



GEOTECHNICAL REPORT

Broadscale Geotechnical Investigation and Landslide Risk Assessment for Proposed Residential Subdivision

End of Courtney Drive

Upper Coomera

HB Qld Pty Ltd

January 2023

PG-4116A

P: (07) 5636 4680 | **F:** (07) 5636 0286

E: info@pacgeo.com.au

A: 3 Jowett Street, Coomera QLD 4209

Postal: PO Box 499, Paradise Point QLD 4216

www.pacgeo.com.au

ABN: 62 615 248 952

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Author: Leigh Bexley

10th January, 2023

HB Qld Pty Ltd
Email: pj@hbland.com.au
CC: johnh@urbansolutions.net.au

ATTN: PETER JOHNSON

Dear Sir,

**BROADSCALE GEOTECHNICAL INVESTIGATION AND LANDSLIDE RISK
ASSESSMENT FOR PROPOSED RESIDENTIAL SUBDIVISION
END OF COURTNEY DRIVE, UPPER COOMERA**

Enclosed is a copy of our report for the above project dated January 2023. An electronic copy of the report has been issued.

Should you have any queries regarding this report, please do not hesitate to contact Leigh Bexley or Peter Elkington at this office.

Yours faithfully,



P. ELKINGTON (RPEQ 7226)

For and on behalf of
PACIFIC GEOTECH PTY LTD



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1.0 INTRODUCTION

This Report presents the results of a broadscale geotechnical investigation and Landslide risk Assessment for a proposed new residential subdivision at the end of Courtney Drive, Upper Coomera. The work was commissioned by Mr Peter Johnson on behalf of HB Qld Pty Ltd.

It is understood that the proposed development is to involve the subdivision of the above site into approximately 200 individual residential Lots with associated roads, parks and detention basins. Earthworks are expected to consist of significant cuts in the elevated portions of the site and significant fills in the lower portions of the site in association with batters and retaining walls to create level building platforms for the proposed residential development.

From a review of the City Plan Overlay Map provided by City of Gold Coast (Council), parts of the site are located in areas which have been assessed as being a 'Moderate' Landslide Hazard. On this basis, the Client is required to provide a Landslide Risk Assessment of the site as part of a development application to Council.

The report therefore includes a BROADSCALE Landslide Risk Assessment which broadly assess the site in its existing condition, identifying significant geotechnical constraints or issues which would impact on the proposed development within each Lot. A Landslide Susceptibility Rating has also been assigned to each individual Lot and recommendations to maintain or achieve a Landslide Susceptibility Rating of Low or better has been provided. The slope stability assessment has been carried out in accordance with the City of Gold Coast Council (CoGC) "SC6.10 City Plan Policy - Geotechnical Stability Assessment Guidelines," January 2021.

This report contains the results of the BROADSCALE Geotechnical Investigation and Landslide Risk Assessment and provides general advice and recommendations relating to the following:

- Subsurface conditions in accordance with AS 1726, including strength properties of encountered materials.
- Landslide Risk Assessment which assesses the suitability of site for residential development. A Landslide Susceptibility Rating has also been assigned to each proposed new Lot and recommendations have been provided to maintain or improve stability.
- Geotechnical issues or constraints for development.
- Drainage recommendations.
- Earthworks considerations including stripping depths, site preparation, filling recommendations, excavation conditions, suitability of excavated material for reuse as structural fill and suggested compaction standards for structural fill.
- Temporary and permanent batter slope recommendations.

2.0 METHODOLOGY

A desk study of the Moreton 1:500,000 Geological Map as well as aerial photographs, contour plans, subdivision proposal plan and the 'City Plan Overlay Map' showing Landslide Hazard Ratings provided by CoGC Council were initially carried out to identify the site geology, sloping terrain and areas of potential instability at the site.

Following the desk study, a walkover survey of the site was performed by a Principal Engineering Geologist from Pacific Geotech. This involved mapping and measuring features of significance to slope stability such as slope angles and direction, erosion features, surface and subsurface drainage, wet zones, vegetation density, cut and fill areas and the presence of any irregular surface features such as curved trees, slips, slumps, debris slides or any associated features.

To assess the subsurface conditions at the site, fourteen (14) boreholes (BH01 to BH14) were drilled at the site. The boreholes were drilled to depths ranging between 1.0m and 4.5m below the existing ground surface using a utility mounted Explora 60 drilling rig fitted with 100mm solid flight augers fitted and a Tungsten Carbide (T.C) bit. Dynamic Cone Penetrometer (DCP) tests were carried out adjacent to all borehole locations. These boreholes and DCP tests were used to assess subsurface profiles to assist with the Landslide Risk Assessment.

The soil classification descriptions and field tests were carried out in general accordance with Australian Standards.

AS 1726

Geotechnical Site Investigations

AS 1289

Methods of Testing Soils for Engineering Purposes

Site photographs are shown in the site description below. The logs of the boreholes including the DCP test results are presented in Appendix B. The laboratory test certificates are attached in Appendix C whilst the Guidelines for Hillside Construction are presented in Appendix D. The Standard Proforma for Geotechnical Certification and Landslide Susceptibility Analysis Forms are attached in Appendix E. A Site Plan showing the location of the boreholes and a Plan of Proposed Staged Subdivision are attached to this report in Appendix F. Bulk earthworks plans including cut and fill batter and retaining wall sections are attached in Appendix G to this report whilst the stability output plots are presented as Appendix H to this report.

3.0 SITE DESCRIPTION

The site is located at End of Courtney Drive, Upper Coomera and is rectangular in shape being approximately 600m long, north to south and 300m wide, east to west. It is made up of five large acreage Lots and is bound by acreage residential properties to the north, south and south west, Courtney Drive to the north west and suburban residential Lots to the east. Several environmental, drainage and recreational areas are also proposed throughout the site.

The site topography typically comprises a ridge line which meanders in a north south lineation through the centre of the site. The ridge line typically comprises flat or gentle sloping terrain of less than 5° in slope gradient. This ridge line is flanked to the east and west by mild sloping terrain typically ranging between 5° and 15° in slope gradient with some localised steeper areas ranging up to approximately 20° in slope gradient.

The site is drained by several gullies and drainage swales throughout the site. The main drainage gully emanates from the elevated terrain in the south western corner of the site and drains towards the north, near the western boundary of the site. The drainage gully then forms a flat, wide drainage area within the central western portion of the site which drains offsite to the west. This flat, wide drainage feature then appears to re-enter the site in the far north western corner of the site and then flows offsite to the north. Development is proposed within the upslope elevated portion of this drainage feature in the south western corner of the site, but is then retained as a drainage feature with no development proposed in the flat, wide central western portion as well as in the far north western portion where it re-enters the site.

Several smaller drainage swales are also evident emanating from the ridge line and flowing into the main drainage gully. A drainage gully also aligns through the south eastern corner of the site and is to remain as a drainage feature with no development proposed. A drainage gully also emanates from the ridge line in the central eastern portion of the site and flows offsite to the east.

Numerous dams are also evident throughout the site. These dams are typically confined to the main drainage gully as well as the drainage swales throughout the site.

At the time of the investigation, existing residential dwellings with associated sheds were located within the elevated portions of each acreage Lot making up the development site. The exception was the Lot in the south west corner which did not contain any development. Minor excavations have also been carried out at several locations, typically around the existing residential dwellings at the site and are typically less than 1-2m in depth.

Fill material was visibly evident around several of the existing residential dwelling house pads at the site as well as at the far southern end of Courtney Drive where a flat fill pad approximately 30m to 40m long and 15m to 20m wide has been constructed. This fill is likely to be uncontrolled fill and will need to be removed prior to development.

Surface levels within the development area at the site range from RL75m in the elevated south western corner of the site down to RL34m in the flat, wide drainage area in the north western portion of the site.

Most of the site has been cleared of vegetation and supports a sparse covering of mature and juvenile native trees with low grass and significant weeds as well as some

moderately dense native tree vegetation within the eastern as well as far south western portions of the site.

Refer following aerial and site photographs for typical site conditions.

AERIAL IMAGE



SITE PHOTOGRAPHS



Plate 1 – Looking westwards from mild sloping terrain towards flat terrain in far northern portion of the site.



Plate 2 – Mild sloping terrain in central portion of the site near borehole BH04.



Plate 3 – Drainage swale in central portion of the site near borehole BH06.



Plate 4 – Lower flat and wide portion of gully which emanates from the southwest corner of the site.



Plate 5 – Gully in south western portion of the site. Gully flattens and widens in the lower portions of the site to the right of photo (north).



Plate 6 – Erosion around side of dam within drainage swale in northern portion of site near borehole BH13.



Plate 7 – Mild sloping terrain in south west corner of site near borehole BH14.



Plate 8 – Head of the gully in south west corner of site.



Plate 9 – Dam in central eastern portion of site adjacent to borehole BH05.

4.0 GEOTECHNICAL MODEL

Based on the results of borehole drilling, the subsurface conditions encountered within the mild sloping terrain and ridge line typically comprise natural topsoil underlain by a thin layer of sand based soil. The sand based soil is underlain in several boreholes (BH04, BH05, BH10, BH11 and BH14) by a thin layer of clay based soil which is underlain by extremely weathered (XW) and highly weathered (HW) sandstone rock encountered at shallow depths of typically less than 1.0m, extending to the borehole termination depths.

The subsurface conditions encountered within the gullies, drainage swales or the low lying relatively flat areas of the site typically comprise natural topsoil underlain by sand based soils ranging between 0.5m and 1.7m in depth. The sand based soils are underlain by a deeper profile of clay soils, extending to depths ranging between 1.6m and 3.1m. The clay based soils are underlain by extremely weathered (XW) and highly weathered (HW) sandstone and siltstone rock, extending to the borehole termination depths.

Minor fill material of 0.5m in thickness was encountered in borehole BH12 which was drilled in the drainage swale adjacent to the dam in the far south eastern corner of the site. Fill material was also visibly evident around several of the existing house pads at the site as well as at the far southern end of Courtney Drive where a flat fill pad approximately 30m to 40m long and 15m to 20m wide has been constructed.

Table 1 presents a summary of the encountered subsurface profile. Detailed borehole record sheets are appended to this report.

TABLE 1 - SUBSURFACE PROFILE SUMMARY

BH No.	FILL	NATURAL					BH TD
		Topsoil	Sand	Clay	Gravel	XW/HW Rock	
		Medium Dense	Medium Dense/Dense	Stiff/Very Stiff/Hard	Dense	VLS/LS	
BH01	NE	0.0-0.1	NE	0.1-3.0	NE	3.0-TD	4.5
BH02	NE	0.0-0.1	0.1-0.5	NE	NE	0.5-TD	1.1*
BH03	NE	0.0-0.05	0.05-0.4	NE	NE	0.4-TD	1.6*
BH04	NE	0.0-0.05	0.05-0.3	0.3-0.6	NE	0.6-TD	1.5*
BH05	NE	0.0-0.1	0.1-0.4	0.4-1.1	NE	1.1-TD	1.15*
BH06	NE	0.0-0.1	0.1-0.5	0.5-1.6	NE	1.6-TD	1.8*
BH07	NE	0.0-0.15	0.15-0.8	0.8-1.6	1.6-2.5	2.5-TD	2.7*
BH08	NE	0.0-0.1	0.1-0.5	0.5-3.1	NE	3.1-TD	4.4*
BH09	NE	0.0-0.1	0.1-1.7	1.7-2.1	NE	2.1-TD	2.9*
BH10	NE	0.0-0.1	0.1-0.7	NE	NE	0.7-TD	1.6*
BH11	NE	0.0-0.1	0.1-0.5	NE	NE	0.5-TD	1.7*
BH12	0.0-0.5	0.5-1.2	NE	1.2-2.7	NE	2.7-TD	2.9*
BH13	NE	0.0-0.1	0.1-1.2	1.2-1.8	NE	1.8-TD	3.0*
BH14	NE	0.0-0.1	0.1-0.4	NE	NE	0.4-TD	1.0*

Notes:

1. All depths in metres below ground level at time of investigation.
2. NE - Not Encountered; TD - Termination Depth.
3. Maximum TC bit; drill rig refusal.

