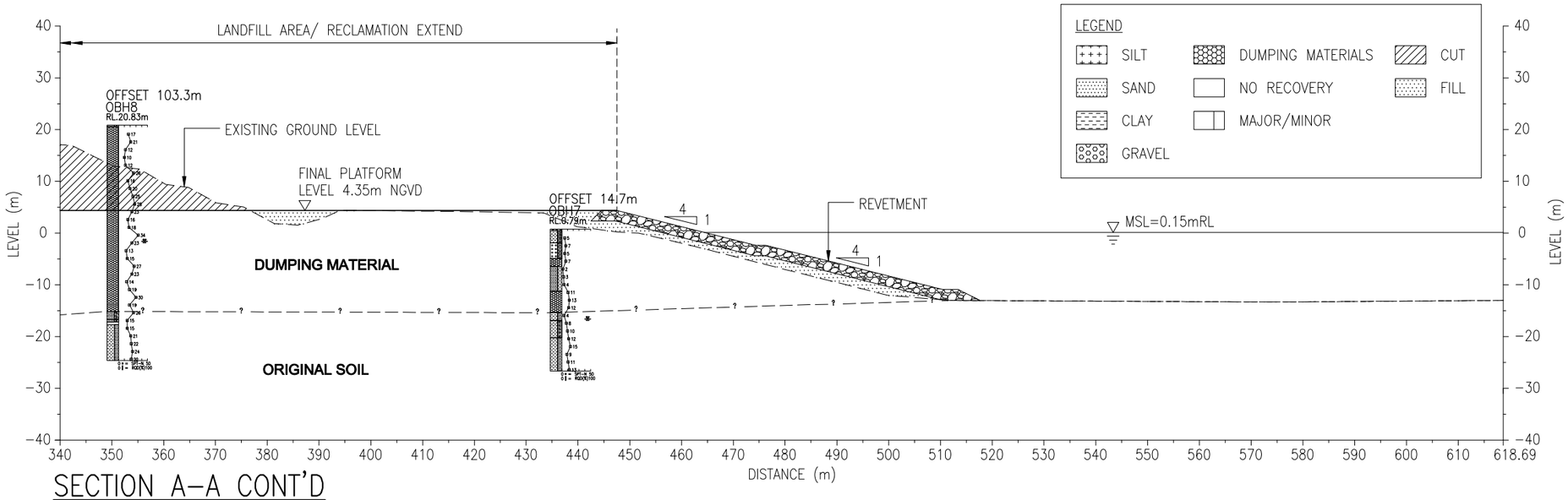


Cross Section Layout

FIGURE 27



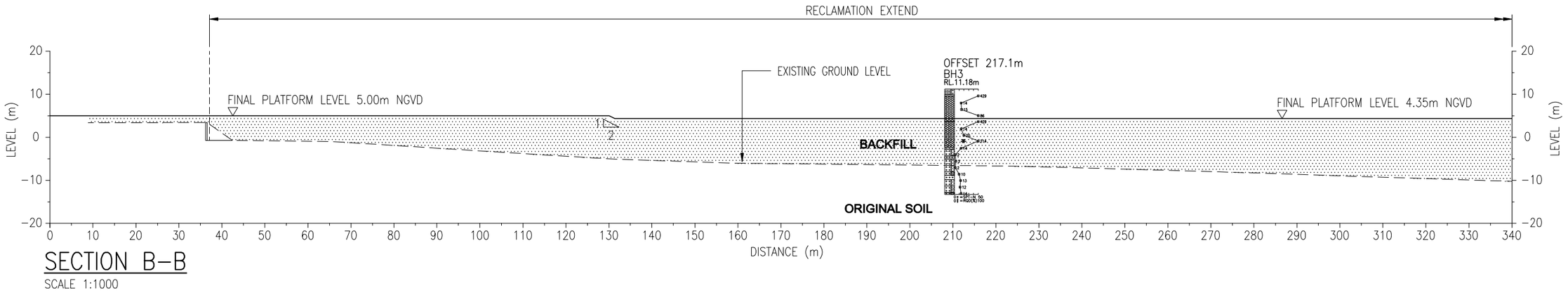
SECTION A–A
SCALE 1:1000



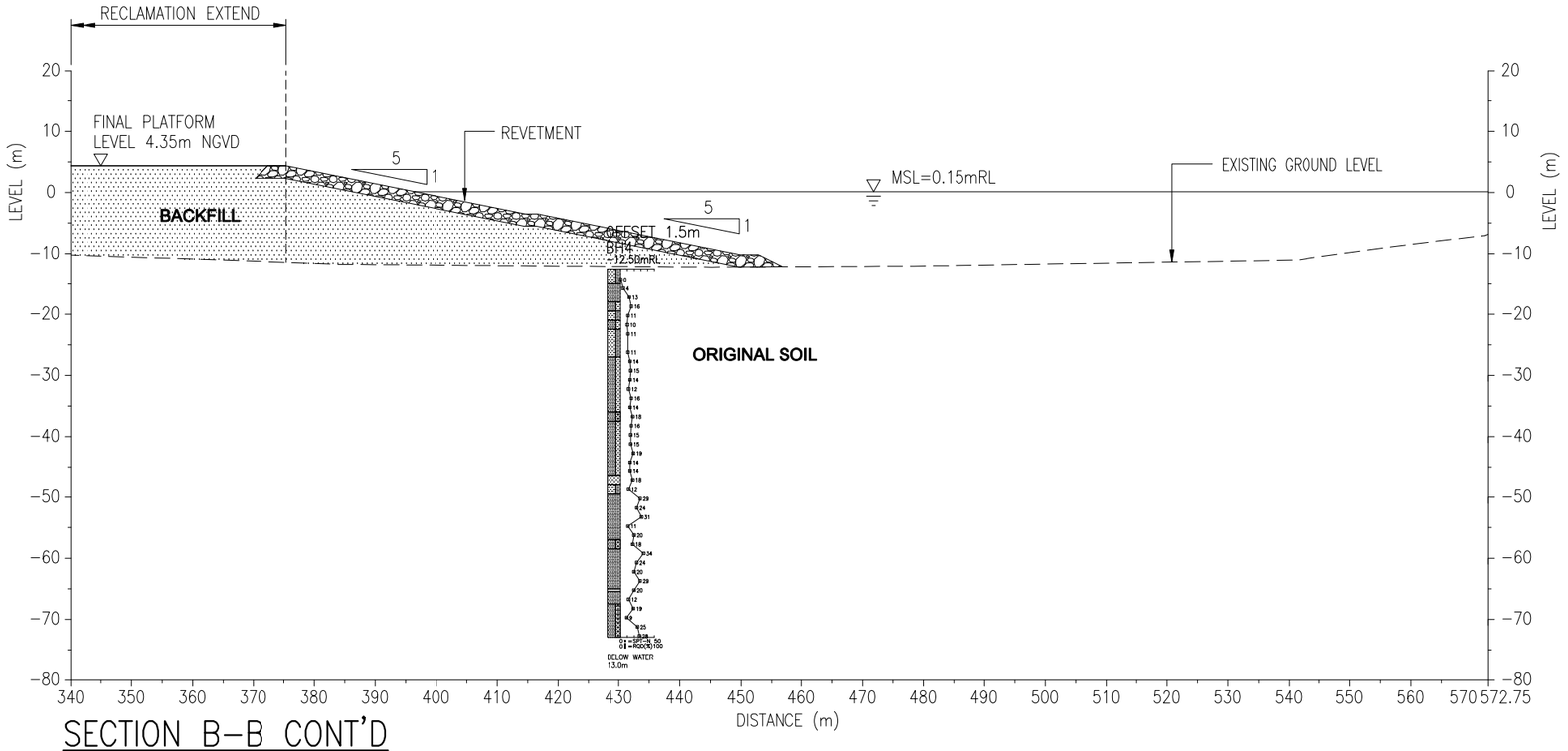
SECTION A–A CONT'D
SCALE 1:1000

Cross Section A-A

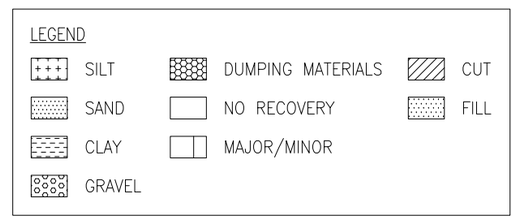
FIGURE 28



SECTION B–B
SCALE 1:1000

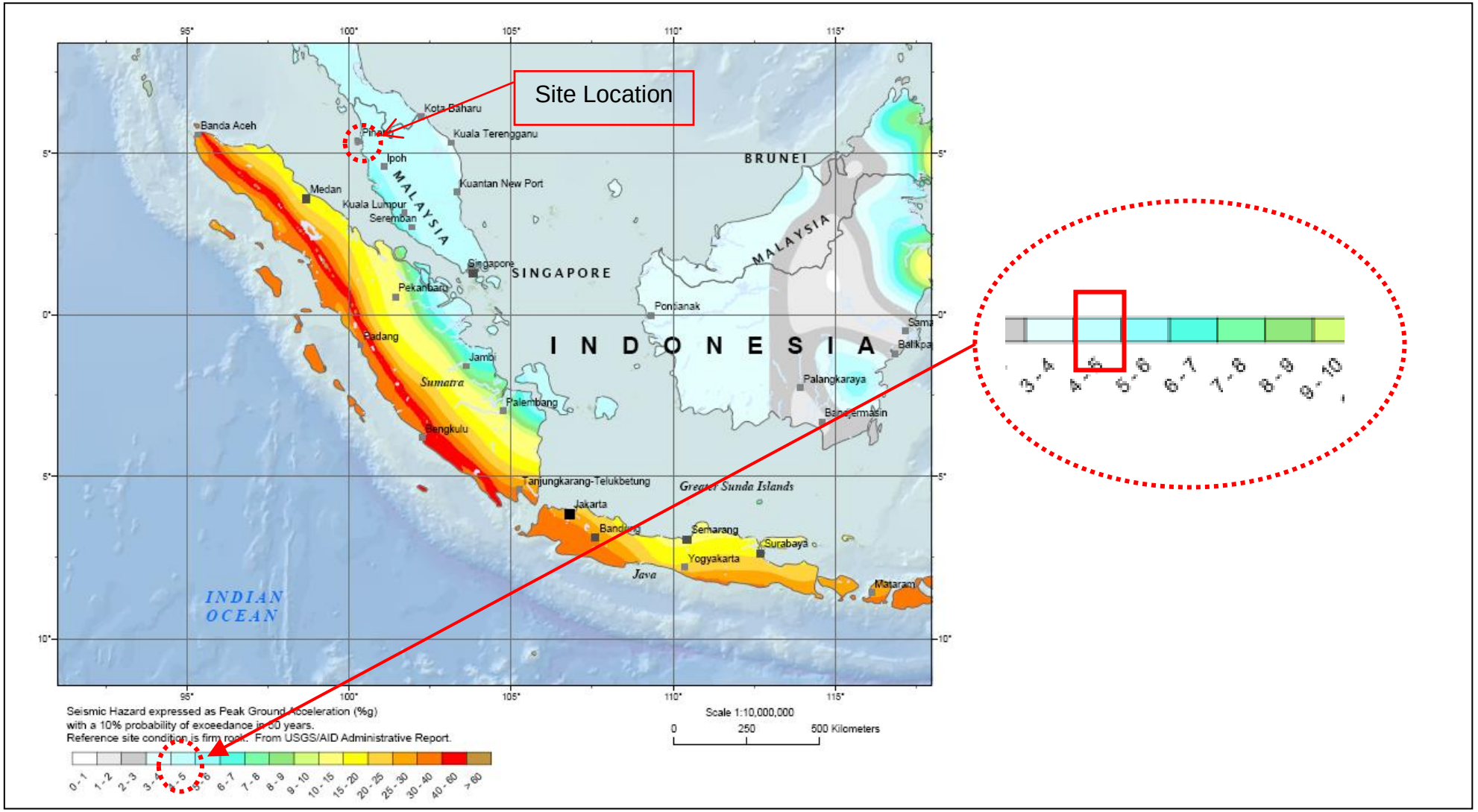


SECTION B–B CONT'D
SCALE 1:1000



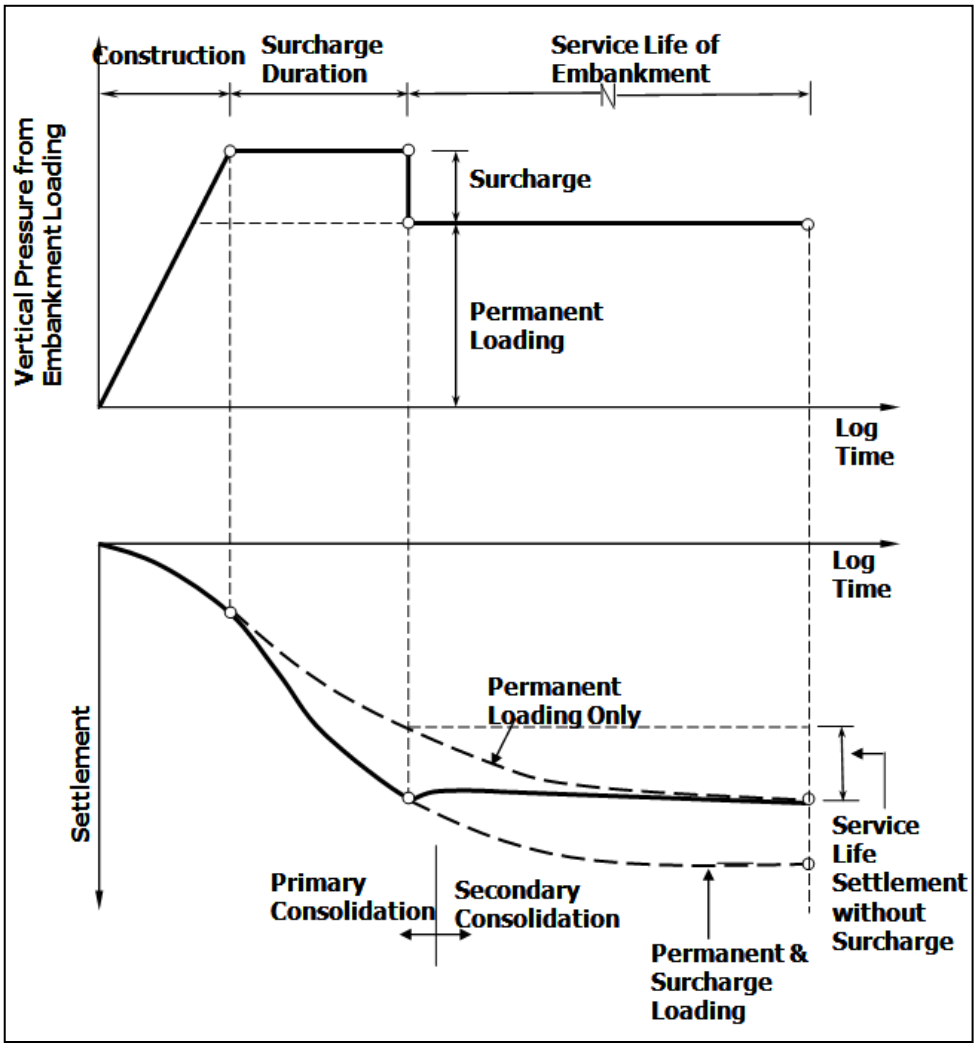
Cross Section B-B

FIGURE 29



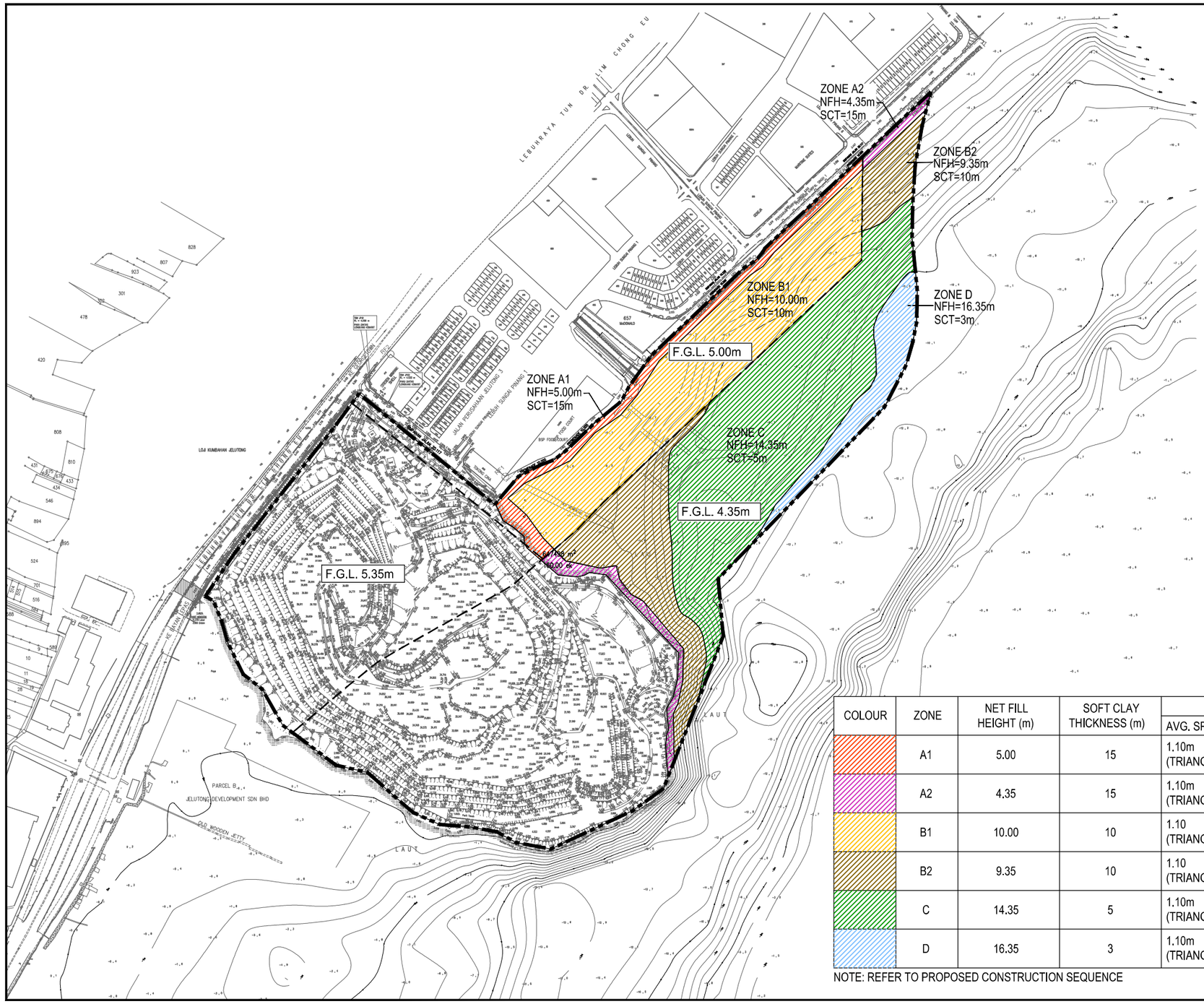
Seismic Hazard Map by US Geological Survey (USGS)

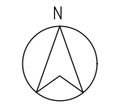
FIGURE 30



Concept of Temporary Surcharge

FIGURE 31





SCALE 1: 7500

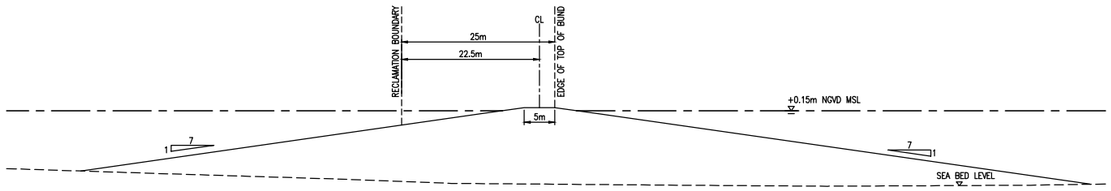
COLOUR	ZONE	NET FILL HEIGHT (m)	SOFT CLAY THICKNESS (m)	PVD		ESTIMATED SETTLEMENT (m)	SURCHARGE THICKNESS (m)	SURCHARGE DURATION (month)
				AVG. SPACING	EST. LENGTH (m)			
	A1	5.00	15	1.10m (TRIANGULAR)	18	4.34	2.0	5
	A2	4.35	15	1.10m (TRIANGULAR)	18	4.11	2.0	5
	B1	10.00	10	1.10 (TRIANGULAR)	18	3.68	2.0	5
	B2	9.35	10	1.10 (TRIANGULAR)	18	3.56	2.0	5
	C	14.35	5	1.10m (TRIANGULAR)	18	2.29	2.0	5
	D	16.35	3	1.10m (TRIANGULAR)	18	1.57	2.0	5

NOTE: REFER TO PROPOSED CONSTRUCTION SEQUENCE

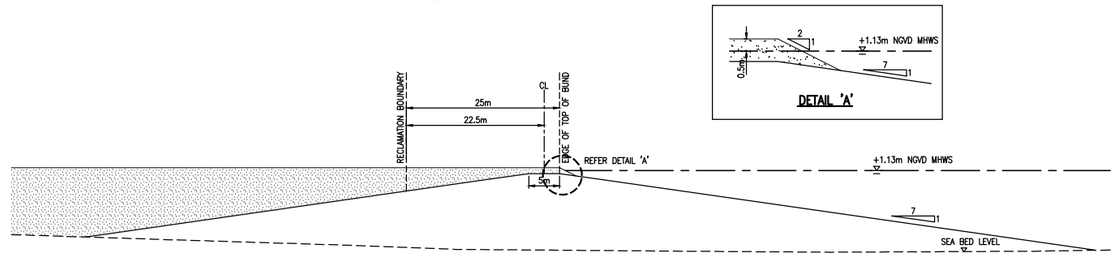
Surcharge Layout

FIGURE 32

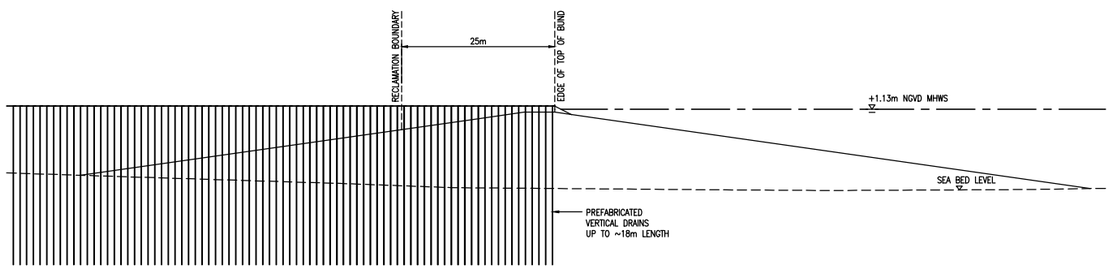
STAGE 1
1. SAND CONTAINMENT BUND SHALL BE FILLED TO 0.5m ABOVE MEAN SEA LEVEL (MSL).
2. THE SLOPE GRADIENT FOR SAND CONTAINMENT BUND SHALL NOT BE STEEPER THAN 1V:7H.
3. CONTRACTOR SHALL CARRY OUT BATHYMETRIC SURVEY AFTER COMPLETION OF SAND CONTAINMENT BUND TO ENSURE SLOPE GRADIENT IS NOT STEEPER THAN 1V:7H.
   IF THE SAND BUND SLOPE GRADIENT IS FOUND TO BE STEEPER THAN 1V:7H, THE CONTRACTOR IS REQUIRED TO BACKFILL AND FORM SLOPE GRADIENT OF 1V:7H AND TO BE VERIFIED VIA BATHYMETRIC SURVEY.



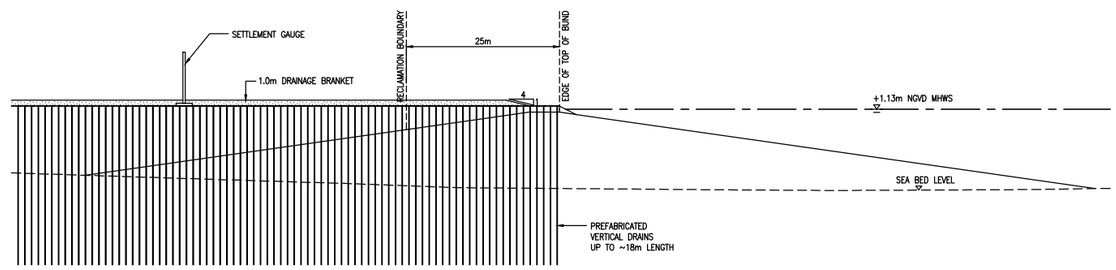
STAGE 2
1. PROCEED WITH RECLAMATION WORKS WITH SAND FILL TO 0.5m ABOVE MEAN HIGH WATER SPRING (MHWS).



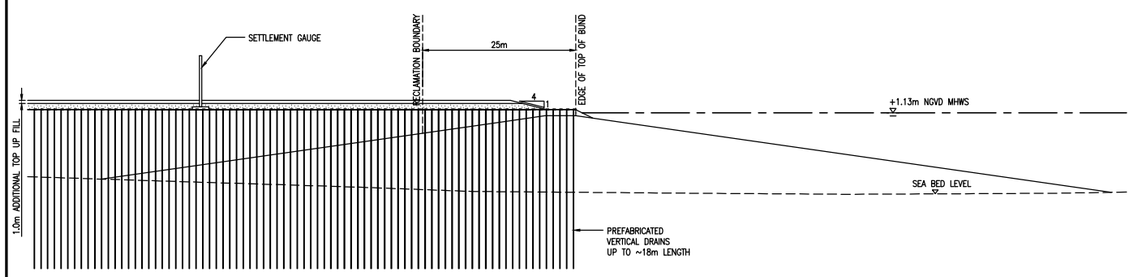
STAGE 3
1. INSTALL PREFABRICATED VERTICAL DRAIN (PVD), WITH 1.1m c/c SPACING.
2. PVD SHALL BE INSTALLED AS SOON AS SAND FILL HAVE REACHED 0.5m ABOVE MHWS.



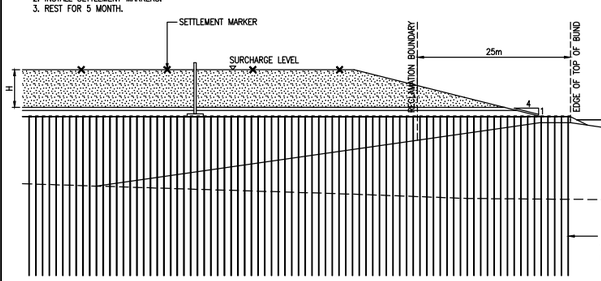
STAGE 4
1. INSTALL SETTLEMENT GAUGE.
2. FILL 1.0m THICK SURCHARGE AS DRAINAGE BRANKET.



STAGE 5
1. FILL 1.0m THICK SURCHARGE AS AS ADDITIONAL TOP UP FILL AND REST FOR 3 MONTHS. THE SAND FILL GRADIENT SHALL NOT BE STEEPER THAN 1V:4H.



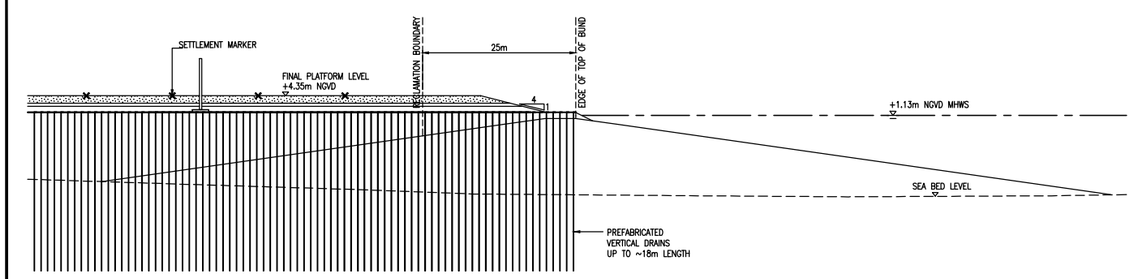
STAGE 6
1. AFTER 3 MONTHS REST PERIOD, PROCEED WITH SUBSEQUENT FILLING AS PER ENGINEER DESIGN TO REACH FINAL DESIGNED SURCHARGE THICKNESS (H) FROM SETTLED PLATFORM.
2. INSTALL SETTLEMENT MARKERS.
3. REST FOR 5 MONTH.



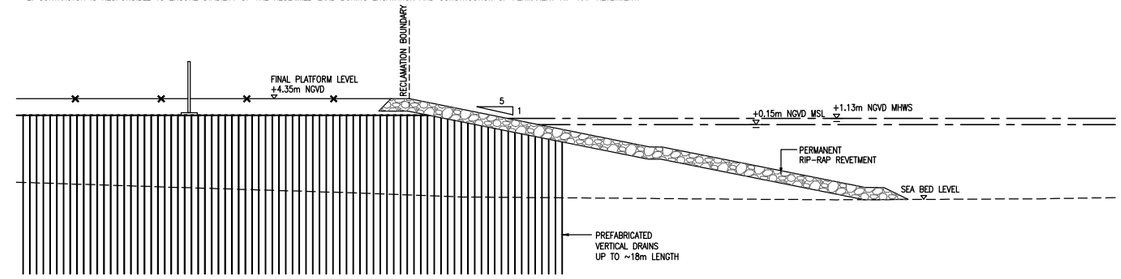
ZONE	SOFT CLAY THICKNESS	FILLING THICKNESS, H (m)	DESIGNED GROUND TREATMENT LEVEL (m NGVD)
A1	15	7.70	11.34
A2	15	6.85	10.46
B1	10	7.05	10.68
B2	10	6.30	9.92
C	5	5.00	8.64
D	3	4.30	7.92

NOTE: REFER TO SURCHARGE LAYOUT

STAGE 7
1. REMOVE SURCHARGE FILL TO FORM FINAL PLATFORM LEVEL (+4.35m NGVD) AFTER THE SURCHARGE REST PERIOD AND INSTRUCTION FROM THE ENGINEER.
2. SETTLEMENT MARKERS SHALL BE REPOSITIONED TO FINAL PLATFORM LEVEL.



STAGE 8
1. SAND CONTAINMENT BUND SHALL BE EXCAVATED AND TRIMMED TO CONSTRUCT PERMANENT RIP-RAP REVETMENT WITH SLOPE GRADIENT NOT STEEPER THAN 1V:5H.
2. CONTRACTOR IS RESPONSIBLE TO ENSURE STABILITY OF THE RECLAIMED LAND DURING EXCAVATION AND CONSTRUCTION OF PERMANENT RIP-RAP REVETMENT.

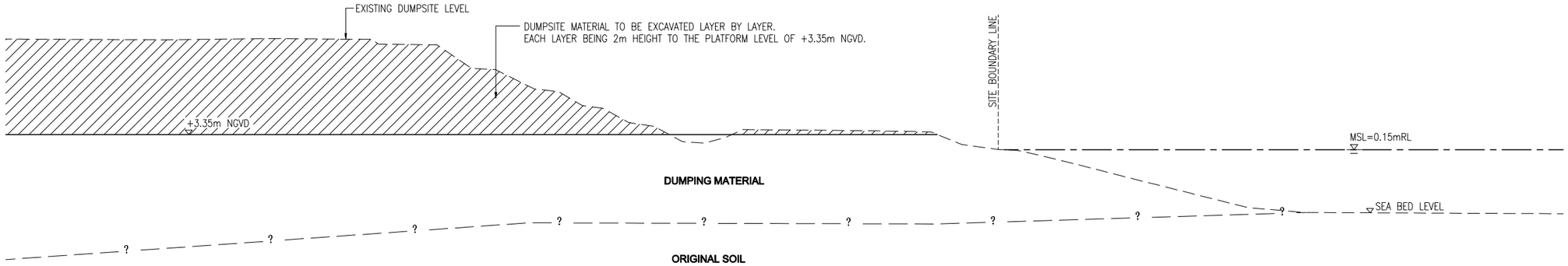


Proposed Construction Sequence (Reclamation)

FIGURE 33

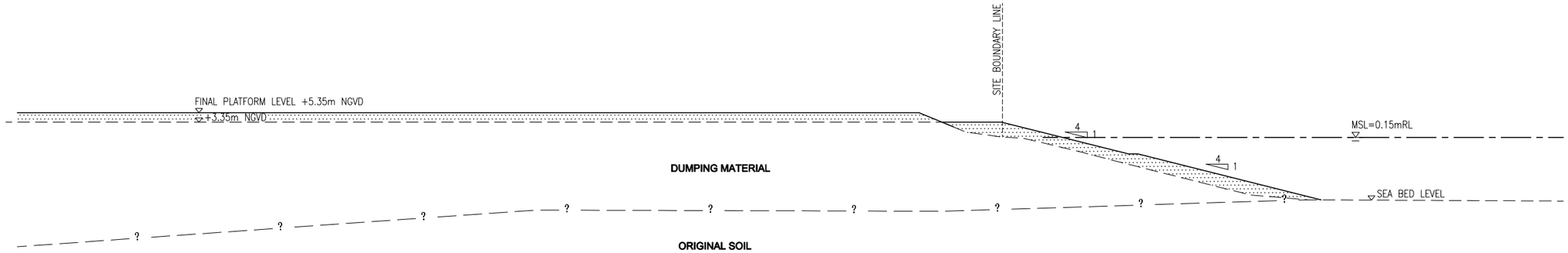
STAGE 1

1. EXISTING DUMPSITE SHALL BE EXCAVATED TO THE PLATFORM LEVEL +3.35m NGVD.
2. EXCAVATION AT EXISTING DUMPSITE AREA TO BE CARRIED OUT BY EXCAVATION LAYER BY LAYER. EACH LAYER BEING 2m HEIGHT TO THE PLATFORM LEVEL OF +3.35m NGVD.
3. DETAILS FOR EXCAVATION REFER TO APPENDIX F (EARTHWORK AND EROSION & SEDIMENT CONTROL (ESCP) REPORT, SECTION 5.0)



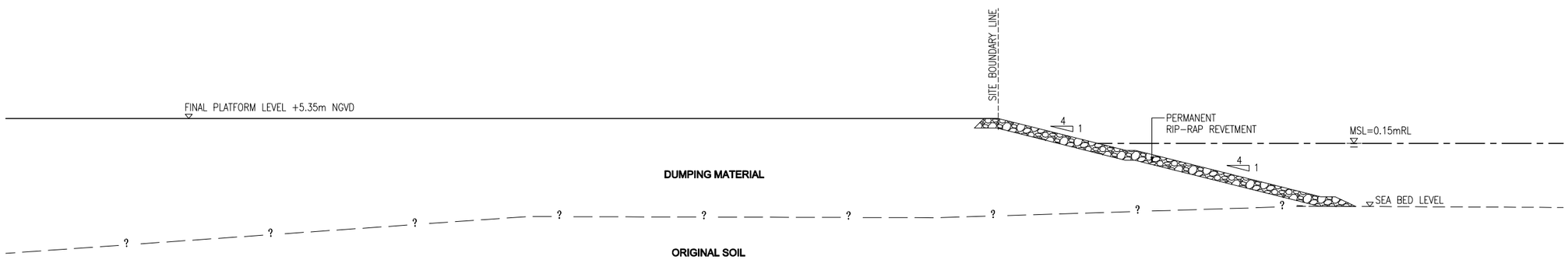
STAGE 2

1. BACKFILL WITH SUITABLE MATERIAL TO FINAL PLATFORM LEVEL, +5.35m NGVD.
2. THE EXISTING SHORELINE SHALL BE SCARIFIED AND REPROFILED TO SLOPE GRADIENT NOT STEEPER THAN 1V:4H AND TO BE VERIFIED VIA BATHYMETRIC SURVEY.



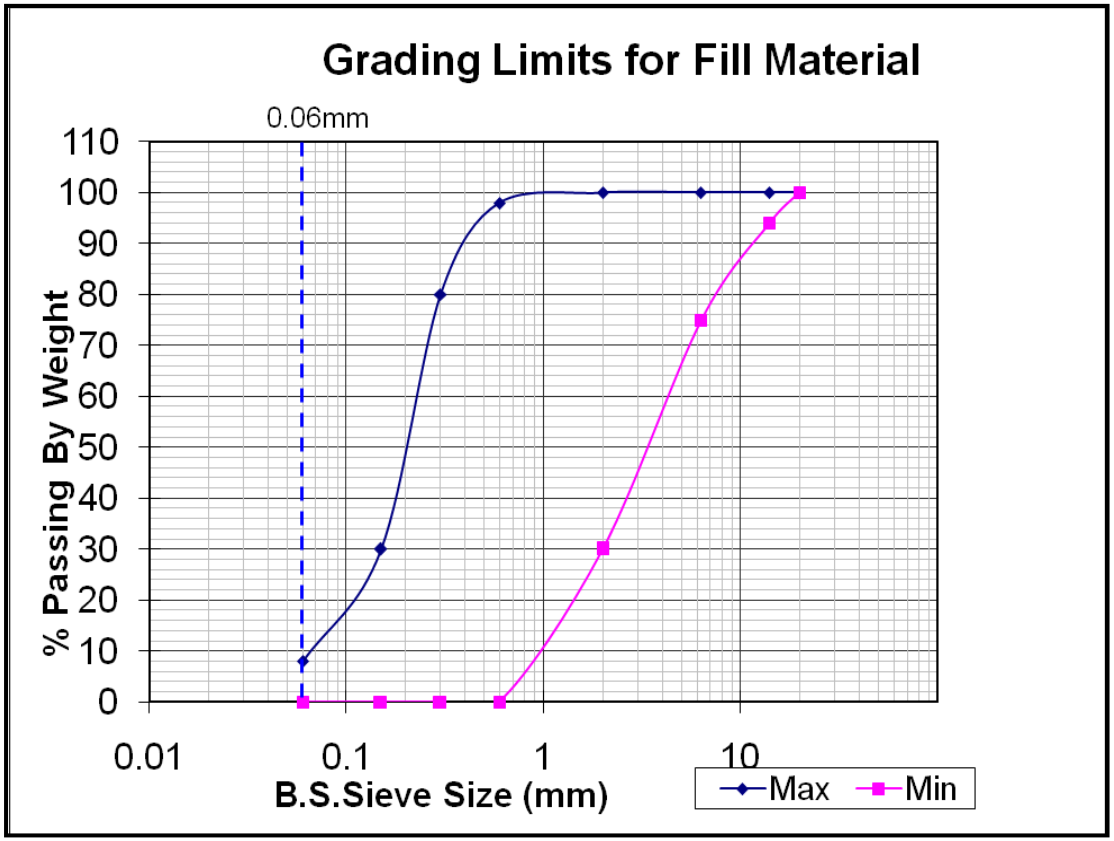
STAGE 3

1. TO CONSTRUCT PERMANENT RIP-RAP REVETMENT WITH SLOPE GRADIENT NOT STEEPER THAN 1V:4H.
2. CONTRACTOR IS RESPONSIBLE TO ENSURE STABILITY OF THE RECLAIMED LAND DURING EXCAVATION AND CONSTRUCTION OF PERMANENT RIP-RAP REVETMENT.