Groundwater or subsurface seepage was not encountered in the boreholes at the time of drilling. Seepage could be expected through the surficial granular soils and at the fill/natural soil and natural soil/rock interface following periods of rainfall.

5.0 LABORATORY TESTING

Laboratory testing was carried out on samples retrieved from the site investigation program and was directed towards assessing the reactivity and subgrade characteristics of the subsurface material. The laboratory tests included California Bearing Ratio (CBR) tests and Shrink/Swell Index tests. The results of the laboratory testing are contained in Appendix C.

6.0 LANDSLIDE RISK ASSESSMENT

There is no evidence of existing or recent past slope instability involving large scale movements of significant quantities of soil or rock in a short duration event such as a slip or landslide within the proposed development area. There is, however evidence of instability involving erosion and slumping within the drainage features as well as around the dams at the site. There is also evidence of minor instability involving movements of the surficial soil in the form of creep movement within the sloping terrain. Minor uncontrolled fill material has also been placed in some areas of the site.

Several drainage features and dams display evidence of instability within the banks in the form of erosion and slumping. It is also expected that in the base of several drainage features as well as the dams, weak, wet soils are likely to be present at the base. The dams will need to be dewatered and the instability within the banks will need to be removed to expose a competent base. Subgrade replacement requiring the removal of the wet, weak soils in the base of the dams and possibly the drainage features may also be required prior to the placement of fill material over the dams and drainage features. This may also require the installation of culverts/pipes at the base of the fills if all surface water and subsurface water cannot be intercepted and directed away from the filled drainage features. Recommendations for treatment of these unsuitable areas and the implementation of drainage provisions is described in Sections 8.0 to 11.0 of this report.

Slow movement or creep of the surficial soil is presently occurring within the mild sloping terrain at the site. The creep movement appears to typically involve up to approximately 0.3m of soil at the surface and is evident by the presence of minor back slants on juvenile trees, typically where the slope exceeds 10° in slope gradient. This minor creep movement of the surficial soil is not expected to impact on the proposed development providing the recommendations outlined in this report are followed.

Minor uncontrolled fill material appears to have been placed around several of the residential dwellings at the site as well as the far southern end of Courtney Drive where a flat fill pad approximately 30m to 40m long and 15m to 20m wide has been

constructed. This uncontrolled fill will need to be removed prior to the placement of controlled fill and prior to residential development at the site

In all terrain within the proposed development area at the site, the likelihood of slope movement in the form of deep seated failures through the soil or rockmass is considered to be low, due to the relatively flat terrain or mild sloping topography and the estimated friction angle of the soil and rock being significantly higher than the angle of the slope.

With the exception of the instability within the drainage features and dams as well as the presence of minor creep movement of the surficial soil, the site displays no evidence of instability which would impact on the proposed development. However, due to the sloping terrain, the minor creep movement, minor uncontrolled fill and several drainage features throughout the site which are proposed to be filled, precautions must be taken during development in relation to earthworks, foundations and drainage to reduce the potential for instability, settlement and erosion. This includes implementing and maintaining properly designed and constructed drainage structures upslope and around the proposed development areas, possible ground improvement works in the dams and drainage features and removing any uncontrolled fill. Recommendations for treatment of these unstable areas and the implementation of drainage provisions is described in subsections below of this report.

6.1 Landslide Susceptibility Ratings for Individual Lots

A site specific Landslide Risk Assessment of each individual Lot was performed in accordance with the City of Gold Coast Council (CoGC) "SC6.10 City Plan Policy - Geotechnical Stability Assessment Guidelines," January 2021, based on the current site conditions. It must be noted that the Landslide Susceptibility Rating assigned to each Lot applies to the risk associated with the majority of the Lot in its existing condition.

It can be expected that some areas of the Lot may contain Landslide Susceptibility Ratings higher than the overall assigned rating for the site. Depths to bedrock and soil profiles have been obtained from borehole drilling at the site and onsite observations.

The individual Lots have been assigned a Landslide Susceptibility Rating based on:-

- Ground surface slope angle and shape
- Geology
- Typical depth of soil cover
- Presence of erosion features, drainage features or surface irregularities
- Seepage and drainage conditions as assessed during the walkover survey carried out for this study

The results of the Landslide Risk Assessment for each individual Lot are presented in Table 2 below.

TABLE 2 – LANDSLIDE SUSCEPTIBILITY RATINGS FOR INDIVIDUAL LOTS

Identified Lot No.	Relative Susceptibility	Susceptibility Rating	Required Works to Maintain/Reduce Susceptibility Rating to Low or Better
101 to 127	0.36	Low	Sections 8.0 to 18.0 as reported herein
128 to 144	0.04	Very Low	Sections 8.0 to 18.0 as reported herein
145 to 149	0.36	Low	Sections 8.0 to 18.0 as reported herein
150 to 153	0.04	Very Low	Sections 8.0 to 18.0 as reported herein
154 to 159	0.36	Low	Sections 8.0 to 18.0 as reported herein
160	0.04	Very Low	Sections 8.0 to 18.0 as reported herein
161 to 166	0.36	Low	Sections 8.0 to 18.0 as reported herein
167 to 168	2.84	High	Sections 8.0 to 18.0 as reported herein
169 to 190	0.36	Low	Sections 8.0 to 18.0 as reported herein
191 to 196	1.70	Moderate	Sections 8.0 to 18.0 as reported herein
197 to 231	0.36	Low	Sections 8.0 to 18.0 as reported herein
232 to 233	2.84	High	Sections 8.0 to 18.0 as reported herein
234	1.70	Moderate	Sections 8.0 to 18.0 as reported herein
235 to 263	0.36	Low	Sections 8.0 to 18.0 as reported herein
264 to 266	0.04	Very Low	Sections 8.0 to 18.0 as reported herein
267 to 281	0.36	Low	Sections 8.0 to 18.0 as reported herein
282 to 285	0.04	Very Low	Sections 8.0 to 18.0 as reported herein
286 to 296	0.36	Low	Sections 8.0 to 18.0 as reported herein

The majority of the Lots at the site have been assessed as having a 'Low' or better Landslide Susceptibility Rating due to the relatively flat or mild sloping topography with no evidence of instability. However, several Lots are located within drainage features or dams and have been assigned a Landslide Risk Rating of 'Moderate' or 'High' in their current state.

It is assessed that all Lots at the site can be maintained or reduced to a 'Low' or better Landslide Susceptibility Rating for the long term providing the recommendations presented in Sections 8.0 to 18.0 of this report are followed.

6.2 Implications of Hazard Classifications

The implications of Hazard Risk Ratings are presented in the City of Gold Coast (CoGC) publication "Guidelines for Control of Slope Instability within the City of the Gold Coast" and reproduced in Table 3.

TABLE 3 – IMPLICATIONS OF HAZARD CLASSIFICATIONS (CoGC PUBLICATION)

Hazard Rating	Implications
VH (Very High Hazard)	Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to acceptable levels.
H (High Hazard)	Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable levels.
M (Moderate Hazard)	Tolerable provided treatment plan is implemented to maintain or reduce risk. May be accepted. May require investigation and planning of treatment options.
L (Low Hazard)	Usually accepted. Treatment requirements and responsibility to be defined to maintain or reduce risk.
VL (Very Low Hazard)	Accepted. Managed by routine procedures.

7.0 GEOTECHNICAL ISSUES OR CONSTRAINTS FOR DEVELOPMENT

Most of the existing site is considered to be suitable for residential development as most of the proposed development areas avoid the major geotechnical issues or constraints which would impact on the proposed development. The Lots are typically located within relatively flat or mild sloping terrain and there is no evidence of any major existing or recent past instability within the development area of the site. There are however, unstable areas associated with the dams, drainage features and uncontrolled fill which have the potential to impact on the proposed development during the design life of the development if not addressed. These geotechnical issues as well as several other geotechnical issues, must be addressed prior to development or earthworks on the site.

These main geotechnical issues which must be addressed prior to development are as follows:-

- The presence of minor uncontrolled fill at several locations across the site which must be addressed.
- The presence of inground elements such as concrete structures, building foundations etc. which must be removed prior to any potential filling or development.
- Presence of several drainage features and dams which must be dewatered and ground improvement works carried out including the removal of all weak wet soils prior to any potential filling or development.
- Sloping terrain.
- Providing adequate drainage or maintaining existing drainage at the site.
- Stripping of the topsoils prior to any potential filling.
- Depressions formed by the removal of trees.
- Potential for differential settlements where fills are significant and fill thickness vary significantly over short distances. (ie filled gullies)

8.0 RECOMMENDATIONS TO REDUCE LANDSLIDE RISK RATING TO LOW

The Landslide Susceptibility Rating for most of the Lots is assessed to be 'Low' or better for the long term. However, several Lots have been assessed to have a 'Moderate' or 'High' Landslide Susceptibility Rating as they are located with dams or drainage features and require treatment prior to filling and residential development. There is also minor creep movement evident within the mild sloping terrain. The following risk maintenance and reduction strategies are required to maintain or reduce the Landslide Susceptibility Rating to a level of 'Low' or better.

- All uncontrolled fill, topsoils and unsuitable surficial soils should be removed as part of the bulk earthworks to expose a competent base prior to the placement of fill. Alternatively, the fill can be adequately retained where possible.
- In areas where drainage features or dams are to be filled, the drainage features and dams must be dewatered and all weak, wet and unsuitable soils must be removed to expose a competent base prior to filling. All surface and subsurface water must then be intercepted and directed away from the drainage features and into dedicated drainage systems. If this cannot be achieved, the installation of drainage such as pipes and culverts will need to be installed at the base of the fills. Fill can then be placed in accordance with AS3798.
- All proposed earthworks including all cut and fill batters and retaining structures must achieve a long term factor of safety in excess of 1.5 against geotechnical global instability.
- Scour protection must be implemented along all batters which are located adjacent to or encroach into drainage features.
- The recommendations described in Sections 8.0 to 18.0 of this report must be followed which includes recommendations for drainage, site preparation prior to filling, filling, safe cut and fill batters slope angles and general recommendations for residential development.

9.0 DRAINAGE RECOMMENDATIONS

Properly designed, constructed and maintained surface and subsurface drainage is critical to the long term performance of the Lots in terms of slope stability, soil creep and erosion. The ingress of surface water into the cleared sloping terrain or potential structural fill platforms is assessed to be a potential trigger for instability within the Lots at the site. Therefore, minimising the ingress of surface and subsurface water into the sloping terrain or potential structural fill platforms is of significant importance as saturation of these materials can result in creep movements and slips.

The following recommendations with regards to drainage at the site should also be implemented:-

- Upslope surficial water flows should be intercepted and directed away from all Lots, future batters and retaining walls limiting the ingress of water into the potential fill platforms. The pavement drainage system may be sufficient for some Lots, batters and retaining walls.
- All Lot runoff should be discharged into stormwater systems via a system of pipe conduits to minimise water infiltration into the slopes and potential fill platforms.
- Storage tanks must be located to the side or downslope of the dwelling.

10.0 SITE PREPARATION AND STRIPPING DEPTHS

Prior to the placement of fill there are several issues and requirements which must be addressed regarding the surficial soils at the site. These issues include trees, grass, topsoil at the surface, uncontrolled fill and wet weak soils. This will most likely require the removal of the upper 0.1m to 0.3m of topsoil in most natural sloping areas but possibly ranging up to approximately 1.0m to 1.5m locally in areas such as drainage features where weak, wet soils are evident at the surface as well as areas where uncontrolled fill is evident. Most boreholes indicate the presence of stable, stiff or better clay soils or medium dense or better sands and gravels below a depth of approximately 0.3m below the natural ground surface.

The following treatment action is recommended within the development area prior to the placement of structural fill:-

- Remove all trees, grass, topsoil, uncontrolled fill (possibly around existing residence) and surface irregularities such as eroded areas from the existing ground surface which is expected to typically extend to depths ranging up to approximately 0.1m to 0.3m but possibly up to approximately 1.0m to 1.5m where wet, weak soils or uncontrolled fill are present and these soils cannot be adequately compacted prior to filling.
- The stripped ground surface should be proof rolled under Pacific Geotech's supervision using a large vibrating roller of minimum weight of 12 tonnes, to identify areas of weak surficial soils and to compact the upper level material.
- Depressions formed by the removal of vegetation or other features should have all disturbed soil removed to expose competent natural soil and be backfilled with compacted and suitably moisture conditioned select fill material.
- Where the ground surface slopes, the stripped surface should be benched prior to filling.

11.0 RECOMMENDATIONS FOR FILLING

It is anticipated that filling will be carried out as part of the works within Lots and Roads at the site. Broad recommendations for filling are as follows:-

- In areas which are to be filled, all trees, grass, weed zones, uncontrolled fill, organic matter and debris must be removed from the existing ground surface to expose competent natural soil.
- No filling or residential development should take place within any recent past surface irregularities such as washouts, hummocky terrain, seepage zones, uncontrolled fill or erosion features without detailed assessment by Pacific Geotech. If filling or development is to occur in these areas, surface irregularities must be removed prior to development and appropriate drainage provisions must be implemented as described in Section 9.0.
- All filling onsite including fill used in the construction of any proposed batters and behind retaining walls is placed and compacted to at least 95% Standard Maximum Dry Density and is "Controlled Fill" in accordance with A.S. 2870 (Clause 6.4.2 (a)) – "Residential Slabs and Footings" and A.S. 3798.
- Where the ground surface slopes, the foundation is benched prior to filling and the fill supported by engineered retaining walls or battered to the appropriate angles described in Section 13.0 below.
- Fill slopes should be over-constructed and trimmed back to ensure compaction in the outer zones.
- Vertical heights of natural soil and fill batters should incorporate a 1.0m wide bench at every 2.5m height interval when battered to maximum allowable slope angle and a 2.5m wide bench at every 5.0m height interval.
- Earthworks should take account of the sloping terrain and be limited to cuts and fills which can be adequately constructed by medium sized civil contractors without resorting to specialised contractors.
- The majority of the soils on site will be suitable for re-use as structural fill, provided the material is free of organic matter and deleterious material. It is likely that the soils will require conditioning to bring them to optimum moisture content. If the clays are overly moist, difficulty in achieving compaction of the materials will be encountered and moisture conditioning will be required. If the sands have a fines content of greater than approximately 5%, difficulties in working the sands could be experienced, particularly if the sands are overly moist.
- When filling, consideration should be given to the exclusion of rock pieces with greatest dimensions of 50mm to 75mm or greater from areas where trenching and piling may occur, as large rock pieces could impede the trenching and piling operations.
- All filling should be undertaken in layer thicknesses of approximately 250mm (or as appropriate for the compaction equipment being used). Fill should be compacted to at least 95% Standard Maximum Dry Density at a placement

moisture content of $\pm 2\%$ of Optimum Moisture Content (OMC), and be "Controlled Fill" in accordance with A.S. 2870 (Clause 6.4.2 (a)) – "Residential Slabs and Footings" and A.S. 3798.

- Field density testing should be carried out to check the standard of compaction achieved and the placement moisture content. The frequency and extent of testing should be as per guidelines in AS.3798-2007.
- Imported select fill material, if required, should be a good quality select fill material with a soaked CBR of at least 10%, a maximum aggregate size of 50mm and have a maximum Shrink/Swell Index of 1.0%.
- With the use of in-situ or imported reactive clay soils, proper control of moisture content during placement and compaction is required so as to minimise the potential for swelling and shrinkage movement. Moisture content within the range of OMC to OMC +2% is recommended. Foundation design must reflect the use of the potentially reactive clays if they are used as structural fill.

12.0 EXCAVATION CHARACTERISTICS

The information and advice presented in this section of the report is based on the conditions encountered in the boreholes drilled within the development area only. Variations in these conditions will occur across the site and must be expected.

Earthworks are expected to consist of significant cuts ranging up to approximately 10m in the elevated portions of the site associated with the ridge line. Bulk excavations extending to depths ranging up to approximately 10m are expected to encounter minor fill material, natural sand and clay as well as extremely weathered (XW), highly weathered (HW), moderately weathered (MW) and slightly weathered (SW) siltstone and sandstone rock.

Bulk excavations to the refusal depths in the boreholes (Refer Table 1) should be achievable using conventional earth moving machinery such as scrapers, small to medium dozers (say Cat D6) and medium sized excavators (say ~15t to 20t) using general purpose and toothed buckets. Excavations beyond these depths to the required depths of 10m are typically unknown but will likely require the use of medium to large sized dozers (say Cat D7-D9) or large sized excavators (say >24t) using general purpose and toothed buckets. Ripper attachments or possibly hydraulic rock breakers may also be required where possibly less weathered sandstone and siltstone is encountered.

Additional drilling in the form of core drilling with a truck or track mounted drilling rig would need to be carried out to the required depths to provide a more accurate assessment of the excavation conditions at the site.

No significant groundwater issues are expected to be encountered in excavations for this site under normal weather conditions.

13.0 BATTERS

It is understood that a series of 2.5m high cut and fill batters separated by flat benches at every 2.5m height interval will be required as part of the proposed earthworks development.

Maximum safe cut batter angles for the different materials encountered on site are shown below in Table 4 for unsurcharged batters less than 3.0m high. Where surcharges are located within H(m) (height of the batter) of the top of the batter, then some reduction in the design angle will be required.

TABLE 4 – SAFE BATTER ANGLES FOR CUTS

Material	Short Term	Long Term
Structural fill	45° (1V:1H)	26° (1V:2H)
Medium Dense or Better Sands	45° (1V:1H)	26° (1V:2H)
Stiff or better Natural Clay Soils	45° (1V:1H)	26° (1V:2H)
XW/HW Rock	63° (2V:1H)	45° (1V:1H)

Structural fill batters should be overconstructed and trimmed back at no steeper than 2(H):1 (V) or 26°.

It is essential that all exposed permanent batters be suitably protected from erosion and scour. Upslope surficial water flows should also be directed away from the batters limiting the ingress of water into the fill. The pavement drainage system may be sufficient for some batters.

For excavations of a very short term nature, and subject to assessment of factors such as the conditions at the time of excavation, length of time excavations are to remain open, working conditions/requirements and most importantly the rock structure in the cut face, etc., steeper excavations could be possible. Pacific Geotech should be contacted to determine an appropriate profile when construction details have been finalised.

14.0 SITE CLASSIFICATION

The results of Shrink/Swell Index testing indicate that the natural clay soil material encountered at the site is moderately reactive to soil moisture changes. On this basis, preliminary potential characteristic ground surface movements of up to 40mm may be expected within this clay material within the upper 1.5m zone of influence on this site corresponding to Class 'M' site prior to additional filling at the site. These typical ground surface movements are estimated in the context of "normal" soil moisture variations, as defined in AS2870-2011 *Residential Slabs and Footings – Construction*.

Where the natural clay soils are excavated and used as structural fill onsite, a higher soil classification than shown above may result.

Where excavations are carried out to expose weathered rock at the surface the development site would be classified Class "S" in accordance with AS 2870-2011 'Residential Slabs and Footings' with potential characteristic ground surface movements of up to 20mm expected.

It is recommended that the readers satisfy themselves that the use of AS 2870-2011 is applicable for the proposed design and the above site classification re-confirmed following the completion of the bulk earthworks operation.

15.0 BUILDING FOUNDATIONS

15.1 High Level Foundations

The most appropriate footing systems for the support of the residential buildings at the site are considered to be high level strip or pad footings or stiffened raft system.

The design of high-level footings including pads, strips and the ground beams of stiffened rafts founding in new controlled fill, medium dense natural sand, stiff/very stiff/hard natural clay or weathered rock at a minimum depth of 0.5m below the finished ground surface can be based on the allowable bearing pressures presented in Table 5 below.

TABLE 5 – ALLOWABLE DESIGN PARAMETERS FOR HIGH LEVEL FOOTINGS

Material ⁽¹⁾		Allowable Bearing Pressure (kPa) ⁽³⁾
Uncontrolled Fill		Not Recommended
Controlled Fill ⁽²⁾		100
Natural Sand	Medium Dense	100
Natural Clay	Stiff	100
	Very Stiff	200
	Hard	400
XW Siltstone	Extremely Low/Very Low/Low Strength	600
Notes: 1. All founding material should be verified by a suitably qualified geotechnical engineer or engineering geologist during construction. 2. In accordance with AS3798-2007 and certified as such. 3. Based on a factor of safety of 3.0.		

Where the foundations for the building found in different materials, consideration should be given to articulating the foundation system to minimise differential settlements.

It is expected that settlements associated with creep of the structural fill may range up to 0.5% of the fill thickness. On this basis, consideration must be given to the potential for significant differential settlements in areas where fill thicknesses vary significantly over short distances. Fill supervision in these areas is critical and should only be carried out by experience geotechnical technicians to reduce fill settlements to a minimum.

It is recommended that detailed site specific investigations be undertaken by Pacific Geotech, following bulk earthworks, to confirm the site classification and foundation recommendations for each structure.

Where footings are located adjacent to excavations such as underground service trenches, it is recommended that the footings be deepened to found at least 200mm below a line drawn up at 45 degrees from the base of the trench.

15.2 Deep Foundations

Where uncontrolled fill is evident or the sloping terrain is greater than approximately 10o in slope gradient, a deep footing system is the preferred foundation system. Piers founding through any existing uncontrolled fill and into the very stiff or hard natural clay soils or extremely weathered (XW) rock are considered a suitable system for deep footings at this site.

The deep foundation system should be designed in accordance with the recommendations of AS 2159-2009 'Piling - Design and Installation'.

Indicative ultimate geotechnical strength ($R_{d,ug}$) of piles can be calculated using the unfactored, ultimate shaft adhesion and end bearing values given in Table 6. The $R_{d,ug}$ values given in Table 6 will need to be multiplied by a suitable geotechnical strength reduction factor (ϕ_g) to obtain the design geotechnical strength ($R_{d,g}$) of piles. In accordance with AS2159-2009, the ϕ_g value must be determined by the designer, but based on the anticipated site, design and installation risk factors, a ϕ_g value of 0.40 is recommended. Higher values may be applicable with suitable supervision and additional investigation.

If working stress methods are used in the pile design, the $R_{d,ug}$ values given in Table 6 will need to be divided by a factor of safety of 2.5 to calculate the maximum single pile working load.

Bored piles can be designed using the indicative ultimate geotechnical pressures presented in Table 6 below.