Proposed Construction Sequence (Dumpsite)

FIGURE 34



Grading Limits for Fill Material

FIGURE 35

APPENDICES

LIST OF APPENDICES

APPENDIX	TITLE OF APPENDIX
A	Curriculum Vitae of Ir. Dr. Tan Yean Chin
B	Settlement Analyses Design Calculation (Reclamation)
C	Stability Analyses (Reclamation)
D	Stability Analyses (Dumpsite)
E	Prefabricated Vertical Drain (PVD) Design Calculation (Reclamation)
F	Earthwork and Erosion & Sediment Control (ESCP) report
G	Master Plan & Approval Letter on Master Plan from Jabatan Perancang Bandar dan Desa Negeri Pulau Pinang
H	Bathymetric Survey Plan – National Geodetic Vertical Distance (NGVD)
I	Approved Master Plan

APPENDIX A

Curriculum Vitae of Ir. Dr. Tan Yean Chin

Brief CV

Ir. Dr. Tan Yean Chin
HP : +6012-2894933
Email: tanyeanchin@gmail.com ; yctan@gnpgroup.com.my

Ir. Dr. Tan Yean Chin obtained his B. Eng. (Civil) degree with First Class Honours from Universiti Teknologi Malaysia (UTM) in 1992. In 1994, he was awarded the Chin Fung Kee prize and M. Eng. (Geotechnical Engineering) from the Asian Institute of Technology (AIT), Bangkok. He later obtained his Engineering Doctorate from UTM in 2017

Ir. Dr. Tan is a Professional Engineer with Practicing Certificate and an Accredited Checker (Geotechnical) registered with the Board of Engineers Malaysia (BEM). He is a registered ASEAN Chartered Professional Engineer (ACPE) as well as an APEC Engineer and International Professional Engineer (IPEA) in Malaysia and Australia. He is also a registered Foreign Professional Engineer in Myanmar and Cambodia.

Ir. Dr. Tan holds the position of Secretary General (2008-2020) of the Federation of Engineering Institutions of Asia and the Pacific (FEIAP), an international independent umbrella organisation for the engineering institutions in the Asia and the Pacific region. He was the President of The Institution of Engineers, Malaysia (IEM) in year 2016-2018. He has also served 10 years as Board member of the Board of Engineers, Malaysia (BEM), a government regulatory body registering and governing all engineering personnel in Malaysia. He is an Honorary Fellow of the ASEAN Federation of Engineering Organisations (AFEO), Fellow of IEM, Institution of Civil Engineers (ICE, UK), ASEAN Academy of Engineering & Technology (AAET) and Academy of Engineering and Technology of the Developing World (AETDEW).

He is also of the Founder and Senior Director of G&P Professionals group of multi disciplines engineering consulting firms. He has led his team in the design of mega projects such as Electrified Double Track Railway project from around Taiping to Alor Setar, Klang Valley MRT Kajang Line and Putrajaya Line. Ir. Dr Tan has published more than 100 technical papers in local and overseas conferences and seminars.

Other key positions :-

In Malaysia:

- Board of Director of Prasarana Malaysia Berhad (Since July 2020)
- Board member of the Board of Architects, Malaysia (BAM) (2008)
- Member of the Expert Panel to Review Malaysian Construction Industry Practices appointed by the Minister of Works (2013-2014)
- Chairman of the Committee on Professional Practice in the Board of Engineers, Malaysia (BEM) (2009-2012, 2013-2018)
- Chairman of the CIDB Working Group on Temporary Works in Construction (2015-2016) which drafted CIDB Construction Industry Standard 22 (CIS22 :2017) “Safe Use of Scaffolding in Construction”.
- Deputy Chairman of Committee drafting the CIDB Construction Industry Standard 23 (CIS23 :2018) “Safe Use of Falsework and Formwork in Construction”.

- Co-Chairman of Committee of Accredited Checker in the Board of Engineers, Malaysia (BEM) (2017-2018)
- Council Member of Nexus Governing Committee (NGC), Malaysia Productivity Corporation (MPC) (under Ministry of Trade and Industry of Malaysia,MITI) (2018 – to date) & Leader of WG4 on Business Environment
- Industry Advisor for Faculty of Civil Engineering of Universiti Teknologi Malaysia (UTM), Johor for Bachelor of Engineering (Civil) and Postgraduate programmes (2017 – 2022).

Overseas:

- Honorary Advisor of ASEAN Federation of Engineering Organisations (AFEO) (2018-2020)
- Board of Governors of ASEAN Federation of Engineering Organisations (AFEO) (2016-2018)
- Secretary General of ASEAN Federation of Engineering Organisations (AFEO) (2007-2009)
- Chartered Professional Engineer and National Engineering Register of Australia (since 2020)
- Committee Member, (Malaysia Representative) of ATC 6 on deep excavation, tunnelling and urban regeneration under International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) (since 2016)
- Foreign Expert and Trainer on Professional Engineer registration and Outcome Base Competence Assessment system for Myanmar Engineering Council (MEngC), Myanmar (2019- to date).
- International Advisory Board Member of Digital@B&R Double Hundred Universities Cooperation Project (DHUCP). (www.aetdew.sugonedu.com) (2018 – to date)

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Wisma G&P, 39-5, Jalan Tasik Selatan 3, Bandar Tasik Selatan, 57000 Kuala Lumpur, Malaysia.

APPENDIX B

Settlement Analyses Design Calculation (Reclamation)

G&P PROFESSIONALS GROUP

DESIGN SHEET

Project
Jelutong Rehabiliation

Project No
22G1646

Work Ref

Sheet No.

Rev

TITLE
CONSOLIDATION SETTLEMENT WITH BUOYANCY EFFECT (1-D CONSOLIDATION/ BOUSSINESQ METHOD)

Design
MHZ/LEYH

Check
LAH

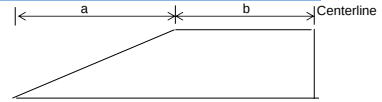
Review
TYC

Date

1.1 GENERAL INPUT

Original Ground Level, OGL = 0 m
Height of Fill , H = 6.2 m
Fill Unit Weight, γ_f = 18 kN/m^3
Surcharge = 0 kN/m^2
Fill Pressure , dP = 111.1 kN/m^2
Ground Water Level = 0 m below OGL

1.2 EMBANKMENT DETAILS



Width of Embankment, b = 1000 m
Width of Sloping Area, a = 1000 m

1.3 SUBSOIL PROFILE :

No.	From RL	To RL	Thk (m)	Depth (m)	Mid Point (m)	Mid of depth (m)	CR	RR	U. Weight (kN/m^3)	OCR	Pc (kN/m^2)	Po (kN/m^2)	u (kN/m^2)	Po' (kN/m^2)	ΔP (kN/m2)	OC Settl. (m)	NC Settl. (m)	Settlement 6.17 m	Cv (m^2/yr)	D (m)
1	0.0	-1.0	1.00	1.00	0.5	0.5	0.340	0.04	13.00	1.50	2.39	6.50	4.9	1.60	111.05	0.007	0.569	0.576	2.00	7.50
2	-1.0	-2.0	1.00	2.00	1.5	1.5	0.340	0.04	13.00	1.50	7.18	19.50	14.7	4.79	111.05	0.007	0.411	0.418	2.00	7.50
3	-2.0	-3.0	1.00	3.00	2.5	2.5	0.340	0.04	13.00	1.50	11.96	32.50	24.5	7.98	111.05	0.007	0.339	0.346	2.00	7.50
4	-3.0	-4.0	1.00	4.00	3.5	3.5	0.340	0.04	13.00	1.30	14.51	45.50	34.3	11.17	111.05	0.005	0.315	0.319	2.00	7.50
5	-4.0	-5.0	1.00	5.00	4.5	4.5	0.340	0.04	13.00	1.20	17.23	58.50	44.1	14.36	111.05	0.003	0.293	0.296	2.00	7.50
6	-5.0	-6.0	1.00	6.00	5.5	5.5	0.340	0.04	13.00	1.10	19.30	71.50	54.0	17.55	111.05	0.002	0.280	0.282	2.00	7.50
7	-6.0	-7.0	1.00	7.00	6.5	6.5	0.340	0.04	13.00	1.10	22.81	84.50	63.8	20.74	111.05	0.002	0.259	0.261	2.00	7.50
8	-7.0	-8.0	1.00	8.00	7.5	7.5	0.340	0.04	13.00	1.10	26.32	97.50	73.6	23.93	111.05	0.002	0.241	0.243	2.00	7.50
9	-8.0	-9.0	1.00	9.00	8.5	8.5	0.340	0.04	13.00	1.10	29.83	110.50	83.4	27.12	111.05	0.002	0.226	0.228	2.00	7.50
10	-9.0	-10.0	1.00	10.00	9.5	9.5	0.340	0.04	13.00	1.10	33.34	123.50	93.2	30.31	111.05	0.002	0.213	0.215	2.00	7.50
11	-10.0	-11.0	1.00	11.00	10.5	10.5	0.340	0.04	13.00	1.10	36.84	136.50	103.0	33.50	111.05	0.002	0.202	0.203	2.00	7.50
12	-11.0	-12.0	1.00	12.00	11.5	11.5	0.340	0.04	13.00	1.10	40.35	149.50	112.8	36.69	111.05	0.002	0.192	0.193	2.00	7.50
13	-12.0	-13.0	1.00	13.00	12.5	12.5	0.340	0.04	13.00	1.10	43.86	162.50	122.6	39.88	111.05	0.002	0.182	0.184	2.00	7.50
14	-13.0	-14.0	1.00	14.00	13.5	13.5	0.340	0.04	13.00	1.10	47.37	175.50	132.4	43.07	111.05	0.002	0.174	0.176	2.00	7.50
15	-14.0	-15.0	1.00	15.00	14.5	14.5	0.340	0.04	13.00	1.10	50.88	188.50	142.2	46.26	111.05	0.002	0.167	0.168	2.00	7.50
																		Final Settl. =	4.109	m

1.4 SETTLEMENT CALCULATION :

Final Settlement = 4.109 m

During Rest Period

Rest Period, t = 200 years
Degree of Consolidation = 100.00 %
Total Settlement during Rest (Consolidation) = 4109 mm

1.5 ITERATION

	Fill height	Settlement	Blw water	Eq. fill height	Net Fill Height
	4.30	3.46	3.46	5.88	0.84
7.76	5.88	4.02	4.02	6.13	3.74
8.32	6.13	4.10	4.10	6.16	4.22
8.40	6.16	4.11	4.11	6.17	4.29
8.41	6.17	4.11	4.11	6.17	4.30
8.41	6.17	4.11	4.11	6.17	4.30
8.41	6.17	4.11	4.11	6.17	4.30
8.41	6.17	4.11	4.11	6.17	4.30
8.41	6.17	4.11	4.11	6.17	4.30
8.41	6.17	4.11	4.11	6.17	4.30
8.41	6.17	4.11	4.11	6.17	4.30
8.41	6.17	4.11	4.11	6.17	4.30
8.41	6.17	4.11	4.11	6.17	4.30
8.41	6.17	4.11	4.11	6.17	4.30
8.41	6.17	4.11	4.11	6.17	4.30
8.41	6.17	4.11	4.11	6.17	4.30

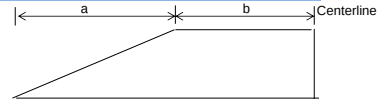
1.6 Graph :

G&P PROFESSIONALS GROUP ***DESIGN SHEET***	*Project* Jelutong Rehabiliation			*Project No* 22G1646	
	Work Ref			*Sheet No.*	*Rev*
TITLE CONSOLIDATION SETTLEMENT WITH BUOYANCY EFFECT (1-D CONSOLIDATION/ BOUSSINESQ METHOD)	*Design* MHZ/LEYH	*Check* LAH	*Review* TYC	*Date*	

1.1 GENERAL INPUT

Original Ground Level, OGL	=	0	m
Height of Fill , H	=	7.0	m
Fill Unit Weight, γ_f	=	18	kN/m^3
Surcharge	=	0	kN/m^2
Fill Pressure , dP	=	125.5	kN/m^2
Ground Water Level	=	0	m below OGL

1.2 EMBANKMENT DETAILS



Width of Embankment, b =	1000	m
Width of Sloping Area, a =	1000	m

1.3 SUBSOIL PROFILE :

No.	From RL	To RL	Thk (m)	Depth (m)	Mid Point (m)	Mid of depth (m)	CR	RR	U. Weight (kN/m^3)	OCR	Pc (kN/m^2)	Po (kN/m^2)	u (kN/m^2)	Po' (kN/m^2)	ΔP (kN/m2)	OC Settl. (m)	NC Settl. (m)	Settlement 6.97 m	Cv (m^2/yr)	D (m)
1	0.0	-1.0	1.00	1.00	0.5	0.5	0.340	0.04	13.00	1.50	2.39	6.50	4.9	1.60	125.52	0.007	0.587	0.594	2.00	7.50
2	-1.0	-2.0	1.00	2.00	1.5	1.5	0.340	0.04	13.00	1.50	7.18	19.50	14.7	4.79	125.52	0.007	0.428	0.435	2.00	7.50
3	-2.0	-3.0	1.00	3.00	2.5	2.5	0.340	0.04	13.00	1.50	11.96	32.50	24.5	7.98	125.52	0.007	0.356	0.363	2.00	7.50
4	-3.0	-4.0	1.00	4.00	3.5	3.5	0.340	0.04	13.00	1.30	14.51	45.50	34.3	11.17	125.52	0.005	0.331	0.336	2.00	7.50
5	-4.0	-5.0	1.00	5.00	4.5	4.5	0.340	0.04	13.00	1.20	17.23	58.50	44.1	14.36	125.52	0.003	0.309	0.312	2.00	7.50
6	-5.0	-6.0	1.00	6.00	5.5	5.5	0.340	0.04	13.00	1.10	19.30	71.50	54.0	17.55	125.52	0.002	0.296	0.297	2.00	7.50
7	-6.0	-7.0	1.00	7.00	6.5	6.5	0.340	0.04	13.00	1.10	22.81	84.50	63.8	20.74	125.52	0.002	0.274	0.276	2.00	7.50
8	-7.0	-8.0	1.00	8.00	7.5	7.5	0.340	0.04	13.00	1.10	26.32	97.50	73.6	23.93	125.52	0.002	0.256	0.258	2.00	7.50
9	-8.0	-9.0	1.00	9.00	8.5	8.5	0.340	0.04	13.00	1.10	29.83	110.50	83.4	27.12	125.52	0.002	0.241	0.243	2.00	7.50
10	-9.0	-10.0	1.00	10.00	9.5	9.5	0.340	0.04	13.00	1.10	33.34	123.50	93.2	30.31	125.52	0.002	0.228	0.229	2.00	7.50
11	-10.0	-11.0	1.00	11.00	10.5	10.5	0.340	0.04	13.00	1.10	36.84	136.50	103.0	33.50	125.52	0.002	0.216	0.218	2.00	7.50
12	-11.0	-12.0	1.00	12.00	11.5	11.5	0.340	0.04	13.00	1.10	40.35	149.50	112.8	36.69	125.52	0.002	0.205	0.207	2.00	7.50
13	-12.0	-13.0	1.00	13.00	12.5	12.5	0.340	0.04	13.00	1.10	43.86	162.50	122.6	39.88	125.52	0.002	0.196	0.198	2.00	7.50
14	-13.0	-14.0	1.00	14.00	13.5	13.5	0.340	0.04	13.00	1.10	47.37	175.50	132.4	43.07	125.52	0.002	0.187	0.189	2.00	7.50
15	-14.0	-15.0	1.00	15.00	14.5	14.5	0.340	0.04	13.00	1.10	50.88	188.50	142.2	46.26	125.52	0.002	0.180	0.181	2.00	7.50
																Final Settl. =		**4.336**	**m**	

1.4 SETTLEMENT CALCULATION :

Final Settlement	=	4.336	m

During Rest Period

Rest Period, t	=	200	years
Degree of Consolidation	=	100.00	%
Total Settlement during Rest (Consolidation)	=	4336	mm

1.5 ITERATION

	Fill height	Settlement	Blw water	Eq. fill height	Net Fill Height
	5.00	3.73	3.73	6.70	1.27
8.73	6.70	4.26	4.26	6.94	4.47
9.26	6.94	4.33	4.33	6.97	4.93
9.33	6.97	4.34	4.34	6.97	4.99
9.34	6.97	4.34	4.34	6.97	5.00
9.34	6.97	4.34	4.34	6.97	5.00
9.34	6.97	4.34	4.34	6.97	5.00
9.34	6.97	4.34	4.34	6.97	5.00
9.34	6.97	4.34	4.34	6.97	5.00
9.34	6.97	4.34	4.34	6.97	5.00
9.34	6.97	4.34	4.34	6.97	5.00
9.34	6.97	4.34	4.34	6.97	5.00
9.34	6.97	4.34	4.34	6.97	5.00
9.34	6.97	4.34	4.34	6.97	5.00
9.34	6.97	4.34	4.34	6.97	5.00
9.34	6.97	4.34	4.34	6.97	5.00

1.6 Graph :

G&P PROFESSIONALS GROUP

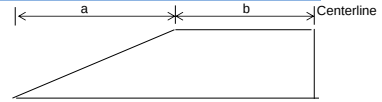
DESIGN SHEET

Project Jelutong Rehabiliation			*Project No* 22G1646	
Work Ref			*Sheet No.*	*Rev*
TITLE CONSOLIDATION SETTLEMENT WITH BUOYANCY EFFECT (1-D CONSOLIDATION/ BOUSSINESQ METHOD)	*Design* MHZ/LEYH	*Check* LAH	*Review* TYC	*Date*

1.1 GENERAL INPUT

Original Ground Level, OGL	=	0	m
Height of Fill , H	=	8.2	m
Fill Unit Weight, γ_f	=	18	kN/m^3
Surcharge	=	0	kN/m^2
Fill Pressure , dP	=	148.0	kN/m^2
Ground Water Level	=	0	m below OGL

1.2 EMBANKMENT DETAILS



Width of Embankment, b =	1000	m
Width of Sloping Area, a =	1000	m

1.3 SUBSOIL PROFILE :

No.	From RL	To RL	Thk (m)	Depth (m)	Mid Point (m)	Mid of depth (m)	CR	RR	U. Weight (kN/m^3)	OCR	Pc (kN/m^2)	Po (kN/m^2)	u (kN/m^2)	Po' (kN/m^2)	ΔP (kN/m2)	OC Settl. (m)	NC Settl. (m)	Settlement 8.22 m	Cv (m^2/yr)	D (m)
1	0.0	-1.0	1.00	1.00	0.5	0.5	0.340	0.04	13.00	1.50	2.39	6.50	4.9	1.60	147.97	0.007	0.611	0.618	2.00	5.00
2	-1.0	-2.0	1.00	2.00	1.5	1.5	0.340	0.04	13.00	1.50	7.18	19.50	14.7	4.79	147.97	0.007	0.452	0.459	2.00	5.00
3	-2.0	-3.0	1.00	3.00	2.5	2.5	0.340	0.04	13.00	1.50	11.96	32.50	24.5	7.98	147.97	0.007	0.379	0.386	2.00	5.00
4	-3.0	-4.0	1.00	4.00	3.5	3.5	0.340	0.04	13.00	1.30	14.51	45.50	34.3	11.17	147.97	0.005	0.354	0.358	2.00	5.00
5	-4.0	-5.0	1.00	5.00	4.5	4.5	0.340	0.04	13.00	1.20	17.23	58.50	44.1	14.36	147.97	0.003	0.331	0.334	2.00	5.00
6	-5.0	-6.0	1.00	6.00	5.5	5.5	0.340	0.04	13.00	1.10	19.30	71.50	54.0	17.55	147.97	0.002	0.317	0.319	2.00	5.00
7	-6.0	-7.0	1.00	7.00	6.5	6.5	0.340	0.04	13.00	1.10	22.81	84.50	63.8	20.74	147.97	0.002	0.295	0.297	2.00	5.00
8	-7.0	-8.0	1.00	8.00	7.5	7.5	0.340	0.04	13.00	1.10	26.32	97.50	73.6	23.93	147.97	0.002	0.277	0.279	2.00	5.00
9	-8.0	-9.0	1.00	9.00	8.5	8.5	0.340	0.04	13.00	1.10	29.83	110.50	83.4	27.12	147.97	0.002	0.261	0.263	2.00	5.00
10	-9.0	-10.0	1.00	10.00	9.5	9.5	0.340	0.04	13.00	1.10	33.34	123.50	93.2	30.31	147.97	0.002	0.248	0.249	2.00	5.00
																Final Settl. =		3.562	m	

1.4 SETTLEMENT CALCULATION :

Final Settlement	=	3.562	m

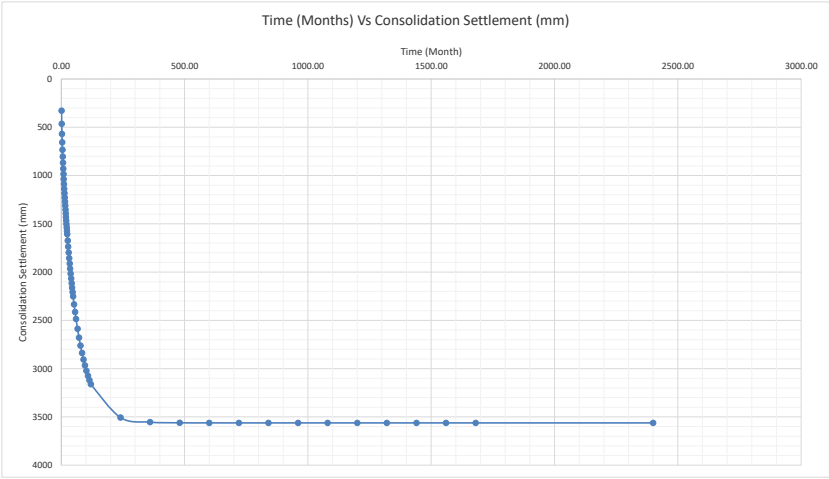
During Rest Period

Rest Period, t	=	200	years
Degree of Consolidation	=	100.00	%
Total Settlement during Rest (Consolidation)	=	3562	mm

1.5 ITERATION

	Fill height	Settlement	Blw water	Eq. fill height	Net Fill Height
	6.60	3.27	3.27	8.09	3.33
9.87	8.09	3.54	3.54	8.21	6.33
10.14	8.21	3.56	3.56	8.22	6.58
10.16	8.22	3.56	3.56	8.22	6.60
10.16	8.22	3.56	3.56	8.22	6.60
10.16	8.22	3.56	3.56	8.22	6.60
10.16	8.22	3.56	3.56	8.22	6.60
10.16	8.22	3.56	3.56	8.22	6.60
10.16	8.22	3.56	3.56	8.22	6.60
10.16	8.22	3.56	3.56	8.22	6.60
10.16	8.22	3.56	3.56	8.22	6.60
10.16	8.22	3.56	3.56	8.22	6.60
10.16	8.22	3.56	3.56	8.22	6.60
10.16	8.22	3.56	3.56	8.22	6.60
10.16	8.22	3.56	3.56	8.22	6.60
10.16	8.22	3.56	3.56	8.22	6.60

1.6 Graph :

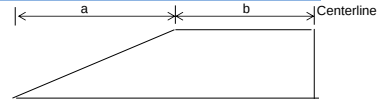


G&P PROFESSIONALS GROUP *DESIGN SHEET*	*Project* Jelutong Rehabiliation			*Project No* 22G1646	
	Work Ref			*Sheet No.*	*Rev*
TITLE **CONSOLIDATION SETTLEMENT WITH BUOYANCY EFFECT (1-D CONSOLIDATION/ BOUSSINESQ METHOD)**	*Design* MHZ/LEYH	*Check* LAH	*Review* TYC	*Date*	

1.1 GENERAL INPUT

Original Ground Level, OGL	=	0	m
Height of Fill , H	=	9.0	m
Fill Unit Weight, γ_f	=	18	kN/m^3
Surcharge	=	0	kN/m^2
Fill Pressure , dP	=	161.5	kN/m^2
Ground Water Level	=	0	m below OGL

1.2 EMBANKMENT DETAILS



Width of Embankment, b =	1000	m
Width of Sloping Area, a =	1000	m

1.3 SUBSOIL PROFILE :

No.	From RL	To RL	Thk (m)	Depth (m)	Mid Point (m)	Mid of depth (m)	CR	RR	U. Weight (kN/m^3)	OCR	Pc (kN/m^2)	Po (kN/m^2)	u (kN/m^2)	Po' (kN/m^2)	ΔP (kN/m2)	OC Settl. (m)	NC Settl. (m)	Settlement 8.97 m	Cv (m^2/yr)	D (m)
1	0.0	-1.0	1.00	1.00	0.5	0.5	0.340	0.04	13.00	1.50	2.39	6.50	4.9	1.60	161.54	0.007	0.623	0.630	2.00	5.00
2	-1.0	-2.0	1.00	2.00	1.5	1.5	0.340	0.04	13.00	1.50	7.18	19.50	14.7	4.79	161.54	0.007	0.464	0.471	2.00	5.00
3	-2.0	-3.0	1.00	3.00	2.5	2.5	0.340	0.04	13.00	1.50	11.96	32.50	24.5	7.98	161.54	0.007	0.391	0.399	2.00	5.00
4	-3.0	-4.0	1.00	4.00	3.5	3.5	0.340	0.04	13.00	1.30	14.51	45.50	34.3	11.17	161.54	0.005	0.366	0.370	2.00	5.00
5	-4.0	-5.0	1.00	5.00	4.5	4.5	0.340	0.04	13.00	1.20	17.23	58.50	44.1	14.36	161.54	0.003	0.343	0.346	2.00	5.00
6	-5.0	-6.0	1.00	6.00	5.5	5.5	0.340	0.04	13.00	1.10	19.30	71.50	54.0	17.55	161.54	0.002	0.329	0.331	2.00	5.00
7	-6.0	-7.0	1.00	7.00	6.5	6.5	0.340	0.04	13.00	1.10	22.81	84.50	63.8	20.74	161.54	0.002	0.307	0.309	2.00	5.00
8	-7.0	-8.0	1.00	8.00	7.5	7.5	0.340	0.04	13.00	1.10	26.32	97.50	73.6	23.93	161.54	0.002	0.288	0.290	2.00	5.00
9	-8.0	-9.0	1.00	9.00	8.5	8.5	0.340	0.04	13.00	1.10	29.83	110.50	83.4	27.12	161.54	0.002	0.272	0.274	2.00	5.00
10	-9.0	-10.0	1.00	10.00	9.5	9.5	0.340	0.04	13.00	1.10	33.34	123.50	93.2	30.31	161.54	0.002	0.258	0.260	2.00	5.00
															Final Settl. =			**3.680**	**m**	

1.4 SETTLEMENT CALCULATION :

Final Settlement	=	3.680	m

During Rest Period

Rest Period, t	=	200	years
Degree of Consolidation	=	100.00	%
Total Settlement during Rest (Consolidation)	=	3680	mm

1.5 ITERATION

	Fill height	Settlement	Blw water	Eq. fill height	Net Fill Height
	7.30	3.40	3.40	8.85	3.90
10.70	8.85	3.66	3.66	8.97	7.04
10.96	8.97	3.68	3.68	8.97	7.28
10.98	8.97	3.68	3.68	8.97	7.30
10.98	8.97	3.68	3.68	8.97	7.30
10.98	8.97	3.68	3.68	8.97	7.30
10.98	8.97	3.68	3.68	8.97	7.30
10.98	8.97	3.68	3.68	8.97	7.30
10.98	8.97	3.68	3.68	8.97	7.30
10.98	8.97	3.68	3.68	8.97	7.30
10.98	8.97	3.68	3.68	8.97	7.30
10.98	8.97	3.68	3.68	8.97	7.30
10.98	8.97	3.68	3.68	8.97	7.30
10.98	8.97	3.68	3.68	8.97	7.30
10.98	8.97	3.68	3.68	8.97	7.30
10.98	8.97	3.68	3.68	8.97	7.30

1.6 Graph :

G&P PROFESSIONALS GROUP

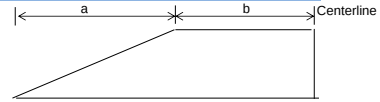
DESIGN SHEET

Project	Jelutong Rehabiliation		*Project No* 22G1646	
Work Ref			*Sheet No.*	*Rev*
TITLE **CONSOLIDATION SETTLEMENT WITH BUOYANCY EFFECT (1-D CONSOLIDATION/ BOUSSINESQ METHOD)**	*Design* MHZ/LEYH	*Check* LAH	*Review* TYC	*Date*

1.1 GENERAL INPUT

Original Ground Level, OGL	=	0	m
Height of Fill , H	=	9.9	m
Fill Unit Weight, γ_f	=	18	kN/m^3
Surcharge	=	0	kN/m^2
Fill Pressure , dP	=	178.9	kN/m^2
Ground Water Level	=	0	m below OGL

1.2 EMBANKMENT DETAILS



Width of Embankment, b =	1000	m
Width of Sloping Area, a =	1000	m

1.3 SUBSOIL PROFILE :

No.	From RL	To RL	Thk (m)	Depth (m)	Mid Point (m)	Mid of depth (m)	CR	RR	U. Weight (kN/m^3)	OCR	Pc (kN/m^2)	Po (kN/m^2)	u (kN/m^2)	Po' (kN/m^2)	ΔP (kN/m2)	OC Settl. (m)	NC Settl. (m)	Settlement 9.94 m	Cv (m^2/yr)	D (m)
1	0.0	-1.0	1.00	1.00	0.5	0.5	0.340	0.04	13.00	1.50	2.39	6.50	4.9	1.60	178.95	0.007	0.638	0.645	2.00	2.50
2	-1.0	-2.0	1.00	2.00	1.5	1.5	0.340	0.04	13.00	1.50	7.18	19.50	14.7	4.79	178.95	0.007	0.479	0.486	2.00	2.50
3	-2.0	-3.0	1.00	3.00	2.5	2.5	0.340	0.04	13.00	1.50	11.96	32.50	24.5	7.98	178.95	0.007	0.406	0.413	2.00	2.50
4	-3.0	-4.0	1.00	4.00	3.5	3.5	0.340	0.04	13.00	1.30	14.51	45.50	34.3	11.17	178.95	0.005	0.380	0.384	2.00	2.50
5	-4.0	-5.0	1.00	5.00	4.5	4.5	0.340	0.04	13.00	1.20	17.23	58.50	44.1	14.36	178.95	0.003	0.357	0.360	2.00	2.50
																	Final Settl. =	**2.289**	**m**	

1.4 SETTLEMENT CALCULATION :

Final Settlement	=	2.289	m

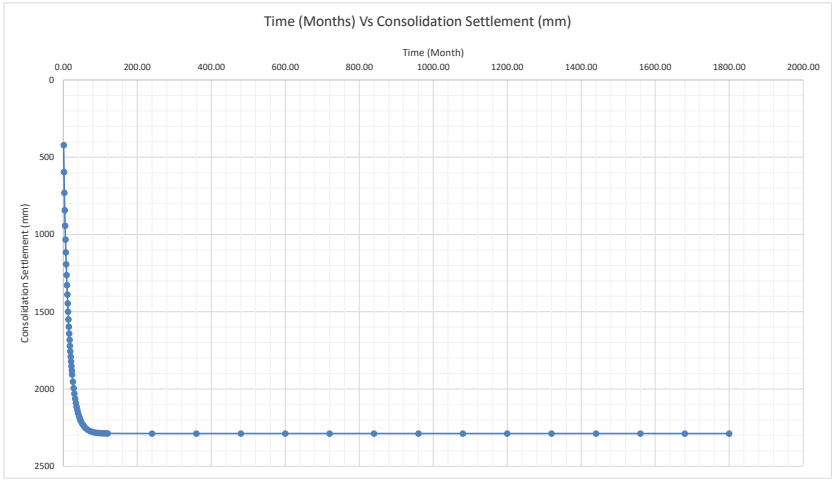
During Rest Period

Rest Period, t	=	200	years
Degree of Consolidation	=	100.00	%
Total Settlement during Rest (Consolidation)	=	2289	mm

1.5 ITERATION

	Fill height	Settlement	Blw water	Eq. fill height	Net Fill Height
	8.90	2.21	2.21	9.91	6.69
11.11	9.91	2.29	2.29	9.94	8.82
11.19	9.94	2.29	2.29	9.94	8.90
11.19	9.94	2.29	2.29	9.94	8.90
11.19	9.94	2.29	2.29	9.94	8.90
11.19	9.94	2.29	2.29	9.94	8.90
11.19	9.94	2.29	2.29	9.94	8.90
11.19	9.94	2.29	2.29	9.94	8.90
11.19	9.94	2.29	2.29	9.94	8.90
11.19	9.94	2.29	2.29	9.94	8.90
11.19	9.94	2.29	2.29	9.94	8.90
11.19	9.94	2.29	2.29	9.94	8.90
11.19	9.94	2.29	2.29	9.94	8.90
11.19	9.94	2.29	2.29	9.94	8.90
11.19	9.94	2.29	2.29	9.94	8.90
11.19	9.94	2.29	2.29	9.94	8.90

1.6 Graph :



G&P PROFESSIONALS GROUP

DESIGN SHEET

Project			*Project No*	
Work Ref			*Sheet No.*	*Rev*
Design	*Check*	*Review*	*Date*	

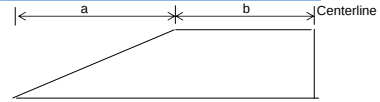
TITLE

CONSOLIDATION SETTLEMENT WITH BUOYANCY EFFECT (1-D CONSOLIDATION/ BOUSSINESQ METHOD)

1.1 GENERAL INPUT

Original Ground Level, OGL	=	0	m
Height of Fill , H	=	10.5	m
Fill Unit Weight, γ_f	=	18	kN/m^3
Surcharge	=	0	kN/m^2
Fill Pressure , dP	=	189.2	kN/m^2
Ground Water Level	=	0	m below OGL

1.2 EMBANKMENT DETAILS



Width of Embankment, b =	1000	m
Width of Sloping Area, a =	1000	m

1.3 SUBSOIL PROFILE :

No.	From RL	To RL	Thk (m)	Depth (m)	Mid Point (m)	Mid of depth (m)	CR	RR	U. Weight (kN/m^3)	OCR	Pc (kN/m^2)	Po (kN/m^2)	u (kN/m^2)	Po' (kN/m^2)	ΔP (kN/m2)	OC Settl. (m)	NC Settl. (m)	Settlement 10.51 m	Cv (m^2/yr)	D (m)
1	0.0	-1.0	1.00	1.00	0.5	0.5	0.340	0.04	13.00	1.50	2.39	6.50	4.9	1.60	189.25	0.007	0.647	0.654	2.00	1.50
2	-1.0	-2.0	1.00	2.00	1.5	1.5	0.340	0.04	13.00	1.50	7.18	19.50	14.7	4.79	189.25	0.007	0.487	0.494	2.00	1.50
3	-2.0	-3.0	1.00	3.00	2.5	2.5	0.340	0.04	13.00	1.50	11.96	32.50	24.5	7.98	189.25	0.007	0.414	0.421	2.00	1.50
																Final Settl. =		**1.568**	**m**	

1.4 SETTLEMENT CALCULATION :

Final Settlement	=	1.568	m

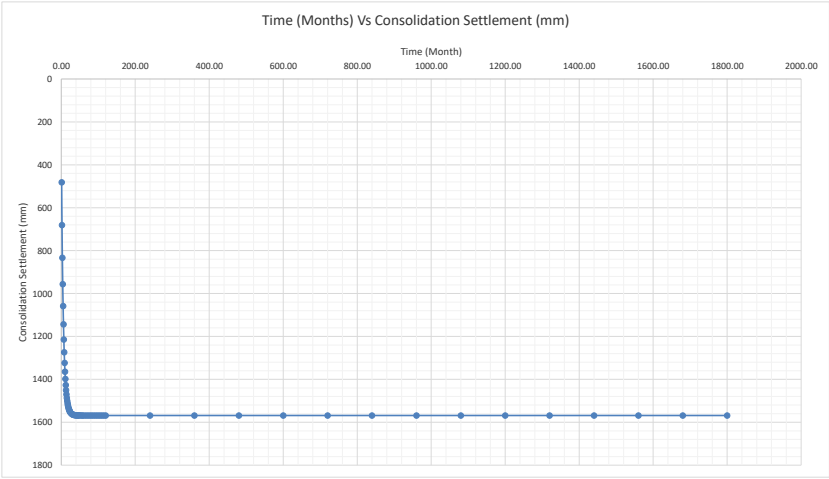
During Rest Period

Rest Period, t	=	200	years
Degree of Consolidation	=	100.00	%
Total Settlement during Rest (Consolidation)	=	1568	mm

1.5 ITERATION

	Fill height	Settlement	Blw water	Eq. fill height	Net Fill Height
	9.80	1.54	1.54	10.50	8.26
11.34	10.50	1.57	1.57	10.51	9.77
11.37	10.51	1.57	1.57	10.51	9.80
11.37	10.51	1.57	1.57	10.51	9.80
11.37	10.51	1.57	1.57	10.51	9.80
11.37	10.51	1.57	1.57	10.51	9.80
11.37	10.51	1.57	1.57	10.51	9.80
11.37	10.51	1.57	1.57	10.51	9.80
11.37	10.51	1.57	1.57	10.51	9.80
11.37	10.51	1.57	1.57	10.51	9.80
11.37	10.51	1.57	1.57	10.51	9.80
11.37	10.51	1.57	1.57	10.51	9.80
11.37	10.51	1.57	1.57	10.51	9.80
11.37	10.51	1.57	1.57	10.51	9.80
11.37	10.51	1.57	1.57	10.51	9.80
11.37	10.51	1.57	1.57	10.51	9.80

1.6 Graph :



APPENDIX C

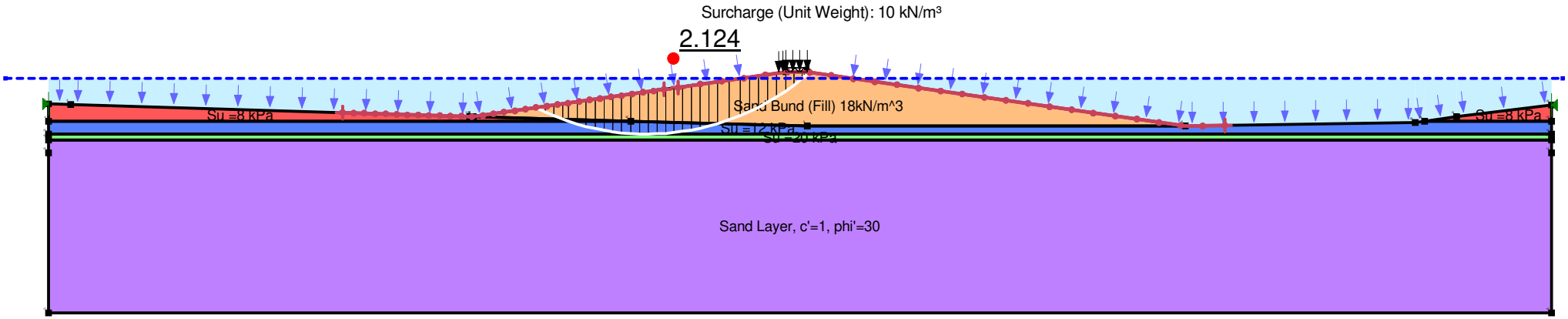
Stability Analyses (Reclamation)

CIRCULAR ANALYSIS

Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Sand Bund (Fill) 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =20 kPa	13	20		
	Su =8 kPa	13	8		

File Name: 01 Sec5 Reclamation_Sand Bund.gsz
Name: Sand Bund 1:7_MLWS_Section 5 _Left