TABLE 6 – INDICATIVE ULTIMATE DESIGN PARAMETERS FOR BORED PILES

Material		Ultimate Geotechnical Shaft Adhesion (kPa)	Ultimate Geotechnical End Bearing Pressure (kPa) ⁽³⁾	
			$L \leq 4D$ ⁽²⁾	$L \geq 4D$ ⁽²⁾
Controlled Fill		NC ⁽¹⁾	NR ⁽¹⁾	NR ⁽¹⁾
Natural Sands	Medium Dense	30	NR ⁽¹⁾	NR ⁽¹⁾
Natural Clay Soils	Stiff	30	NR ⁽¹⁾	NR ⁽¹⁾
	Very Stiff	50	600 ⁽⁴⁾	900 ⁽⁴⁾
	Hard	70	1200 ⁽⁴⁾	1800 ⁽⁴⁾
XW Rock	Very Low/Low Strength	120	2400	3600
Notes: (1) NC – Not considered; NR – Not recommended. (2) L – Total pier socket length; D – Pile diameter. (3) Values given above are based on founding material extending to at least four pile diameters below the pile base. (4) Upward ultimate geotechnical shaft adhesion resistance and ultimate end bearing pressure should only be considered below a depth of 2 pile diameters due to possible moisture variations where clay soils are present.				

Construction Considerations

If bored piers are adopted, the bases of the bored pile holes must be thoroughly cleaned of all loose soil and rock debris using a proper cleaning tool. The practice of adding water and spinning the auger is generally not acceptable. If there is any doubt as to the effectiveness of the base cleaning, the base resistance must be ignored.

Groundwater or seepage was not encountered in any of the boreholes and is not expected during bored pile installation. If seepage is encountered, inflow rates are expected to be slow and the pile holes will need to be poured immediately following the excavation of the holes. If significant seepage is encountered, the holes will need to be lined with steel liners which must be socketed into low permeability material to achieve an impermeable seal against any water charged soils above.

Alternatively, groundwater seepages may be controllable by pumping, otherwise requiring the piles to be constructed under water or bentonite using tremie methods. Shaft adhesion must be ignored for the portion of the pile that is permanently lined. As an alternative to bored piles, grout injected CFA piles could be adopted.

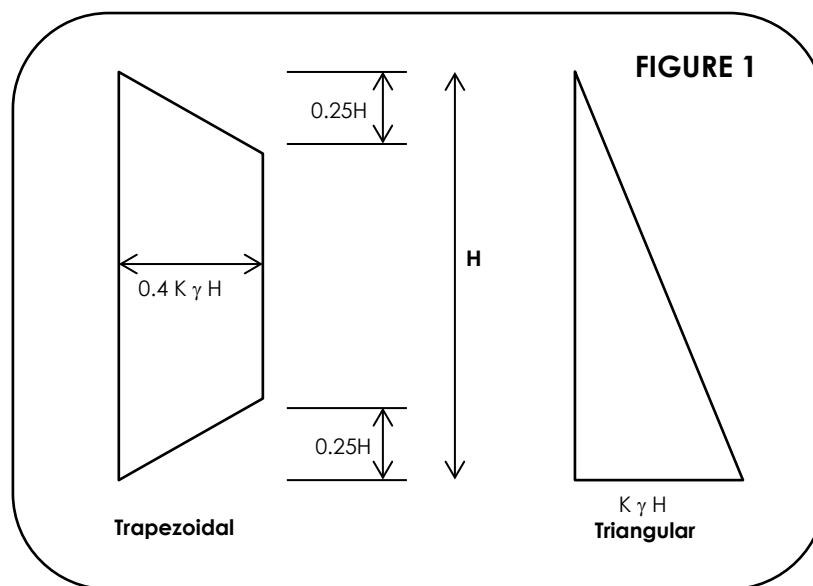
Drilling piles is not only dependent on the subsurface profile characteristics, but also the type (power and size) of the bored pile drilling rig, drilling teeth, size of pile, etc. It is recommended that a specialist drilling contractor be consulted to be able to manage the above conditions and materials encountered.

During construction, it is recommended that footing inspections be undertaken by Pacific Geotech, following excavation, to confirm the specified founding strata has been reached.

16.0 RETAINING WALLS

Retaining walls should be specifically engineer designed in accordance with AS 4678-2002 (Ref 9).

The design of flexible and rigid retaining walls could be undertaken using a triangular pressure distribution and the earth pressure parameters given in Table 7. Flexible walls are those which are free to rotate or tilt (such as cantilevered walls) and should be designed using active (K_a) earth pressure coefficient. Rigid walls are those which are restrained against rotation or tilt (i.e. single anchored/propped walls) and should be designed using the at-rest earth pressure (K_o) and a trapezoidal pressure distribution as per Figure 1.



Passive resistance (K_p) at the toe of the wall should be ignored in the zone where future disturbance (e.g. services trenches) could occur.

The effects of surcharge in the retained zone should be included by multiplying the vertical pressure developed by the surcharge by the appropriate lateral earth pressure coefficient. Allowance should also be made for the surcharge due to sloping crests if applicable.

TABLE 7 - EARTH PRESSURE COEFFICIENTS (NON-SLOPING CREST BACKFILL)

Material	Unit Weight (kN/m ³)	Cohesion c' (kPa)	Friction Angle (degrees)	Active K _a	At Rest K _o	Passive K _p
Controlled Clay Fill*	19	2	26	0.39	0.56	2.57
Controlled Gravel Fill*	19	0	32	0.31	0.47	3.26
Clays - Stiff	19	5	26	0.39	0.56	2.57
Clays - Very Stiff/Hard	20	5	28	0.35	0.53	2.77
Sands - Medium Dense	20	0	32	0.31	0.47	3.26
Sands - Dense	20	0	34	0.28	0.44	3.55
Gravels - Medium Dense/Dense	20	0	34	0.28	0.44	3.55
XW/HW Rock	23	8	34	0.28	0.44	3.55

Notes: * Depends on fill material type and level of compaction. Assumes material compacted under 'Level 1' supervision.

The generalized lateral earth pressure distribution is given as:

$$p = K\gamma H + Kq + \sigma_L \text{ (kPa)}$$

- K is either K_a, K_o, or K_p for "active", "at rest" or "passive" earth pressure conditions, respectively
- γ (kN/m³) is the relevant density of the soil or rock
- H (m) is the distance down from the top of the wall
- q (kPa) is any uniform surface surcharge load behind the wall
- σ_L (kPa) is the lateral pressure on the wall resulting from adjacent surcharges.

It is assumed that no groundwater is present and adequate drainage will be provided behind the wall.

It is recommended that the design parameters for retaining walls presented in this section be confirmed by on-site inspection when the subsurface conditions are exposed during construction.

Preference should be given to adopting thin soil layers and using small hand-controlled compaction equipment during backfilling against retaining walls. This is in order to limit the stress applied to the walls during construction. Should heavy compaction be required, then wall stresses will be well in excess of K_o and temporary propping should be used.

Clay backfill should not be placed dry of optimum moisture content, as this can lead to increased future swelling with changes to moisture content or inundation from water creating additional load on the back of the wall.

It is recommended that all retaining walls be drained for full height in order to minimise hydrostatic pressure build-up behind the wall. Additional guidelines on wall drainage are provided in Appendix G of AS 4678-2002.

17.0 PAVEMENT DESIGN CONSIDERATIONS

Soaked CBR laboratory testing was conducted on samples of the natural clay soils from Boreholes BH01 and BH06. The Soaked CBR tests produced values of 2.0% (BH01) and 5.0% (BH06).

Considering the nature of the natural clays, a design CBR value of 2% to 3% and a modulus of subgrade reaction of 20kPa/mm to 25kPa/mm are recommended for the pavement design. This value should be confirmed with additional on-site sampling and testing following the bulk earthworks operation on site.

Following excavations, in areas where XW/HW siltstone or sandstone are to form the subgrade for pavements, a design CBR value of 3% to 5% and a modulus of subgrade reaction of 25kPa/mm to 40kPa/mm could be considered for the pavement design. This value should be confirmed with additional on-site sampling and testing following the bulk earthworks operation on site.

Specific additional construction considerations are offered in regard to the construction of the pavements on the site:-

- Suitable subsurface drainage should be installed around the perimeter of the pavements
- It should be ensured that the subgrade of the pavement is suitably graded to allow any seepage to flow from under the pavement to the perimeter drains.
- Pavement materials should comply with MRS 11.05 specifications and the corresponding minimum dry density ratios are recommended:
 - i) Lower Sub-base (Type 2.5) 95% (Modified)
 - ii) Sub-base (Type 2.3) 95% (Modified)
 - iii) Base (Type 2.1) 98% (Modified)
- Inspections and testing should be carried out by Pacific Geotech following the completion of the bulk earthworks to confirm subgrade conditions across the pavement areas.

18.0 GENERAL RECOMMENDATIONS FOR DEVELOPMENT

To maintain the long term performance of the proposed development, good management of the soil conditions and the development is vital throughout the life of the development.

The following are some specific comments with respect to site management and general development at the site:

- The ground surface around the perimeter of the buildings should slope away from the structure and fall to the stormwater system. Water should not be allowed to pond adjacent to the buildings.
- Founding soils should not be allowed to become saturated.
- Service trenches under the buildings should be kept to a minimum. Saturation of the on-site material will result in an increase in potential ground surface movements.
- Footings should be poured immediately after excavation. If footings cannot be poured on the same day as excavation, a blinding layer of 50mm thickness is recommended.
- Trees, garden beds and other vegetation should be planted at a distance at least equivalent to three quarters of their mature height away from the structures. This will assist in minimising shrinkage movements in the expansive on-soils.
- Trafficability across the site at the time of the investigation was assessed to be fair to good. If significant rainfall events occur during the earthworks operation, some difficulties could be experienced in trafficking the exposed surface, particularly following stripping of the ground surface to expose the high plasticity clay soils or clayey sands. Site trafficability may be improved by constructing haulage roads into and on the site or placing rock along high traffic areas.
- All permanent excavations exceeding 1.0m must be supported by adequately engineered retaining walls incorporating drainage or battered at appropriate angles.
- All retaining walls must be individually designed to have a factor of safety of at least 1.5 with respect to internal stability, including sliding and overturning. This is the responsibility of the retaining wall designer.
- The residential development within all Lots must be designed, constructed and maintained in accordance with the attached Guidelines for Hillside Construction and the development examples of good and poor hillside practice.
- Revegetation must commence immediately after the completion of any potential earthworks to minimise future erosion.
- Excavations into the slope must not undermine the stability of any existing structures, i.e. all footings from adjacent buildings or structures must be founded at least 200mm below a line drawn up at 45 degrees from the base of any excavation.

- The feasibility and suitability of the site for the proposed residential development based on existing geotechnical conditions of the site is considered satisfactory providing the recommendations stated in this report are followed and implemented.

19.0 PROPOSED RESIDENTIAL BUILDING RECOMMENDATIONS

The recommendations for any proposed development within the proposed new Lots in the future must be followed as part of the operational building works:-

- All house footings must found into structural fill platforms, medium dense or better natural sands or stiff or better natural soil or weathered rock, below any uncontrolled fill, topsoils, weak soils or soils which may be susceptible to settlement or creep movement.
- A detailed geotechnical investigation of any proposed new development must also be carried out prior to development to confirm the foundation requirements stated above. All structures must also be adequately designed to restrain any upper level soil creep and withstand lateral forces from the movement of soil.
- All roof water from any possible future development should be discharged into stormwater systems via a system of pipe conduits clear of the site to minimise water infiltration into the slopes and fill platforms. Alternatively, roof water can be discharged into roof water tanks for storage.
- Storage tanks must be located to the side or downslope of any potential dwellings that may be constructed in the future.

20.0 GLOBAL STABILITY ANALYSIS OF PROPOSED EARTHWORKS

A global stability analysis of the proposed earthworks including all cut/fill batters and retaining walls was carried out to assess if the earthworks will achieve a long term factor of safety of at least 1.5 against geotechnical instability for batters steeper than 4(H):1(V) and for retaining structures greater than 1.0m in height. It particularly excludes the structural adequacy of all retaining systems including two tier retaining wall systems with respect to internal instability. Internal instability may include such mechanisms as excessive rotation and settlement of posts and panels. This is the responsibility of the retaining wall designer. We note that a regular mechanism of instability of post and panel systems comprises outward rotation of the upper wall especially where the soils in front of the upper wall posts become weakened or saturated and softened by seepages through the upper panel wall.

A desk study of the supplied earthworks plans (provided by Mortons Urban Solutions) was initially carried out. The following drawings were reviewed as part of the desk study and are attached in Appendix G to this report:

- Sections Plan;
- Longitudinal Sections 1 to 12;
- Longitudinal Sections A to F;

Based on the earthworks drawings provided by Mortons Urban Solutions for Stages 1 to 5, the bulk earthworks comprise cuts and fills ranging up to approximately 10m in depth and thickness to form batter heights no higher than 3.0m. Batters higher than 3m incorporate flat benches at every 2.5m height interval when battered to the maximum slope angle. All earthworks batters involving cutting and filling are limited to a maximum slope angle of no steeper than 2(H):1 (V) or 26° for the long term, which is usually considered to be the maximum slope angle for cut or fill batters to achieve a factor of safety in excess of 1.5 against geotechnical instability.

Retaining walls are expected to comprise post and panel retaining walls with single tiered walls ranging up to 2.3m in height and two tiered walls ranging up to 1.5m in height separated by 1m wide flat benches.

To analyse the global stability of the cut and fill batters and retaining wall sections, six (6) computer generated stability analysis models of the most significant cut and fill batter and retaining wall sections were created using the software GSLOPE. Sections 1, 2, 4, 5, 11 and Section B were established for a global stability analysis with the proposed earthworks sections attached to this report. No surcharge loads are to be applied within 3m behind the crest of any batters or retaining walls. Any structures located within this area will require further analysis to be carried out or the foundations must extend below the toe of the batters.

The geometry of the cut and fill batter and retaining wall cross sections was derived from the attached Mortons Urban Solutions design drawings. Based on the results of boreholes drilling at the site from the broadscale investigation as well as our experience and testing on and near the site, the following parameters shown in Table 8 have been adopted for analysis of the cut and fill batter and retaining wall sections.

TABLE 8 – ESTIMATED STRENGTH PARAMETERS

Material	Bulk Density (kN/m ³)	Cohesion c' (kPa)	Friction Angle Ø (degrees)
Structural Fill	19	3	26
Select Fill	19	5	26
Natural Soil	20	5	28

Calculations of the global stability of the cut/fill batter and retaining wall sections using the above parameters for the structural fill and natural soil, result in a minimum Factor of Safety of at least 1.5 for the long term, which is usually considered to be the minimum design target value for similar developments.

On this basis, all proposed earthworks, including all cut/fill batters and retaining structures within Stages 1 to 5 of the Development, are considered to be satisfactory and will achieve a long term factor of safety in excess of 1.5 providing the following recommendations are implemented:

- The fill used in the construction of batters has been placed and compacted to at least 95% Standard Maximum Dry Density and is "Controlled Fill" in accordance with A.S. 2870 (Clause 6.4.2 (a)) – "Residential Slabs and Footings" and A.S. 3798.
- Where 2 tiered post and panel retaining walls are to be constructed retaining fill material, select fill material with a friction angle (ϕ) of 28° and a cohesion (c') of 5kPa is used as backfill material extending at least 5m back behind the post and panel retaining walls as well as for the fill batters in front of the wall (refer Figure 2 – Section 2). This select fill material will require close observation during compaction and will also need to be appropriately tested prior to placement to confirm the required parameters can be achieved.
- The foundations for all post and panel retaining walls are to extend to a depth at least equal to the height of the retaining wall.
- Where the ground surface slopes at more than say 8° , the stripped surface must be suitably benched prior to filling.
- Upslope surficial water flows must be directed away from all sloping batters and retaining walls to limit the ingress of water into the fill and behind the walls which can create stability problems. In some areas the road drainage system should minimise surface water flow onto the batters and retaining walls.
- All Lot runoff and roof water must be discharged into stormwater systems via a system of pipe conduits or lined drains to minimise water infiltration into the slopes. Alternatively roof water can be discharged into water tanks for storage.
- Batters are to be stabilised using techniques such as vegetation and mulching or similar to minimise erosion. Properly maintained vegetation should reduce the occurrence of surface erosion by impingent rainfall.
- No dwellings or structures are permitted within 3m of the crest of any batters constructed on site. If dwellings or structures are to be constructed within 3m of the crest of the batter slopes, further analyses will be required or foundations must extend below the toe of the batters.
- No additional earthworks including cuts, fills or retaining walls that are not shown on the approved Mortons Urban Solutions drawings should be carried out within any Lot unless approved by a professional engineer or engineering geologist.

It should be noted that the exposed fill material and batters must be constantly maintained and repaired during the early stages of mulching and vegetation, as erosion may be expected until vegetation is fully established.

If the recommendations described above are followed, all proposed earthworks, including all cut and fill batters and retaining structures within Stages 1 to 5 will achieve long term factors of safety of greater than 1.5 against slope instability.

Bulk earthworks plans showing the proposed earthworks at the site including cut and fill batter and retaining wall sections are attached in Appendix G to this report whilst the stability output plots are presented as Appendix H to this report.

21.0 LIMITATIONS

We have prepared this report for the Broadscale Geotechnical Investigation and Landslide Risk Assessment for Proposed Residential Subdivision at End of Courtney Drive, Upper Coomera. The report is provided for the exclusive use of HB Qld Pty Ltd, for this project only and for the purposes outlined in the report. It should not be used by, or relied upon, for other projects on the same or different sites or by a third party. In preparing this report, we have relied upon information provided by the client or their agents.

The results are indicative of the subsurface conditions on site only at the specific testing locations. Subsurface conditions can change between test locations and the design and construction should take the spacing of the testing and testing methods adopted and the potential for variation between the test locations.

It is recommended that Pacific Geotech be engaged to provide advice and ensure the development is undertaken in accordance with the assumptions made in writing this report.

This is not to reduce the level of responsibility accepted by Pacific Geotech, but rather to ensure that the parties who may rely on the information contained in this report are aware of the responsibilities they assume in doing so.



L. BEXLEY

For and on behalf of

PACIFIC GEOTECH PTY LTD



P. ELKINGTON (RPEQ 7226)

APPENDICES

APPENDIX A

NOTES RELATING TO THIS REPORT

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis.

Every care has been taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical conditions and contains recommendations or suggestions for design and construction. However, unexpected variations in ground conditions will occur. The potential for this will depend partly on testing, spacing and sampling frequency.

If variations are identified, Pacific Geotech would be pleased to assist with additional investigations or advice to resolve the matter.

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Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Description and Classification Methods

The description and classification of soils and rocks used in this report are based on AS 1726.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the percent of

other particles present (e.g. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	less than 0.002mm
Silty	0.002 to 0.06mm
Sand	0.06 to 2mm
Gravel	2 to 60mm

Non-cohesive soils are classified on the basis of relative density which can be correlated from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very Loose	less than 4
Loose	4 – 10
Medium Dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Cohesive soils are classified on the basis of strength (consistency) and can be quantified by the Pocket Penetrometer test, Vane Shear test, laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	Unconfined Compressive Strength kPa
Very Soft	less than 25
Soft	25 - 50
Firm	50 – 100
Stiff	100 – 200
Very Stiff	200 - 400
Hard	greater than 400
Friable	strength not attainable – soil crumbles

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc.

Planarity	
CU	Curved
DIS	Discontinuous
IR	Irregular
PR	Planar
ST	Stepped
UN	Undulose

Roughness	
POL	Polished
RJ	Rough
S	Smooth
SL	Slickened
VR	Very Rough

Defects	Type
BP	Bedding Parting
CL	Cleavage
CO	Contact
CS	Crushed Seam
CZ	Crushed Zone
DB	Drilling Break
DK	Dyke
DL	Drill Lift
DZ	Decomposed Zone
FC	Fracture
FL	Foliation
FZ	Fracture Zone
HB	Handling Break
IS	Infilled Seam
JT	Joint
H	Schistosity
SI	Sill
SM	Seam
SS	Shear Seam
SZ	Shear Zone
VN	Vein
VO	Void

Sampling

Sampling is undertaken during the fieldwork to allow examination of the soil or rock and to allow laboratory testing to be undertaken.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content and minor constituents. Bulk samples are similar but of greater volume required for some test procedures such as CBR testing.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and collecting a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

Investigation Methods

Test Pits: These are typically undertaken with a backhoe or a tracked excavator, allowing examination of the insitu soils. Limitations of test pits are the problems associated with collapse of the pits, disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of typical diameter of between 50mm to 75mm advance manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as fill, gravel, hard clays and collapse of the borehole (typically in non-cohesive soil).

Continuous Spiral flight Augers: The borehole is advanced using 65mm to 100mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. Augers of up to 300mm in diameter are used to recover larger volumes of sample. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights. Samples can be disturbed and layers may become mixed. Augering below the groundwater table can be less reliable than augering above the water table.

A Tungsten Carbide (TC) bit for auger drilling into rock can be used to indicate rock strength and continuity by variation in drilling resistance and from examination of recovered rock fragments but provides only an indication of the likely rock strength. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is advanced by a bit attached to the end of a hollow rod string, with water being pumped down the drill rods and returned up the annulus of the borehole, carrying the drill cuttings. Changes in stratification can be determined from the return, together with information from "feel" and rate of penetration.

The borehole can be stabilised through the use of drilling mud as a circulating fluid. The term 'mud' encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. This technique provides a reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel is used, which gives a core of about 50mm diameter. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength and also of obtaining a disturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposed", Test 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63kg hammer, with a free fall of 760mm. The sample is driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense soils, hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of , say, 4, 6 and 7 blows, as
N = 13
4, 6, 7
- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as
N > 30
15, 30/40mm

Cone Penetrometer Testing (CPT): Cone Penetrometer Testing with or without pore pressure measurement (CPTu) is carried out

using a Cone Penetrometer in general accordance with AS 1289 6.5.1, 1999.

In the tests, a 36mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the fractional resistance on a separate 135mm long sleeve, immediately behind the cone. Pore Pressure is recovered through a pore ring located either within, or more usually immediately behind the cone/tip.

As penetration occurs (at a rate of approximately 20mm per second) and data is recorded every 20mm of penetration, the results are presented graphically.

The information provided on the plot comprises:

- Cone resistance – expressed in mPa
- Sleeve friction – expressed in kPa
- Friction ratio – the ratio of sleeve friction to cone resistance expressed as a percentage.
- Pore pressure in kPa
- Tilt of probe (in degrees).

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and rising to 2% to as high as 8%, and higher in organic soils. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes, etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive.

Dynamic Cone Penetrometers:

Dynamic Cone Penetrometer (DCP) tests are carried out by driving a 16mm diameter rod into the ground with a 9kg sliding hammer dropping 510mm and counting the blows for successive 100mm increments of penetration.

Logs

The borehole or test pit logs are an interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of the boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

Groundwater

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be flushed from the hole and drilling mud must be washed out of the hole or 'reverted' chemically if water observations are to be made.

More reliable measurements can be made by installing standpipes from which ongoing monitoring can be undertaken.

Fill

The present of fill materials can often be determined only by the inclusion of foreign objects (e.g. bricks, steel ,etc.) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used

for fill, it may be difficult to reliably determine the extent of the fill.