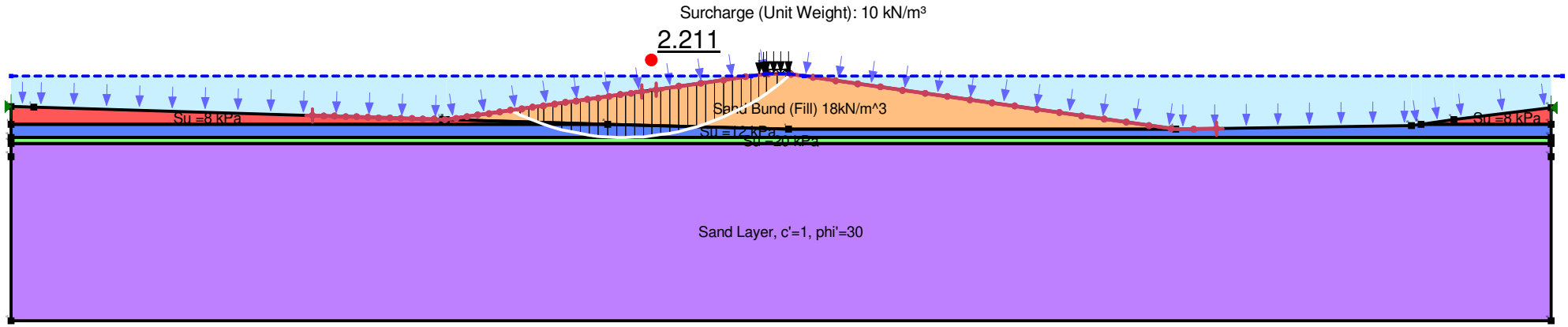
Factor of Safety: 2.124



Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Sand Bund (Fill) 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =20 kPa	13	20		
	Su =8 kPa	13	8		

File Name: 01 Sec5 Reclamation_Sand Bund.gsz
Name: Sand Bund 1:7_MHWS to MSL_Section 5 _Left

Factor of Safety: 2.211

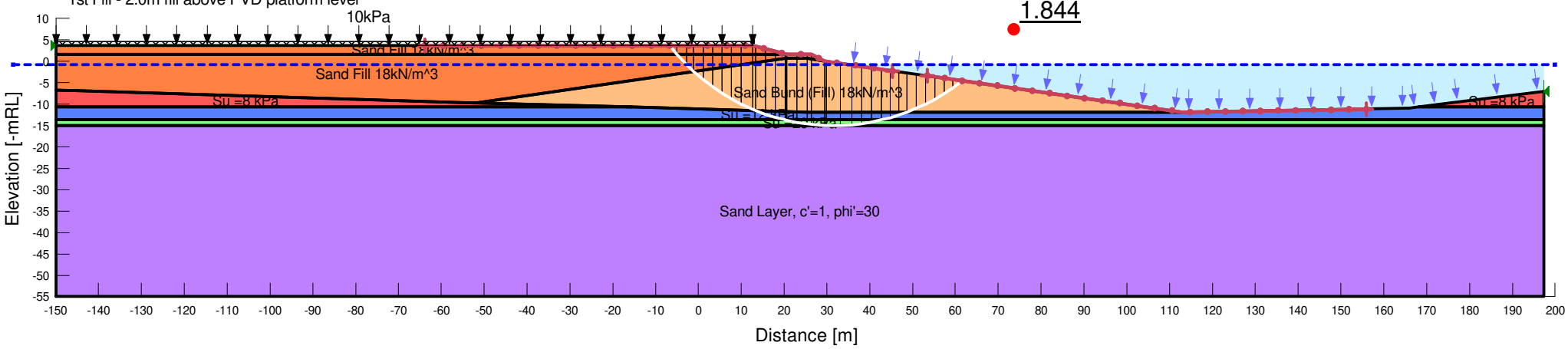


Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Sand Bund (Fill) 18kN/m^3	18		0	30
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =20 kPa	13	20		
	Su =8 kPa	13	8		

File Name: 02 Sec5 Reclamation_1st Fill-R1.gsz
Name: 1ST FILL 1:4_MLWS_Section 5 _ Right

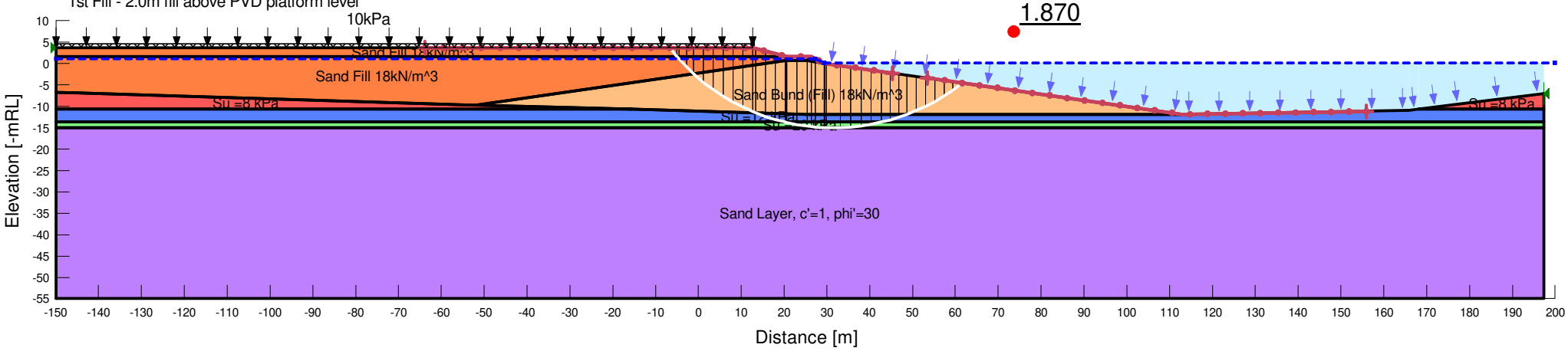
Factor of Safety: 1.844

1st Fill - 2.0m fill above PVD platform level



Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Sand Bund (Fill) 18kN/m^3	18		0	30
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =20 kPa	13	20		
	Su =8 kPa	13	8		

File Name: 02 Sec5 Reclamation_1st Fill-R1.gsz
Name: 1ST FILL 1:4_MHWS to MSL_Section 5 _ Right
Factor of Safety: 1.870
1st Fill - 2.0m fill above PVD platform level

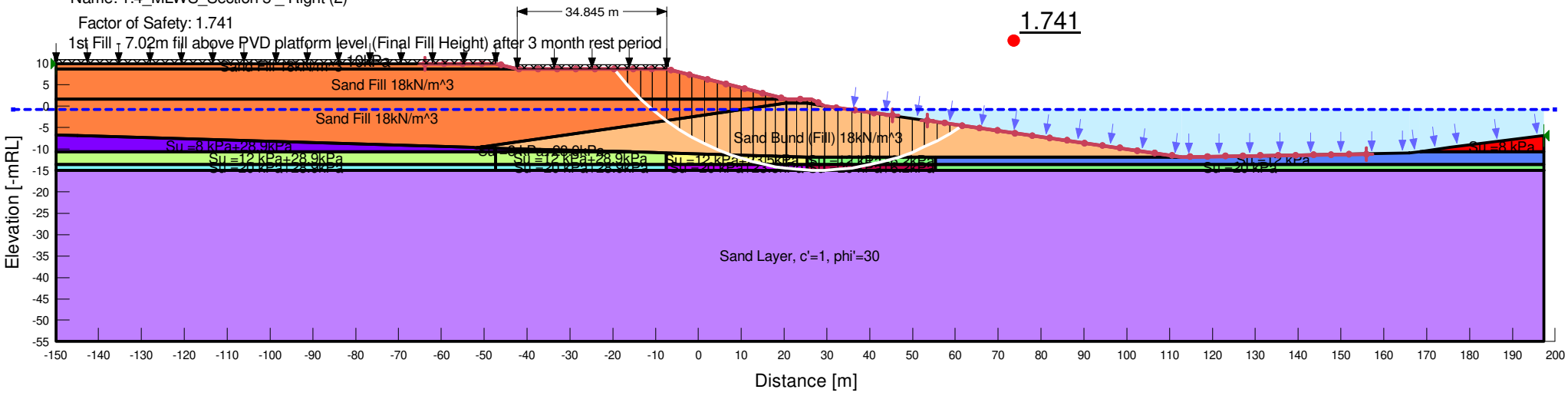


Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Sand Bund (Fill) 18kN/m^3	18		0	30
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =12 kPa+23.5kPa	13	35.5		
	Su =12 kPa+28.9kPa	13	40.9		
	Su =12 kPa+6.2kPa	13	18.2		
	Su =20 kPa	13	20		
	Su =20 kPa+23.5kPa	13	43.5		
	Su =20 kPa+28.9kPa	13	4,839		
	Su =20 kPa+6.2kPa	13	26.2		
	Su =8 kPa	13	8		
	Su =8 kPa+28.9kPa	13	36.9		

File Name: 03 Sec5 Reclamation_2nd Fill-R1.gsz
Name: 1:4_MLWS_Section 5 _ Right (2)

Factor of Safety: 1.741

1st Fill - 7.02m fill above PVD platform level (Final Fill Height) after 3 month rest period

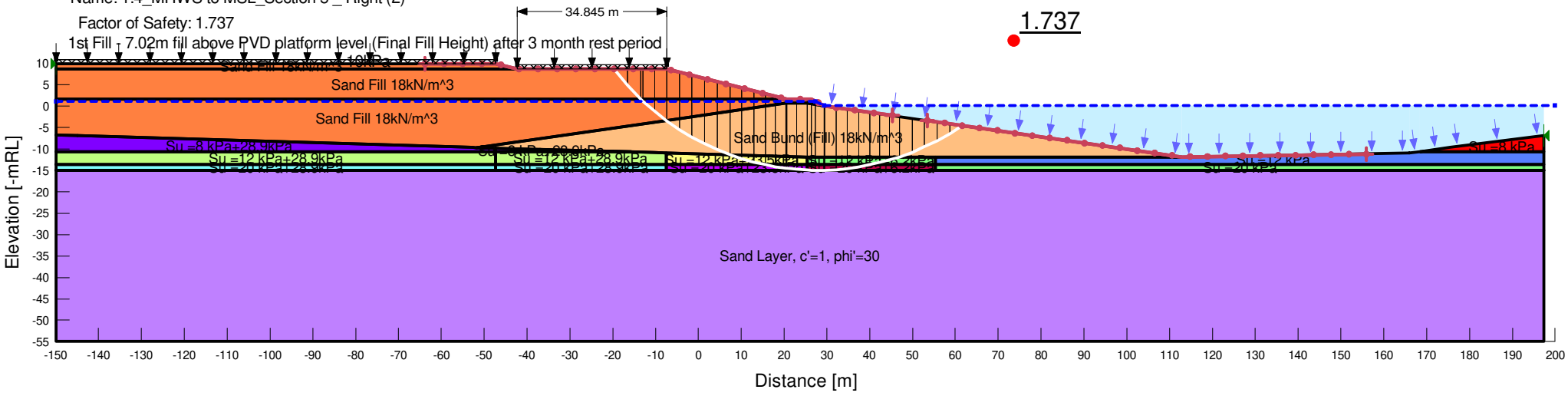


Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Sand Bund (Fill) 18kN/m^3	18		0	30
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =12 kPa+23.5kPa	13	35.5		
	Su =12 kPa+28.9kPa	13	40.9		
	Su =12 kPa+6.2kPa	13	18.2		
	Su =20 kPa	13	20		
	Su =20 kPa+23.5kPa	13	43.5		
	Su =20 kPa+28.9kPa	13	4,839		
	Su =20 kPa+6.2kPa	13	26.2		
	Su =8 kPa	13	8		
	Su =8 kPa+28.9kPa	13	36.9		

File Name: 03 Sec5 Reclamation_2nd Fill-R1.gsz
Name: 1:4_MHWS to MSL_Section 5 _ Right (2)

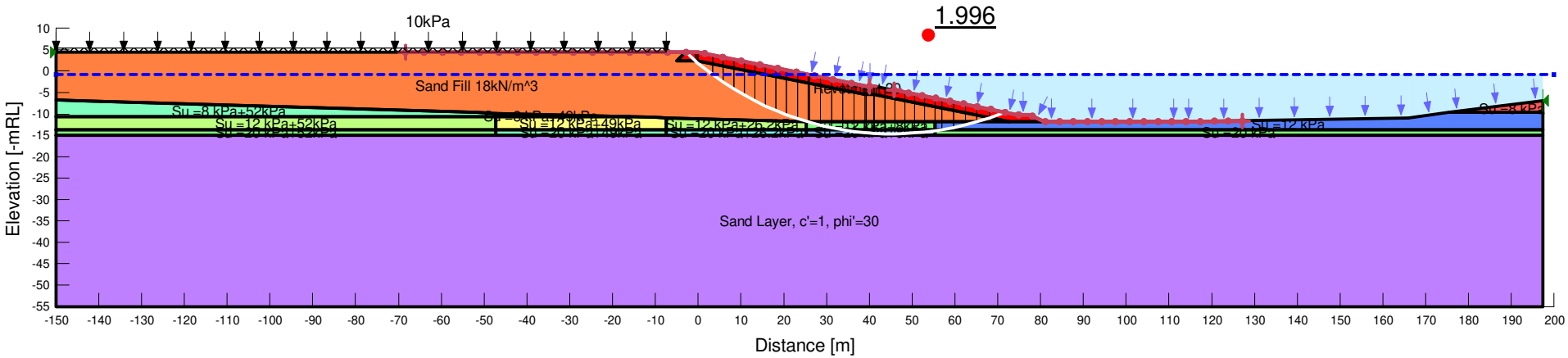
Factor of Safety: 1.737

1st Fill - 7.02m fill above PVD platform level (Final Fill Height) after 3 month rest period



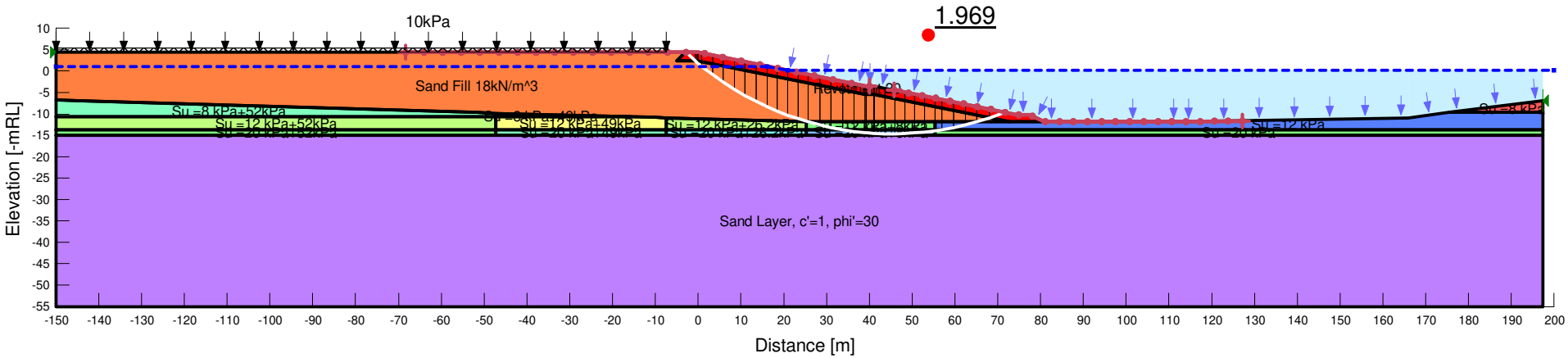
Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Revetment 20	20		0	40
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =12 kPa+26.2kPa	13	38.2		
	Su =12 kPa+49kPa	13	61		
	Su =12 kPa+52kPa	13	64		
	Su =12 kPa+8kPa	13	20		
	Su =20 kPa	13	20		
	Su =20 kPa+26.2kPa	13	46.2		
	Su =20 kPa+49kPa	13	69		
	Su =20 kPa+52kPa	13	72		
	Su =20 kPa+8kPa	13	28		
	Su =8 kPa	13	8		
	Su =8 kPa+49kPa	13	57		
	Su =8 kPa+52kPa	13	60		

File Name: 04 Sec5 Reclamation_Revetment_Undrained-R2.gsz
Name: Revetment 1:5_MLWS_Section 5 _Right
Factor of Safety: 1.996



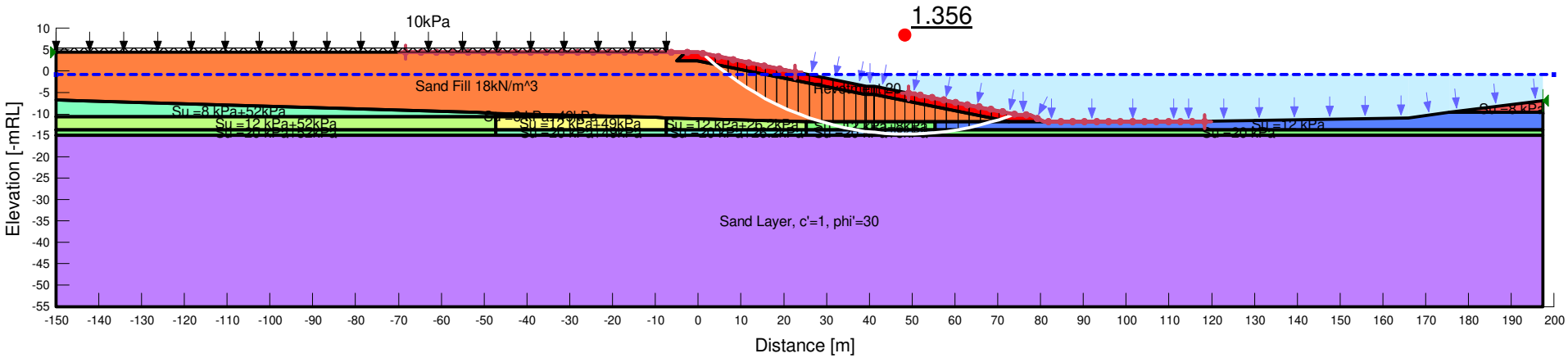
Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Revetment 20	20		0	40
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =12 kPa+26.2kPa	13	38.2		
	Su =12 kPa+49kPa	13	61		
	Su =12 kPa+52kPa	13	64		
	Su =12 kPa+8kPa	13	20		
	Su =20 kPa	13	20		
	Su =20 kPa+26.2kPa	13	46.2		
	Su =20 kPa+49kPa	13	69		
	Su =20 kPa+52kPa	13	72		
	Su =20 kPa+8kPa	13	28		
	Su =8 kPa	13	8		
	Su =8 kPa+49kPa	13	57		
	Su =8 kPa+52kPa	13	60		

File Name: 04 Sec5 Reclamation_Revetment_Undrained-R2.gsz
Name: Revetment 1:5_MHWS to MSL_Section 5 _Right
Factor of Safety: 1.969



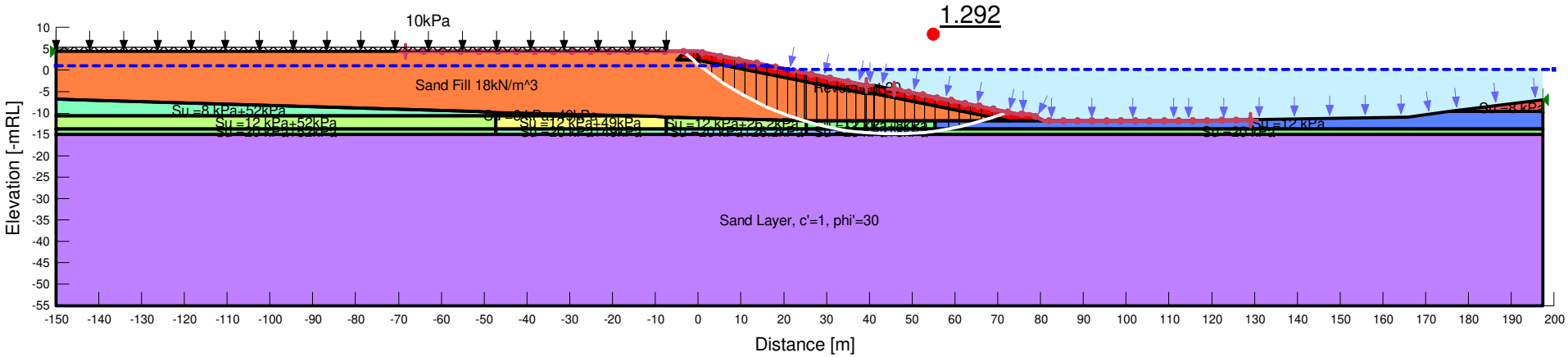
Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Revetment 20	20		0	40
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =12 kPa+26.2kPa	13	38.2		
	Su =12 kPa+49kPa	13	61		
	Su =12 kPa+52kPa	13	64		
	Su =12 kPa+8kPa	13	20		
	Su =20 kPa	13	20		
	Su =20 kPa+26.2kPa	13	46.2		
	Su =20 kPa+49kPa	13	69		
	Su =20 kPa+52kPa	13	72		
	Su =20 kPa+8kPa	13	28		
	Su =8 kPa	13	8		
	Su =8 kPa+49kPa	13	57		
	Su =8 kPa+52kPa	13	60		

File Name: 04 Sec5 Reclamation_Revetment_Undrained-R2.gsz
Name: Revetment 1:5_MLWS_Section 5 _Right (seismic-5.55%g)
Factor of Safety: 1.356



Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Revetment 20	20		0	40
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =12 kPa+26.2kPa	13	38.2		
	Su =12 kPa+49kPa	13	61		
	Su =12 kPa+52kPa	13	64		
	Su =12 kPa+8kPa	13	20		
	Su =20 kPa	13	20		
	Su =20 kPa+26.2kPa	13	46.2		
	Su =20 kPa+49kPa	13	69		
	Su =20 kPa+52kPa	13	72		
	Su =20 kPa+8kPa	13	28		
	Su =8 kPa	13	8		
	Su =8 kPa+49kPa	13	57		
	Su =8 kPa+52kPa	13	60		

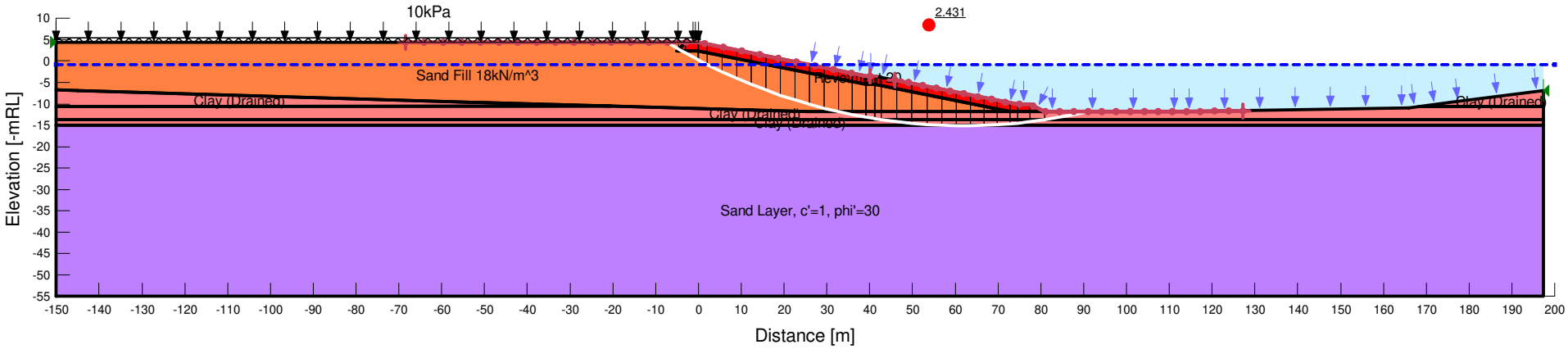
File Name: 04 Sec5 Reclamation_Revetment_Undrained-R2.gsz
Name: Revetment 1:5_MHWS to MSL_Section 5 _Right (seismic-5.55%g)
Factor of Safety: 1.292



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Clay (Drained)	13	1	28
	Revetment 20	20	0	40
	Sand Fill 18kN/m^3	19	0	30
	Sand Layer, c'=1, phi'=30	18	1	30

File Name: 04 Sec5 Reclamation_Revetment_Drained.gsz
Name: Revetment 1:5_MLWS_Section 5 _Right

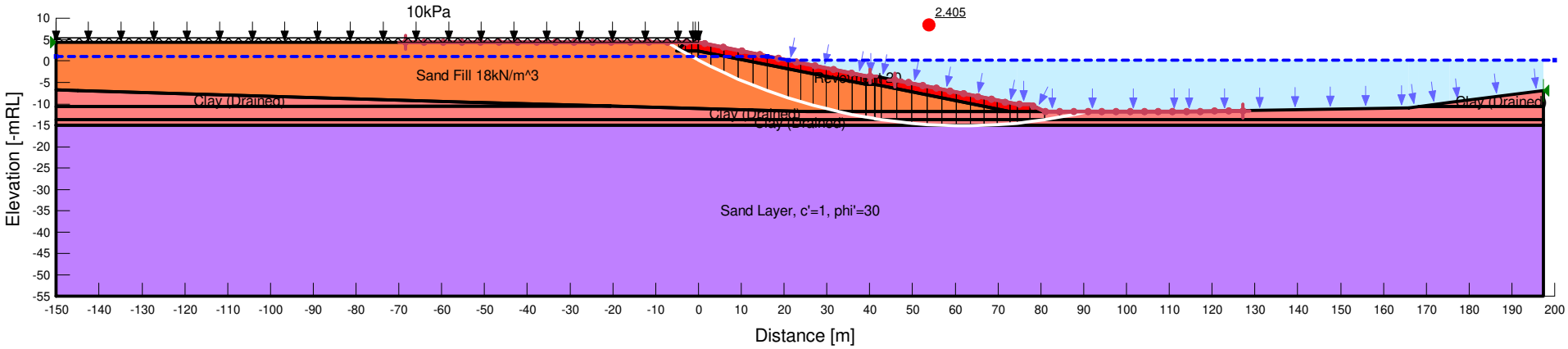
Factor of Safety: 2.431



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Clay (Drained)	13	1	28
	Revetment 20	20	0	40
	Sand Fill 18kN/m^3	19	0	30
	Sand Layer, c'=1, phi'=30	18	1	30

File Name: 04 Sec5 Reclamation_Revetment_Drained.gsz
Name: Revetment 1:5_MHWS to MSL_Section 5 _Right

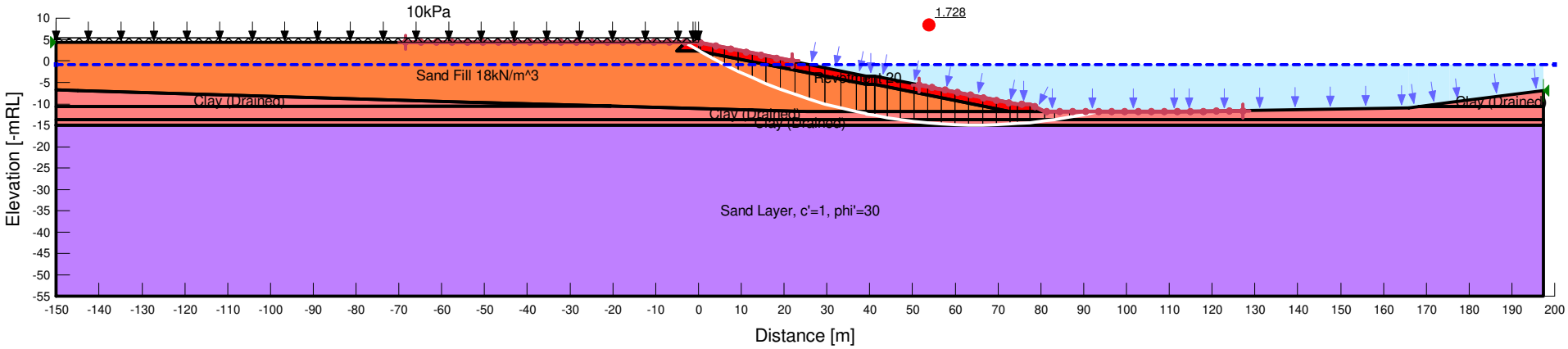
Factor of Safety: 2.405



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Clay (Drained)	13	1	28
	Revetment 20	20	0	40
	Sand Fill 18kN/m^3	19	0	30
	Sand Layer, c'=1, phi'=30	18	1	30

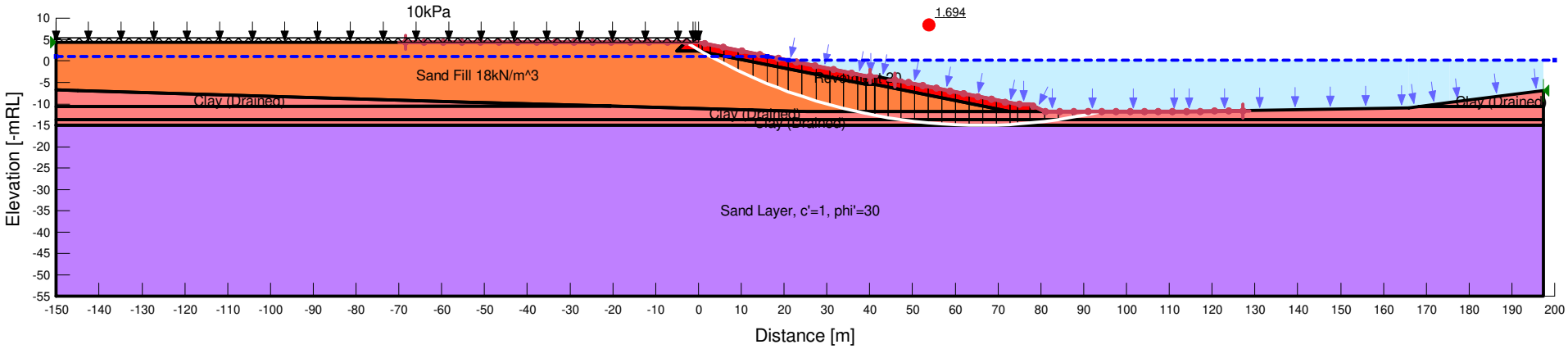
File Name: 04 Sec5 Reclamation_Revetment_Drained.gsz
Name: Revetment 1:5_MLWS_Section 5 _Right (seismic-5.55%g)

Factor of Safety: 1.728



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Clay (Drained)	13	1	28
	Revetment 20	20	0	40
	Sand Fill 18kN/m^3	19	0	30
	Sand Layer, c'=1, phi'=30	18	1	30

File Name: 04 Sec5 Reclamation_Revetment_Drained.gsz
Name: Revetment 1:5_MHWS to MSL_Section 5 _Right (seismic-5.55%g)
Factor of Safety: 1.694

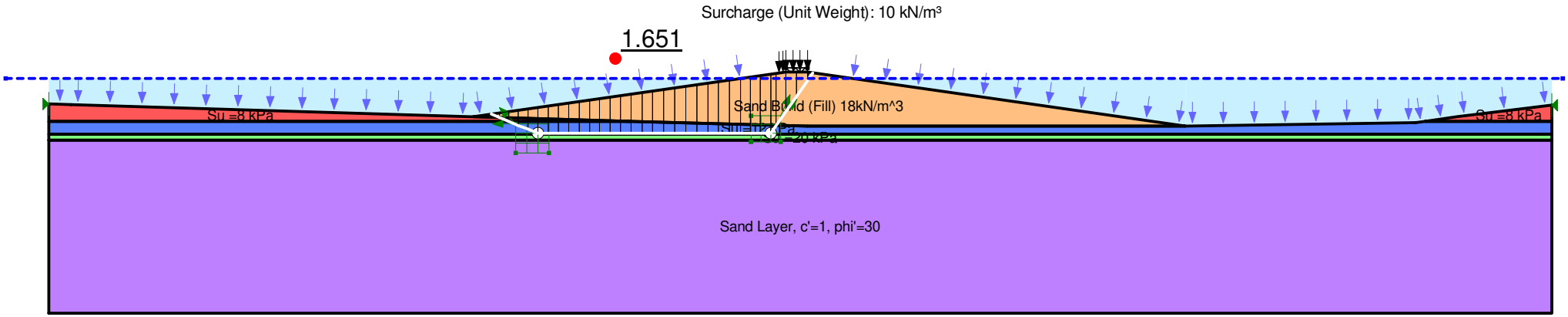


WEDGE ANALYSIS

Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Sand Bund (Fill) 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =20 kPa	13	20		
	Su =8 kPa	13	8		

File Name: 01 Sec5 Reclamation_Sand Bund.gsz
Name: Sand Bund 1:7_MLWS_Section 5 _Left

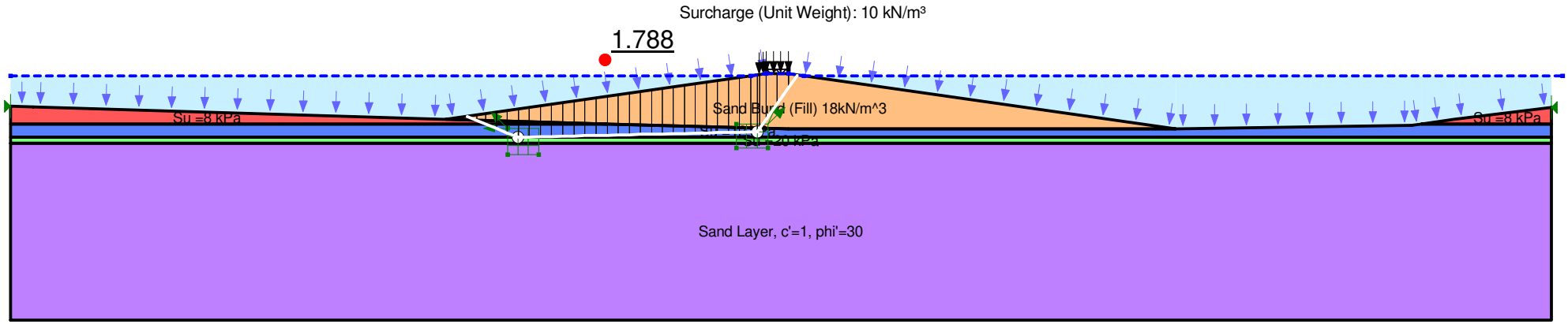
Factor of Safety: 1.651



Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Sand Bund (Fill) 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =20 kPa	13	20		
	Su =8 kPa	13	8		

File Name: 01 Sec5 Reclamation_Sand Bund.gsz
Name: Sand Bund 1:7_MHWS to MSL_Section 5 _Left

Factor of Safety: 1.788

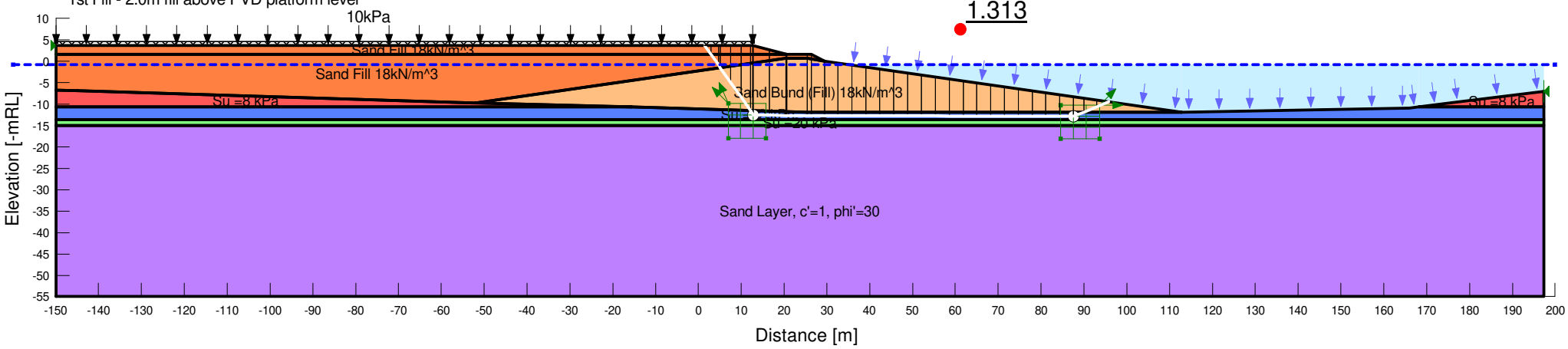


Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Sand Bund (Fill) 18kN/m^3	18		0	30
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =20 kPa	13	20		
	Su =8 kPa	13	8		

File Name: 02 Sec5 Reclamation_1st Fill-R1.gsz
Name: 1ST FILL 1:4_MLWS_Section 5 _ Right

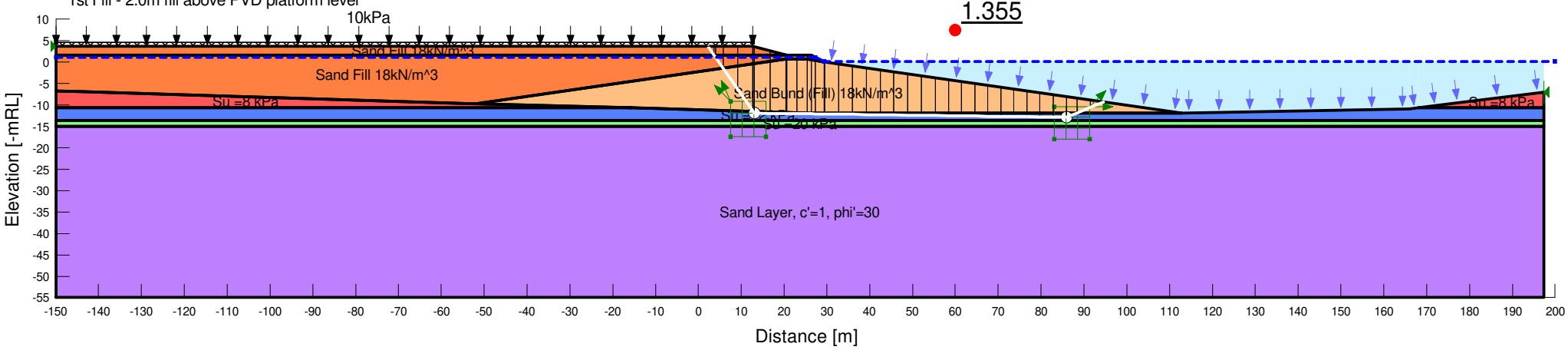
Factor of Safety: 1.313

1st Fill - 2.0m fill above PVD platform level



Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Sand Bund (Fill) 18kN/m^3	18		0	30
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =20 kPa	13	20		
	Su =8 kPa	13	8		

File Name: 02 Sec5 Reclamation_1st Fill-R1.gsz
Name: 1ST FILL 1:4_MHWS to MSL_Section 5 _ Right
Factor of Safety: 1.355
1st Fill - 2.0m fill above PVD platform level