Laboratory Testing

Laboratory testing is carried out in general accordance with Australian Standard 1289 'Methods of Testing Soil for Engineering Purposes'.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage.

Review of Design

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/constraints are quite complex, it is prudent to have a design review.

Site Inspection

Pacific Geotech would be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related:

Requirements could range from:

- i. a site visit to confirm that conditions exposed are no worse than those interpreted, to
- ii. a visit to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, or
- iii. full time engineering present on site.

APPENDIX B
BOREHOLE RECORD SHEETS

Project No.: PG-4116

Client: Gallery Homes
Project Name: Proposed Subdivision
Hole Location: Courtney Drive, Upper Coomera
Hole Position: 527555.0 m E 6917412.0 m N MGA94 Zone 56

Commenced: 15/05/2020
Logged By: SR
Checked By:

Drill Model and Mounting: Digga Explora 60
Hole Diameter:

RL Surface: No survey
Datum: AHD Operator: SR

Drilling Information							Soil Description				DCP					
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm						
AD/T			B 0.10-0.80 m			0.10		SM	NATURAL Silty SAND (SM) Medium dense, fine to medium grained, grey, low plasticity fines, with organics, moist.	0	5	10	15	20	25	
			U50 0.40-0.55 m PP=>600kPa			0.30		CH	Silty CLAY (CH) Very stiff, high plasticity, mottled orange brown, with fine grained sand, moist.							
									CH	Silty CLAY (CH) Very stiff to hard, high plasticity, mottled orange brown, with fine grained sand, moist.						
						0.80		CH	Silty CLAY (CH) Hard, high plasticity, mottled orange brown, with fine grained sand, moist.							
						1										
						2										
						2.60		CL	Silty CLAY (CL) Hard, low plasticity, light grey mottled orange brown and grey, moist.							
						3										
						3.00			SILTSTONE (HW) Highly weathered, very low strength, light grey mottled orange brown.							
					4											
					4.50											
								Hole Terminated at 4.50 m								
Method AS - Auger RR - Rock Roller WB - Washbore							Water  Level (Date)  Inflow			Samples and Tests U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test B - Bulk Sample			Remarks 1. Groundwater not encountered.			
Support C - Casing							Classification Symbols and Soil Descriptions Based on Unified Soil Classification System									

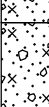
Project No.: PG-4116

Client: Gallery Homes
Project Name: Proposed Subdivision
Hole Location: Courtney Drive, Upper Coomera
Hole Position: 527365.0 m E 6917329.0 m N MGA94 Zone 56

Commenced: 15/05/2020
Logged By: SR
Checked By:

Drill Model and Mounting: Digga Explora 60
Hole Diameter:

RL Surface: No survey
Datum: AHD Operator: SR

Drilling Information							Soil Description			DCP					
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm					
AD/T						0.10		SM	NATURAL Silty Gravelly SAND (SM) Medium dense, fine to medium grained, grey, fine to medium grained gravel, low plasticity fines, moist.	0	5	10	15	20	25
						0.50		SM	Silty Gravelly SAND (SM) Dense, fine to medium grained, orange brown mottled grey, fine to medium grained gravel, low plasticity fines, moist.						
						0.90			SANDSTONE (XW) Extremely weathered, very low strength, orange brown mottled grey.						
						1.10			SANDSTONE (HW) Highly weathered, low strength, orange brown mottled grey.						
									Hole Terminated at 1.10 m						
						2									
						3									
						4									

Method

AS - Auger
RR - Rock Roller
WB - Washbore

Water

Level (Date)
Inflow

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
B - Bulk Sample

Remarks

1. Groundwater not encountered.
2. Maximum "TC" bit refusal met at 1.1m.

Support

C - Casing

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

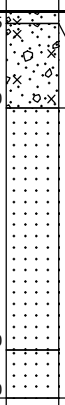
Project No.: PG-4116

Client: Gallery Homes
Project Name: Proposed Subdivision
Hole Location: Courtney Drive, Upper Coomera
Hole Position: 527518.0 m E 6917231.0 m N MGA94 Zone 56

Commenced: 15/05/2020
Logged By: SR
Checked By:

Drill Model and Mounting: Digga Explora 60
Hole Diameter:

RL Surface: No survey
Datum: AHD Operator: SR

Drilling Information							Soil Description			DCP					
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm					
AD/T						0.05		SM	NATURAL Silty Gravelly SAND (SM) Medium dense, fine to medium grained, grey, fine to medium grained gravel, low plasticity fines, with organics, moist.	0	5	10	15	20	25
						0.40		SM	Silty Gravelly SAND (SM) Dense, fine to medium grained, orange brown mottled grey, fine to medium grained gravel, low plasticity fines, moist.						
						1			SANDSTONE (XW) Extremely weathered, very low strength, orange brown mottled light grey.						
						1.40			SANDSTONE (HW) Highly weathered, low strength, orange brown mottled light grey.						
						1.60			Hole Terminated at 1.60 m						
						2									
						3									
						4									

Method

AS - Auger
RR - Rock Roller
WB - Washbore

Water

Level (Date)
Inflow

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
B - Bulk Sample

Remarks

1. Groundwater not encountered.
2. DCP refusal met at 0.25m.
3. Maximum 'TC' bit refusal met at 1.6m.

Support

C - Casing

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Project No.: PG-4116

Client: Gallery Homes
Project Name: Proposed Subdivision
Hole Location: Courtney Drive, Upper Coomera
Hole Position: 527406.0 m E 6917243.0 m N MGA94 Zone 56

Commenced: 15/05/2020
Logged By: SR
Checked By:

Drill Model and Mounting: Digga Explora 60
Hole Diameter:

RL Surface: No survey
Datum: AHD Operator: SR

Drilling Information							Soil Description			DCP					
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm					
AD/T						0.05		SM	NATURAL Silty Gravelly SAND (SM) Medium dense, fine to medium grained, grey, fine to medium grained gravel, low plasticity fines, with organics, moist.	0	5	10	15	20	25
						0.30		SM	NATURAL Silty Gravelly SAND (SM) Medium dense, fine to medium grained, orange brown, fine to medium grained gravel, low plasticity fines, with organics, moist.						
						0.60		CL	NATURAL Silty Gravelly SAND (SM) Medium dense, fine to medium grained, orange brown, fine to medium grained gravel, low plasticity fines, with organics, moist.						
						1.00			Sandy CLAY (CL) Hard, low plasticity, orange brown mottled light grey, fine to medium grained sand, moist.						
						1.30			SANDSTONE (XW) Extremely weathered, very low strength, orange brown mottled light grey.						
						1.50			SANDSTONE (HW) Highly weathered, low strength, orange brown mottled light grey.						
									Hole Terminated at 1.50 m						
						2									
						3									
						4									

Method
AS - Auger
RR - Rock Roller
WB - Washbore

Water
Level (Date)
Inflow

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
B - Bulk Sample

Remarks
1. Groundwater not encountered.
2. DCP refusal met at 0.55m.
3. Maximum 'TC' bit refusal met at 1.5m.

Support
C - Casing

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Project No.: PG-4116

Client: Gallery Homes
Project Name: Proposed Subdivision
Hole Location: Courtney Drive, Upper Coomera
Hole Position: 527532.0 m E 6917139.0 m N MGA94 Zone 56

Commenced: 15/05/2020
Logged By: SR
Checked By:

Drill Model and Mounting: Digga Explora 60
Hole Diameter:

RL Surface: No survey
Datum: AHD Operator: SR

Drilling Information							Soil Description			DCP					
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm					
AD/T						0.10		SM	NATURAL Silty SAND (SM) Medium dense, fine to medium grained, grey, low plasticity fines, with organics, moist.	0	5	10	15	20	25
						0.40		SM	Silty SAND (SM) Medium dense, fine to medium grained, orange brown mottled grey, low plasticity fines, with fine to medium grained gravel, moist.	0	5	10	15	20	25
						0.80		CH	Sandy CLAY (CH) Very stiff, high plasticity, orange brown mottled grey, fine to medium grained sand, moist.	0	5	10	15	20	25
						1.10		CL	Sandy CLAY (CL) Hard, low plasticity, orange brown mottled grey, fine to medium grained sand, moist.	0	5	10	15	20	25
						1.15			SANDSTONE (XW) Extremely weathered, very low strength, orange brown mottled light grey. Hole Terminated at 1.15 m	0	5	10	15	20	25
						2									
						3									
						4									

Method

AS - Auger
RR - Rock Roller
WB - Washbore

Water

Level (Date)
 Inflow

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
B - Bulk Sample

Remarks

1. Groundwater not encountered.
2. DCP refusal met at 1.15m.
3. Maximum 'TC' bit refusal met at 1.15m.

Support

C - Casing

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Project No.: PG-4116

Client: Gallery Homes
Project Name: Proposed Subdivision
Hole Location: Courtney Drive, Upper Coomera
Hole Position: 527377.0 m E 6917115.0 m N MGA94 Zone 56

Commenced: 15/05/2020
Logged By: SR
Checked By:

Drill Model and Mounting: Digga Explora 60
Hole Diameter:

RL Surface: No survey
Datum: AHD Operator: SR

Drilling Information							Soil Description				DCP					
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm						
AD/T			D 0.10-0.40 m			0.10		SM	NATURAL Silty SAND (SM) Medium dense, fine to medium grained, dark grey, low plasticity fines, with organics, moist.							
								SM	Silty SAND (SM) Medium dense, fine to medium grained, dark grey, low plasticity fines, moist.							
			B 0.50-0.90 m			0.50		CH	Sandy CLAY (CH) Stiff to very stiff, high plasticity, grey mottled orange brown and dark grey, fine to medium grained sand, moist.							
			U50 0.50-0.70 m			0.90		CH	Sandy CLAY (CH) Stiff to very stiff, high plasticity, grey mottled orange brown and dark grey, fine to medium grained sand, with fine to coarse grained gravel, moist.							
			PP=?			1.10		CL-CI	Sandy CLAY (CL-CI) Hard, low to medium plasticity, light grey mottled orange brown, fine to medium grained sand, moist.							
						1.60			SANDSTONE (HW) Highly weathered, low strength, light grey mottled orange brown.							
						1.80			Hole Terminated at 1.80 m							
						2										
						3										
						4										
<u>Method</u> AS - Auger RR - Rock Roller WB - Washbore							<u>Water</u>  Level (Date)  Inflow			<u>Samples and Tests</u> U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test B - Bulk Sample			<u>Remarks</u> 1. Groundwater not encountered. 2. DCP refusal met at 0.82m. 3. Maximum 'TC' bit refusal met at 1.8m.			
<u>Support</u> C - Casing							<u>Classification Symbols and Soil Descriptions</u> Based on Unified Soil Classification System									

Project No.: PG-4116

Client: Gallery Homes
Project Name: Proposed Subdivision
Hole Location: Courtney Drive, Upper Coomera
Hole Position: 527293.0 m E 6917222.0 m N MGA94 Zone 56

Commenced: 15/05/2020
Logged By: SR
Checked By:

Drill Model and Mounting: Digga Explora 60
Hole Diameter:

RL Surface: No survey
Datum: AHD Operator: SR

Drilling Information							Soil Description			DCP										
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm										
AD/T		▽				0.15		SM	NATURAL Silty SAND (SM) Medium dense, fine to medium grained, dark grey, low plasticity fines, with organics, moist.	0	5	10	15	20	25					
						SM		Silty SAND (SM) Medium dense, fine to medium grained, dark grey, low plasticity fines, moist.	0	5	10	15	20	25						
						0.80		CL-CI	Sandy CLAY (CL-CI) Stiff, low to medium plasticity, dark grey mottled orange brown, fine grained sand, moist.	0	5	10	15	20	25					
						1.20		CL-CI	Sandy Gravelly CLAY (CL-CI) Very stiff, low to medium plasticity, orange brown mottled grey, fine to coarse grained gravel, fine to coarse grained sand, moist.	0	5	10	15	20	25					
						1.60		GC	Clayey Sandy GRAVEL (GC) Dense, fine to coarse grained, grey brown, fine to coarse grained sand, low plasticity fines, wet.	0	5	10	15	20	25					
						2.50			SANDSTONE (HW) Highly weathered, low strength, light grey mottled orange brown.	0	5	10	15	20	25					
						2.70		Hole Terminated at 2.70 m	0	5	10	15	20	25						
						3														
						4														

Project No.: PG-4116

Client: Gallery Homes
Project Name: Proposed Subdivision
Hole Location: Courtney Drive, Upper Coomera
Hole Position:

Commenced: 15/05/2020
Logged By: SR
Checked By:

Drill Model and Mounting: Digga Explora 60
Hole Diameter:

RL Surface: No survey
Datum: AHD Operator: SR

Drilling Information							Soil Description			DCP					
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm					
AD/T			U50 0.70-0.85 m PP=? D 0.80-1.10 m			0.10		SM	NATURAL Silty SAND (SM) Medium dense, fine to medium grained, grey, low plasticity fines, with organics, moist.	0	5	10	15	20	25
								SM	Silty SAND (SM) Medium dense, fine to medium grained, orange brown mottled grey, low plasticity fines, with fine to medium grained gravel, moist.						
						0.50		CI	Sandy CLAY (CI) Very stiff to hard, medium plasticity, orange brown mottled grey and dark grey, fine to medium grained sand, with fine to coarse grained gravel, moist.						
						0.80		CH	Sandy CLAY (CH) Very stiff to hard, medium plasticity, grey mottled orange brown, fine to medium grained sand, trace of fine to medium grained gravel, moist.						
					1	1.10		CH	Sandy CLAY (CH) Hard, medium plasticity, grey mottled orange brown, fine to medium grained sand, moist.						
						1.60		CH	Silty CLAY (CH) Very stiff, high plasticity, dark grey mottled orange brown, with fine grained sand, moist.						
					2										
						2.70		CI	Silty CLAY (CI) Hard, medium plasticity, dark grey mottled orange brown, with fine grained sand, moist.						
					3	3.10									
									SANDSTONE (HW) Highly weathered, very low strength, orange brown mottled pale grey						
						4									
						4.20			SANDSTONE (HW) Highly weathered, low strength, orange brown mottled pale grey						
						4.40			Hole Terminated at 4.40 m						

Method

AS - Auger
RR - Rock Roller
WB - Washbore

Water

 Level (Date)
 Inflow

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
B - Bulk Sample

Remarks

1. Groundwater not encountered.
2. DCP refusal met at 0.35m.
3. Maximum 'TC' bit refusal met at 4.4m.

Support

C - Casing

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Project No.: PG-4116

Client: Gallery Homes
Project Name: Proposed Subdivision
Hole Location: Courtney Drive, Upper Coomera
Hole Position: 527282.0 m E 6917114.0 m N MGA94 Zone 56

Commenced: 15/05/2020
Logged By: SR
Checked By:

Drill Model and Mounting: Digga Explora 60
Hole Diameter:

RL Surface: No survey
Datum: AHD Operator: SR

Drilling Information							Soil Description				DCP					
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm						
AD/T						0.10		SM	Silty SAND (SM) Medium dense, fine to medium grained, dark grey, low plasticity fines, with organics, moist.	0	5	10	15	20	25	
								SM	Silty SAND (SM) Medium dense, fine to medium grained, dark grey, low plasticity fines, some fine to coarse grained gravel, with organics, moist.							
						0.50		SM	Silty SAND (SM) Medium dense, fine to medium grained, dark grey, low plasticity fines, some fine to coarse grained gravel, moist.							
						1.10		SM	Silty Gravelly SAND (SM) Medium dense, fine to coarse grained, orange brown, fine to coarse grained gravel, low plasticity fines, moist.							
						1.70										
						1.90		CI	Sandy Gravelly CLAY (CI) Hard, medium plasticity, orange brown, fine to coarse grained gravel, fine to coarse grained sand, moist to wet.							
						2.10		CL	Sandy Gravelly CLAY (CL) Very stiff, low plasticity, light grey mottled orange brown, fine to coarse grained gravel, fine to coarse grained sand, moist.							
						2.70			SANDSTONE (HW) Highly weathered, very low strength, light grey mottled orange brown.							
						2.90			SANDSTONE (HW) Highly weathered, low strength, light grey mottled orange brown.							
						3			Hole Terminated at 2.90 m							
					4											
Method AS - Auger RR - Rock Roller WB - Washbore							Water Level (Date) Inflow			Samples and Tests U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test B - Bulk Sample			Remarks 1. Groundwater not encountered.			
Support C - Casing							Classification Symbols and Soil Descriptions Based on Unified Soil Classification System									

Project No.: PG-4116

Client: Gallery Homes
Project Name: Proposed Subdivision
Hole Location: Courtney Drive, Upper Coomera
Hole Position: 527206.0 m E 6917003.0 m N MGA94 Zone 56

Commenced: 15/05/2020
Logged By: SR
Checked By:

Drill Model and Mounting: Digga Explora 60
Hole Diameter:

RL Surface: No survey
Datum: AHD Operator: SR

Drilling Information							Soil Description			DCP					
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm					
AD/T						0.10		SM	NATURAL Silty SAND (SM) Medium dense, fine to medium grained, dark grey, low plasticity fines, with organics, moist.	0	5	10	15	20	25
								SM	Silty SAND (SM) Medium dense, fine to medium grained, dark grey, low plasticity fines, moist.						
						0.50		SM	Silty SAND (SM) Medium dense, fine to medium grained, grey mottled orange brown, low plasticity fines, moist.						
						0.70		SM	Silty SAND (SM) Medium dense, fine to medium grained, grey mottled orange brown, low plasticity fines, moist.						
						1.00			SANDSTONE (HW) Highly weathered, very low strength, orange brown mottled grey, moist.						
						1.40			SANDSTONE (HW) Highly weathered, low strength, orange brown mottled grey, moist.						
						1.60			Hole Terminated at 1.60 m						
						2.00									
						3.00									
						4.00									

Method
AS - Auger
RR - Rock Roller
WB - Washbore

Water
 Level (Date)
 Inflow

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
B - Bulk Sample

Remarks
1. Groundwater not encountered.
2. DCP refusal met at 0.75m.
3. Maximum 'TC' bit refusal met at 1.6m.

Support
C - Casing

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Project No.: PG-4116

Client: Gallery Homes
Project Name: Proposed Subdivision
Hole Location: Courtney Drive, Upper Coomera
Hole Position: 527591.0 m E 6916992.0 m N MGA94 Zone 56

Commenced: 15/05/2020
 Logged By: SR
 Checked By:

Drill Model and Mounting: Digga Explora 60
Hole Diameter:

RL Surface: No survey
Datum: AHD Operator: SR

Drilling Information							Soil Description			DCP					
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm					
										0	5	10	15	20	25
AD/T						0.10		SM	NATURAL Silty SAND (SM) Medium dense, fine to medium grained, brown, low plasticity fines, with organics, moist.						
							SM	Silty SAND (SM) Medium dense, fine to medium grained, orange brown, low plasticity fines, trace of fine to medium grained gravel, moist.							
						0.50			SANDSTONE (HW) Highly weathered, very low strength, orange brown mottled light grey, moist.						
						1.60									
						1.70			SANDSTONE (HW) Highly weathered, low strength, orange brown mottled light grey, moist. Hole Terminated at 1.70 m						
						2									
						3									
						4									
Method AS - Auger RR - Rock Roller WB - Washbore Support C - Casing Water Level (Date) Inflow Samples and Tests U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test B - Bulk Sample Classification Symbols and Soil Descriptions Based on Unified Soil Classification System Remarks 1. Groundwater not encountered. 2. DCP refusal met at 0.15m. 3. Maximum 'TC' bit refusal met at 1.7m.															

Project No.: PG-4116

Client: Gallery Homes
Project Name: Proposed Subdivision
Hole Location: Courtney Drive, Upper Coomera
Hole Position: 527380.0 m E 6916907.0 m N MGA94 Zone 56

Commenced: 15/05/2020
Logged By: SR
Checked By:

Drill Model and Mounting: Digga Explora 60
Hole Diameter:

RL Surface: No survey
Datum: AHD Operator: SR

Drilling Information							Soil Description				DCP					
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm						
AD/T						0.50		SM	FILL Silty Gravelly SAND (SM) Medium dense, fine to coarse grained sand, dark brown, fine to coarse grained gravel, moist.							
						0.90		SM	NATURAL Silty SAND (SM) Medium dense, fine to medium grained, dark grey, low plasticity fines, moist							
						1.20		SM	Silty SAND (SM) Medium dense, fine to medium grained, grey, low plasticity fines, wet.							
						1.70		CL-CI	Sandy CLAY (CL-CI) Very stiff, low to medium plasticity, mottled orange brown and dark grey, fine to coarse grained sand, moist.							
						1.90		CL-CI	Sandy CLAY (CL-CI) Hard, low to medium plasticity, mottled orange brown and dark grey, fine to coarse grained sand, moist.							
						2.10		CH	Sandy CLAY (CH) Very stiff, high plasticity, grey mottled orange brown, fine to coarse grained sand, moist.							
						2.40		CH	Sandy CLAY (CH) Hard, high plasticity, grey mottled orange brown, fine to coarse grained sand, moist.							
						2.70		CL-CI	Sandy CLAY (CL-CI) Hard, low to medium plasticity, grey mottled orange brown, fine to coarse grained sand, moist.							
						2.90			SANDSTONE (HW) Highly weathered, low strength, orange brown mottled light grey.							
						3			Hole Terminated at 2.90 m							
					4											
Method AS - Auger RR - Rock Roller WB - Washbore							Water Level (Date) Inflow		Samples and Tests U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test B - Bulk Sample		Remarks 1. Groundwater not encountered. 2. DCP refusal met at 0.35m. 3. Maximum 'TC' bit refusal met at 2.9m.					
Support C - Casing							Classification Symbols and Soil Descriptions Based on Unified Soil Classification System									

Project No.: PG-4116

Client: Gallery Homes
Project Name: Proposed Subdivision
Hole Location: Courtney Drive, Upper Coomera
Hole Position: 527478.0 m E 6917320.0 m N MGA94 Zone 56

Commenced: 15/05/2020
Logged By: SR
Checked By:

Drill Model and Mounting: Digga Explora 60
Hole Diameter:

RL Surface: No survey
Datum: AHD Operator: SR

Drilling Information							Soil Description			DCP					
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm					
AD/T			D 0.10-0.50 m			0.10		SM	NATURAL Silty SAND (SM) Medium dense, fine to medium grained, dark grey, low plasticity fines, with organics, moist.	0	5	10	15	20	25
								SM	Silty SAND (SM) Medium dense, fine to medium grained, dark grey, low plasticity fines, moist.						
						0.90		SC	Clayey SAND (SC) Medium dense, fine to medium grained, grey mottled orange brown, low plasticity fines, moist to wet.						
						1.20		CI	Sandy CLAY (CI) Hard, medium plasticity, grey mottled orange brown, fine to medium grained sand, moist.						
						1.50		CI	Sandy CLAY (CI) Stiff, medium plasticity, light grey mottled orange brown, fine to medium grained sand, moist.						
						1.80									
						2.80			SANDSTONE (HW) Highly weathered, low strength, orange brown mottled light grey, moist.						
						3.00									
									Hole Terminated at 3.00 m						
Method AS - Auger RR - Rock Roller WB - Washbore Support C - Casing										Water Level (Date) Inflow Samples and Tests U - Undisturbed Sample D - Disturbed Sample SPT - Standard Penetration Test B - Bulk Sample Classification Symbols and Soil Descriptions Based on Unified Soil Classification System					
										Remarks 1. Groundwater not encountered. 2. DCP refusal met at 1.8m. 3. Maximum 'TC' bit refusal met at 3.0m.					