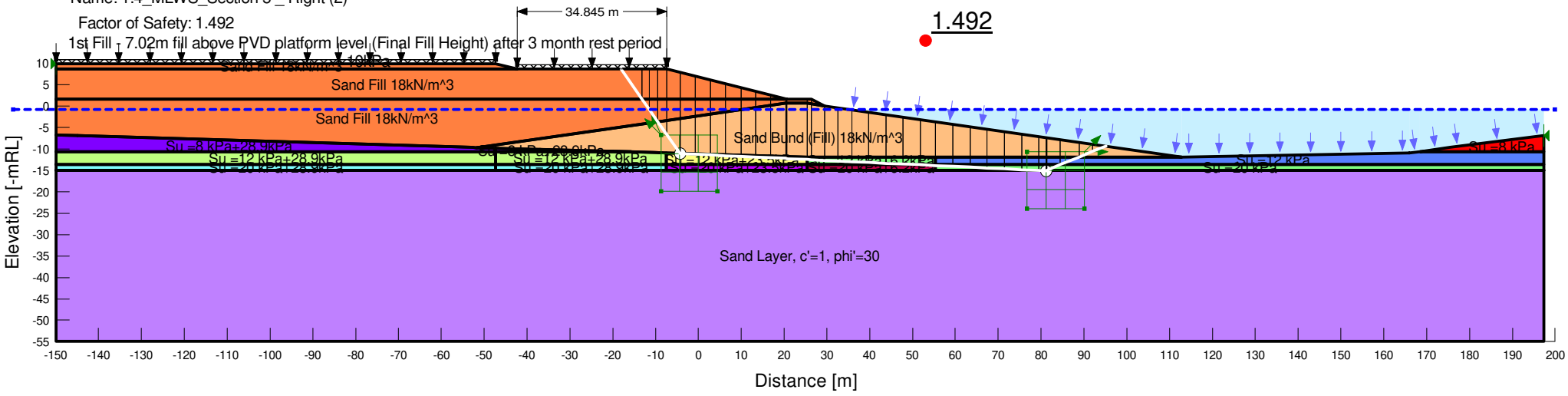


Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Sand Bund (Fill) 18kN/m^3	18		0	30
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =12 kPa+23.5kPa	13	35.5		
	Su =12 kPa+28.9kPa	13	40.9		
	Su =12 kPa+6.2kPa	13	18.2		
	Su =20 kPa	13	20		
	Su =20 kPa+23.5kPa	13	43.5		
	Su =20 kPa+28.9kPa	13	4,839		
	Su =20 kPa+6.2kPa	13	26.2		
	Su =8 kPa	13	8		
	Su =8 kPa+28.9kPa	13	36.9		

File Name: 03 Sec5 Reclamation_2nd Fill-R1.gsz
Name: 1:4_MLWS_Section 5 _ Right (2)

Factor of Safety: 1.492

1st Fill - 7.02m fill above PVD platform level (Final Fill Height) after 3 month rest period

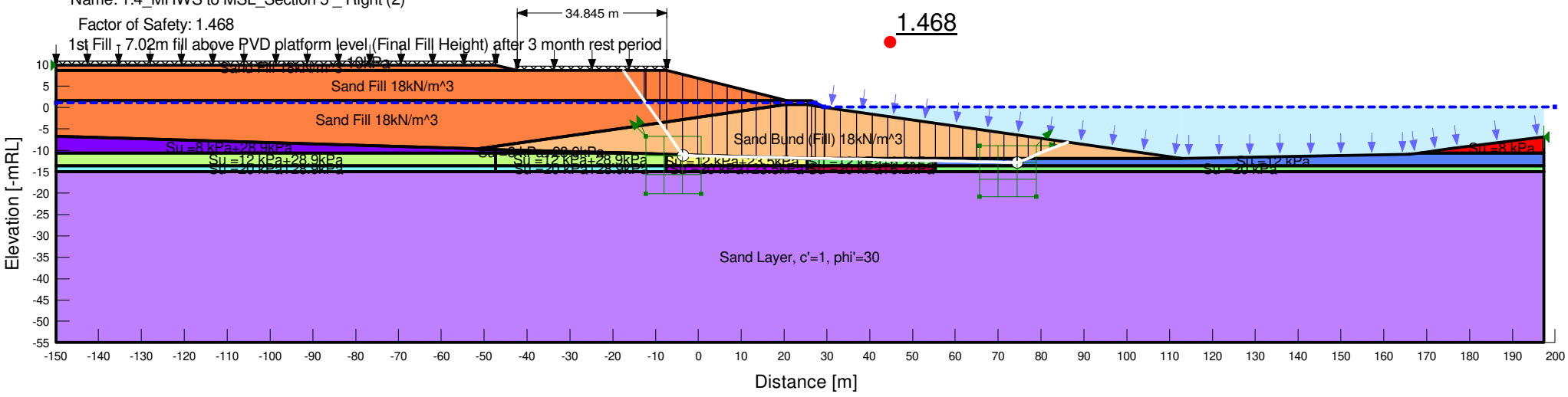


Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Sand Bund (Fill) 18kN/m^3	18		0	30
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =12 kPa+23.5kPa	13	35.5		
	Su =12 kPa+28.9kPa	13	40.9		
	Su =12 kPa+6.2kPa	13	18.2		
	Su =20 kPa	13	20		
	Su =20 kPa+23.5kPa	13	43.5		
	Su =20 kPa+28.9kPa	13	4,839		
	Su =20 kPa+6.2kPa	13	26.2		
	Su =8 kPa	13	8		
	Su =8 kPa+28.9kPa	13	36.9		

File Name: 03 Sec5 Reclamation_2nd Fill-R1.gsz
Name: 1:4_MHWS to MSL_Section 5 _ Right (2)

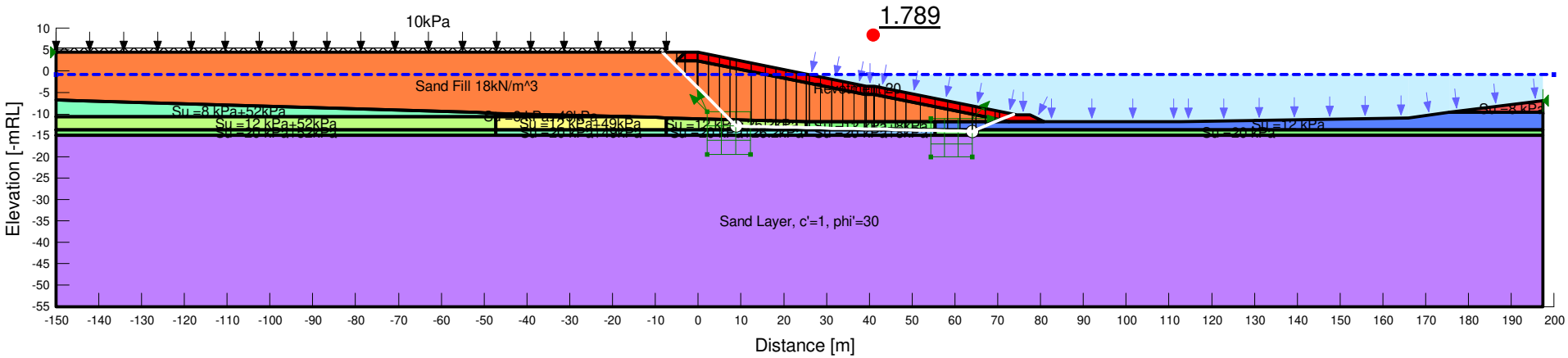
Factor of Safety: 1.468

1st Fill - 7.02m fill above PVD platform level (Final Fill Height) after 3 month rest period



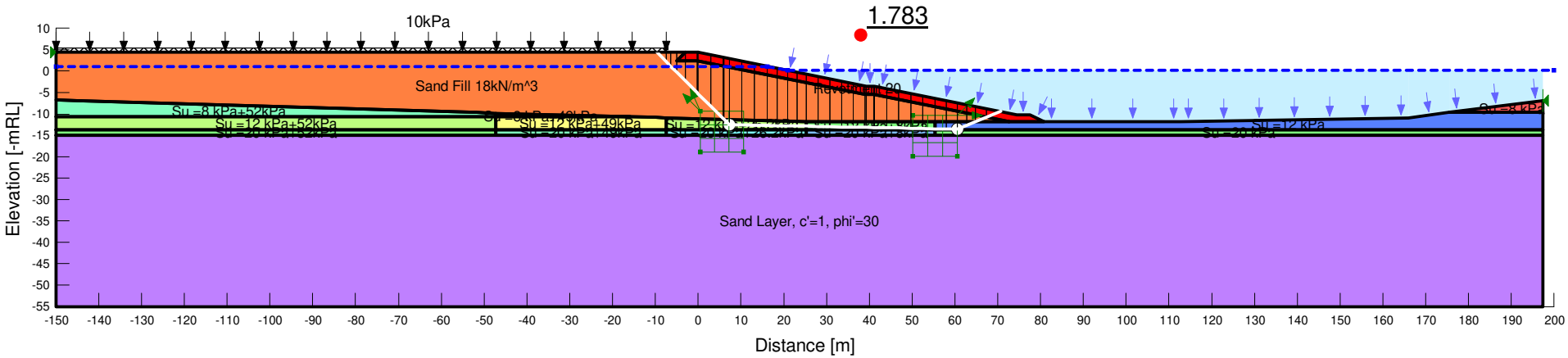
Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Revetment 20	20		0	40
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =12 kPa+26.2kPa	13	38.2		
	Su =12 kPa+49kPa	13	61		
	Su =12 kPa+52kPa	13	64		
	Su =12 kPa+8kPa	13	20		
	Su =20 kPa	13	20		
	Su =20 kPa+26.2kPa	13	46.2		
	Su =20 kPa+49kPa	13	69		
	Su =20 kPa+52kPa	13	72		
	Su =20 kPa+8kPa	13	28		
	Su =8 kPa	13	8		
	Su =8 kPa+49kPa	13	57		
	Su =8 kPa+52kPa	13	60		

File Name: 04 Sec5 Reclamation_Revetment_Undrained-R2lah.gsz
Name: Revetment 1:5_MLWS_Section 5 _Right
Factor of Safety: 1.789



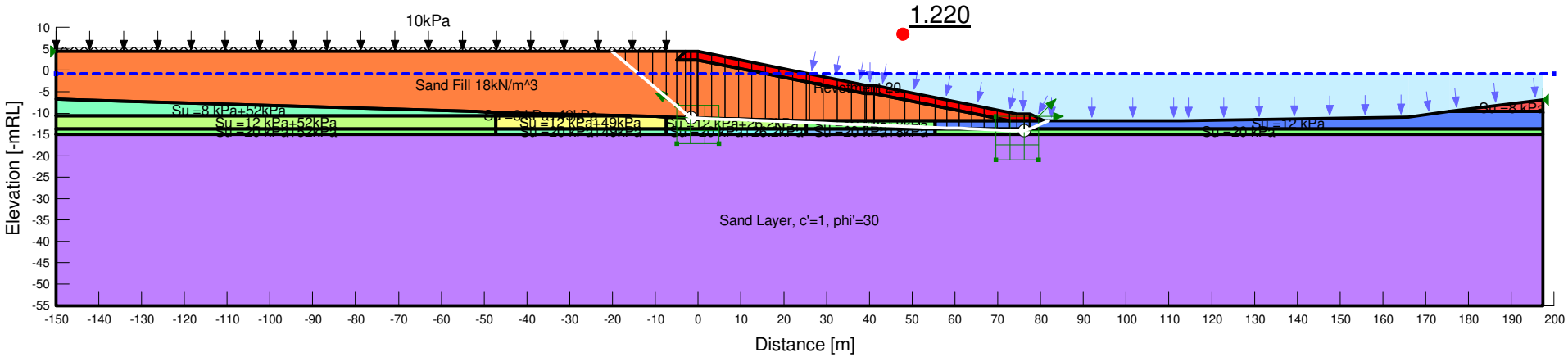
Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Revetment 20	20		0	40
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =12 kPa+26.2kPa	13	38.2		
	Su =12 kPa+49kPa	13	61		
	Su =12 kPa+52kPa	13	64		
	Su =12 kPa+8kPa	13	20		
	Su =20 kPa	13	20		
	Su =20 kPa+26.2kPa	13	46.2		
	Su =20 kPa+49kPa	13	69		
	Su =20 kPa+52kPa	13	72		
	Su =20 kPa+8kPa	13	28		
	Su =8 kPa	13	8		
	Su =8 kPa+49kPa	13	57		
	Su =8 kPa+52kPa	13	60		

File Name: 04 Sec5 Reclamation_Revetment_Undrained-R2lah.gsz
Name: Revetment 1:5_MHWS to MSL_Section 5 _Right
Factor of Safety: 1.783



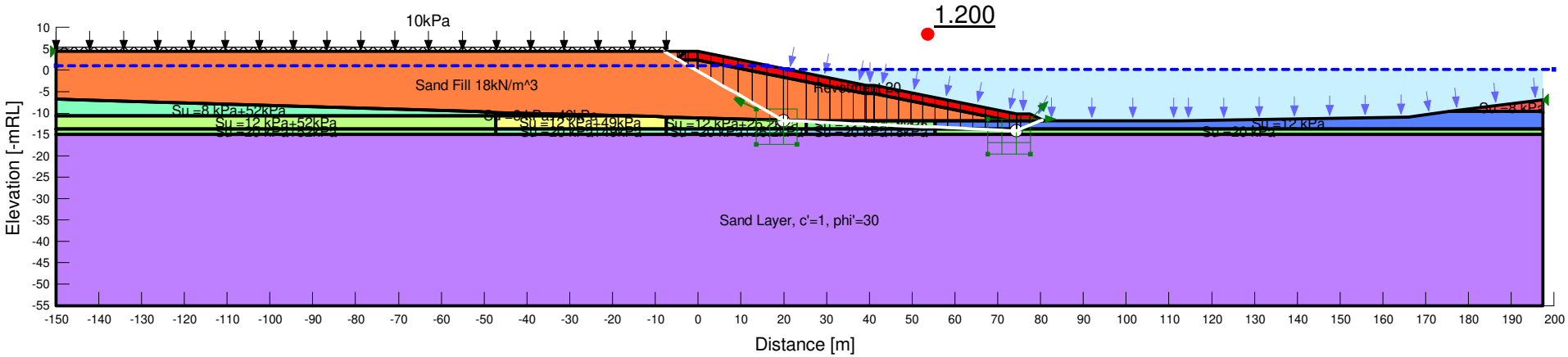
Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Revetment 20	20		0	40
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =12 kPa+26.2kPa	13	38.2		
	Su =12 kPa+49kPa	13	61		
	Su =12 kPa+52kPa	13	64		
	Su =12 kPa+8kPa	13	20		
	Su =20 kPa	13	20		
	Su =20 kPa+26.2kPa	13	46.2		
	Su =20 kPa+49kPa	13	69		
	Su =20 kPa+52kPa	13	72		
	Su =20 kPa+8kPa	13	28		
	Su =8 kPa	13	8		
	Su =8 kPa+49kPa	13	57		
	Su =8 kPa+52kPa	13	60		

File Name: 04 Sec5 Reclamation_Revetment_Undrained-R2lah.gsz
Name: Revetment 1:5_MLWS_Section 5 _Right (seismic-5.55%g) (2)
Factor of Safety: 1.220



Color	Name	Unit Weight (kN/m³)	Total Cohesion (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Revetment 20	20		0	40
	Sand Fill 18kN/m^3	18		0	30
	Sand Layer, c'=1, phi'=30	19		1	30
	Su =12 kPa	13	12		
	Su =12 kPa+26.2kPa	13	38.2		
	Su =12 kPa+49kPa	13	61		
	Su =12 kPa+52kPa	13	64		
	Su =12 kPa+8kPa	13	20		
	Su =20 kPa	13	20		
	Su =20 kPa+26.2kPa	13	46.2		
	Su =20 kPa+49kPa	13	69		
	Su =20 kPa+52kPa	13	72		
	Su =20 kPa+8kPa	13	28		
	Su =8 kPa	13	8		
	Su =8 kPa+49kPa	13	57		
	Su =8 kPa+52kPa	13	60		

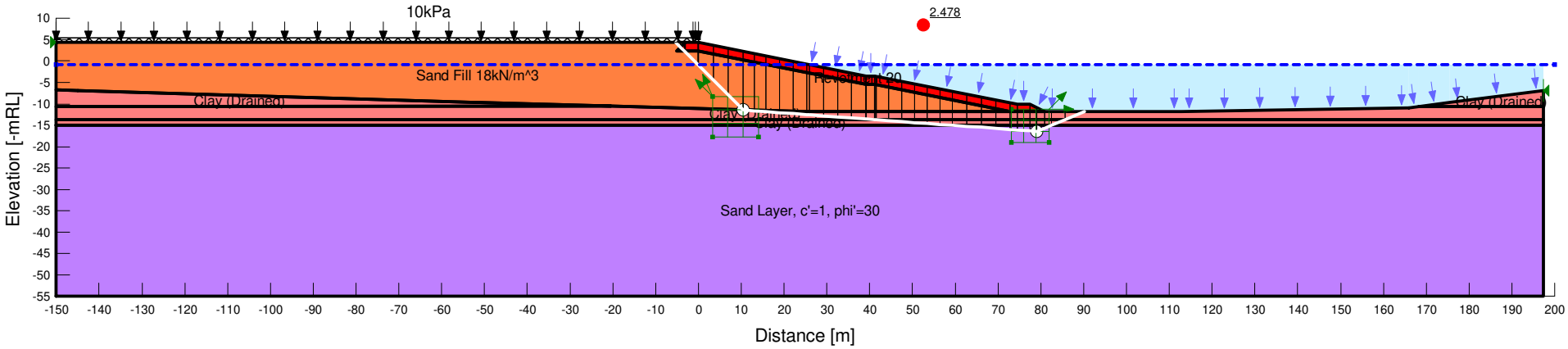
File Name: 04 Sec5 Reclamation_Revetment_Undrained-R2lah.gsz
Name: Revetment 1:5_MHWS to MSL_Section 5 _Right (seismic-5.55%g) (2)
Factor of Safety: 1.200



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Clay (Drained)	13	1	28
	Revetment 20	20	0	40
	Sand Fill 18kN/m^3	19	0	30
	Sand Layer, c'=1, phi'=30	18	1	30

File Name: 04 Sec5 Reclamation_Revetment_Drained.gsz
Name: Revetment 1:5_MLWS_Section 5 _Right

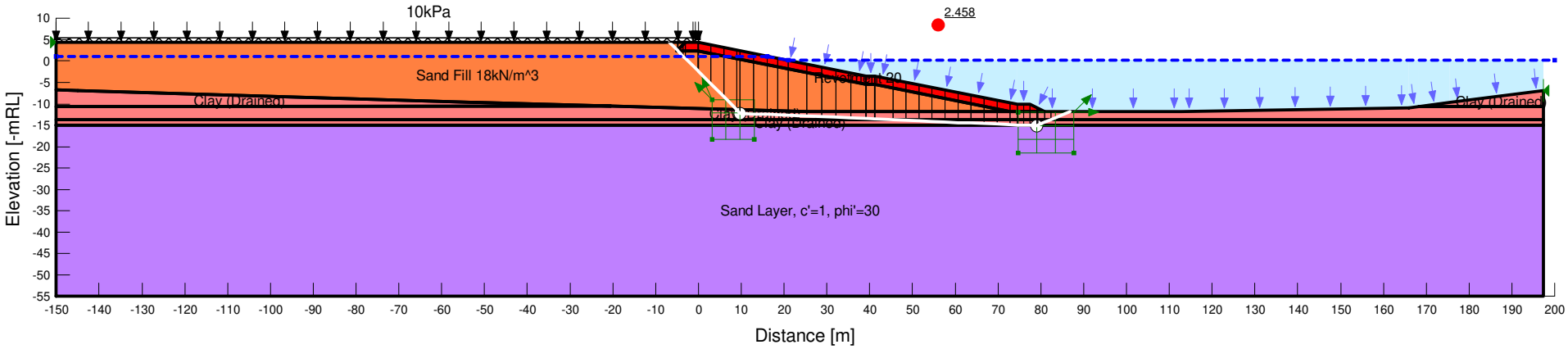
Factor of Safety: 2.478



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Clay (Drained)	13	1	28
	Revetment 20	20	0	40
	Sand Fill 18kN/m^3	19	0	30
	Sand Layer, c'=1, phi'=30	18	1	30

File Name: 04 Sec5 Reclamation_Revetment_Drained.gsz
Name: Revetment 1:5_MHWS to MSL_Section 5 _Right

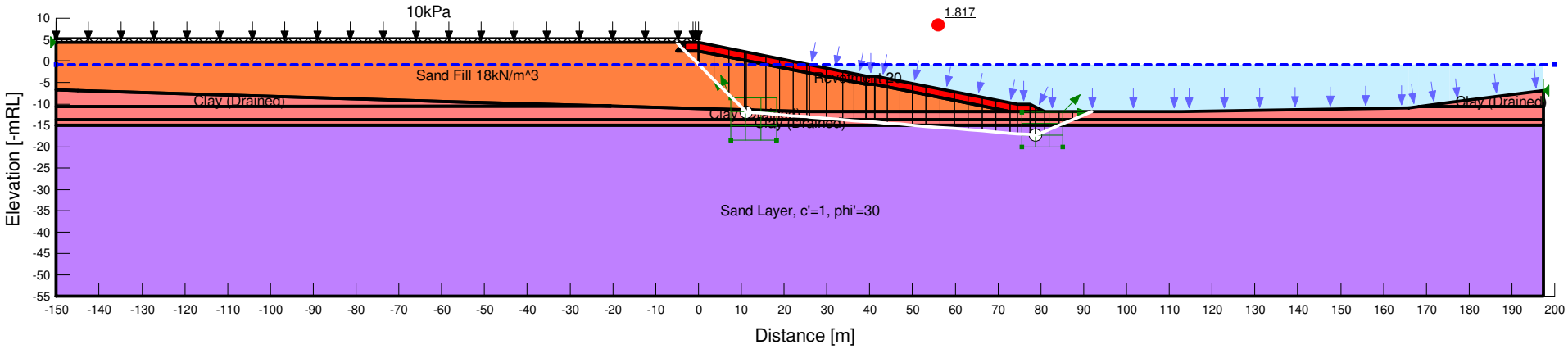
Factor of Safety: 2.458



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Clay (Drained)	13	1	28
	Revetment 20	20	0	40
	Sand Fill 18kN/m^3	19	0	30
	Sand Layer, c'=1, phi'=30	18	1	30

File Name: 04 Sec5 Reclamation_Revetment_Drained.gsz
Name: Revetment 1:5_MLWS_Section 5 _Right (seismic-5.55%g)

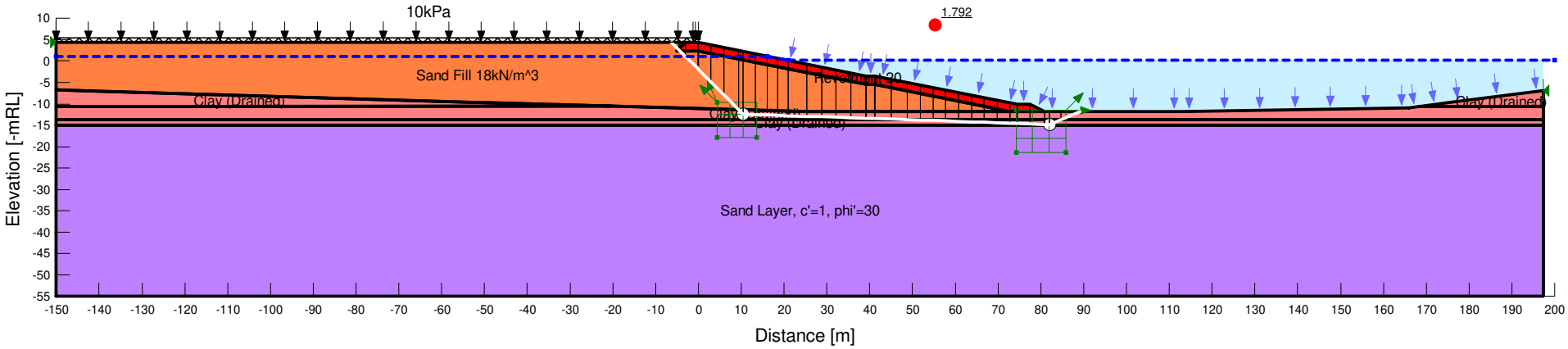
Factor of Safety: 1.817



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Clay (Drained)	13	1	28
	Revetment 20	20	0	40
	Sand Fill 18kN/m^3	19	0	30
	Sand Layer, c'=1, phi'=30	18	1	30

File Name: 04 Sec5 Reclamation_Revetment_Drained.gsz
Name: Revetment 1:5_MHWS to MSL_Section 5 _Right (seismic-5.55%g)

Factor of Safety: 1.792



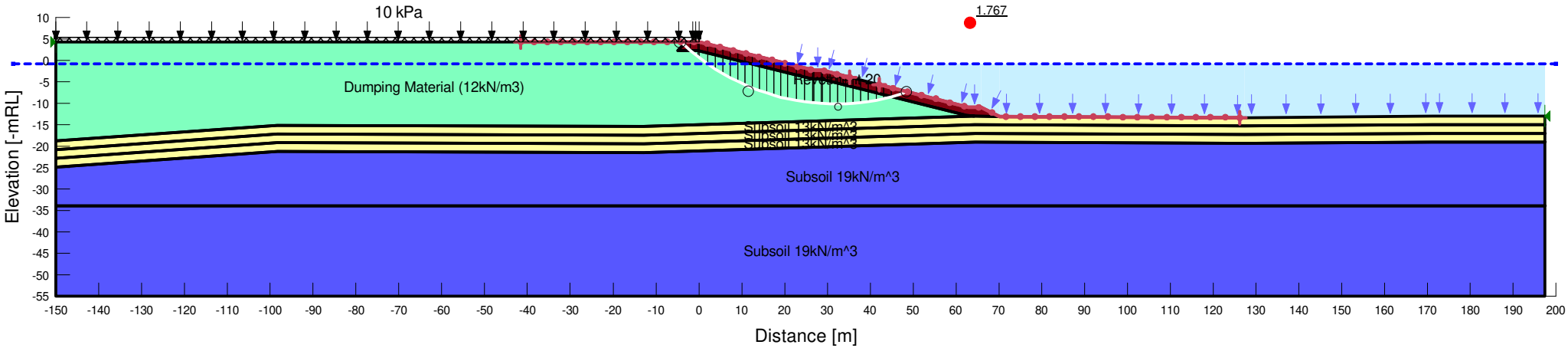
APPENDIX D

Stability Analyses (Dumpsite)

CIRCULAR ANALYSIS

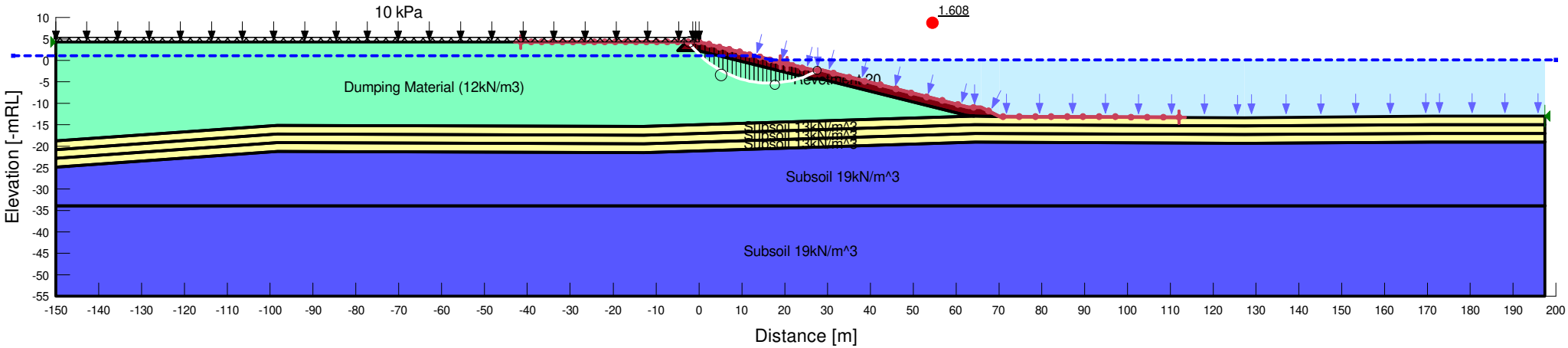
Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Dumping Material (12kN/m3)	12	0	26
	Revetment 20	20	0	40
	Subsoil 13kN/m^3	13	1	28
	Subsoil 19kN/m^3	19	1	30

Slip Surface Option: Entry and Exit
File Name: 01 Sec1 Dumpsite Revetment.gsz
Name: Revetment 1:4_MLWS_Section 1_Right
Factor of Safety: 1.767



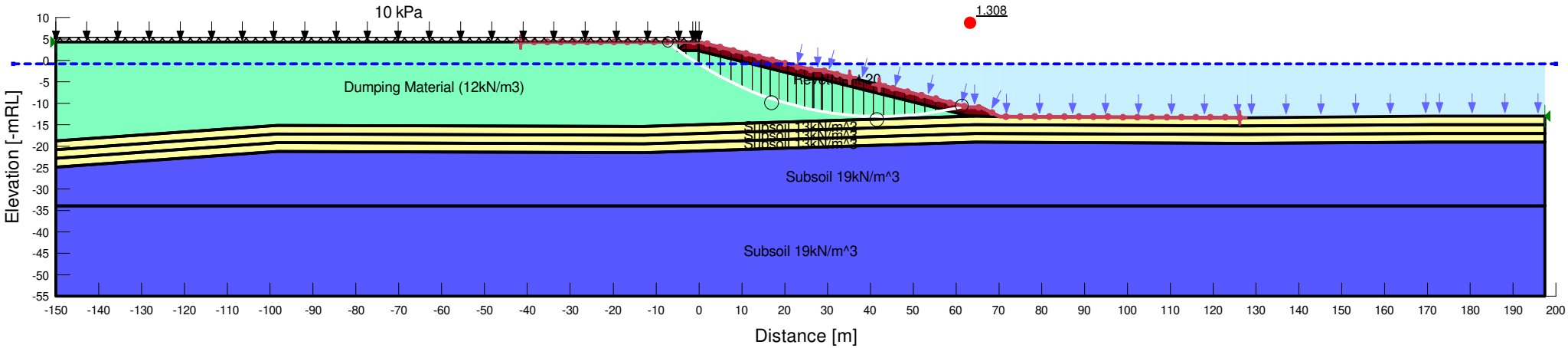
Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Dumping Material (12kN/m3)	12	0	26
	Revetment 20	20	0	40
	Subsoil 13kN/m^3	13	1	28
	Subsoil 19kN/m^3	19	1	30

Slip Surface Option: Entry and Exit
File Name: 01 Sec1 Dumpsite Revetment.gsz
Name: Revetment 1:4_MHWS to MSL_Section 1_Right
Factor of Safety: 1.608



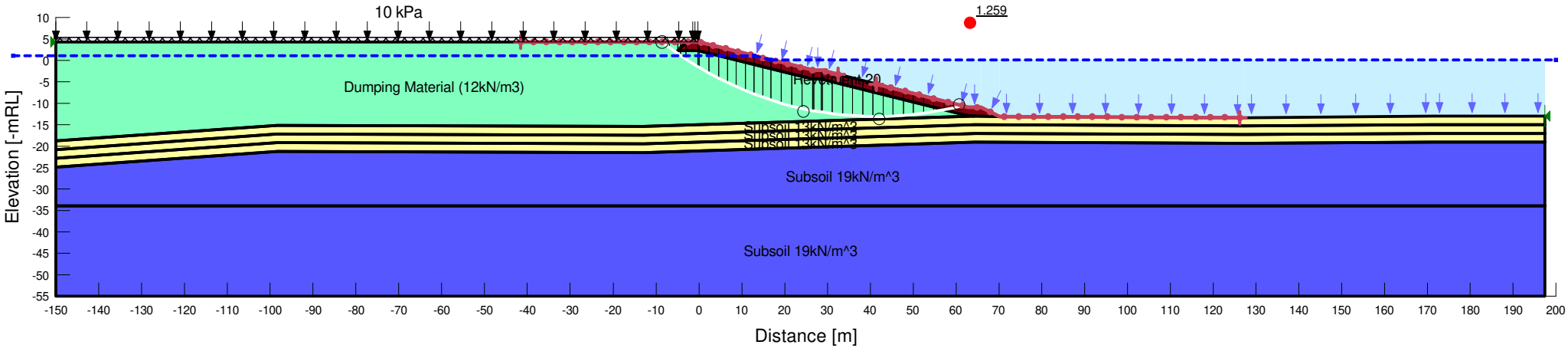
Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Dumping Material (12kN/m3)	12	0	26
	Revetment 20	20	0	40
	Subsoil 13kN/m^3	13	1	28
	Subsoil 19kN/m^3	19	1	30

Slip Surface Option: Entry and Exit
File Name: 01 Sec1 Dumpsite Revetment.gsz
Name: Revetment 1:4_MLWS_Section 1_Right (Seismic-5.55%g)
Factor of Safety: 1.308



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Dumping Material (12kN/m3)	12	0	26
	Revetment 20	20	0	40
	Subsoil 13kN/m^3	13	1	28
	Subsoil 19kN/m^3	19	1	30

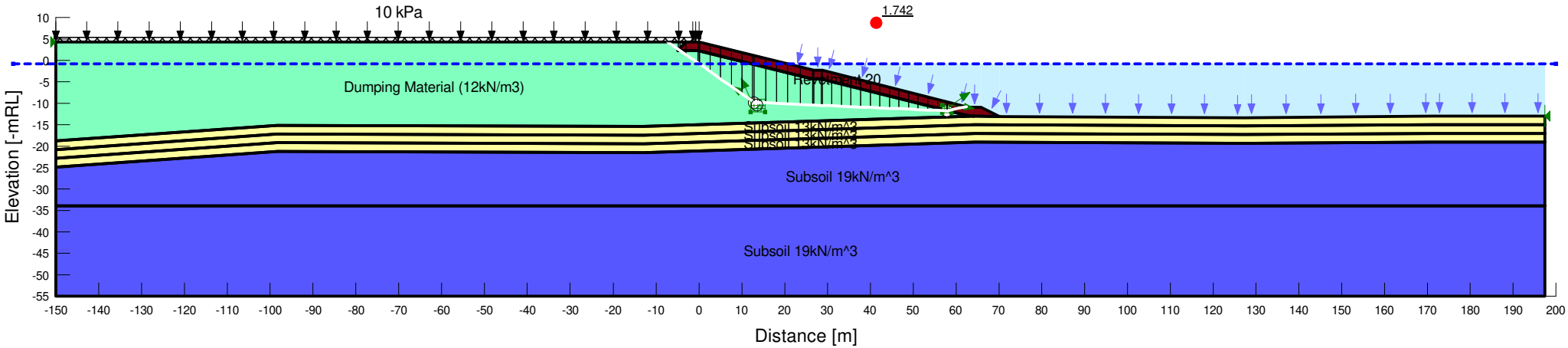
Slip Surface Option: Entry and Exit
File Name: 01 Sec1 Dumpsite Revetment.gsz
Name: Revetment 1:4_MHWS to MSL_Section 1_Right (Seismic-5.55%g)
Factor of Safety: 1.259



WEDGE ANALYSIS

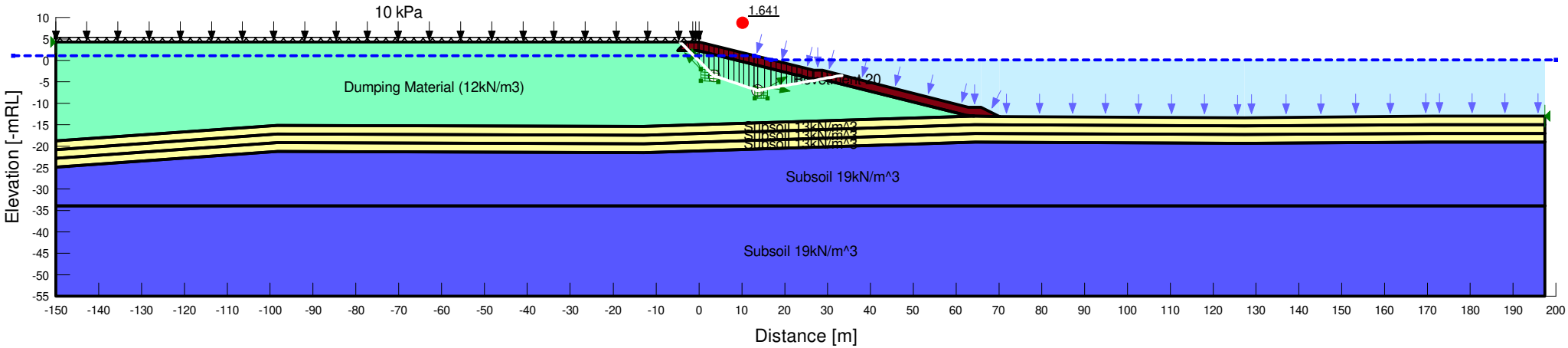
Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Dumping Material (12kN/m3)	12	0	26
	Revetment 20	20	0	40
	Subsoil 13kN/m^3	13	1	28
	Subsoil 19kN/m^3	19	1	30

Slip Surface Option: Block
File Name: 01 Sec1 Dumpsite Revetment.gsz
Name: Revetment 1:4_MLWS_Section 1_Right (2)
Factor of Safety: 1.742



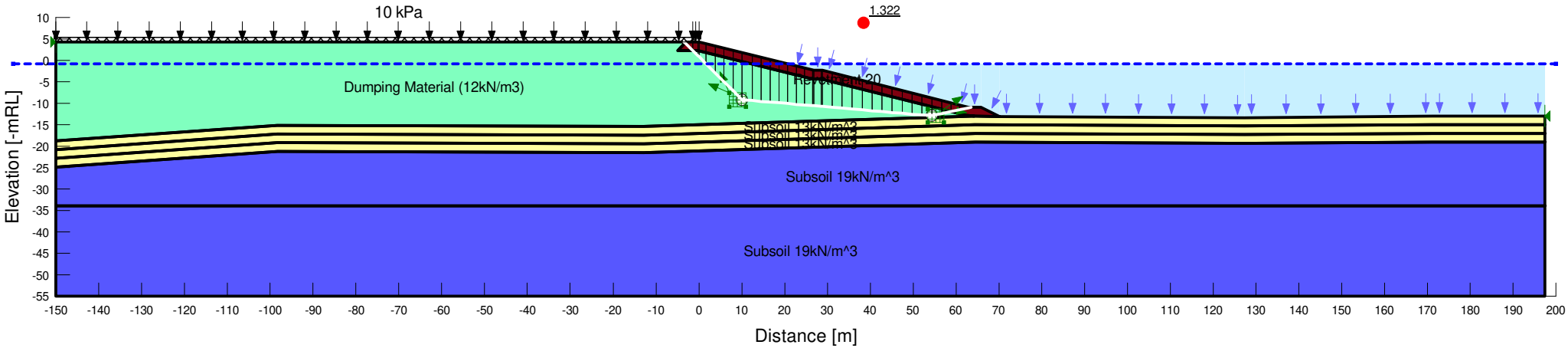
Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Dumping Material (12kN/m3)	12	0	26
	Revetment 20	20	0	40
	Subsoil 13kN/m^3	13	1	28
	Subsoil 19kN/m^3	19	1	30

Slip Surface Option: Block
File Name: 01 Sec1 Dumpsite Revetment.gsz
Name: Revetment 1:4_MHWS to MSL_Section 1_Right (2)
Factor of Safety: 1.641



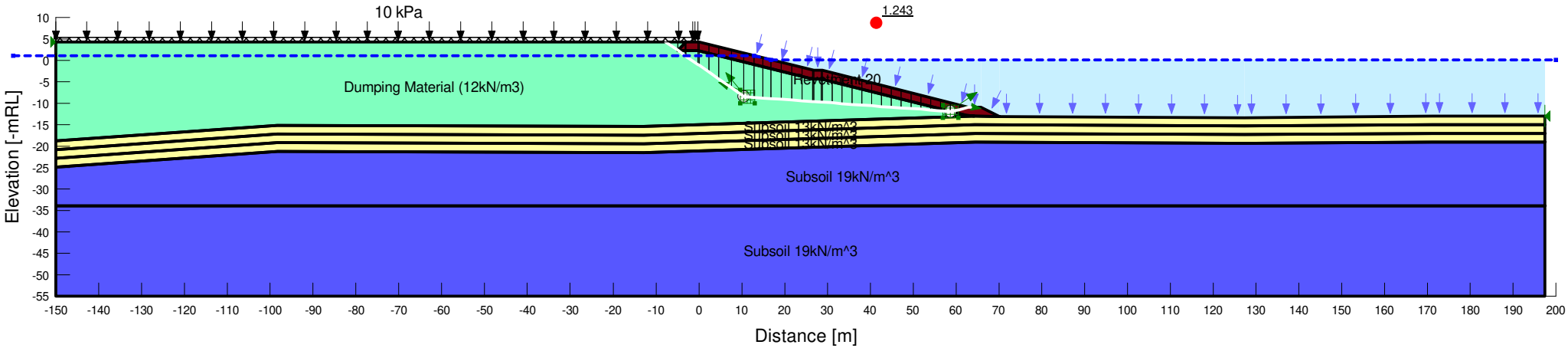
Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Dumping Material (12kN/m3)	12	0	26
	Revetment 20	20	0	40
	Subsoil 13kN/m^3	13	1	28
	Subsoil 19kN/m^3	19	1	30

Slip Surface Option: Block
File Name: 01 Sec1 Dumpsite Revetment.gsz
Name: Revetment 1:4_MLWS_Section 1_Right (Seismic-5.55%g) (2)
Factor of Safety: 1.322



Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Dumping Material (12kN/m3)	12	0	26
	Revetment 20	20	0	40
	Subsoil 13kN/m^3	13	1	28
	Subsoil 19kN/m^3	19	1	30

Slip Surface Option: Block
File Name: 01 Sec1 Dumpsite Revetment.gsz
Name: Revetment 1:4_MHWS to MSL_Section 1_Right (Seismic-5.55%g) (2)
Factor of Safety: 1.243



APPENDIX E

Prefabricated Vertical Drain (PVD) Design Calculation (Reclamation)

GLOBAL WATER CONSULTANTS SDN. BHD.	Project: 22G1646-Jelutong Rehabilitation			Project No.	
DESIGN SHEET	Work Ref.			Sheet No.	Rev.
TITLE: PVD-15m clay	Design	Check	Review	Date	

REF.	DESIGN				OUTPUT
	PRIMARY CONSOLIDATION SETTLEMENT WITH VERTICAL DRAINS				
	Design Parameters				
	Drain Width, b	:	100	mm	
	Drain Thickness, t	:	4	mm	
	Radius of Vertical Drain, r_w	:	26	mm	
	Ratio Radius Smear Zone (r_s) to r_w, r_s/r_w :		5		
	Radius of Smear Zone, r_s	:	130.00	mm	
	Square/Triangular Grids, Ds	:	Triangular	1.10 m Grid	
	Radius of Equivalent Circle, r_e	:	577.54	mm	
	Vertical Drainage Distance, H_{dr}	:	7.5	m	
	Coef. Of Consolidation (Radial), C_{vr}	:	4	m^2/yr	
	Coef. Of Consolidation (Vertical), C_v	:	2	m^2/yr	
	Permeability Ratio, k_h/k_s	:	2		
	Time Lapse for Treatment, t	:	0.42	years = 5 Months	
	Average Drain Length, L_d	:	18.0	m	
	Calculated Parameters				
	Ratio, n = r_e/r_w	:	22.21		
	Ratio, S = r_s/r_w	:	5.00		
	m	:	3.89		
	Average Degree of Consolidation (Equal Strain Conditions) :				
	For Radial Flow, U_r	:	92.342	%	
	For Vertical Flow, U_v	:	13.73	%	
	Overall Consolidation, U_{total}	:	93.39	%	
	References:				
	Barron, R. A. (1948), "Consolidation of fine-grained soils by drain wells", Trans Am Soc. Civ. Engrs, 113, Paper 2346, 718-754.				
	Hansbo, S. (1979), "Consolidation of clay by band-shaped prefabricated drains", Ground Engineering, 12, 5, 16-25.				
	Kjellman, W. (1948), "Accelerating consolidation of fine grained soils by means of cardboard wicks", Proc. 2nd Int. Conf. On Soil Mech.and Foun. Eng. Vol. II, Rotterdam, 302-305.				

GLOBAL WATER CONSULTANTS SDN. BHD.	Project: Jelutong Rehabilitation			Project No.	
DESIGN SHEET	Work Ref.			Sheet No.	Rev.
TITLE: PVD-15m clay	Design	Check	Review	Date	

REF. | DESIGN | OUTPUT

Spacing (m)

Rest Period (Month)	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90
1	50.55	43.86	38.38	33.90	30.21	27.16	24.62	22.48	20.68	19.15
2	74.65	67.33	60.64	54.71	49.51	45.00	41.10	37.72	34.79	32.24
3	86.93	80.87	74.71	68.78	63.26	58.23	53.70	49.66	46.07	42.88
4	93.24	88.77	83.71	78.42	73.19	68.18	63.50	59.19	55.26	51.70
5	96.50	93.39	89.48	85.05	80.39	75.71	71.17	66.85	62.82	59.08
6	98.18	96.11	93.20	89.63	85.64	81.44	77.20	73.04	69.05	65.28
7	99.06	97.71	95.60	92.80	89.47	85.80	81.95	78.05	74.22	70.52
8	99.51	98.65	97.15	95.00	92.28	89.13	85.69	82.12	78.50	74.94
9	99.74	99.20	98.15	96.52	94.33	91.67	88.66	85.42	82.07	78.69
10	99.87	99.53	98.80	97.58	95.84	93.61	91.00	88.10	85.03	81.87
11	99.93	99.72	99.22	98.32	96.94	95.10	92.86	90.29	87.50	84.56
12	99.96	99.83	99.50	98.83	97.75	96.24	94.33	92.07	89.55	86.85

GLOBAL WATER CONSULTANTS SDN. BHD.	Project: 22G1646-Jelutong Rehabilitation			Project No.	
DESIGN SHEET	Work Ref.			Sheet No.	Rev.
TITLE: PVD-10m clay	Design	Check	Review	Date	

REF.	DESIGN					OUTPUT
	PRIMARY CONSOLIDATION SETTLEMENT WITH VERTICAL DRAINS					
	Design Parameters					
	Drain Width, b	:	100	mm		
	Drain Thickness, t	:	4	mm		
	Radius of Vertical Drain, r_w	:	26	mm		
	Ratio Radius Smear Zone (r_s) to r_w, r_s/r_w :		5			
	Radius of Smear Zone, r_s	:	130.00	mm		
	Square/Triangular Grids, Ds	:	Triangular	1.10	m Grid	
	Radius of Equivalent Circle, r_e	:	577.54	mm		
	Vertical Drainage Distance, H_{dr}	:	5	m		
	Coef. Of Consolidation (Radial), C_{vr}	:	4	m^2/yr		
	Coef. Of Consolidation (Vertical), C_v	:	2	m^2/yr		
	Permeability Ratio, k_h/k_s	:	2			
	Time Lapse for Treatment, t	:	0.42	years =	5 Months	
	Average Drain Length, L_d	:	18.0	m		
	Calculated Parameters					
	Ratio, n = r_e/r_w	:	22.21			
	Ratio, S = r_s/r_w	:	5.00			
	m	:	3.89			
	Average Degree of Consolidation (Equal Strain Conditions) :					
	For Radial Flow, U_r	:	92.342	%		
	For Vertical Flow, U_v	:	20.60	%		
	Overall Consolidation, U_{total}	:	93.92	%		
	References:					
	Barron, R. A. (1948), "Consolidation of fine-grained soils by drain wells", Trans Am Soc. Civ. Engrs, 113, Paper 2346, 718-754.					
	Hansbo, S. (1979), "Consolidation of clay by band-shaped prefabricated drains", Ground Engineering, 12, 5, 16-25.					
	Kjellman, W. (1948), "Accelerating consolidation of fine grained soils by means of cardboard wicks", Proc. 2nd Int. Conf. On Soil Mech.and Foun. Eng. Vol. II, Rotterdam, 302-305.					

GLOBAL WATER CONSULTANTS SDN. BHD.	Project			Project No.	
	Jelutong Rehabilitation				
DESIGN SHEET	Work Ref.			Sheet No.	Rev.
TITLE	Design	Check	Review	Date	
PVD-10m clay					

REF. | DESIGN | OUTPUT

Spacing (m)

Rest Period (Month)	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90
1	52.17	45.69	40.40	36.06	32.49	29.54	27.08	25.02	23.28	21.79
2	75.86	68.88	62.52	56.86	51.91	47.62	43.90	40.68	37.89	35.46
3	87.71	82.01	76.22	70.64	65.45	60.72	56.46	52.66	49.28	46.28
4	93.71	89.56	84.85	79.93	75.06	70.41	66.06	62.05	58.39	55.08
5	96.78	93.92	90.32	86.24	81.95	77.65	73.47	69.49	65.78	62.34
6	98.34	96.45	93.80	90.55	86.91	83.08	79.22	75.43	71.79	68.36
7	99.15	97.93	96.02	93.50	90.50	87.18	83.70	80.18	76.72	73.38
8	99.56	98.79	97.45	95.52	93.09	90.27	87.20	84.00	80.76	77.58
9	99.77	99.29	98.36	96.92	94.97	92.61	89.94	87.07	84.09	81.10
10	99.88	99.58	98.95	97.87	96.34	94.38	92.09	89.54	86.83	84.05
11	99.94	99.76	99.32	98.53	97.33	95.73	93.77	91.53	89.10	86.54
12	99.97	99.86	99.56	98.99	98.06	96.75	95.10	93.14	90.97	88.63

GLOBAL WATER CONSULTANTS SDN. BHD.	Project: 22G1646-Jelutong Rehabilitation			Project No.	
DESIGN SHEET	Work Ref.			Sheet No.	Rev.
TITLE: PVD-5m clay	Design	Check	Review	Date	

REF.	DESIGN			OUTPUT
	PRIMARY CONSOLIDATION SETTLEMENT WITH VERTICAL DRAINS			
	Design Parameters			
	Drain Width, b	: 100	mm	
	Drain Thickness, t	: 4	mm	
	Radius of Vertical Drain, r_w	: 26	mm	
	Ratio Radius Smear Zone (r_s) to r_w, r_s/r_w :	5		
	Radius of Smear Zone, r_s	: 130.00	mm	
	Square/Triangular Grids, Ds	: Triangular	1.10 m Grid	
	Radius of Equivalent Circle, r_e	: 577.54	mm	
	Vertical Drainage Distance, H_{dr}	: 2.5	m	
	Coef. Of Consolidation (Radial), C_{vr}	: 4	m^2/yr	
	Coef. Of Consolidation (Vertical), C_v	: 2	m^2/yr	
	Permeability Ratio, k_h/k_s	: 2		
	Time Lapse for Treatment, t	: 0.42	years = 5 Months	
	Average Drain Length, L_d	: 18.0	m	
	Calculated Parameters			
	Ratio, n = r_e/r_w	: 22.21		
	Ratio, S = r_s/r_w	: 5.00		
	m	: 3.89		
	Average Degree of Consolidation (Equal Strain Conditions) :			
	For Radial Flow, U_r	: 92.342	%	
	For Vertical Flow, U_v	: 41.20	%	
	Overall Consolidation, U_{total}	: 95.50	%	
	References:			
	Barron, R. A. (1948), "Consolidation of fine-grained soils by drain wells", Trans Am Soc. Civ. Engrs, 113, Paper 2346, 718-754.			
	Hansbo, S. (1979), "Consolidation of clay by band-shaped prefabricated drains", Ground Engineering, 12, 5, 16-25.			
	Kjellman, W. (1948), "Accelerating consolidation of fine grained soils by means of cardboard wicks", Proc. 2nd Int. Conf. On Soil Mech.and Foun. Eng. Vol. II, Rotterdam, 302-305.			

GLOBAL WATER CONSULTANTS SDN. BHD.

DESIGN SHEET

Project Jelutong Rehabilitation			*Project No.*	
Work Ref.			*Sheet No.*	*Rev.*
TITLE PVD-5m clay	*Design*	*Check*	*Review*	*Date*

REF. | DESIGN | OUTPUT

Spacing (m)

Rest Period (Month) 95	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90
1	57.02	51.21	46.45	42.55	39.34	36.69	34.48	32.63	31.06	29.73
2	79.47	73.54	68.13	63.32	59.12	55.47	52.30	49.57	47.19	45.13
3	90.04	85.43	80.73	76.22	72.01	68.18	64.73	61.65	58.91	56.48
4	95.13	91.92	88.27	84.46	80.70	77.09	73.72	70.62	67.79	65.23
5	97.61	95.50	92.83	89.81	86.64	83.45	80.35	77.41	74.66	72.11
6	98.83	97.49	95.61	93.30	90.73	88.01	85.27	82.59	80.01	77.58
7	99.42	98.60	97.31	95.60	93.56	91.31	88.95	86.57	84.22	81.96
8	99.72	99.22	98.35	97.10	95.53	93.70	91.71	89.64	87.54	85.48
9	99.86	99.56	98.99	98.09	96.89	95.43	93.78	92.01	90.17	88.32
10	99.93	99.76	99.38	98.75	97.84	96.69	95.34	93.84	92.25	90.61
11	99.97	99.86	99.62	99.17	98.49	97.58	96.47	95.21	93.83	92.38
12	99.98	99.92	99.76	99.45	98.95	98.24	97.35	96.29	95.12	93.85

GLOBAL WATER CONSULTANTS SDN. BHD.	Project: 22G1646-Jelutong Rehabilitation			Project No.	
DESIGN SHEET	Work Ref.			Sheet No.	Rev.
TITLE: PVD-3m clay	Design	Check	Review	Date	

PRIMARY CONSOLIDATION SETTLEMENT WITH VERTICAL DRAINS

REF.	DESIGN			OUTPUT
	Design Parameters			
	Drain Width, b	: 100	mm	
	Drain Thickness, t	: 4	mm	
	Radius of Vertical Drain, r_w	: 26	mm	
	Ratio Radius Smear Zone (r_s) to r_w, r_s/r_w :	5		
	Radius of Smear Zone, r_s	: 130.00	mm	
	Square/Triangular Grids, Ds	: Triangular	1.10 m Grid	
	Radius of Equivalent Circle, r_e	: 577.54	mm	
	Vertical Drainage Distance, H_{dr}	: 1.5	m	
	Coef. Of Consolidation (Radial), C_{vr}	: 4	m^2/yr	
	Coef. Of Consolidation (Vertical), C_v	: 2	m^2/yr	
	Permeability Ratio, k_h/k_s	: 2		
	Time Lapse for Treatment, t	: 0.42	years = 5 Months	
	Average Drain Length, L_d	: 18.0	m	
	Calculated Parameters			
	Ratio, n = r_e/r_w	: 22.21		
	Ratio, S = r_s/r_w	: 5.00		
	m	: 3.89		
	Average Degree of Consolidation (Equal Strain Conditions) :			
	For Radial Flow, U_r	: 92.342	%	
	For Vertical Flow, U_v	: 67.50	%	
	Overall Consolidation, U_{total}	: 97.51	%	

References:

Barron, R. A. (1948), "Consolidation of fine-grained soils by drain wells", Trans Am Soc. Civ. Engrs, 113, Paper 2346, 718-754.

Hansbo, S. (1979), "Consolidation of clay by band-shaped prefabricated drains", Ground Engineering, 12, 5, 16-25.

Kjellman, W. (1948), "Accelerating consolidation of fine grained soils by means of cardboard wicks", Proc. 2nd Int. Conf. On Soil Mech.and Foun. Eng. Vol. II, Rotterdam, 302-305.

GLOBAL WATER CONSULTANTS SDN. BHD.	Project			Project No.	
	Jelutong Rehabilitation				
DESIGN SHEET	Work Ref.			Sheet No.	Rev.
TITLE	Design	Check	Review	Date	
0					

REF.	DESIGN	OUTPUT

Spacing (m)

Rest Period (Month)	98	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90
	1	63.49	58.55	54.51	51.20	48.48	46.23	44.35	42.78	41.44	40.31
	2	84.30	79.76	75.62	71.94	68.72	65.93	63.51	61.42	59.60	58.02
	3	93.15	89.98	86.76	83.65	80.76	78.12	75.75	73.63	71.75	70.08
	4	96.99	95.00	92.75	90.40	88.07	85.84	83.76	81.85	80.10	78.51
	5	98.68	97.51	96.04	94.37	92.61	90.85	89.14	87.51	85.99	84.58
	6	99.42	98.76	97.83	96.70	95.42	94.09	92.73	91.41	90.14	88.94
	7	99.75	99.38	98.81	98.06	97.17	96.18	95.14	94.09	93.06	92.06
	8	99.89	99.69	99.35	98.86	98.24	97.53	96.75	95.93	95.11	94.30
	9	99.95	99.85	99.65	99.33	98.91	98.40	97.82	97.20	96.56	95.91
	10	99.98	99.92	99.81	99.61	99.33	98.97	98.54	98.08	97.58	97.07
	11	99.99	99.96	99.89	99.77	99.58	99.33	99.03	98.68	98.30	97.90
	12	100.00	99.98	99.94	99.87	99.74	99.57	99.35	99.09	98.80	98.49

APPENDIX F

Earthwork and Erosion & Sediment Control (ESCP) report

PLB ENGINEERING BERHAD

(Company No: 199701002728 (418224-X))

REHABILITATION AND RECLAMATION PLAN & EARTHWORK EROSION AND SEDIMENT CONTROL PLAN (ESCP) REPORT

PERMOHONAN PELAN KERJA TANAH UNTUK KERJA-KERJA TEBUSGUNA TANAH BAGI PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIADA), SEKSYEN 8, BANDAR GEORGETOWN, PULAU PINANG.

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PLB ENGINEERING BERHAD

(Company No: 199701002728 (418224-X))

REHABILITATION AND RECLAMATION PLAN & EARTHWORK EROSION & SEDIMENT CONTROL PLAN (ESCP) REPORT

PERMOHONAN PELAN KERJA TANAH UNTUK KERJA-KERJA TEBUSGUNA TANAH BAGI PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIADA), SEKSYEN 8, BANDAR GEORGETOWN, PULAU PINANG.

Prepared for:
PLB ENGINEERING BERHAD
1320, Jalan Baru,
Taman Chai Leng,
13700 Prai,
Penang.

November 2023

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Project Information 2
1.2 Limitation on Use and Liability 3
2.0 BACKGROUND 4
3.0 SITE DESCRIPTION 5
3.1 Project Location and Layout Plan 5
3.2 Water Levels and Tidal Range 8
4.0 REHABILITATION / RECLAMATION STRATEGY 9
5.0 PROJECT METHOD STATEMENT 11
5.1 Rehabilitation and Reclamation Phases 13
5.2 Reclamation Construction Stages 17
6.0 PROJECT WORK PROGRAMME 19
7.0 EROSION AND SEDIMENT CONTROL PLAN (ESCP) 20
7.1 Introduction 20
7.2 General Construction Condition 20
7.3 Proposed Control Measures 20
7.3.1 Hoarding 21
7.3.2 Silt Curtain for Filling Works 21
7.3.3 Silt Fence 22
7.3.4 Site Access and Wash Trough 22
7.3.5 Temporary Earth Drain 23
7.4 Best Management Practices 24
7.4.1 Silt Curtain and Filling Works 24
7.4.2 Silt Fence 24
7.4.3 Wash Trough 25
7.4.4 Temporary Earth Drain 25
7.4.5 Laydown Area 25
8.0 SITE INSPECTION, MAINTENANCE AND MONITORING 26
8.1 Site Inspection and Maintenance 26
9.0 SUMMARY 27
10.0 ENGINEER'S DECLARATION 28

LIST OF FIGURES

Figure 1: Key Plan and Location Plan. 5
Figure 2: Rehabilitation and Reclamation Layout Plan. 6
Figure 3: Reclamation Cross Section (Section A-A) & (Section B-B). 7
Figure 4: Layout of the Waste Bulk Construction Material Recycling Machines. 10
Figure 5: Overall Work Flow of the Rehabilitation and Reclamation Plan. 12
Figure 6: Reclamation Construction Stages. 18

LIST OF TABLES

Table 1: Tidal Chart. 8
Table 2: The Proposed Work Programme for the Rehabilitation and Reclamation. 19
Table 3: Specification of Silt Curtain. 21

LIST OF APPENDICES

Appendix A: Erosion and Sediment Control Plan (ESCP) Layout
Appendix B: Proposed Hoarding Details
Appendix C: Proposed Silt Curtain Details
Appendix D: Proposed Silt Fence, Wash Trough and Temporary Earth Drain Details

1.0 INTRODUCTION

Global Water Consultants Sdn. Bhd. has been engaged by PLB Engineering Bhd. (hereinafter refer to as the 'Client'), as the reclamation and geotechnical consultant for land reclamation of the proposed development (hereinafter refer to as the 'Project') titled:

"PERMOHONAN PELAN KERJA TANAH UNTUK CADANGAN PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIADA), SEKSYEN 8, BANDAR GEORGETOWN, PULAU PINANG UNTUK TETUAN: PLB ENGINEERING BHD".

The proposed development consists of two parts namely the rehabilitation of the existing 90 acres Jelutong dumpsite (JDS) and 70 acres reclamation fill adjacent to the dumpsite.

The objective of this report is to present the **rehabilitation and reclamation plan & erosion and sediment control plan (ESCP)** for the Project.

1.1 Project Information

Project Title	PERMOHONAN PELAN KERJA TANAH BAGI PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIADA), SEKSYEN 8, BANDAR GEORGETOWN, PULAU PINANG UNTUK TETUAN: PLB ENGINEERING BHD
Developer	**PLB Engineering Bhd.** 1320, Jalan Baru, Taman Chai Leng, 13700 Prai, Penang. Tel: +604-390 5737 Fax: +604-397 5350 Contact Person: Dato Siow Kok Yong
Architect	**W. K. Khor Architect Sdn. Bhd.** 33, College Avenue, 10250, Georgetown, Penang Tel.: +604-228 8770 Fax: +604-226 6771 Contact Person: Ang Boon Huat
Reclamation Engineer	**Global Water Consultants Sdn. Bhd.** 23-4, Jalan Tasik Selatan 3, Bandar Tasik Selatan, 57000 Kuala Lumpur. Tel: +603-9059 5396 Fax: +603-9059 5869 Contact Person: Ir. Lim Choon Lin
Approving Authorities	Majlis Bandaraya Pulau Pinang Jabatan Pengairan dan Saliran Negeri Pulau Pinang Jabatan Kerja Raya Pulau Pinang Jabatan Mineral dan Geosains Malaysia (Kedah / Perlis / Pulau Pinang)

1.2 Limitation on Use and Liability

This report is confined to and for the sole use by the Client and the Local Authorities for the specific purpose to which it refers. It may be disclosed to other professional advisors assisting the Client and/or the Local Authorities in respect of the particular purpose only. This report is given in good faith based on best available information obtained from the Client and the Consultant shall not be held liable in any way whatsoever for misuse of the report.

Please note that as this rehabilitation and reclamation plan & ESCP report is submitted for excavation at existing dumpsite for rehabilitation and sea reclamation works, control measures for landside development are not included. A separate ESCP shall be submitted by the C&S Engineer for infrastructure and landside development.

2.0 BACKGROUND

Based on the report entitled “Jelutong Dump Site, Penang – Preliminary Investigation & Conceptual Closure Options Appraisal” prepared for the Penang Development Corporation by the consultants M.E.I. Consultants Sdn. Bhd. based in Penang and CH2M HILL Malaysia Sdn. Bhd., records indicate that waste disposal commenced within JDS as early as the late 1990s as part of the redevelopment of adjoining land and the construction of the Tun Dr Lim Chong Eu Expressway in 2001. The predominant waste stream is understood to have been residential collection wastes comprising putrescible, biodegradable materials (referred to herein as MSW) such as food, packaging, paper, timber, and plastics.

A majority of the wastes after 2002 comprised of construction, demolition and soils excavated as part of the ongoing development works on Penang Island. Green wastes collected from parkland areas were also disposed at the JDS.

Formal records of individual waste streams are not available prior to 2005. However, it is considered that a greater proportion of the waste input would be comprised of MSW derived from residential dwellings.

From 2005, following the diversion of residential (household) waste streams away from the JDS, disposal of wastes was largely estimated to be from construction, demolition and soil materials derived from foundation construction works on the Island (e.g., piling). Green (park) type wastes are still being accepted at JDS, but is likely to represent a low percentage by tonne of the current total waste input to the site.

Based on a topographic survey of the dumpsite carried out in August 2021, the estimated volume of the dump site materials is 7,380,000 m^3 and the waste height has reached some 37 m above mean sea level (MSL).

The current lateral extent of the JDS is already at its capacity for the waste disposal operations to expand southwards, northwards or eastwards. Expansion of the waste disposal operations is blocked by two stormwater / treatment plant drains located immediately north and south of the dumpsite. However, it is understood that wastes are still being dumped at JDS annually by increasing the waste height. This is significant in terms of maintaining stable side slopes now that the waste height is up to 37 m above MSL.

3.0 SITE DESCRIPTION

3.1 Project Location and Layout Plan

The location plan for the proposed reclamation and development is as shown in **Figure 1.** The proposed project site is located at Jelutong Town, bounded between The Light reclamation at the southern side and Sungai Pinang at the northern side. The existing Jelutong dumpsite is located directly adjacent to Tun Dr. Lim Chong Eu Highway and stretches ~820 m seaward and is approximately 90 acres. The existing level of the dumpsite is up to +37 mNGVD at its highest and closer towards Tun Dr. Lim Chong Eu Highway and is +4mNGVD at its lowest further seaward and slopes into the sea. The dumpsite is to be rehabilitated and dump materials removed to final platform level of +4.35 mNGVD.

The proposed reclamation is approximately 70 acres and is located north of the existing Jelutong dumpsite and adjacent to Karpal Singh Drive. The final platform level of the proposed reclamation development is +4.35 mNGVD. The layout of proposed reclamation and sections are shown in **Figure 2** and **Figure 3** respectively.

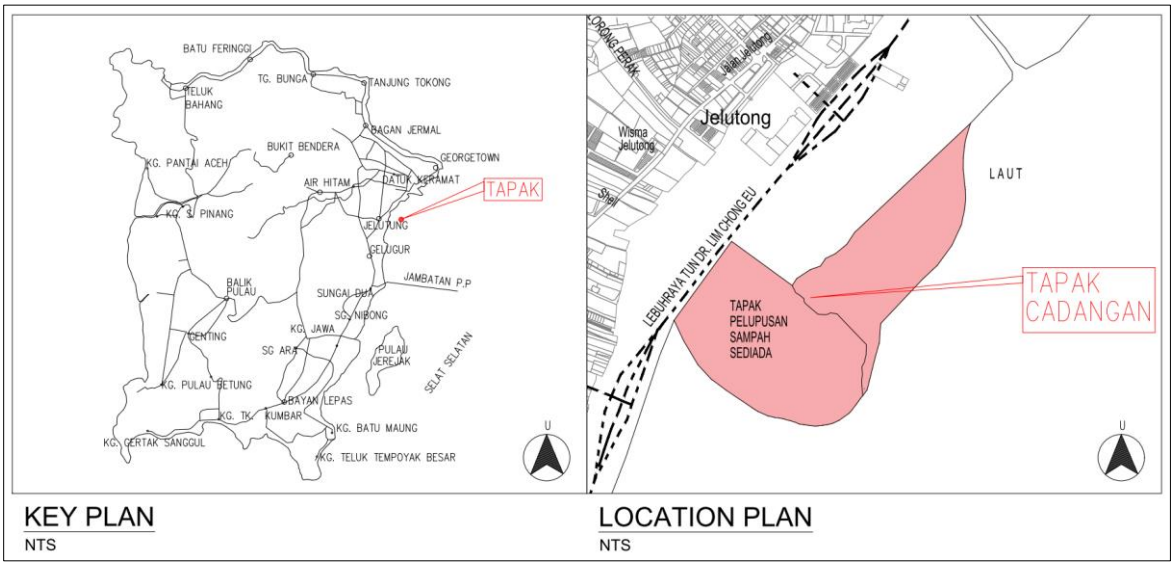


Figure 1: Key Plan and Location Plan.

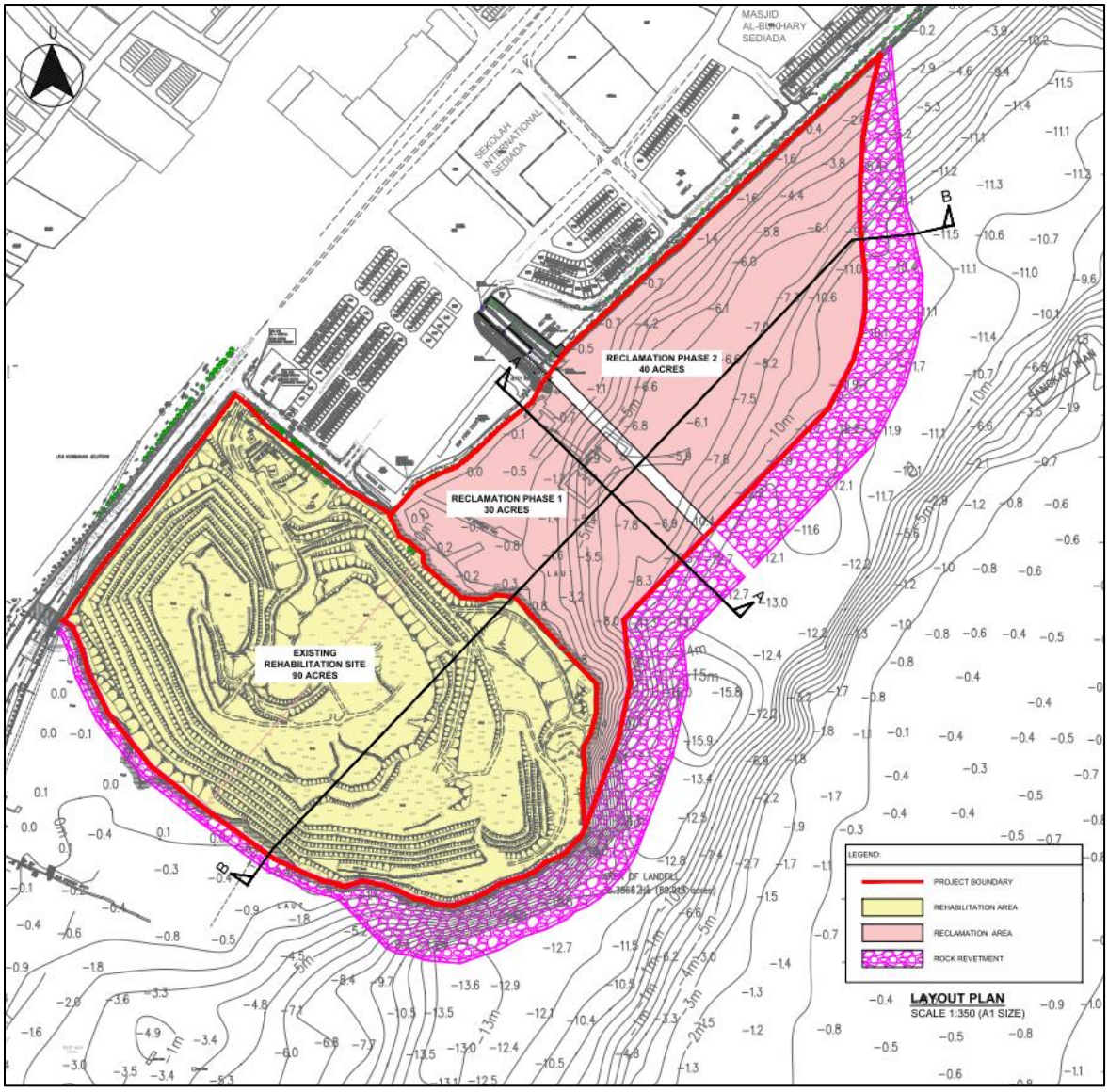


Figure 2: Rehabilitation and Reclamation Layout Plan.

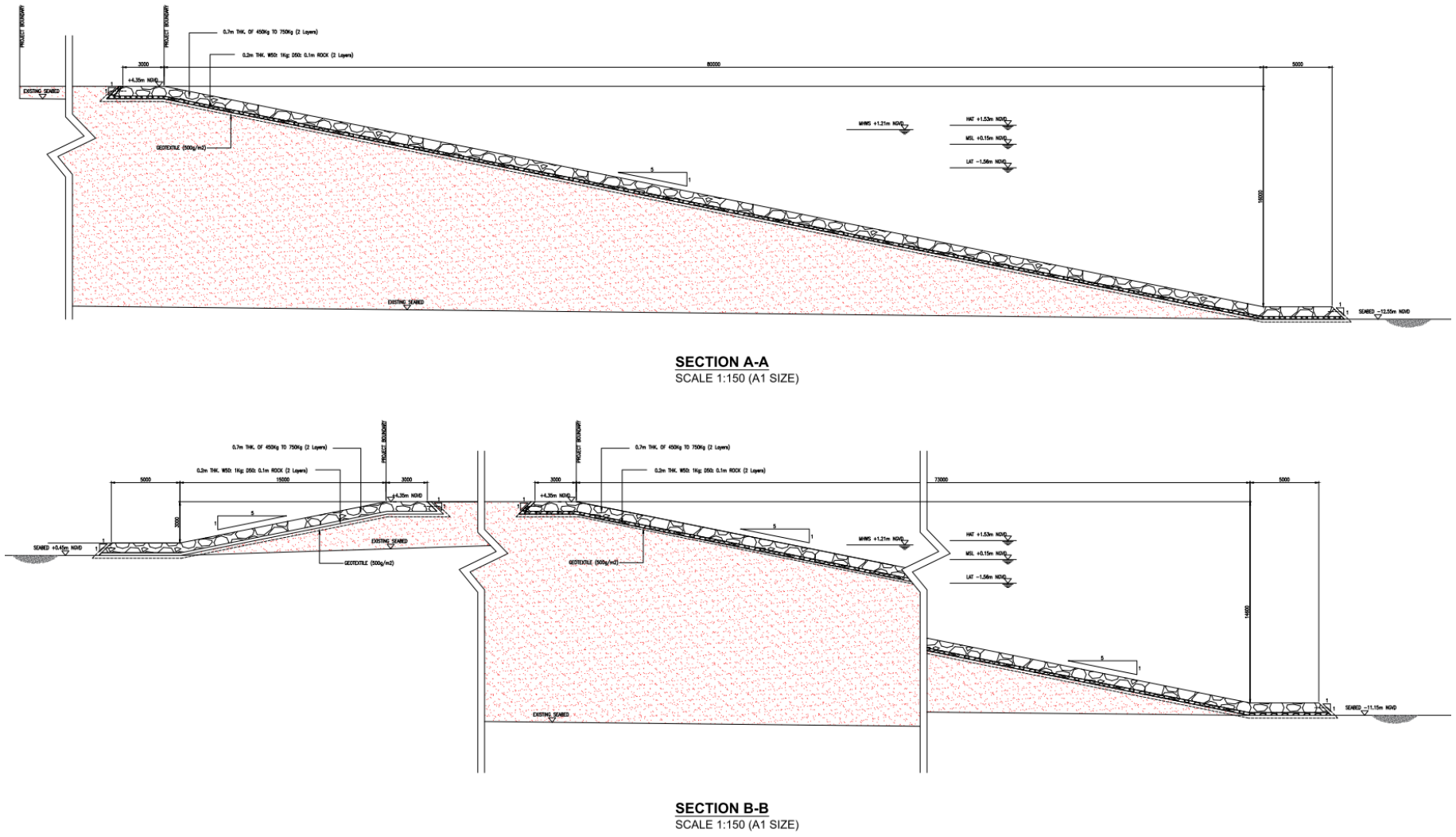


Figure 3: Reclamation Cross Section (Section A-A) & (Section B-B).

3.2 Water Levels and Tidal Range

Due to the influence of tidal effects in the open sea (near-shore and off-shore), seawater levels can vary considerably. As such, it is important to be aware of the seawater levels under the influence of tidal effects. **Table 1** summarises the abovementioned tidal levels at Standard Port at Kedah Pier, Penang.

According to the Tide Tables Malaysia 2023 published by the National Hydrographic Centre, Royal Malaysian Navy and the Bathymetric Survey of the proposed site dated July 2020, the seawater levels at the outermost region of the proposed reclamation is estimated to range from 9m to 13m above the seabed (based on Mean High Water Spring – MHWS at +1.13mNGVD).

Table 1: Tidal Chart.

Tide	Chart Datum Level (mCD)	National Geodatic Vertical Datum Level (mNGVD)
Lowest Astronomical Tide (LAT	0.00	-1.56
Mean Low Water Spring (MLWS)	0.72	-0.84
Mean Low Water Neap (MLWN)	1.45	-0.11
Mean Sea Level (MSL)	1.71	0.15
Mean High Water Neap (MHWN)	1.96	0.40
Mean High Water Spring (MHWS)	2.69	1.13
Highest Astronomical Tide (HAT)	3.09	1.53
Proposed Platform Level	5.91	4.35

Note: Tidal Levels above are referenced to the Standard Port at Kedah Pier, Penang.

4.0 REHABILITATION / RECLAMATION STRATEGY

PLB Engineering Bhd. has proposed a combination of the following strategies when carrying out the rehabilitation / reclamation plan:

- The need to reduce waste heights to improve amenity and safety for surrounding communities. One of the key outcomes of the community consultation process is to provide some open space when JDS is rehabilitated. It is thus considered that some reshaping of the current waste profile is required in order to achieve this.
- In reducing the waste heights a large proportion of materials would be recovered, recycled and used to construct engineered fill development platforms within the JDS site and also along other sections of the coastline. This not only enhances the current dumpsite but would also provide additional land along the coastline.
- In constructing an engineered fill development platform at JDS there is also a need to cap, contain and manage MSW within the JDS.

In order to rehabilitate the JDS site an adjacent 70 acres reclamation site platform need to be reclaimed so that recycling equipment could be installed progressively to meet the schedule masterplan timeline. The details of this combined 90 acres JDS rehabilitation plan and 70 acres adjoining reclamation plan is described in the next section. Broadly, the volumes involved are as follows:

1. Estimated Volume of waste at Rehabilitation Area from level 0.00m MSL to +37.00m MSL = **7,380,000 m^3** ;
2. Volume of suitable sand required at adjoining reclaimed site to fill up to an initial platform level of Mean High-Water Spring (MHWS) + 0.5 m, 1.63m NGVD = **2,520,000 m^3;**
3. Volume of recycled suitable material that is required to fill the 70 acres reclamation area from MHWS + 0.5 m until the surcharge height of 7 m = **3,350,000 m^3;**
4. Estimated volume of **6,624,000 m^3** available from level +3.35m MSL to +37.00m MSL that can be recycled to usable material for reclamation in **Item 3** above is 65% = 0.65 x 6,624,000 = **4,305,600 m^3;**
5. Of the 4,305,600 m^3, 3,350,000m^3 would be utilised for Item 3 above and the balance **960,000m^3** could be used for topping up the platform level from +4.35m NGVD to +5.00m NGVD and +5.35m NGVD at New Reclamation Area and Rehabilitation Area respectively.
6. Estimated volume of the balance 35% = 0.35 x 6,624,000 m^3 = **2,318,000 m^3** unsuitable material can be sold as secondary bulk aggregate material (reinforcement bars, old tyres, etc) for construction and the balance would be disposed of at an approved dumping ground at Pulau Burong.

In total, 20 waste bulk construction material recycling machines (see **Figure 4** below) would be installed progressively commencing from the only suitable site on the 90 acres JDS dumpsite and the balance to be installed on the adjoining 70 acres reclamation site.

Each sorting line of Recycling Machines input / output and performance criteria would be as follows:

a) Design capacity for 1 sorting line is 60 m^3/hr.
b) Working operation for the machine is 10 hours.
c) 1 sorting line will need 5,000 m^2 of drying area for lowering moisture of waste.
d) 25 days to finish installation of 1 sorting line.
e) Working platform for 1 line will be about 55 m long, 22 m wide and 9 m high.
f) Working platform for 1 line with another sorting line is 20 m.
g) Estimated time for setting up 1 rehabilitation working platform to accommodate 2 recycling machines (2 sorting lines) is 4 months.
h) Designed capacity for 1 sorting line is 60m^3 / hr
i) Working operation for machine is 10hours
j) Hence , 60m3 x 10hr = 600m^3/day/line
k) Assuming 65% are the reusable material to be reused for surcharging at reclamation area = 65% x 600m^3/day/line = 400m^3/day/line
l) Daily production based on 2 sorting lines, = 2 x 400 = **800m3/day**
m) The initial area (WP1) described and shown in the subsequent section would be near to the existing weigh-bridge office and current site office area.
n) It is envisaged that during the process of rehabilitating the 90 acres JDS dumpsite, there will be ongoing waste dumping activities, therefore, coordination between all relevant parties involved is needed so that both activities can go on concurrently and smoothly until a point in time when the waste dumping activities can be relocated to another site.

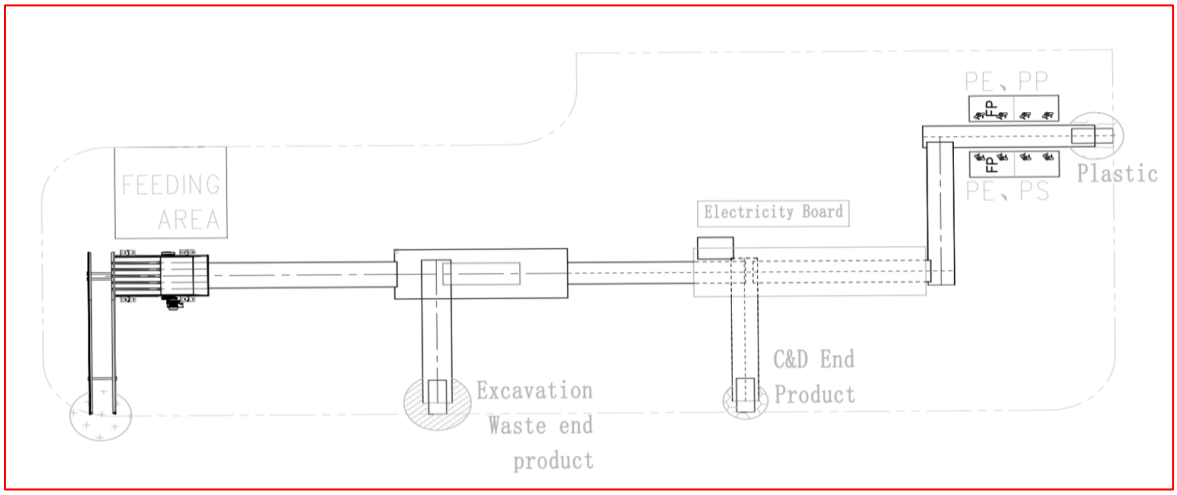


Figure 4: Layout of the Waste Bulk Construction Material Recycling Machines.

5.0 PROJECT METHOD STATEMENT

The overall workflow of the rehabilitation and reclamation plan is shown in the following **Figure 6**. At the existing dumpsite area (JDS), the excavation to be carried out by excavators will start from the highest elevation area and will be lowered layer by layer, each layer being 2m height up to the platform level of +3.35m NGVD. The excavated material will be transported to Working Platform Area (WP1-WP7) via lorries. The dump site materials at respective WP1-WP7 will be processed and separated into two categories; not suitable or suitable for surcharge material. Suitable material will be reused as surcharge material and transported via lorries from Working Platform to WP2 to WP7. Unsuitable material will be disposed to an approved dumping site.

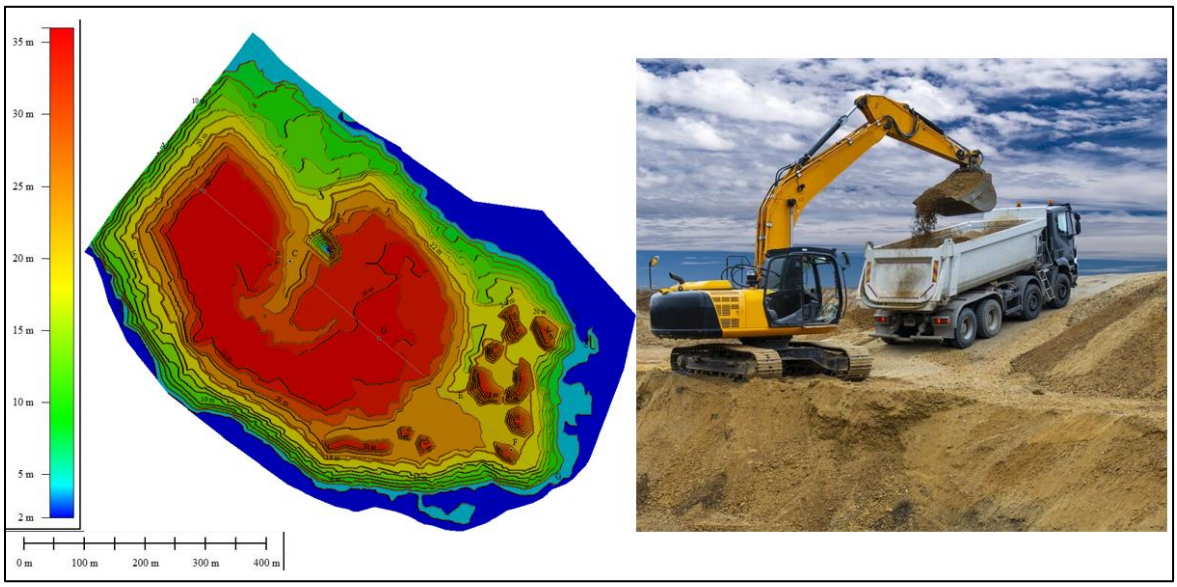


Figure 5: Layout of Rehabilitation Area to be excavated layer by layer with each layer being2m in height up to platform level +3.35m NGVD.

At the same time the reclamation works will be installed with double layer silt curtains around the Project Site to control sediment dispersion and protect the surrounding environment. Following that, the construction of a perimeter bund will takes place, which shall serve as a barrier for the reclamation work. To reinforce the perimeter bund, a slope protection rock mattress will be laid along its slope. Once the perimeter bunds are almost complete, the reclamation phase will begin, involving the filling with imported sand from existing seabed levelsto the designated platform level. The sand will be sourced from an approved sand source concession area and filled, raising the seabed level to a height of 0.5 m above MHWS. To enhance the ground's stability, prefabricated vertical drains (PVD) are then installed. The next step involves surcharging the area with suitable materials obtained from the rehabilitation area. Finally, the platform is trimmed to achieve the desired design platform level, set at +4.35 m and +5.00m NGVD respectively.

The rehabilitation and reclamation phases are described in more details in **Section 5.1** while the reclamation construction sequence is detailed in **Section 5.2**.

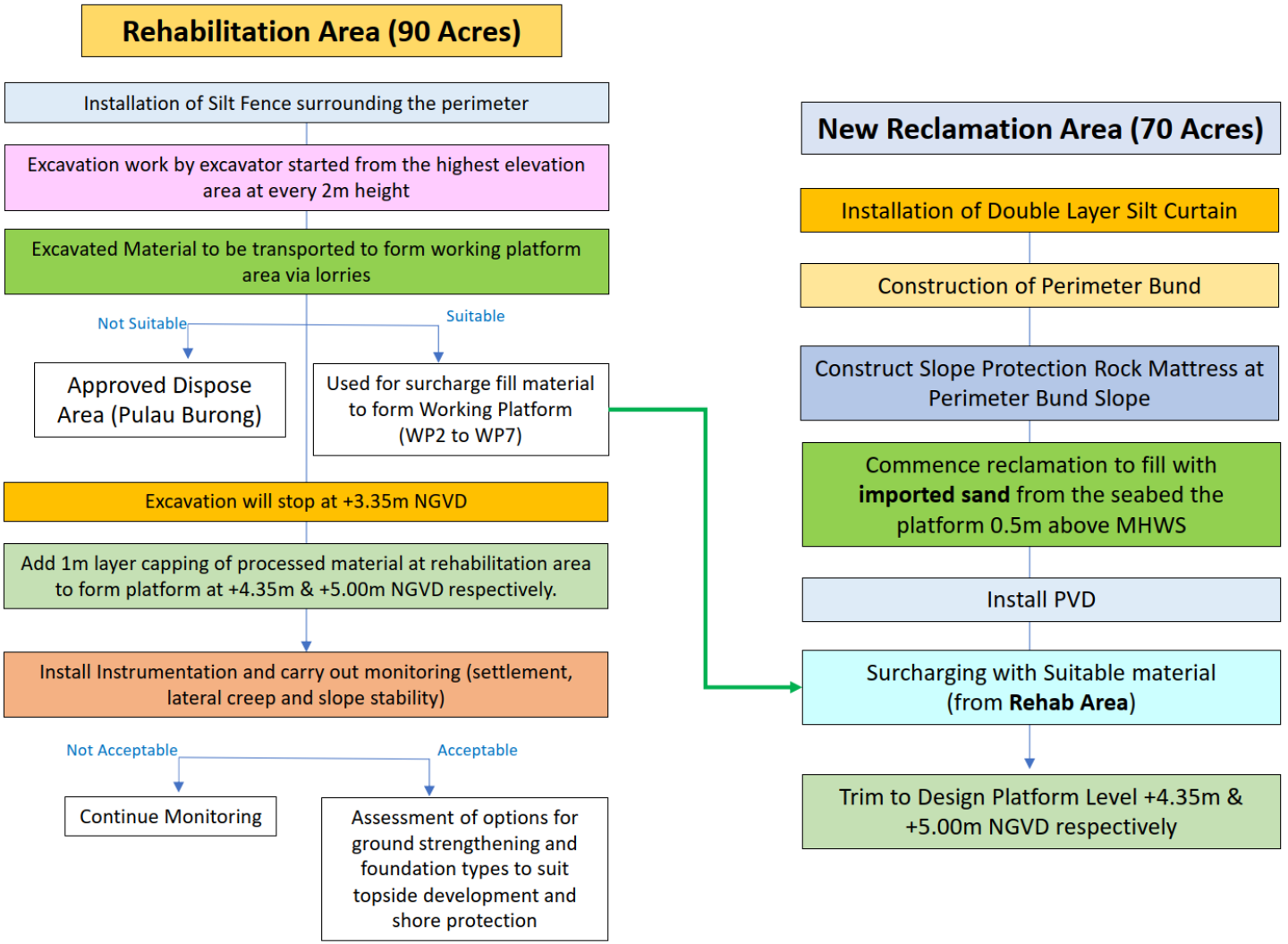


Figure 6: Overall Work Flow of the Rehabilitation and Reclamation Plan.

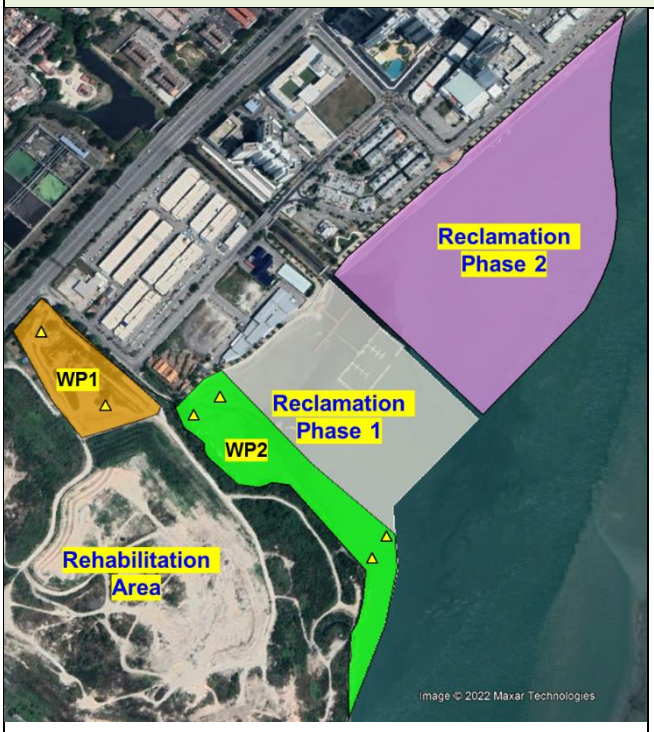
5.1 Rehabilitation and Reclamation Phases

The rehabilitation and reclamation are proposed to be carried in phases as follows:

Year 0-1

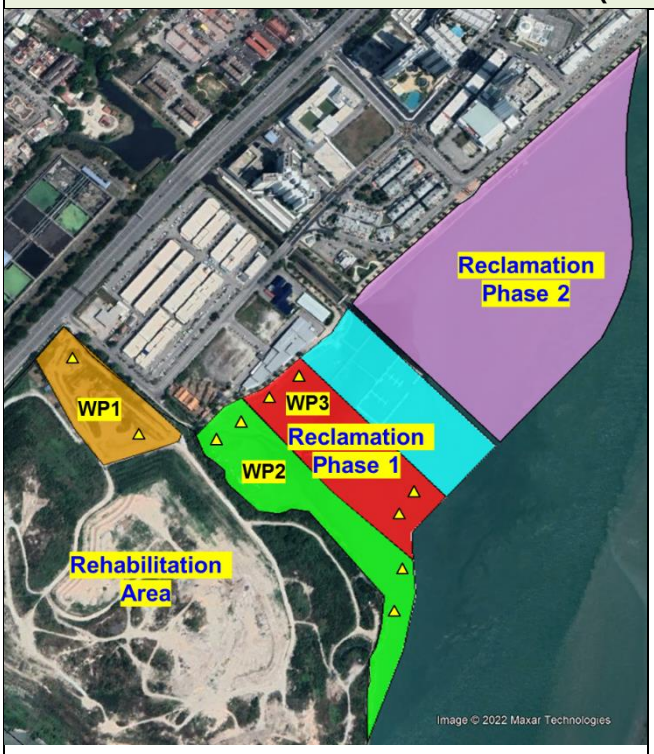
a) Setting up Rehab Working Platform (WP1) and install 2 nos. of recycling machines △ at WP1:
   WP1 = 2 Nos
   Total = 2 x 400 m^3/day
   = 800 m^3/day
   (Suitable materials)
b) Excavation at Rehabilitation Area via excavators and transport the material to WP1 via lorries.
c) Process dumpsite materials for WP2 – 800 m^3/day.
d) Reclamation Phase 1
   - Construction of perimeter bund.
   - Lay rock mattress at slope of perimeter bund.
   - Sand filling up to 0.5 m above mean high water spring (MHWS).

Year 1-2



a) Excavation at Rehabilitation Area via excavators and transport the material to WP1 via lorries.
b) Process dumpsite materials (800 m^3/day).
c) PVD Installation at Working Platform 2 (WP2).
d) Subsequent surcharge filling for WP2.
e) Setting out 4 recycling machines △ at WP2:
   WP1 = 2 Nos
   WP2 = 4 Nos
   Total = 6 x 400 m^3/day
   = 2,400 m^3/day
   (Suitable materials)
f) Excavation at Rehabilitation Area via excavators and transport the material to WP1 & WP2 via lorries.
g) Reclamation Phase 2
   - Construction of perimeter bund.
   - Lay rock mattress at slope of perimeter bund.
   - Sand filling up to 0.5 m above mean high water spring (MHWS).

YEAR 1-2 (Cont'd)



a) Excavation at Rehabilitation Area via excavators and transport the material to WP1 & WP2 via lorries.
b) Process dumpsite materials at WP1 and WP2 (2,400 m^3/day).
c) PVD installation & surcharge filling for Working Platform 3 (WP3).
d) Setting out 4 recycling machines △ at WP3:

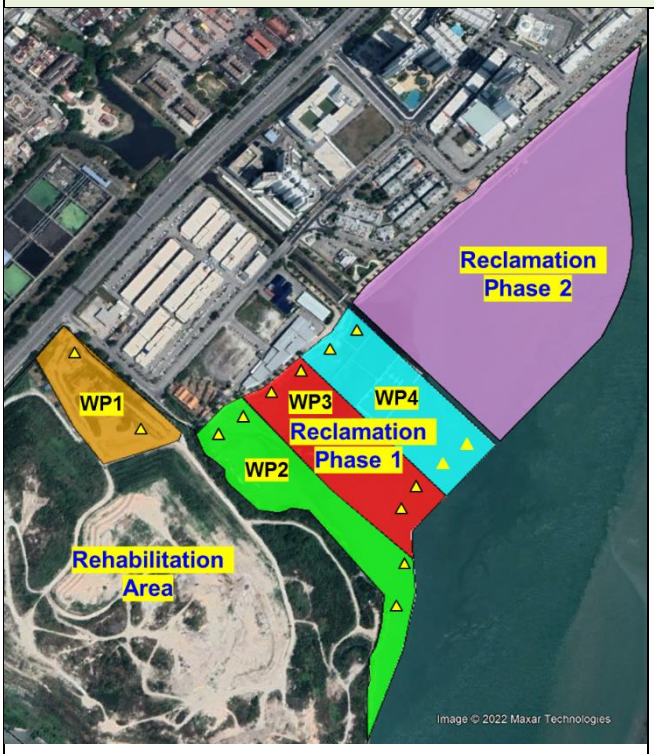
WP1	= 2 Nos
WP2	= 4 Nos
WP3	= 4 Nos
Total	= 10 x 400 m^3/day
	= 4,000 m^3/day

(Suitable materials)

Excavation at Rehabilitation Area via excavators and transport the material to WP1, WP2 & WP3 via lorries.

e) Reclamation Phase 2
- Construction of perimeter bund.
- Lay rock mattress at slope of perimeter bund.
- Sand filling up to 0.5 m above mean high water spring (MHWS).

YEAR 2-3



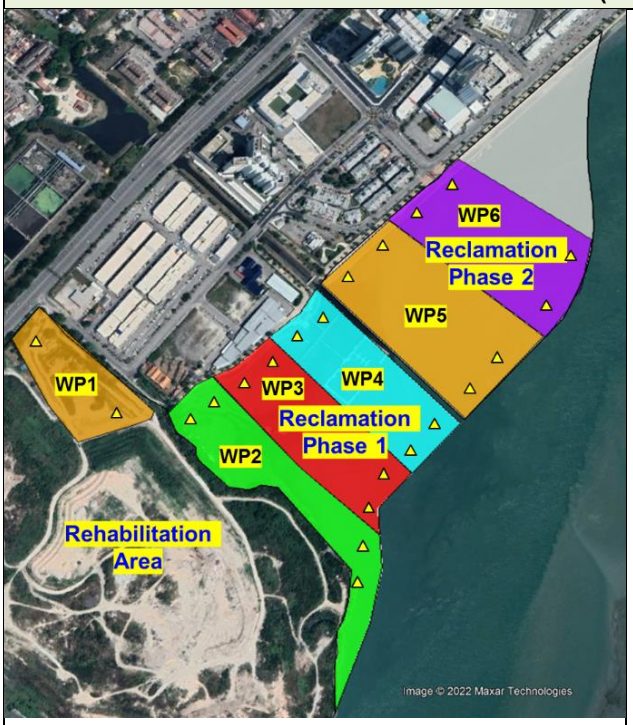
a) Excavation at Rehabilitation Area via excavators and transport the material to WP1, WP2 & WP3 via lorries.
b) Process Dumpsite Materials at WP1, WP2 and WP3 (4,000 m^3/day).
c) PVD installation & surcharge filling for Working Platform 4 (WP4).
d) Setting out 4 recycling machines △ at WP4:

WP1	= 2 Nos
WP2	= 4 Nos
WP3	= 4 Nos
WP4	= 4 Nos
Total	= 14 x 400 m^3/day
	= 5,600 m^3/day

(Suitable materials)

e) Excavation at Rehabilitation Area via excavators and transport the material to WP1, WP2, WP3 & WP4 via lorries.

YEAR 2-3 (Cont'd)



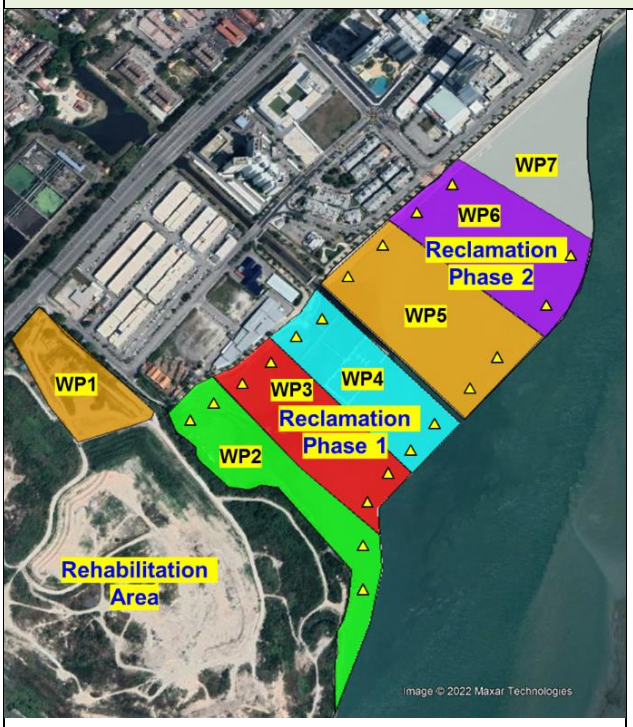
a) Excavation at Rehabilitation Area via excavators and transport the material to WP1, WP2, WP3 & WP4 via lorries.
b) Process dumpsite materials (5,600 m^3/day).
c) Installation of PVD & surcharge filling for Working Platform 5 (WP5).
d) Setting out 4 recycling machines △ each at WP5:

WP1	= 2 Nos
WP2	= 4 Nos
WP3	= 4 Nos
WP4	= 4 Nos
WP5	= 4 Nos
Total	= 18 x 400 m^3/day
	= 7,200 m^3/day
	(Suitable materials)

e) Excavation at Rehabilitation Area via excavators and transport the material to WP1, WP2, WP3, WP4 & WP5 via lorries.
f) Installation of PVD & surcharge filling for Working Platform 6 (WP6).
g) Setting out 4 recycling machines △ at WP6 (2 nos moved from WP1 to WP6):

WP1	= 0 Nos
WP2	= 4 Nos
WP3	= 4 Nos
WP4	= 4 Nos
WP5	= 4 Nos
WP6	= 4 Nos
Total	= 20 x 400 m^3/day
	= 8,000 m^3/day
	(Suitable materials)

h) Excavation at Rehabilitation Area via excavators and transport the material to WP1, WP2, WP3, WP4, WP5 & WP6 via lorries.

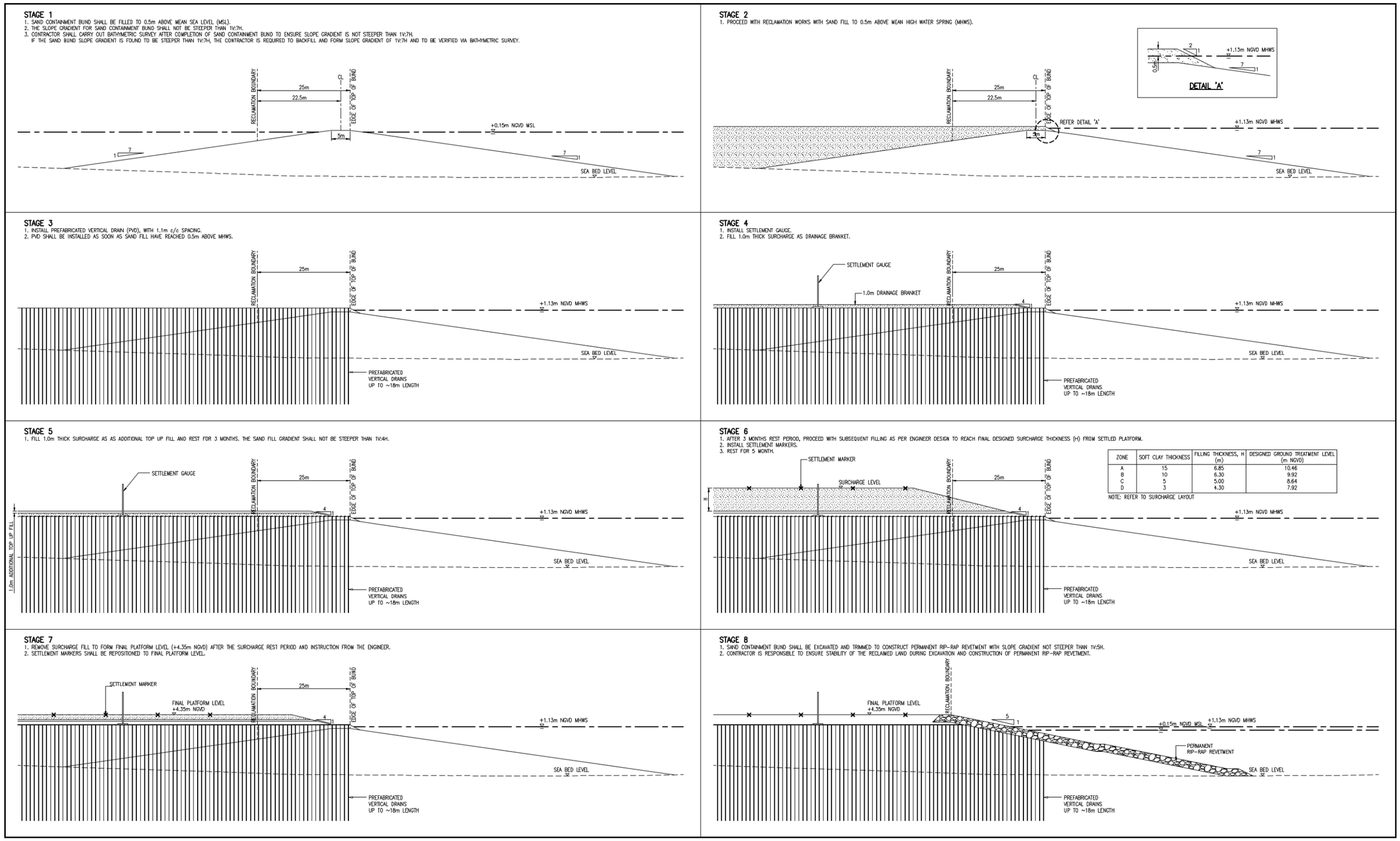
YEAR 3-4	
	a) Excavation at Rehabilitation Area via excavators and transport the material to WP1, WP2, WP3, WP4, WP5 & WP6 via lorries. b) Process dumpsite materials (8,000 m^3/day). c) Surcharge filling for Working Platform 7 (WP7). d) Continue to process dumpsite materials until level +3.35 mNGVD. e) 1 m capping filling at rehabilitation area to level +4.35 mNGVD using processed materials. f) Install Instrumentation and carry out monitoring (settlement, lateral creep and slope stability)

5.2 Reclamation Construction Stages

For the reclamation, the following construction stages are proposed (as illustrated in **Figure 7**):

- Stage 1 – Sand containment bund to be filled to 0.5 m above Mean Sea Level (MSL) (+0.65 mNGVD) and to form slope gradient of not steeper than 1V:7H on both sides.
- Stage 2 – To continue the reclamation filling works at inner area to 0.5 m above Mean High Water Spring (MHWS) (+1.63 mNGVD).
- Stage 3 – Install Prefabricated Vertical Drains (PVD) with 1.1 m c/c spacing as soon as fill has reached 0.5m above MHWS.
- Stage 4 – Install settlement gauges and fill 1.0m thick surcharge as drainage blanket.
- Stage 5 – Fill 1.0m thick surcharge as additional top up fill and rest for 3 months. The sand fill gradient shall not be steeper than 1V:4H.
- Stage 6 – After 3 months rest period, carry out subsequent filling of 4.3 to 6.85 m thick surcharge to reach final surcharge level and install settlement markers. Rest another 5 months.
- Stage 7 – Temporary surcharge shall be removed after resting period or as per Engineer's instruction to the proposed platform level (+4.35 mNGVD) and settlement markers are to be repositioned to the final platform level.
- Stage 8 – Sand containment bund shall be trimmed to construct permanent rip-rap revetment with slope gradient not steeper than 1V:5H.

During the reclamation works, double layer silt curtains shall be provided to minimise the advection and dispersion of sediment plumes; and as there may be some construction works to be carried out from the landside, site access for heavy construction works vehicles and wash trough are proposed.



ZONE	SOFT CLAY THICKNESS	FILLING THICKNESS, H (m)	DESIGNED GROUND TREATMENT LEVEL (m NGVD)
A	15	6.85	10.46
B	10	6.30	9.92
C	5	5.00	8.64
D	3	4.30	7.92

Figure 7: Reclamation Construction Stages.

6.0 PROJECT WORK PROGRAMME

The estimated project flow and duration as shown in the following work programme.

Table 2: The Proposed Work Programme for the Rehabilitation and Reclamation.

Task	Duration (Months)	Year 1												Year 2												Year 3												Year 4											
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Rehabilitation Material Production																																																	
Site Preparation & Machine Installation at WP1	3																																																
Reusable Material Production for WP2	17																																																
Reusable Material Production for WP3	5																																																
Reusable Material Production for WP4	3																																																
Reusable Material Production for WP5	3																																																
Reusable Material Production for WP6	3																																																
Reusable Material Production for WP7	3																																																
Reclamation Phase 1																																																	
Mobilisation & Perimeter Bund	4																																																
Sandfilling up to 0.5 m MHWS	5																																																
Installation of PVD + 2 m (1+1) Surcharge	19																																																
Rest for 3 Months	3																																																
Surcharge Filling at Phase 1 Reclamation	19																																																
Reclamation Phase 2																																																	
Perimeter Bund	6																																																
Sandfilling up to 0.5m MHWS	10																																																
Installation of PVD + 2 m (1+1) Surcharge	6																																																
Rest for 3 Months	3																																																
Surcharge Filling at Phase 2 Reclamation	10																																																
Remove Surcharge	10																																																
Construction of Revetment	10																																																

7.0 EROSION AND SEDIMENT CONTROL PLAN (ESCP)

7.1 Introduction

Construction works will disturb the existing land surface and condition that may contribute to increase in surface run-off and high concentration of Total Suspended Solids (TSS) in the stormwater discharge especially during rain events. Therefore, the erosion and sediment control plan shall be provided prior to construction works. The ESC Plan is crucial to manage the surface runoff and stormwater discharge from the construction site. Suitable erosion and sediment control measures shall be provided during the construction stage to minimise the impact resulting from construction works to the neighbouring area. The proposed detailed ESCP cover the construction works of the reclamation works which only cater for sandfilling works up to design platform level and rock revetment works.

7.2 General Construction Condition

(i) The Erosion and sediment control Plan shall be read in conjunction with the engineering plans or written instructions that may be issued in relation with this project

(ii) Contractor shall ensure that erosion and sediment control works are undertaken in accordance with the Urban Stormwater Management Manual for Malaysia, 2012 (MSMA 2nd Edition).

(iii) All contractors shall be informed of their responsibilities in minimizing the potential for soil erosion and pollution of down slope areas.

(iv) Contractor is required to carry out earthwork in accordance with recommendations contained in CP 2003 Code of Practice for Earthworks.

7.3 Proposed Control Measures

The erosion and sediment control measure proposed for this reclamation works is shown in **Appendix A**: **Layout of Proposed Erosion and Sediment Control Plan (ESCP)**. The detailed descriptions of proposed erosion and sediment control measures are as follows and not limited to;

(1) Hoarding
(2) Silt curtains
(3) Silt Fence
(4) Site Access and Wash Trough
(5) Temporary Earth Drain

7.3.1 Hoarding

Despite no construction works is being carried out from the landside, hoarding shall be used to barricade the construction area. The proposed hoarding location is along the land boundary of the Project Site (as depicted in **Appendix B: Proposed Hoarding Details**.) The hoarding shall be erected prior to start of construction works to prevent any interference or entry from unauthorised personnel to the site. Hoarding is important to barricade the active construction area and control access to the site via one access point. It is also able to minimise noise from the Project Site.

7.3.2 Silt Curtain for Filling Works

The construction method involves sand filling works from sea-going barges and no major land disturbance works will be carried out outside of the Project Boundary. Silt curtain is proposed to be installed along the Project Boundary as shown in **Appendix C: Proposed Silt Curtain Details** to minimise plume dispersion. The silt curtain shall be installed prior to commencement of filling works. The silt curtain will function as a barrier to control the sediment plume spreading towards the sensitive receptors adjacent to the Project Site. The silt curtain will minimise sediment pollutants flowing across the curtain while allowing water volume exchange through and under the curtains.

The recommended silt curtain specification shall be as follows:

Table 3: Specification of Silt Curtain.

Item	Details
Silt Curtain Type	III (Heavy Duty to be used at area with current speed up to 1.5 m/s with presence wind or wave with tidal action)
Curtain Depth	Up to 7.3 m allowing at least 0.5 m clearance between skirt and seabed bottom during low tide
Fabric Strength	150 kN/m
Float Size	300 mm
Chain Weight	5 kg/m
Span length	20 m

Figure 8: Example of Silt Curtain

7.3.3 Silt Fence

The silt fence consists of filter fabric stretched across and attached to series of supporting posts. The silt fence shall be installed around the reclaimed area as shown in **Appendix D: Proposed Silt Fence, Wash Trough and Temporary Earth Drain Details** to ensure that the silt from the surface run-off from the dumpsite area does not silt up inside any drain or directly flow to the sea.

Figure 9: Example of Silt Fence

7.3.4 Site Access and Wash Trough

The site access should be constructed with heavy duty interlocking paver block. Vehicle access to site shall be limited to only essential vehicles for construction work and all vehicles shall enter and exit the site through the established site access point. Wash trough as shown in **Appendix D: Proposed Silt Fence, Wash Trough and Temporary Earth Drain Details** shall be provided at the site access to remove excessive sediment from out bound vehicles prior to leaving the site. The discharge from wash trough shall be diverted to the temporary earth drain and no direct discharge to existing drain is allowed.

The photo below shows an example of a wash trough located at the entrance of a construction site.

Figure 10: Proposed Wash trough at site entrance

7.3.5 Temporary Earth Drain

The purpose of the temporary earth drain is to divert discharges from the wash trough and along the perimeter of rehabilitation area. The details of the proposed temporary earth drain is enclosed in **Appendix D: Proposed Silt Fence, Wash Trough and Temporary Earth Drain Details** The drain is proposed to have a longitudinal slope of V:H 1:1000 with a minimum bottom width of 1.5 and side slope of V:H 1:2. The overall length of the temporary drain at its longest is approximately 720 m.

The photo below shows an example of a temporary earth drain within the perimeter of rehabilitation area.

Figure 11: Example of Temporary Earth Drain

7.4 Best Management Practices

The following best management practices shall also be carried out by the Contractor during the construction phase to ensure the effectiveness of the proposed control measures.

7.4.1 Silt Curtain and Filling Works

a. Filling works from the barges shall not be carried out outside of the silt curtain area.
b. Excavators or bulldozers shall only be used once the filling works have reached above water level.
c. Any material which is deposited outside the boundary of the works or any debris which falls or is deposited into tidal waters during the filling works shall be removed by the Contractor at its cost and expenses prior to the practical completion of the works.
d. If at any time during the course of filling works, an environmental incident occurs or an environmental risk is identified, all measures must be taken immediately and informed to the relevant authority.
e. All floating plant and associated moorings will be kept clear of navigational channels when working or moored.
f. Navigational lights, buoys, marks or any warning signs shall be supplied, installed and maintained.
g. All filling works or any associated works shall stop during storm or dangerous weather conditions.
h. Discharge of ballast water (including bilge water) to the sea/lagoon shall not be allowed. Temporary storage facilities shall be provided inside the vessel.
i. Proper drainage of the site shall be maintained. Drains shall be checked that they are in good operational condition.
j. Recently stabilised lands shall be checked to ensure that erosion hazards have been effectively reduced and any repair works conducted properly.
k. All erosion and sediment control measures shall be kept in good conditions until all earthworks activities are completed and the site has stabilised.
l. Additional erosion and sediment control works shall be constructed as necessary to ensure the desired protection is given to the site and areas downstream.

7.4.2 Silt Fence

a. Settled soil or sediment built-up behind the silt fence shall be removed periodically.
b. Damaged or torn silt fence shall be replaced immediately to ensure effectiveness of the system.
c. Damaged fence post shall be placed and secured immediately.

7.4.3 Wash Trough

a. Accumulated sediment and dirt inside washing area shall be removed periodically to prevent blockage or overspill
b. The outflow from wash trough outlet must be drained to nearest temporary drain
c. Site supervisor or environmental officer shall ensure that there is no overflow of discharged water into existing drain

7.4.4 Temporary Earth Drain

a. The temporary earth drain shall be stabilised and compacted properly if there is any sign of slope failure or bed erosion
b. Earth drain shall be free from any rubbish or excessive sedimentation built-up in the drain

7.4.5 Laydown Area

a. All waste shall be stored at designated area before disposing to authority's approved disposal area
b. If skid tank is provided inside the laydown area to store diesel or fuel, the tank shall be placed in a containment tray to prevent and minimise possibility of direct spillage at the project site. The tank shall be checked periodically to ensure no leakage at the containment tray
c. All construction materials shall be stored properly within the laydown area. Any materials that are highly erosive of dissolve when in contact with water shall be stored in closed container.

8.0 SITE INSPECTION, MAINTENANCE AND MONITORING

8.1 Site Inspection and Maintenance

The following site inspection and maintenance shall be carried out on a regular basis to ensure the proposed control measures are in good conditions:

1. On-board supervisors will be assigned to check the condition of the silt curtain before commencement of works on a regular basis.
2. Water quality monitoring and regular inspection need to be carried out to ensure no suspended solids are passing through the silt curtain system and maintain proper functioning of the silt curtain during the entire filling works period.
3. Filling works will stop immediately if silt curtain is found damaged. Lift up the silt curtain from the water and sew (double-line sew) a new piece of screen to the existing screen to cover the damaged area. A sufficient overlapping length is needed (at least 1 m).
4. Rubbish around the silt curtains will be collected at regular intervals on a daily basis to ensure water behind the silt curtain will be kept free from floating debris.
5. Sufficient spare screens will be kept on site for replacing damaged curtains. The screens need to be stored properly to avoid direct contact with water and sunlight.
6. All blinkers or reflective strips need to be inspected regularly to ensure they are in good working condition.
7. Sediment build up behind silt fence shall be removed regularly.
8. Condition of fence fabric, fence post and joints shall be inspected monthly or within 24 hours after a rain event that exceeds 12.5 mm.
9. Wash trough shall be inspected monthly or within 24 hours after a rain event that exceeds 12.5 mm to ensure no debris or minimal sediment is accumulated inside the wash trough.

9.0 SUMMARY

The rehabilitation and filling works for the reclamation shall adhere to the proposed method statement and construction sequences. Prior to commencing construction, the recommended ESCP measures shall be installed and implemented at the site. These control measures and Best Management Practices (BMPs) are to meet the minimum requirements specified to safeguard the surrounding environment and prevent any adverse impacts from the construction activities. The proposed BMPs cover both preventive and mitigation measures, ensuring comprehensive environmental protection.

During the construction stage, it is the responsibility of the contractor to monitor and maintain the recommended BMPs. Any damages or issues that arise must be promptly repaired or reinstated as necessary. To ensure compliance and evaluate the effectiveness of the BMPs, a monthly site inspection shall be conducted by an appointed environmental officer. This inspection will provide valuable feedback, allowing for the modification or addition of BMPs if required to further enhance environmental protection measures.

By following the proposed method statement, implementing the recommended ESCP measures, and conducting regular inspections, the project will ensure compliance with environmental standards, minimise impacts on the surroundings, and uphold the principles of sustainable construction practices.

10.0 ENGINEER'S DECLARATION

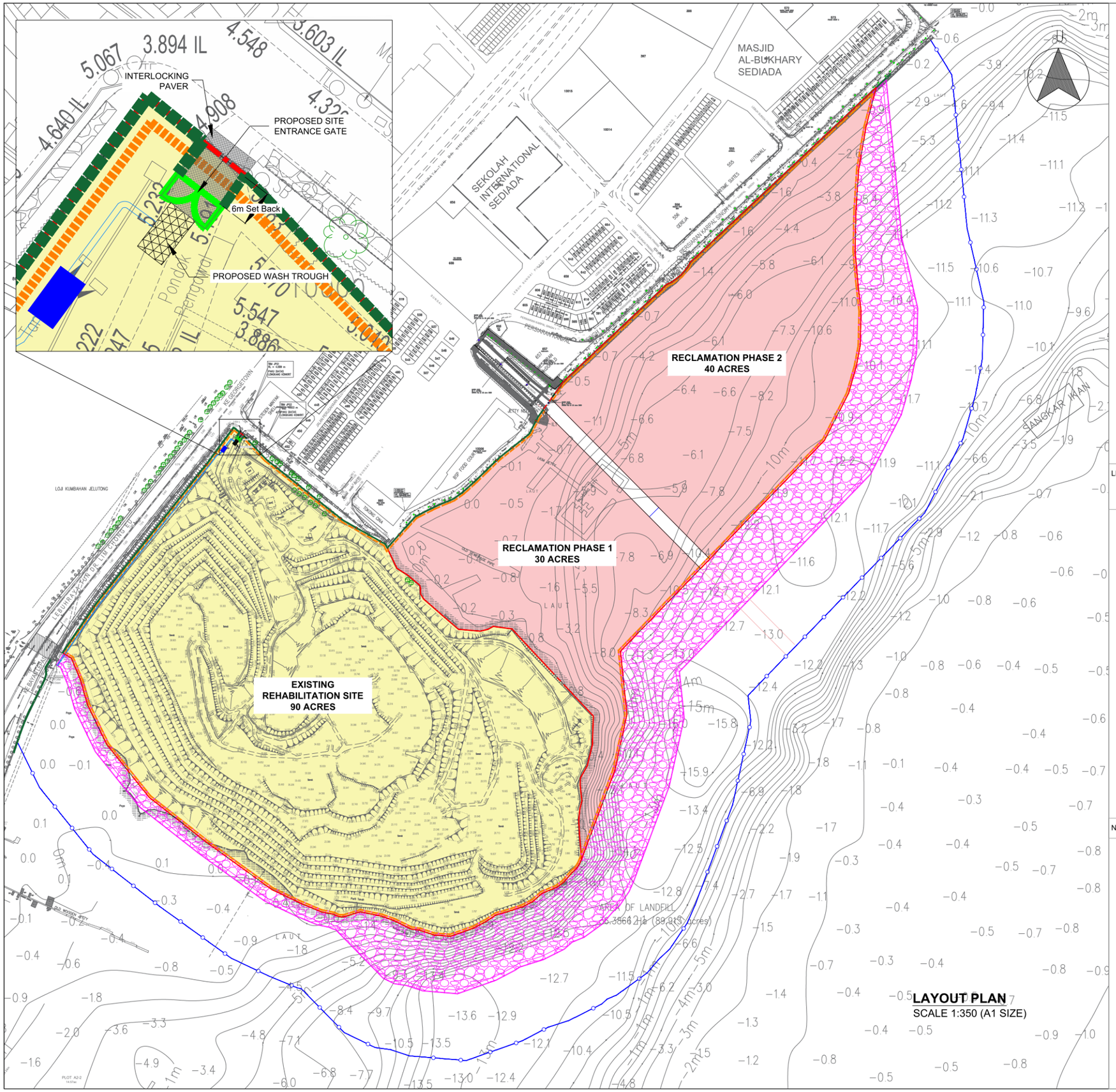
I hereby certify that these works have been designed by me in accordance with sound engineering practice and that I take full responsibility for the design, and proper performance of the same.

Professional Engineer Endorsement

Name: Ir. Lim Choon Lin

Company: Global Water Consultants Sdn. Bhd.

Appendix A
Erosion and Sediment Control Plan (ESCP) Layout



LAYOUT PLAN
SCALE 1:350 (A1 SIZE)

LEGEND:

- PROJECT BOUNDARY
- REHABILITATION AREA
- PROPOSED RECLAMATION AREA
- ROCK REVETMENT
- SILT CURTAIN
- PROPOSED ENTRANCE
- HOARDING
- SILT FENCE
- WASH TROUGH
- INTERLOCKING PAVER
- SEDIMENT BASIN
- TEMPORARY EARTH DRAIN / FUTURE PERMANENT DRAIN (TO BE CONFIRMED BY INFRA ENGINEER)

NOTES:

1. All levels are in metre National Geodetic Vertical Datum (m NGVD) unless otherwise stated.
2. The topographic and bathymetric survey level is based on survey carried out by Jurukur Perunding Services Sdn. Bhd. in June 2020.
3. The position of silt curtain is indicatives and contractor may proposed alternative silt position to suit their construction method statement. The alternative silt curtain position shall be reviewed and approved by the Engineer.
4. Silt curtain shall be installed prior to start of filling works for sand containment bund.
5. All silt curtain accessories including concrete sinkers shall be removed after the completion of the works.
6. All discharged from the wash trough shall be diverted to the temporary earth drain that will be routed to the sediment basin.
7. The maintenance works for the sediment basin shall be carried out regularly during construction period.

FOR SUBMISSION ONLY

No. Fail

Kegunaan Pejabat

Tajuk Projek:

PERMOHONAN PELAN KERJA TANAH DI BAWAH AKTA 133 BAGI TUJUAN PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIA ADA), SEKSYEN 8, BANDAR JELUTONG, PULAU PINANG UNTUK TETUAN PLB ENGINEERING BERHAD

Tandatangan Pemilik Tanah & Pemaju :

NAMA : DATO SIOW KOK YONG

PLB ENGINEERING BERHAD
Company No. : 199701002728 (418224-X)
1320, JALAN BARU, TAMAN CHAI LENG, 13700 PRAI, PENANG.

Arkitek :

W. K. Khor Architect Sdn Bhd
(TMM3874?)

L33, COLLEGE AVENUE
10250 GEORGETOWN, PENANG.
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GLOBAL WATER CONSULTANTS SDN. BHD. (200601017878)
23-4, JALAN TASIK SELATAN 3,
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57000 KUALA LUMPUR, MALAYSIA.
TEL: 03-90595396 FAX: 03-90595869
E-MAIL: gnp@gnpgroup.com.my
WEB SITE: www.gnpgroup.com.my

Tandatangan Jurutera

JURUTERA PROFESIONAL
LESEN PERAKUAN AMALAN
AWAM
Ir. LIM CHOON LIN
C15534
MALAYSIA

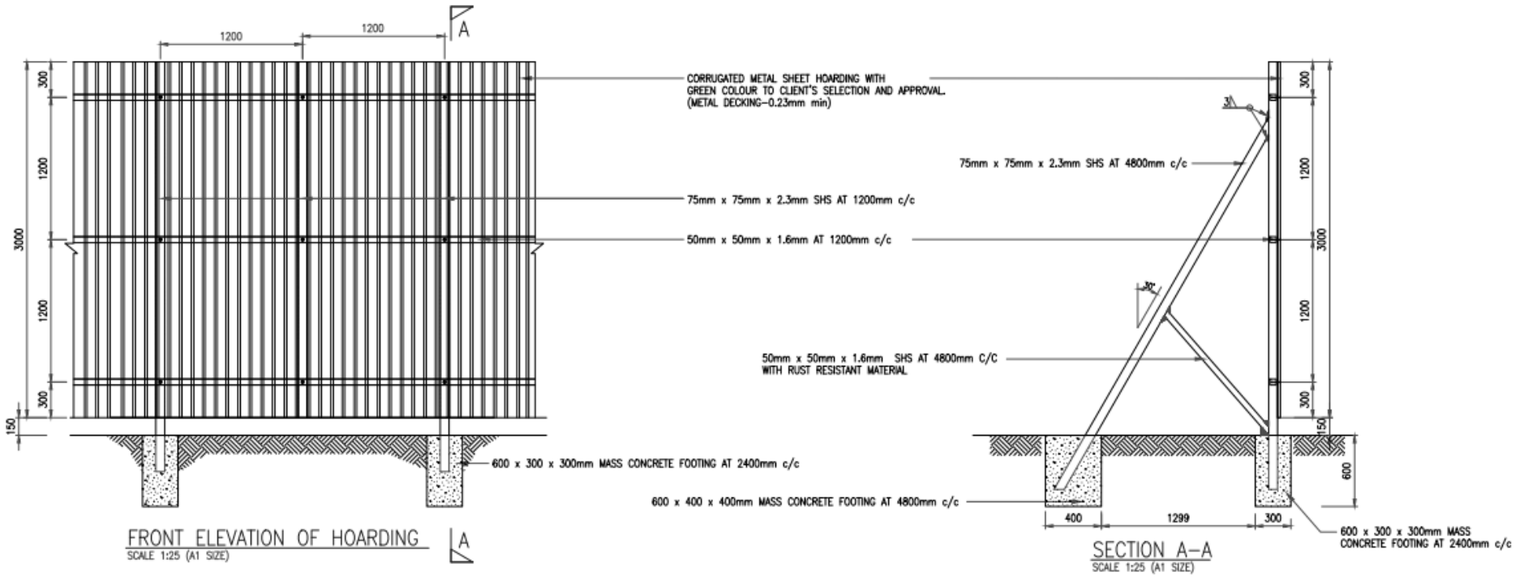
NAMA : IR. LIM CHOON LIN

Tajuk Lukisan

EARTHWORK
ESCP LAYOUT PLAN

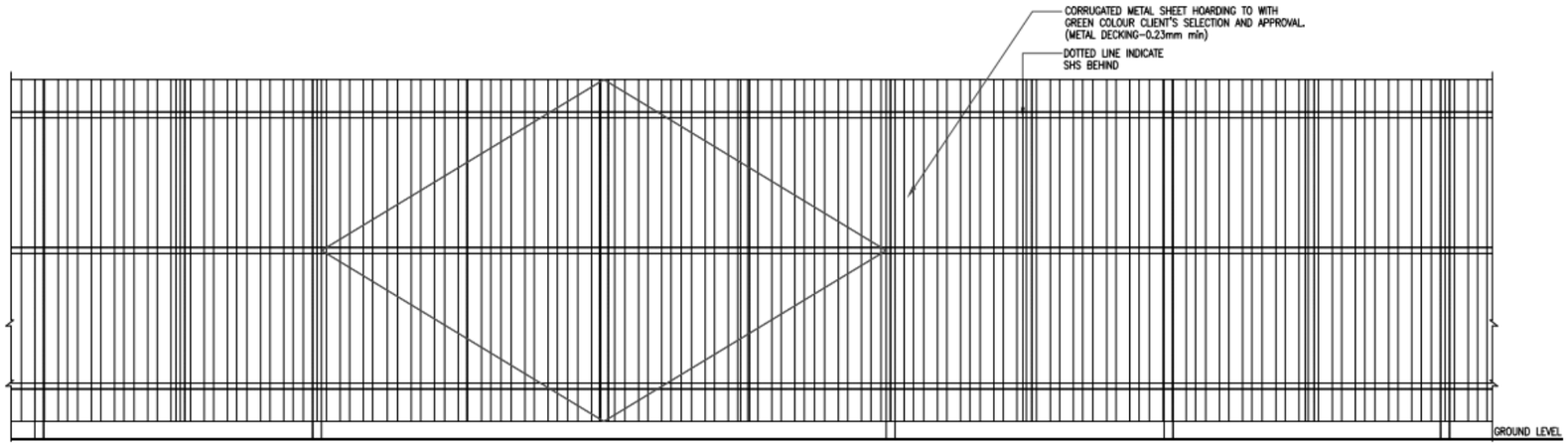
Skala	Tarikh	Direka	Dilukis
AS SHOWN	NOVEMBER 2022	LXH	LXH
Peringkat	Kontrak	Disemak	Diluluskan
SUBMISSION		LCL	LCL
No Projek	No. Lukisan		Pdn
484GU22	484GU22/ESCP/LAY/01		

Appendix B
Proposed Hoarding Details

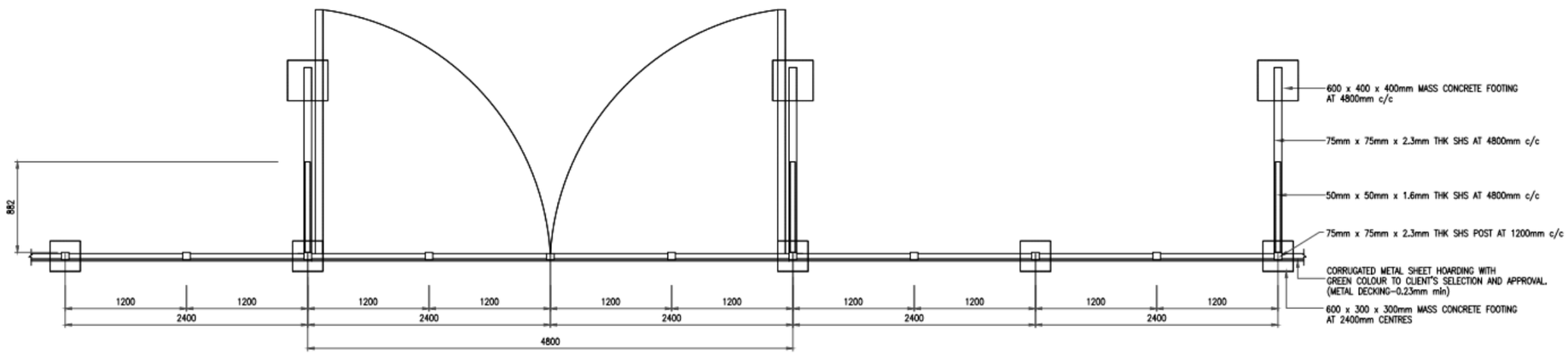


FRONT ELEVATION OF HOARDING
SCALE 1:25 (A1 SIZE)

SECTION A-A
SCALE 1:25 (A1 SIZE)



FRONT ELEVATION OF HOARDING
SCALE 1:25 (A1 SIZE)



PLAN OF HOARDING
SCALE 1:25 (A1 SIZE)

NOTES:
1. All units are in millimetre (mm) unless otherwise stated.

FOR SUBMISSION ONLY

No. Fail

Rujukan Pejabat

Tajuk Projek:

PERMOHONAN PELAN KERJA TANAH DI BAWAH AKTA 133 BAGI TUJUAN PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA, JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIA ADA), SEKSYEN 8, BANDAR JELUTONG, PULAU PINANG UNTUK TETUAN PLB ENGINEERING BERHAD

Tandatangan Pemilik Tanah & Pemaju :

NAMA : DATO SIOW KOK YONG

PLB ENGINEERING BERHAD
Company No. : 199701002728 (418224-X)
1320, JALAN BARU, TAMAN CHAI LENG, 13700 PRAI, PENANG.

Arkitek :

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Juruukur Perunding

GLOBAL WATER CONSULTANTS SDN. BHD.
(200601017878)
23-4, JALAN TASIK SELATAN 3,
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57000 KUALA LUMPUR, MALAYSIA.
TEL: 03-90595396 FAX: 03-90595869
E-MAIL: gnp@gnpgroup.com.my
WEB SITE: www.gnpgroup.com.my

Tandatangan Juruteru

JURUTERA PROFESIONAL
LEMBAGA PERAKUAN AMALAN
AWAM
Ir. LIM CHOON LIN
C15534
MALAYSIA

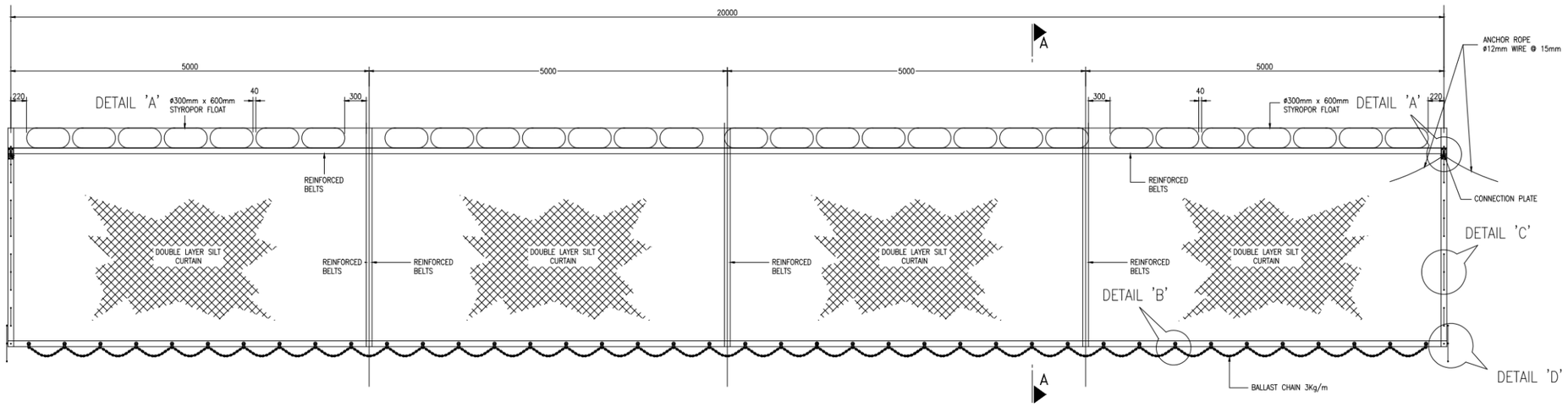
NAMA : IR. LIM CHOON LIN

Tajuk Lukisan

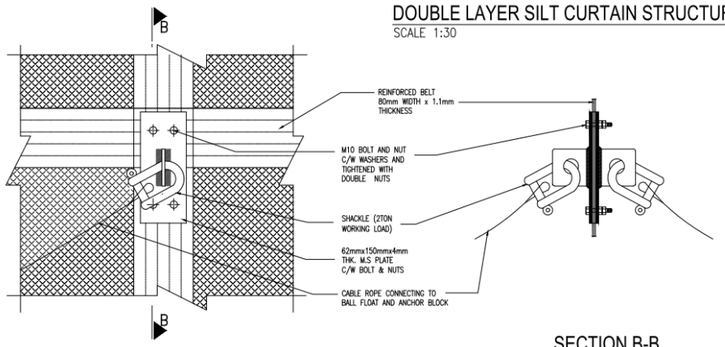
EARTHWORK
HOARDING DETAILS

Skala	Tarikh	Direka	Dilukis
AS SHOWN	NOVEMBER 2022	FAA	LKH
Peringkat	Kontrak	Disemak	Diluluskan
SUBMISSION		LCL	LCL
No Projek	No. Lukisan		Pin
404GU22	404GU22/ESOP/DET01		

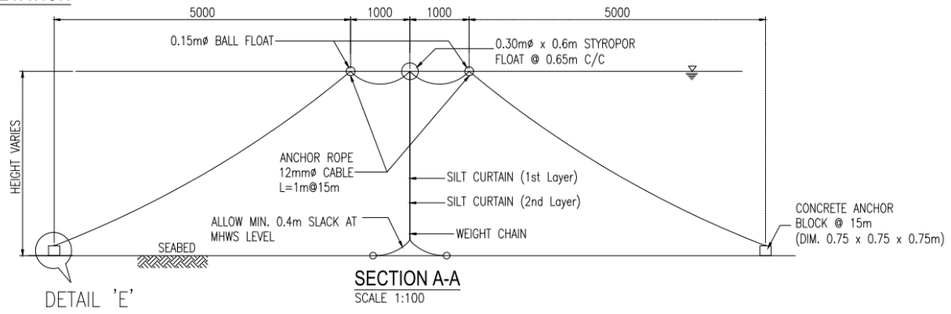
Appendix C
Proposed Silt Curtain Details



DOUBLE LAYER SILT CURTAIN STRUCTURE - ELEVATION
SCALE 1:30

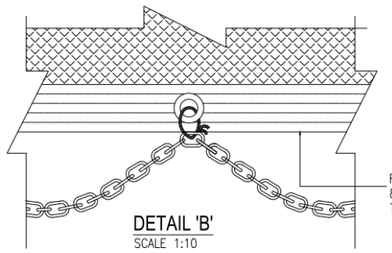


DETAIL 'A'
SCALE 1:4

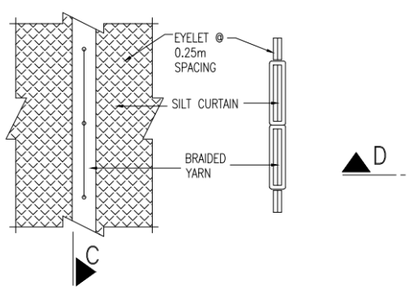


SECTION A-A
SCALE 1:100

SECTION B-B
SCALE 1:4

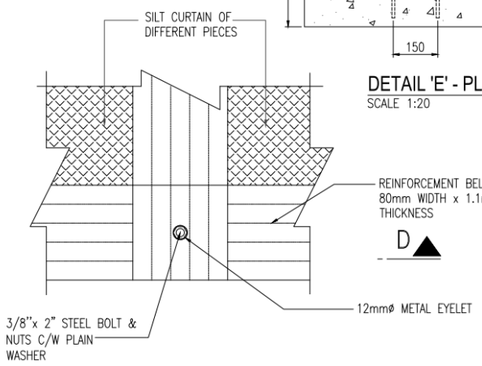


DETAIL 'B'
SCALE 1:10

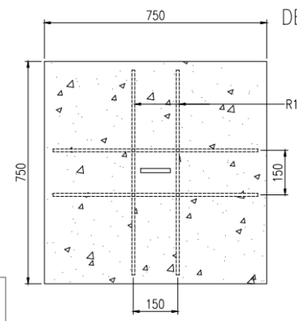


DETAIL 'C'
SCALE 1:20

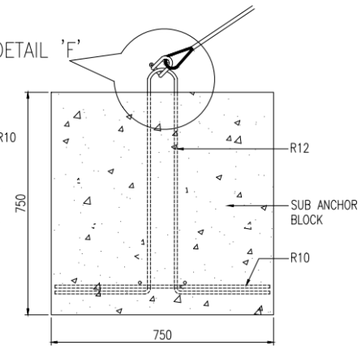
SECTION C-C
SCALE 1:20



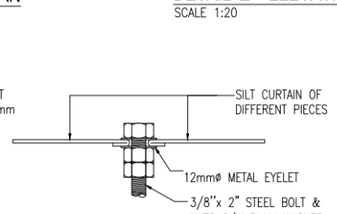
DETAIL 'D'
SCALE 1:20



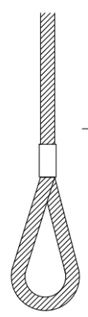
DETAIL 'E' - PLAN
SCALE 1:20



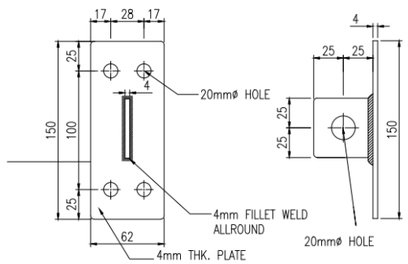
DETAIL 'E' - ELEVATION
SCALE 1:20



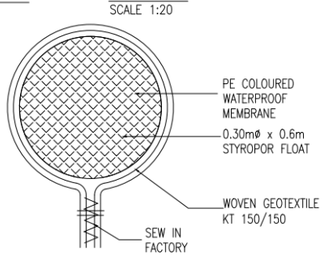
SECTION D-D
SCALE 1:20



DETAIL 'F'
SCALE 1:20



CONNECTION PLATE DIMENSIONS
SCALE 1:5



DETAIL OF FLOAT
SCALE 1:10

NOTES :

1. ALL DIMENSIONS ARE IN MILIMETRE UNLESS STATED OTHERWISE.
2. SILT CURTAIN TYPE: KT150/150 WITH MIN. ULTIMATE TENSILE STRENGTH OF 150kN/m.
3. ALL STEEL PARTS EXCEPT CHAINS, WIRE ROPES & RE-BAR OF ANCHOR BLOCKS TO BE GALVANISED.
4. EACH SET (15m LONG) OF SILT CURTAIN HAS 22 FLOATS OF 0.28 DIA. x 0.6m GAP BETWEEN FLOAT IS APPROXIMATELY 40mm AT EVERY 7 FLOATS, SPACING OF ABOUT 300mm IS PROVIDED.
5. CONTRACTOR SHALL MONITOR THE CONDITION OF THE TIMBER STAKES, SILT CURTAIN PERIODICALLY MAINTAIN/REPAIR/REPLACE THEM AS AND WHEN NECESSARY AS INSTRUCTED BY THE ENGINEER.

FOR SUBMISSION ONLY

No. Fail

Kegunaan Projekt

Tajuk Projek:

PERMOHONAN PELAN KERJA TANAH DI BAWAH AKTA 133 BAGI TUJUAN PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIA ADA), SEKSYEN 8, BANDAR JELUTONG, PULAU PINANG UNTUK TETUAN PLB ENGINEERING BERHAD

Tandatangan Pemilik Tanah & Pemaju :

NAMA : DATO SIOW KOK YONG

PLB ENGINEERING BERHAD
Company No. : 199701002728 (418224-X)
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Arkitek :

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Jurutera Perunding

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57000 KUALA LUMPUR, MALAYSIA.
TEL: 03-90595396 FAX: 03-90595869
E-MAIL: gnp@gnpgroup.com.my
WEB SITE: www.gnpgroup.com.my

Tandatangan Jurutera

JURUTERA PROFESIONAL (DENGAN PERAKUAN AMALAN) AWAM Ir. LIM CHOON LIN C15534 MALAYSIA

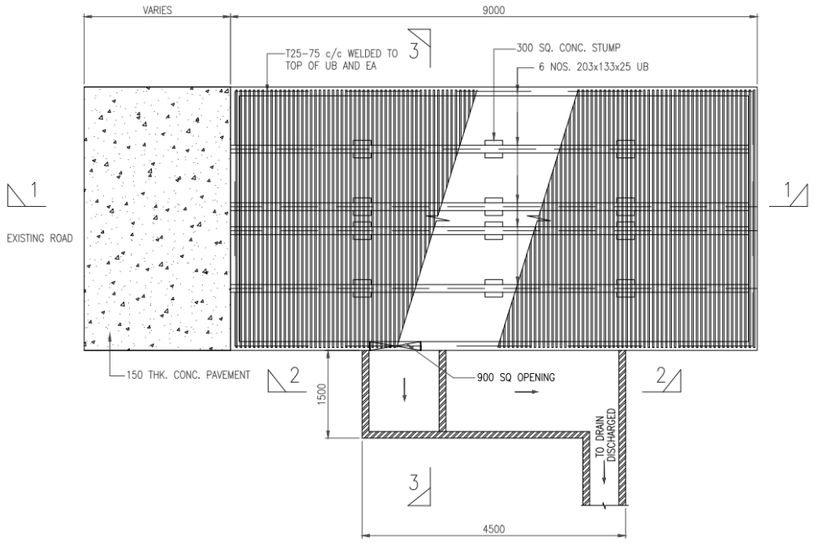
NAMA : IR. LIM CHOON LIN

Tajuk Lukisan

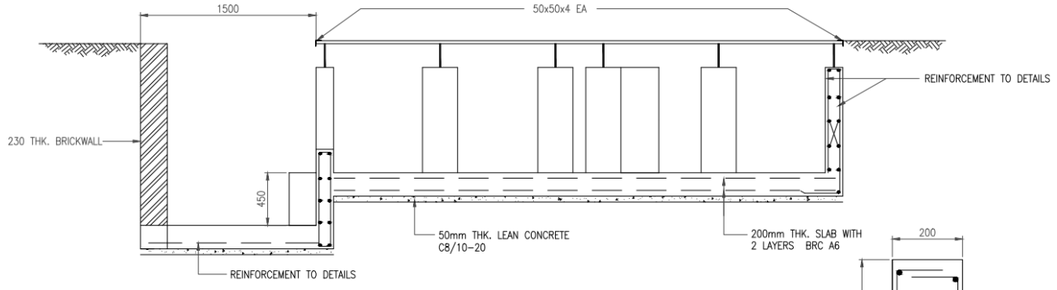
EARTHWORK
SILT CURTAIN DETAILS

Skala	Tarikh	Direka	Dilukis
AS SHOWN	NOVEMBER 2022	FAA	LXH
Peringkat	Kontrak	Disemak	Dilulus
SUBMISSION		LCL	LCL
No Projek	No. Lukisan		Pdn
484GU22	484GU22/ESC/PIDET/02		

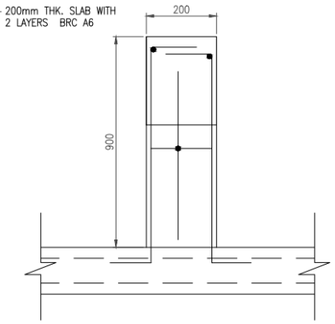
Appendix D
Proposed Silt Fence Wash Trough and Temporary Earth Drain Details



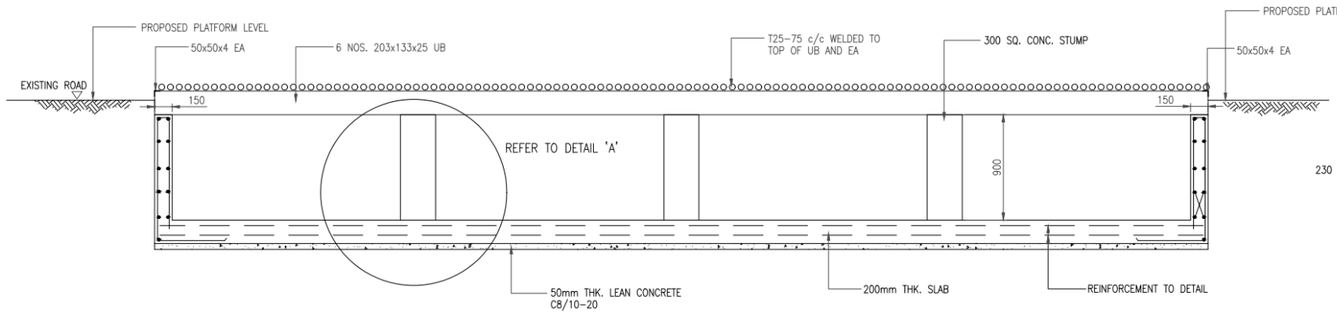
PLAN OF WASH TROUGH
NOT TO SCALE



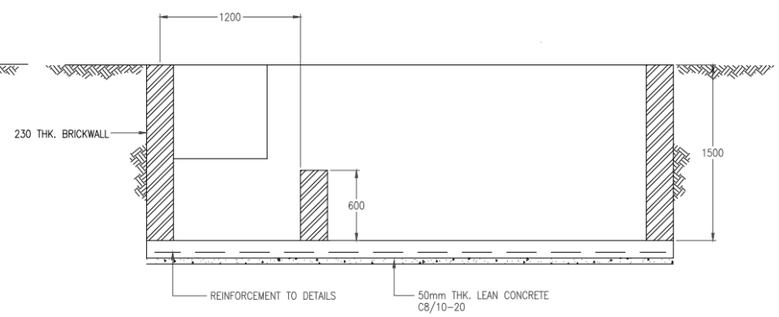
SECTION 3
NOT TO SCALE



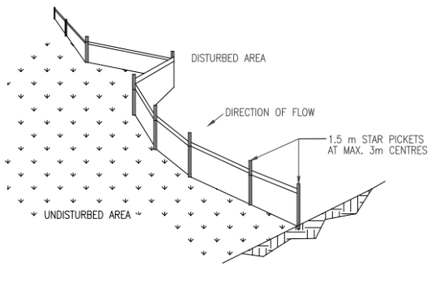
DETAIL 'A'
NOT TO SCALE

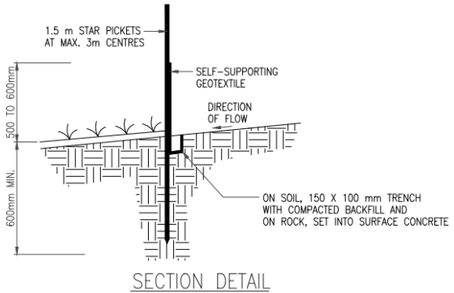


SECTION 1
NOT TO SCALE

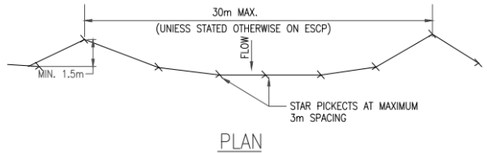


SECTION 2
NOT TO SCALE





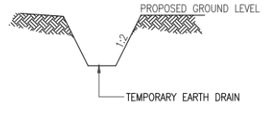
SECTION DETAIL



PLAN

TYPICAL DETAIL OF SILT FENCE
NOT TO SCALE

CONSTRUCTION NOTES:
1. CONSTRUCT SEDIMENT FENCE AS CLOSE AS POSSIBLE TO THE CONTOURS OF THE SITE
2. DRIVE 1.5 METRE LONG STAR PICKETS INTO GROUND, 3 METRES APART.
3. DIG A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
4. BACKFILL TRENCH OVER BASE OF FABRIC.
5. FIX SELF-SUPPORTING GEOTEXTILE TO UPSLOPE SIDE POSTS WITH WIRE TIES OR AS RECOMMENDED BY GEOTEXTILE MANUFACTURER.
6. JOINT SECTION OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.



TYPICAL EARTH DRAIN SECTION
NOT TO SCALE

NOTES:
1. All units are in millimetre (mm) unless otherwise stated.

FOR SUBMISSION ONLY

No. Fail

Kegunaan Pejabat

Tajuk Projek:

PERMOHONAN PELAN KERJA TANAH DI BAWAH AKTA 133 BAGI TUJUAN PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIA ADA), SEKSYEN 8, BANDAR JELUTONG, PULAU PINANG UNTUK TETUAN PLB ENGINEERING BERHAD

Tandatangan Pemilik Tanah & Pemaju :

NAMA : DATO SIOW KOK YONG

PLB ENGINEERING BERHAD
Company No. : 199701002728 (418224-X)
1320, JALAN BARU, TAMAN CHAI LENG, 13700 PRAI, PENANG.

Arkitek :

W. K. Khor Architect Sdn Bhd
(TMM38747)
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FAX: 03 2143 9076

Jurutera Perunding

GLOBAL WATER CONSULTANTS SDN. BHD. (200601017878)
23-4, JALAN TASIK SELATAN 3,
BANDAR TASIK SELATAN,
57000 KUALA LUMPUR, MALAYSIA.
TEL: 03-90595396 FAX: 03-90595869
E-MAIL: gnp@gnpgroup.com.my
WEB SITE: www.gnpgroup.com.my

Tandatangan Jurutera

JURUTERA PROFESIONAL DENGAN PERAKUAN AMALAN AWAM Ir. LIM CHOON LIN C15534 MALAYSIA

NAMA : IR. LIM CHOON LIN

Tajuk Lukisan

EARTHWORK
WASH TROUGH, SILT FENCE & TEMPORARY EARTH DRAIN DETAILS

Skala	Tarikh	Direka	Dilukis
AS SHOWN	NOVEMBER 2022	FAA	LXH
Peringkat	Kontrak	Disemak	Diluluskan
SUBMISSION		LCL	LCL
No Projek	No. Lukisan		Pdn
484GU22	484GU22/ESCP/DET/03		

APPENDIX G

Master Plan & Approval Letter on Master Plan from Jabatan Perancang Bandar dan Desa Negeri Pulau Pinang

JABATAN PERANCANG BANDAR DAN DESA
NEGERI PULAU PINANG

Tingkat 57, KOMTAR
10000 Pulau Pinang

Pengarah : 04 650 5270
Timbalan I : 04 650 5555
Timbalan II : 04 650 5560
Kawalan : 04 650 5545 / 5372 / 5429
Korporat / LR : 04 650 5273 / 5275 / 5588
MGTN & ICT : 04 650 5589 / 5398
Projek Khas : 04 650 5428 / 5274 / 5544
Pengurusan : 04 650 5476 / 5276
Faks : 04 263 7580 / 261 2103

PLAN Malaysia
@Pulau Pinang
Perancangan Melangkaui Kelaziman
Planning Beyond Conventional

Portal Jabatan : http://jpbd.penang.gov.my
Geoportal : http://jpbd.geoportal.gov.my

Ruj. Tuan :
Ruj. Kami : JPBD/01/0701/31
Tarikh : 10 NOVEMBER 2022
15 RABIULAKHIR 1444H

TETUAN PLB ENGINEERING BERHAD
1320, Jalan Baru, Taman Chai Leng,
13700 Prai, Pulau Pinang.

W.K. KHOR ARCHITECT
33, Lebuhraya Maktab,
10250 Pulau Pinang.

Tuan / Puan,

PERMOHONAN PELAN INDUK UNTUK CADANGAN PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIADA), SEKSYEN 8, BANDAR JELUTONG, PULAU PINANG.

UNTUK TETUAN PLB ENGINEERING BERHAD

Dengan segala hormatnya saya merujuk kepada perkara di atas.

2. Dimaklumkan bahawa **Mesyuarat Jawatankuasa Perancang Negeri Bil.10/2022** pada **27 Oktober 2022** dan **disahkan pada hari yang sama** memutuskan untuk **meluluskan** permohonan ini tertakluk kepada syarat-syarat seperti berikut :

1. **Memperakukan** penggunaan ketumpatan/nisbah plot maksima **5:1** bagi cadangan pelan induk ini.

2. Pemaju dikehendaki menggantikan jeti nelayan sediada yang dibina oleh pihak IJM sepertimana keputusan Mesyuarat Majlis Mesyuarat Kerajaan (MMK) Bil. 32/2021 pada 25 Ogos 2021 dan disahkan pada 8 September 2021.

3. Lokasi pembinaan jeti nelayan baru haruslah berdekatan dengan laut dan mudah diakses oleh jalan darat serta membina semula Kompleks Pendaratan Ikan yang baru (termasuk dengan bangunan stor nelayan) bagi menggantikan kompleks sedia ada di atas sebahagian Plot 29.

4. Melaksanakan langkah-langkah mitigasi dan kawalan kualiti air laut ketika kerja-kerja pengorekkan dan tambakan dijalankan oleh kerana tapak cadangan berhampiran dengan kawasan *Middle Bank*.

5. Tapak Rumah Ibadat Bukan Islam (RIBI) di Plot 07 dicadangkan untuk dipindahkan ke sebahagian tapak Plot 24 memandangkan ia lebih sesuai dan strategik kerana berdekatan dengan Tokong Cina Hean Chooi sedia ada.

6. Pemaju dikehendaki menunjukkan di atas pelan induk ini penyediaan Rumah Mampu Milik (RMM) termasuk penyediaan 30% Rumah Kos Sederhana Rendah (LMC) bagi tujuan pematuhan syarat.

7. Mengambilkira Indeks Kerapuhan Persisiran Pantai Negara (NVCI) bagi UPZPP19, Daerah Timur Laut, Pulau Pinang berada pada Tahap 3 (Sederhana). Ini berdasarkan keputusan komponen CVIP (fizikal) tahap 2 (Rendah), CVIB (Biodiversiti) tahap 1 (Sangat Rendah) dan CVIS (Sosio-Ekonomi) pula menunjukkan Tahap 5 (Sangat Tinggi). Oleh itu, langkah dan cadangan penambahbaikan yang diterangkan di dalam RFZPPN2 bagi kawasan ini perlu diambilkira di dalam projek ini.

8. Pemaju perlu menyediakan Pelan Induk Sistem Saliran bagi melihat sistem saliran kawasan pembangunan dan langkah-langkah mitigasi yang akan dicadangkan oleh perunding yang dilantik.

9. Menyediakan Laporan Kajian Hidraulik dan dikemukakan ke Bahagian Pengurusan Pantai, JPS Malaysia.

10. Penyediaan Laporan Kajian Impak Lalulintas (TIA), Laporan Kajian Terperinci Impak Alam Sekitar (DEIA) serta Laporan Kajian Impak Perikanan (FIA) perlu dikemukakan ke jabatan/agensi yang berkaitan.

11. Laporan Hidrologi yang komprehensif bersama Laporan Geoteknikal perlu dikemukakan ke Jawatankuasa Pembangunan Tanah Berisiko Negeri Pulau Pinang.

12. Penyediaan Laporan Impak Sosial (SIA) akan dikenakan mengikut jadual 'Tambahan Pemajuan SIA Kategori 3 Peringkat Negeri Pulau Pinang' secara berasingan bagi setiap pembangunan yang akan dibangunkan kelak.

13. Penyediaan laluan pejalan dan basikal hendaklah selaras dengan hasrat Kerajaan Negeri bermula dari Straits Quay ke Jambatan Kedua Pulau Pinang.

14. Sistem laluan dalaman yang mengambilkira keperluan koridor utiliti bawah tanah bagi mewujudkan persekitaran jalan kemas dan dilengkapi dengan perabot jalan yang sistematik.

15. Perlu mematuhi dasar-dasar dan polisi Kerajaan Negeri serta garispanduan terkini yang sediada.

16. Tertakluk kepada lain-lain syarat yang akan dikenakan diperingkat kebenaran merancang dan pelan bangunan.

Sekian, terima kasih.

"WAWASAN KEMAKMURAN BERSAMA 2030"
"CEKAP, AKAUNTABILITI, TELUS"
"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

(TPr ROZITA BINTI HAMIT)
Pengarah
PLANMalaysia@Pulau Pinang
(Jabatan Perancang Bandar dan Desa)
Merangkap Setiausaha Jawatankuasa Perancang Negeri
Pulau Pinang.

s.k.: Pemangku Pengarah
Jabatan Perancangan
Pembangunan,
Majlis Bandaraya Pulau Pinang,
Tingkat 16, KOMTAR,
10000 Pulau Pinang.

JABATAN PERANCANG BANDAR DAN DESA NEGERI PULAU PINANG

Tingkat 57, KOMTAR
10000 Pulau Pinang

Pengarah : 04 650 5270
Timbalan I : 04 650 5555
Timbalan II : 04 650 5560
Kawalan : 04 650 5545 / 5372 / 5429
Korporat / LR : 04 650 5273 / 5275 / 5588
MGTN & ICT : 04 650 5589 / 5398
Projek Khas : 04 650 5428 / 5274 / 5544
Pengurusan : 04 650 5476 / 5276
Faks : 04 263 7580 / 261 2103

PLANMalaysia
@Pulau Pinang
Perancangan Melangkaui Kelaziman
Planning Beyond Conventional

Portal Jabatan : http://jpbd.penang.gov.my
Geoportal : http://jpbd.geoportal.gov.my

Ruj.Kami : JPBD/01/0701/36

Tarikh :20 Februari 2023
29 Rejab 1444

SEPERTI EDARAN

Y.Bhg Dato' / Tuan/ Puan,

PERMOHONAN PELAN INDUK UNTUK CADANGAN PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIADA), SEKSYEN 8, BANDAR JELUTONG, PULAU PINANG.

UNTUK : TETUAN PLB ENGINEERING BERHAD

-PELAN INDUK LULUS

Dengan segala hormatnya saya merujuk kepada perkara di atas.

2. Bersama-sama ini disertakan 1 set Pelan Induk Untuk Cadangan Pembangunan Bercampur Dan Perdagangan Dengan Nisbah Plot 5:1, Di Atas Tanah Kerajaan Tebusguna Jelutong (Tapak Pelupusan Sampah Sediada), Seksyen 8, Bandar Jelutong, Pulau Pinang untuk Tetuan PLB Engineering Berhad yang telah diluluskan oleh Mesyuarat Jawatankuasa Perancang Negeri Bil.10/2022 pada 27 Oktober 2022 dan keputusan disahkan pada hari yang sama untuk simpanan dan rujukan Y.Bhg Dato' / Tuan/ Puan.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"
"CEKAP, AKAUNTABILITI DAN TELUS"

Saya yang menjalankan amanah,

(TPr ROZITA BINTI HAMIT)
Pengarah
PLANMalaysia@Pulau Pinang
C:\Users\840603075258\Downloads\JPBD.01.0701.36 - Pelan Induk PLB Engineering_utk rujukan dan simpanan.doc

SEPERTI EDARAN

Setiausaha Bahagian
Bahagian Perancang Ekonomi Negeri
Tingkat 26, KOMTAR
Pulau Pinang

Pengarah
Pejabat Tanah dan Galian
Tingkat 21 & 22 KOMTAR
10000 Pulau Pinang

Pengarah
Jabatan Kerja Raya Pulau Pinang
Jalan JKR, Sungai Pinang
11600 Pulau Pinang

Pengarah
Jabatan Pengairan dan Saliran
Negeri Pulau Pinang
Tingkat 55, KOMTAR
Pulau Pinang

Jurutera Daerah
Jabatan Pengairan dan Saliran
Daerah Timur Laut
Tingkat 29, KOMTAR
10000 Pulau Pinang

Pengarah
Jabatan Alam Sekitar Negeri
Aras Bawah – Zon B, Wisma Persekutuan
Seberang Perai Utara
13200 Kepala Batas

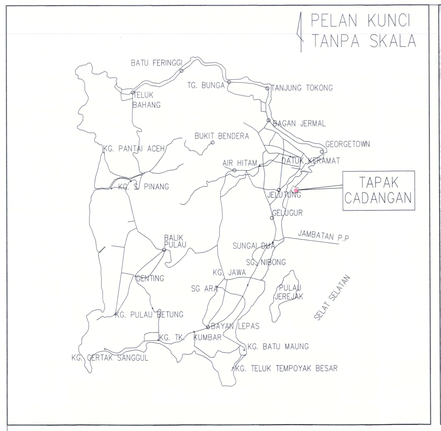
Pegawai Daerah Timur Laut
Pejabat Daerah dan Tanah
Daerah Timur Laut
Tingkat 50 & 51 KOMTAR
10000 Pulau Pinang

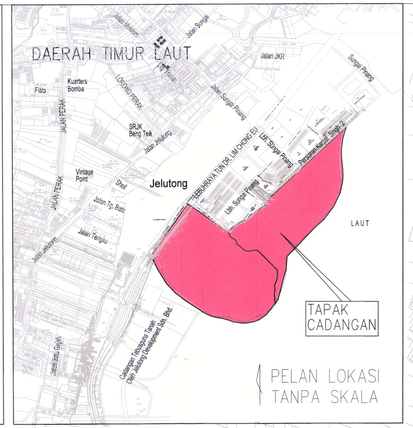
Pengarah
Jabatan Perancangan Pembangunan
Majlis Bandaraya Pulau Pinang
Tingkat 16, KOMTAR
10000 Pulau Pinang

Ketua Penolong Setiausaha Kanan
Bahagian Kerajaan Tempatan
Tingkat 56, KOMTAR
10503 Pulau Pinang

Tetuan PLB Engineering Berhad
1320, Jalan Baru, Taman Chai Leng
13700 Prai, Pulau Pinang.

W.K. KHOR ARCHITECT
33, Lebuhraya Maktab,
10250 Pulau Pinang.





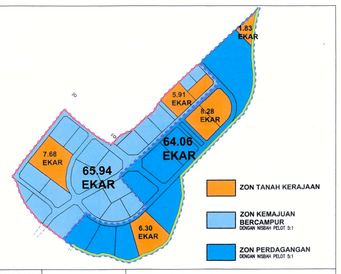
PELAN INDUK

TANAH PELUPUSAN SAMPAH JELUTONG
SEKSYEN 8, BANDAR GEORGETOWN

PULAU PINANG

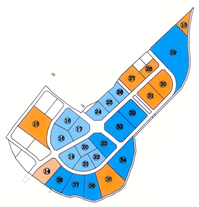
SKALA 1: 3,000
SYIT PIAWAI: 11-D-I

A) PENGEZONAN DAN PENGIRAAN KETUMPATAN DAN NISBAH PELOT SECARA KESELURUHAN



	KELUASAN (EKAR)	KEGUNAAN TANAH	PECAHAN PENGIRAAN TERPERINCI
	65.94	KEMAJUAN BERCAMPUR DENGAN NISBAH PELOT = 5:1	(I) KEDIAMAN (NISBAH PELOT 2.8 :1) KETUMPATAN = 2.8 X 65.94 EKAR X 43,560 K.P. KEDIAMAN MAXIMA = 108.46 X 43,560 K.P. = 8,042.570 K.P. TOTAL UNITS = 6,992 UNITS 25 % RMM (850 K.P.) = 6992 X 0.25 = 1748 UNITS 1748 X 850 K.P. = 1,485,800 K.P. 75 % BUKAN RMM = 6992 X 0.75 = 5244 UNITS 5244 X 1250 K.P. = 6,555,000 K.P. TOTAL AREA = 1,485,800 K.P. + 6,555,000 K.P. = 8,040,800 K.P. (<8,042,570 K.P.) (II) PERDAGANGAN (NISBAH PELOT 2.2 :1) KELUASAN LANTAI PERDAGANGAN MAKSIMA = 2.2 X 65.94 EKAR X 43,560 K.P. = 145.01 X 43,560 K.P. = 6,319,162 K.P.
	64.06	PERDAGANGAN DENGAN NISBAH PELOT = 5:1	(II) PERDAGANGAN (NISBAH PELOT 5 :1) KELUASAN LANTAI PERDAGANGAN MAKSIMA = 5 X 64.06 EKAR X 43,560 K.P. = 320.3 X 43,560 K.P. = 13,952,268 K.P.
	30.00	TANAH KERAJAAN	-
	160.00	JUMLAH BESAR	

B) TANAH YANG AKAN DISERAHKAN KEPADA KERAJAAN NEGERI



PELOT	KEGUNAAN		K.NEGERI	PLBE
15	TANAH KERAJAAN NEGERI		7.68	
27			3.92	
28			1.99	
30			4.44	
31			3.84	
35			6.30	
39			1.83	
	JUMLAH KECIL (I)		30.00	
14	KEMAJUAN BERCAMPUR DENGAN NISBAH PELOT =5:1	25% RMM		4.09
16				3.24
17				3.21
18				4.13
19		75% RUMAH BIASA DAN PERDAGANGAN		3.14
20				2.45
21				2.52
22				2.06
24				2.75
25				2.47
26				2.34
	JUMLAH KECIL (II)			32.40
23	PERDAGANGAN DENGAN NISBAH PELOT =5:1			3.97
29				14.32
32				4.61
33				5.80
34				6.30
36				4.06
37				4.05
38				4.08
	JUMLAH KECIL (III)			47.19
	TOTAL NETT AREA FOR DEVELOPMENT JUMLAH BESAR (I + II + III)			109.59

I) 25% BAGI 84 EKAR YANG PERTAMA	= 84 EKAR X 0.25 = 21 EKAR	PERATUSAN TANAH YANG AKAN DISERAHKAN KEPADA KERAJAAN NEGERI	= (I) ÷ (II) = (21÷22.8) EKAR = 43.80 EKAR = 43.80 / 160 EKAR = 27.375 %
II) 30% BAGI KELUASAN TANAHYANG SETERUSNYA	= (160-84) EKAR X 0.30 = 76 EKAR X 0.30 = 22.8 EKAR		

JUMLAH KELUASAN TANAH (NETT AREA) SEBENAR YANG DISERAH	= JUMLAH TANAH(NETT AREA) UNTUK PEMBANGUNAN / 160 X 43.80 EKAR = 109.59 /160 X 43.80 EKAR = 0.6849 X 43.80 EKAR = 30.00 EKAR

C) DATA PEMBANGUNAN

	PELOT	KEGUNAAN	KELUASAN EKAR	PENGIRAAN KETUMPATAN MAXIMA (%) SECARA KESELURUHAN				
	01	SEKOLAH RENDAH	3.00					
	02	SEKOLAH MENENGAH	3.00					
	03	KAWASAN LAPANG BERPUSAT	2.00					
(TA)	04	TANGKI AIR	1.00					
	05	MASJID	3.00					
(PA)	06	PMU	2.63					
	07	RIBI	0.50					
(BI)	08	BALAI BOMBA	1.00					
(BI)	09	BALAI POLIS	1.00					
	10	SIMPANAN PARIT	0.58					
	11	SIMPANAN PARIT	0.77					
	12	PROMENADE	4.56					
	13	REZAB JALAN	27.36					
		JUMLAH KECIL (1)	**50.40**					
	15	TANAH KERAJAAN	7.68					
	27		3.92					
	28		1.99					
	30		4.44					
	31		3.84					
	35		6.30					
	39		1.83					
		JUMLAH KECIL (2)	**30.00**			UNITS	JENIS KEDIAMAN	PERDAGANGAN (K.P)
	14	KEMAJUAN BERCAMPUR DENGAN NISBAH PELOT =5:1	4.09	-	-	1748	25% RMM	T/B
	16		3.24	3.24÷28.31=	0.1144	600.16	75% PERUMAHAN BIASA	723,210
	17		3.21	3.21÷28.31=	0.1134	594.60		716,514
	18		4.13	4.13÷28.31=	0.1459	765.02		921,870
	19		3.14	3.14÷28.31=	0.1109	581.64		700,889
	20		2.45	2.45÷28.31=	0.0865	453.83		546,872
	21		2.52	2.52÷28.31=	0.0890	466.79		562,497
	22		2.06	2.06÷28.31=	0.0728	381.58		459,819
	24		2.75	3.25÷28.31=	0.0971	509.40		613,836
	25		2.47	2.47÷28.31=	0.0872	457.53		551,336
	26		2.34	2.34÷28.31=	0.0827	433.45		522,319
		JUMLAH KECIL (3)	**32.40**		**1.00**	**6,992**		**6,319,162**
	23	PERDAGANGAN DENGAN NISBAH PELOT =5:1	3.97	3.97÷47.19=	0.0841			1,173,776
	29		14.32	14.32÷47.19=	0.3035			4,233,873
	32		4.61	4.61÷47.19=	0.0977			1,363,000
	33		5.80	5.80÷47.19=	0.1229			1,714,837
	34		6.30	6.30÷47.19=	0.1335			1,862,668
	36		4.06	4.06÷47.19=	0.0860			1,200,386
	37		4.05	4.05÷47.19=	0.0858			1,197,429
	38		4.08	4.08÷47.19=	0.0865			1,206,299
		JUMLAH KECIL (4)	**47.19**		**1.00**			**13,952,268**
		JUMLAH BERSH (2) + (3) + (4)	**109.59**			**6,992**		**20,271,430**
		JUMLAH BESAR (1) + (2) + (3) + (4)	**160.00**					

NO PELAN:

JPBD/P2/Jelutong/PLB/221027

TAJUK :

PELAN INDUK UNTUK CADANGAN PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIADA), SEKSYEN 8, BANDAR JELUTONG, PULAU PINANG.

Pelan ini telah diluluskan oleh Jawatankuasa Perancang Negeri Bil.10/2022 pada 27 Oktober 2022 dan disahkan pada hari yang sama.

PEMILIK TANAH :

DATO' HAJI ZULKIFLI JELUTONG
Pengarah Tanah Dan Galian
Pulau Pinang

PENGARAH
PEJABAT TANAH DAN GALIAN
NEGERI PULAU PINANG.

TARIKH : 16 FEB 2023

DISEMAK OLEH :

TPr ROSITA BINTI HAMIT
Pengarah
PLANMalaysia@Pulau Pinang
(Jabatan Perancang Bandar Dan Desa Negeri Pulau Pinang)

PENGARAH
PLANMALAYSIA@PULAU PINANG
(JABATAN PERANCANG BANDAR DAN DESA)
Merangkap
SETIAUSAHA JAWATANKUASA PERANCANG NEGERI

TARIKH : 16 FEB 2023

DISAHKAN OLEH :

Dato' Mohd Fauzi bin Bakar
Setiausaha Kerajaan Negeri
Pulau Pinang

SETIAUSAHA KERAJAAN NEGERI
PULAU PINANG

TARIKH : 16 FEB 2023

DILULUSKAN OLEH :

Y.A.B TUAN CHOW KON YEOW
PENGERUSI JAWATANKUASA PERANCANG NEGERI
PULAU PINANG

TARIKH : 16 FEB 2023

LUKISAN

PELAN KUNCI, PELAN LOKASI,PELAN INDUK & JADUAL PEMBANGUNAN

RUJ FAIL : KK/21/976

FAIL ACAD: WKKA/PLB/JLT/JPBD/221209

PINDAAN : 02

TARIKH : 09.12.2022

DISEDIAKAN OLEH:

PLANMalaysia@Pulau Pinang

JABATAN PERANCANG BANDAR DAN DESA
NEGERI PULAU PINANG
TINGKAT 57, KOMTAR,
10000 PULAU PINANG

APPENDIX H

Bathymetric Survey Plan – National Geodetic Vertical Distance (NGVD)

PROJECT :

FIELD MEASUREMENT WORKS FOR THE PROPOSED REHABILITATION AT JELUTONG, PULAU PINANG

DRAWING TITLE :

BATHYMETRIC SURVEY PLAN

- NATIONAL GEODETIC VERTICAL DISTANCE (NGVD) -

Report No : 1008/2020

CLIENT :

PLB ENGINEERING BERHAD

1320, JALAN BARU,
TAMAN CHAI LENG
13700 PERAI, PULAU PINANG

TEL: (604) 390 5737
FAX: (604) 399 8323

CHARTERED & LICENSED LAND SURVEYORS :

JURUKUR PERUNDING SERVICES SDN. BHD. (37933-V)

7 , JALAN INDUSTRI PBP 3
TAMAN INDUSTRI PUSAT BANDAR PUCHONG
47100 PUCHONG , SELANGOR DARUL EHSAN
TEL : (603) 5623 3228
FAX : (603) 8062 2999 & (603) 8061 3399
e-mail : surveys@jpsurveys.com

Positions obtained from satellite navigation systems, such as the Global Positioning System (GPS), are normally referred to the World Geodetic System (WGS) 1984 Datum. Such positions can be plotted directly on this chart.

SOUTH CHANNEL

Vessels of more than 5 metres in height intending to pass beneath Penang Bridge must make a written [illegible] Penang, at least 12 [illegible]e. Vessels of more [illegible]bited from passing

[illegible]eight or 30 metres [illegible]rmission from the [illegible]ng the area.

[illegible]LINE

[illegible]or or trawl in the [illegible]amaged oil or gas [illegible]n, lose of vessel's

FISHING STAKES. Fishing stakes, the positions of which are frequently altered, exit in the area covered by this chart; especially within the 10 metre contour.

LEGEND	
SYMBOLS	DESCRIPTIONS
	METALLED ROAD
	CHAIN LINK FENCE
	SLOPE / CUTTING
	RETAINING ROCK
	ROCK
	BEACON LIGHT
	SUMP
WATER LEVEL RL : -0.42m @10.26 hrs on 19 April 2020	WATER LEVEL SYMBOL
	CONCRETE WALL
-1.4	BATHY TEXT
-986IL	INVERT LEVEL
	FOOTPATH
	MINOR CONTOUR
	MAJOR CONTOUR
	IRON RAILING/ GUARDRAIL
	COVERED DRAIN
	CULVERT
RETAINING WALL	LABLE SCALE
HAT 1.53m	HIGHEST ASTRONOMICAL TIDE
MHWS 1.13m	MEAN HIGH WATER SPRING/SHORE LINE
LAT -1.56m	LOWEST ASTRONOMICAL TIDEA @ CHART DATUM

JELUTONG
PERMATANG TENGAH
(MIDDLE BANK)
Permatang Syrang
(Syrang Bank)
GELUGUR
Labuhan Bahan Peledak
(Explosived Anchorage)
Kawasan Labuhan Kuarantin
(Quarantine Anchorage Area)
Labuhan Petroleum untuk Kapal Kecil
(Petroleum Anchorage for Small Craft)
Takungan
(Reservoir)
Radio Masts
(R Lts)
(122)
Radio Masts
Kg. Sungai
Gelugur
Jeti Polis Marin
(Marine Police Jetty)
Submarine Cable
Transit No.1
Submarine Cable
Transit No.2
OIL/GAS PIPELINE
SUBMARINE POWER CABLE AREA
SUBMARINE POWER CABLE AREA
RESTRICTION AREA
Sugai Tuju 185°
Leading Lights
OLD WOODEN JETTY
MONSOON DRAIN
Sg. Gelugur
LIGHT BUOY
FLOATING LIGHT
SANGKAR IKAN
OLD SEWERAGE PIPE
BLACKCOCK
BW.
Obstn
WK

N

CONTOUR INTERVAL 1 METRE
LAND SURVEY DATUM (NGVD)

LAT 5° 24' 20" N
LAT 5° 24' 00" N
LAT 5° 23' 40" N
LAT 5° 23' 20" N
LAT 5° 23' 00" N
LAT 5° 22' 40" N
LAT 5° 22' 20" N
LONG 100° 18' 10" E
LONG 100° 18' 30" E
LONG 100° 18' 50" E
LONG 100° 19' 10" E
LONG 100° 19' 30" E
LONG 100° 19' 50" E
LONG 100° 20' 10" E
LONG 100° 20' 30" E
LONG 100° 20' 50" E

LEGEND / NOTES :

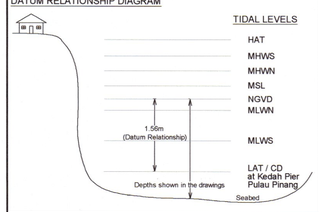
1. All measurements are in metres.
2. Coordinates in Penang State Cassini Geocentric System and was referred to the Boundary Stones Lot 419 (PA 42716).
3. All levels are in National Geodetic Vertical Datum (NGVD) based on JUPEM Benchmark BM P0057 (RL:3.730m NGVD) and BM P0058 (RL:3.531m NGVD).
4. Chart Datum at Kedah Pier, Pulau Pinang is 1.555m below NGVD situated at corner of Fort Cornwallis.
5. -0.6 Denotes metres below NGVD.
6. 3.53 Denotes metres above NGVD.
7. 6.36IL (Invert Level) denotes metres above NGVD.
8. Topographic data at Jelutong Dumpsite Area was abstracted from Jurukur Pinang's drawing number JPG/0410/A.
9. The overlaid Nautical Chart was abstracted from MAL Chart No. 5299.
10. All depths of Nautical Chart ( ) are in Chart Datum at Kedah Pier, Pulau Pinang.

NOTES :

TIDAL LEVELS AT KEDAH PIER, PULAU PINANG
(Abstracted from Royal Malaysian Navy Tide Table 2020)

	NGVD (m)	LAT/CD (m)
Highest Astronomical Tide (HAT)	1.53	3.09
Mean High Water Spring (MHWS)/SHORE LINE	1.13	2.69
Mean High Water Neap (MHWN)	0.40	1.96
Mean Sea Level (MSL)	0.15	1.71
National Geodetic Vertical Datum (NGVD)	0.00	1.56
Mean Low Water Neap (MLWN)	-0.11	1.45
Mean Low Water Spring (MLWS)	-0.84	0.72
Lowest Astronomical Tide (LAT) @ Chart Datum (CD)	-1.56	0.00

DATUM RELATIONSHIP DIAGRAM



GEODETIC INFORMATION :

Geodetic Data

Spheroid	: GRS 1980
Semi Major Axis	: 6 378 137.000 metres
Semi Minor Axis	: 6 356 752.314 metres
Reciprocal Flattening (1/f)	: 298.2572

Origin of Meridian of Reference

Projection	: P.Pinang & Seberang Prai State Cassini Geocentric
Origin of Meridian of Reference	: Fort Cornwallis
Longitude of Origin (CM)	: E 100° 20' 40.76024"
Latitude of Origin	: N 05° 25' 15.20433"
False Easting	: 0 m
False Northing	: 0 m
Scale Factor	: 1.000000

CLIENT :

PLB ENGINEERING BERHAD
1320, Jalan Baru,
Taman Chai Leng
13700 Perai, Pulau Pinang
Tel: (604) 390 5737
Fax: (604) 399 8323

PROJECT TITLE:

FIELD MEASUREMENT WORKS FOR THE PROPOSED REHABILITATION WORK AT JELUTONG, PULAU PINANG

DRAWING TITLE:

BATHYMETRIC SURVEY PLAN
GENERAL SITE PLAN
- NATIONAL GEODETIC VERTICAL DATUM (NGVD) -

Surveyed By: Samsi	Date Of Survey: 17th - 22th June 2020
Plotted By: Ariffah	Drawn By: Ariffah
Checked By: Bazli & Mohd Hairul	Approved By: Sr Lee Chenk Hock

SCALE : 1 : 8000

HORIZONTAL 160 80 0 160 40 60 METRES

Surveyor's Drawing No : JPWS/20/PNG/145/001	Sheet No :	Rev : 0
Client's Drawing No :	Sheet No :	Rev :

REVISION	DATE	REPORT NO : 1008/2020
		Date : 1st July 2020

Chartered & Licensed Land Surveyors :

JURUKUR PERUNDING SERVICES SDN. BHD. (3933-V)
7, Jalan Industri PBP 3
Taman Industri Pusat Bandar Puchong
47100 Puchong
Selangor Darul Ehsan
Tel : +603 5623 3228
Fax : +603 8062 2999 & 8061 3399
Email : surveys@jpsurveys.com

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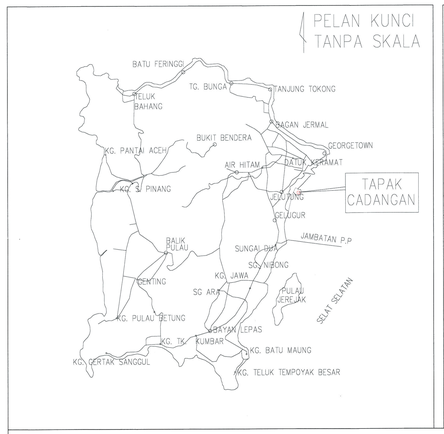
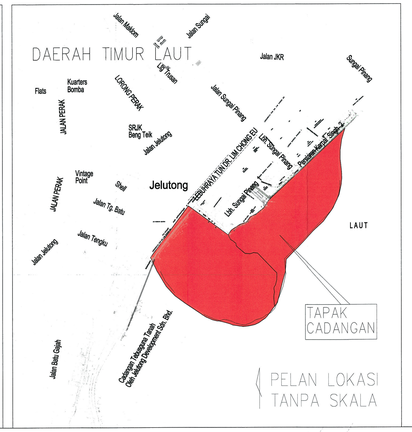
APPENDIX I

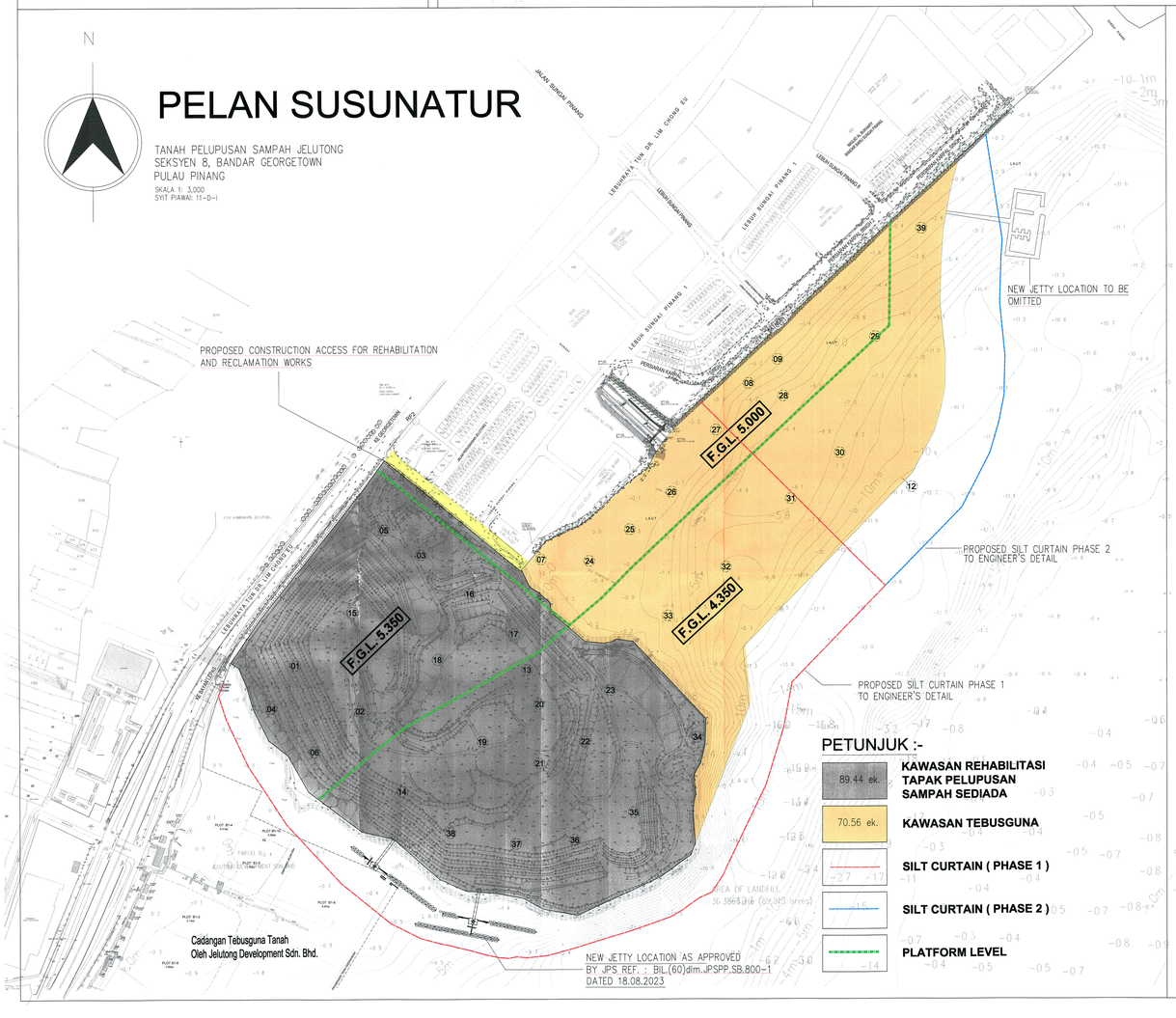
Approved Master Plan



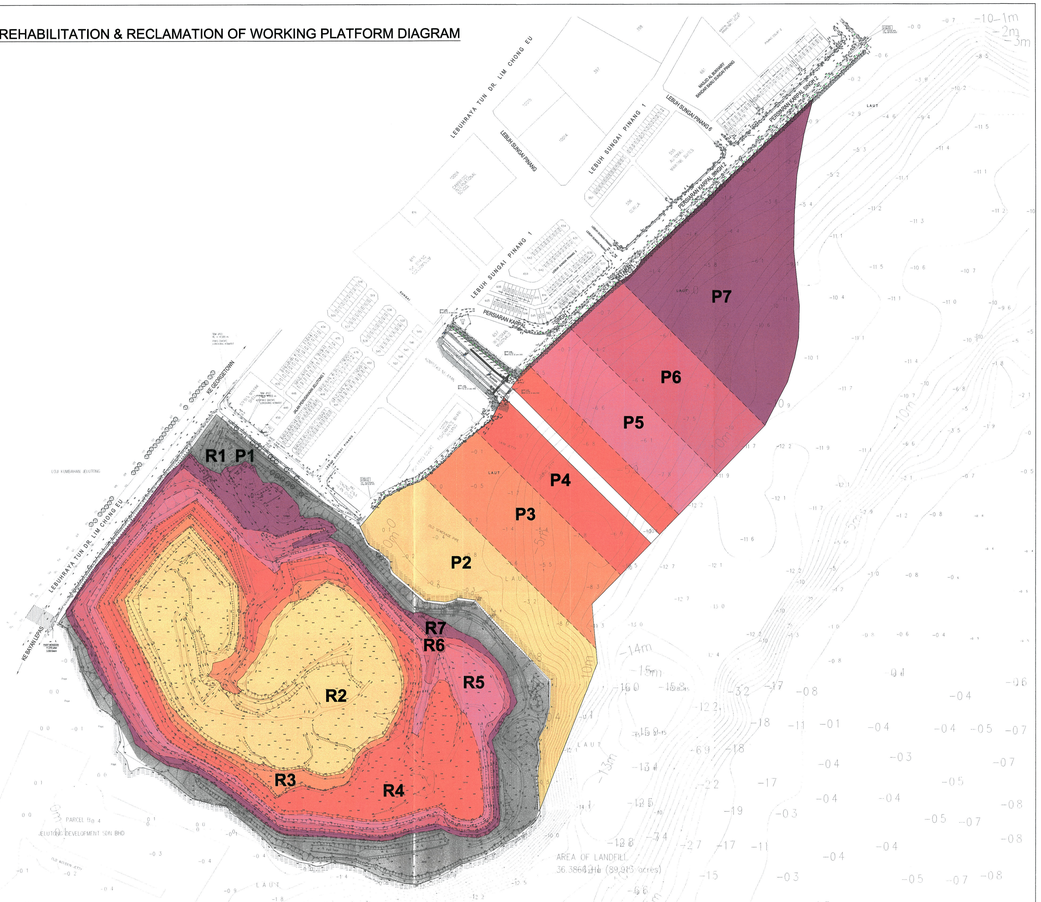


A) JADUAL JANGKAMASA DAN ISIPADU, KELUASAN KERJA-KERJA REHABILITASI DAN TEBUSGUNA "WORKING PLATFORM"

REHABILITASI					TEBUS GUNA "WORKING PLATFORM"				JANGKA MASA (HARI)
ZON	KELUASAN KAWASAN TERLIBAT (m^2)	ISIPADU KERJA REHABILITASI (m^3)	KETINGGIAN MSL (m)	ISIPADU TERTINGGAL (m^3)	ZON	KELUASAN KAWASAN TERLIBAT (m^2)	65% BAHAN GUNABALIK (m^3)	MESIN UNTUK KERJA REHABILITASI (UNIT)	
R1	–	T/B	37.00	7,380,000	P1	–	T/B	2	120
R2	104,009m^2	520,045	32.00	6,859,955	P2	54,323m^2	418,287	4	600
R3	126,709m^2	760,254	26.00	6,099,701	P3	39,117m^2	301,201	4	210
R4	199,277m^2	1,195,662	20.00	4,904,039	P4	39,117m^2	301,201	4	160
R5	232,402m^2	1,394,412	14.00	3,509,627	P5	31,002m^2	238,715	4	120
R6	259,942m^2	1,299,710	9.00	2,209,917	P6	37,804m^2	291,091	4 (2 DARI P1)	120
R7	290,764m^2	1,453,820	4.00	**756,097**	P7	77,427m^2	596,188	T/B	150
REMAINING WASTE	-	**756,097**			REHABILITATION AREA	363,866m^2	1,200,758	T/B	160
							JUMLAH MESIN (UNIT)	20	
					JUMLAH JANGKA MASA KERJA REHABILITASI DAN TEBUS GUNA				1640 HARI (4.5 TAHUN)



B) REHABILITATION & RECLAMATION OF WORKING PLATFORM DIAGRAM



NO. PELAN:

TAJUK :

PERMOHONAN KEBENARAN MERANCANG UNTUK KERJA-KERJA TEBUSGUNA TANAH BAGI PEMBANGUNAN BERCAMPUR DAN PERDAGANGAN DENGAN NISBAH PLOT 5:1, DI ATAS TANAH KERAJAAN TEBUSGUNA JELUTONG (TAPAK PELUPUSAN SAMPAH SEDIADA), SEKSYEN 8, BANDAR GEORGETOWN, PULAU PINANG.

UNTUK :-

TETUAN PLB ENGINEERING BERHAD

JADUAL KELUASAN

KAWASAN REHABILITASI	**89.44 EKAR**
KAWASAN TEBUSGUNA	**70.56 EKAR**
JUMLAH	**160.00 EKAR**

NOTA:

PEMILIK TANAH :

PENGARAH
PEJABAT TANAH DAN GALIAN
NEGERI PULAU PINANG.

TARIKH :

PEMEGANG KONSESI :

DATO' SIOW KOK YONG,JP
GROUP CHIEF OPERATING OFFICER
NO. K/P : 590223-05-5053
TARIKH :

PLB ENGINEERING BERHAD (418224-X)
1320, JALAN BARU, TAMAN CHAI LENG,
13700 PERAI, PENANG, MALAYSIA.
TEL : 604-3905737 FAX : 604-3998323

TANDATANGAN ARKITEK:

Ar. Khor Wooi Khean
ARKITEK
No Pendaftaran LAM : A/K 77
W. K. KHOR ARCHITECT
33, COLLEGE AVENUE,
10250 PENANG
TEL : 04-2286770
FAX : 04-2266771
E-MAIL : wkka333@gmail.com
ARCHITECTURE • LANDSCAPE • PLANNING • URBAN DESIGN

TAJUK LUKISAN:

PELAN KUNCI, PELAN LOKASI, PELAN SUSUNATUR & JADUAL PEMBANGUNAN

SKALA :	NO KERJA :
DILUKIS OLEH : TEAM WORK	
TARIKH : 18.09.2023	NO LUKISAN :
DISEMAK OLEH : ABH	WKKA_PLB/J.K.T./PSD_PPA/_1001