Project No.: PG-4116

Client: Gallery Homes
Project Name: Proposed Subdivision
Hole Location: Courtney Drive, Upper Coomera
Hole Position: 527206.0 m E 6916944.0 m N MGA94 Zone 56

Commenced: 15/05/2020
Logged By: SR
Checked By:

Drill Model and Mounting: Digga Explora 60
Hole Diameter:

RL Surface: No survey
Datum: AHD Operator: SR

Drilling Information							Soil Description			DCP					
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm					
AD/T						0.10		SM	NATURAL Silty Gravelly SAND (SM) Medium dense, fine to medium grained, orange brown, fine to coarse grained gravel, low plasticity fines, with organics, moist.	0	5	10	15	20	25
						0.40		SM	Silty Gravelly SAND (SM) Dense, fine to medium grained, orange brown mottled grey, fine to coarse grained gravel, low plasticity fines, with organics, moist.						
						0.80			SANDSTONE (HW) Highly weathered, very low strength, orange brown mottled light grey, moist.						
						1.00			SANDSTONE (HW) Highly weathered, low strength, orange brown mottled light grey, moist.						
						1			Hole Terminated at 1.00 m						
						2									
						3									
						4									

Method
AS - Auger
RR - Rock Roller
WB - Washbore

Water
 Level (Date)
 Inflow

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
B - Bulk Sample

Remarks
1. Groundwater not encountered.
2. DCP refusal met at 0.15m.
3. Maximum 'TC' bit refusal met at 1.0m.

Support
C - Casing

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

APPENDIX C

LABORATORY TEST CERTIFICATES

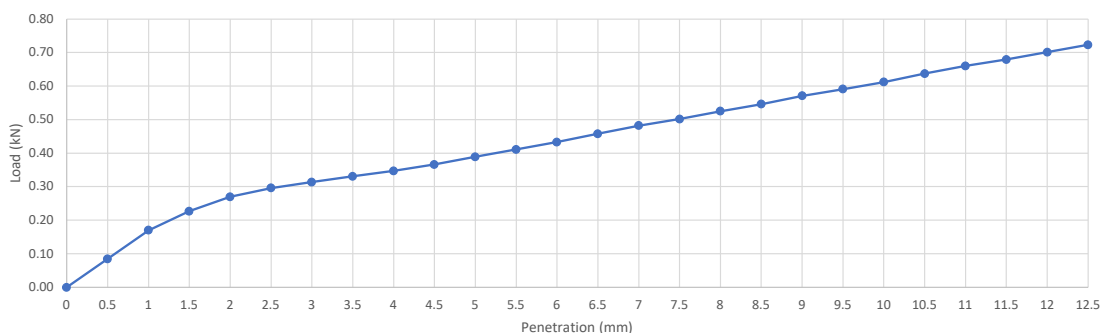
CALIFORNIA BEARING RATIO REPORT (1 POINT)

CLIENT:	Gallery Homes	PROJECT NUMBER:	PG-4116
ADDRESS:	Courtney Court, Upper Coomera	REPORT NUMBER:	PG-4116-CBR-01
PROJECT NAME:	Proposed Residential Subdivision	REPORT DATE:	29/05/2020
		TEST METHOD:	AS 1289.6.1.1

SAMPLE LOCATION:	BH 1@ 0.1m-0.8m
SAMPLING METHOD:	DISTURBED
SAMPLED BY:	PACIFIC GEOTECH
DATE SAMPLED:	
DATE TESTED:	25/05/2020
PREPARATION METHOD:	AS 1289.1.1
MOISTURE METHOD:	AS 1289.2.1.1
MATERIAL TYPE:	BULK

MAXIMUM DRY DENSITY (t/m ³):	1.604
OPTIMUM MOISTURE CONTENT (%):	18.40
COMPACTIVE EFFORT:	Standard
COMPACTIVE HAMMER:	AS 1289.5.1.1
LABORATORY DENSITY RATIO:	100.5
LABORATORY MOISTURE RATIO:	100
DRY DENSITY BEFORE SOAK (t/m ³):	1.61
DRY DENSITY AFTER SOAK (t/m ³):	1.66
MOISTURE CONTENT BEFORE SOAK (%):	18.4
MOISTURE CONTENT OF TOP 30mm AFTER PENETRATION (%):	21.4
MOISTURE CONTENT REST OF SAMPLE AFTER PENETRATION (%):	19.8
SWELL (%):	5
CBR SURCHARGE (kg):	4.5
SOAK PERIOD (days):	4
CURING HOURS:	48
OVERSIZE MATERIAL (%):	0
CBR 2.5mm (%):	2.0
CBR 5 mm (%):	2.0
CBR VALUE (%):	2.0

CBR 1 POINT GRAPH



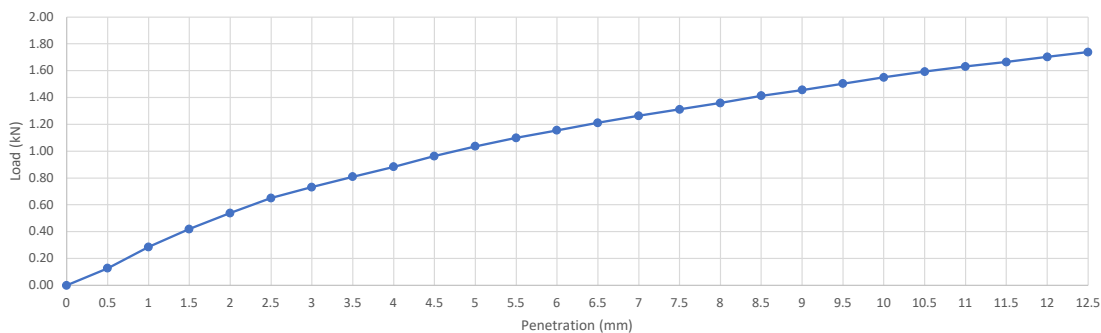
CALIFORNIA BEARING RATIO REPORT (1 POINT)

CLIENT:	Gallery Homes	PROJECT NUMBER:	PG-4116
ADDRESS:	Courtney Court, Upper Coomera	REPORT NUMBER:	PG-4116-CBR-02
PROJECT NAME:	Proposed Residential Subdivision	REPORT DATE:	29/05/2020
		TEST METHOD:	AS 1289.6.1.1

SAMPLE LOCATION:	BH 6@ 0.50m-0.90m
SAMPLING METHOD:	DISTURBED
SAMPLED BY:	PACIFIC GEOTECH
DATE SAMPLED:	
DATE TESTED:	25/05/2020
PREPERATION METHOD:	AS 1289.1.1
MOISTURE METHOD:	AS 1289.2.1.1
MATERIAL TYPE:	BULK

MAXIMUM DRY DENSITY (t/m ³):	1.857
OPTIMUM MOISTURE CONTENT (%):	14.90
COMPACTIVE EFFORT:	Standard
COMPACTIVE HAMMER:	AS 1289.5.1.1
LABORATORY DENSITY RATIO:	100
LABORATORY MOISTURE RATIO:	100.5
DRY DENSITY BEFORE SOAK (t/m ³):	1.86
DRY DENSITY AFTER SOAK (t/m ³):	1.87
MOISTURE CONTENT BEFORE SOAK (%):	15.0
MOISTURE CONTENT OF TOP 30mm AFTER PENETRATION (%):	15.4
MOISTURE CONTENT REST OF SAMPLE AFTER PENETRATION (%):	15.1
SWELL (%):	1
CBR SURCHARGE (kg):	4.5
SOAK PERIOD (days):	4
CURING HOURS:	48
OVERSIZE MATERIAL (%):	0
CBR 2.5mm (%):	5.0
CBR 5 mm (%):	5.0
CBR VALUE (%):	5.0

CBR 1 POINT GRAPH



SHRINK SWELL INDEX REPORT

CLIENT:	Gallery Homes	PROJECT NUMBER:	PG-4116
ADDRESS:	Courtney Court, Upper Coomera	REPORT NUMBER:	PG-4116-SS-01
PROJECT NAME:	Proposed Residential Subdivision	REPORT DATE:	30/05/2020
		TEST METHOD:	AS 1289.7.1.1

SAMPLE LOCATION:	BH01 @ 0.4-0.55m
SAMPLING METHOD:	U50
SAMPLED BY:	PACIFIC GEOTECH
DATE SAMPLED:	15/05/2020
DATE TESTED:	29/05/2020
MATERIAL TYPE:	Silty Clay

SHRINKAGE MOISTURE CONTENT (%):	15.2
SHRINKAGE (%):	3.2
SWELL MOISTURE CONTENT INITIAL (%):	17.7
SWELL MOISTURE CONTENT FINAL (%):	22.2
SWELL (%):	3.0
UNIT WEIGHT (t/m ³):	1.94
SHRINK SWELL INDEX I_{ss} (%):	2.5
CRACKING:	no
CRUMBLING:	no

REMARKS:



SHRINK SWELL INDEX REPORT

CLIENT:	Gallery Homes	PROJECT NUMBER:	PG-4116
ADDRESS:	Courtney Court, Upper Coomera	REPORT NUMBER:	PG-4116-SS-02
PROJECT NAME:	Proposed Residential Subdivision	REPORT DATE:	30/05/2020
		TEST METHOD:	AS 1289.7.1.1

SAMPLE LOCATION:	BH06 @ 0.5-0.7m
SAMPLING METHOD:	U50
SAMPLED BY:	PACIFIC GEOTECH
DATE SAMPLED:	15/05/2020
DATE TESTED:	29/05/2020
MATERIAL TYPE:	Sandy Clay

SHRINKAGE MOISTURE CONTENT (%):	14.2
SHRINKAGE (%):	1.5
SWELL MOISTURE CONTENT INITIAL (%):	12.8
SWELL MOISTURE CONTENT FINAL (%):	15.1
SWELL (%):	0.0
UNIT WEIGHT (t/m ³):	2.16
SHRINK SWELL INDEX I_{ss} (%):	0.8
CRACKING:	no
CRUMBLING:	no

REMARKS:



SHRINK SWELL INDEX REPORT

CLIENT:	Gallery Homes	PROJECT NUMBER:	PG-4116
ADDRESS:	Courtney Court, Upper Coomera	REPORT NUMBER:	PG-4116-SS-03
PROJECT NAME:	Proposed Residential Subdivision	REPORT DATE:	30/05/2020
		TEST METHOD:	AS 1289.7.1.1

SAMPLE LOCATION:	BH08 @ 0.7-0.85m
SAMPLING METHOD:	U50
SAMPLED BY:	PACIFIC GEOTECH
DATE SAMPLED:	15/05/2020
DATE TESTED:	29/05/2020
MATERIAL TYPE:	Silty Clay

SHRINKAGE MOISTURE CONTENT (%):	12.7
SHRINKAGE (%):	2.8
SWELL MOISTURE CONTENT INITIAL (%):	13.0
SWELL MOISTURE CONTENT FINAL (%):	14.5
SWELL (%):	0.3
UNIT WEIGHT (t/m ³):	2.08
SHRINK SWELL INDEX I_{ss} (%):	1.6
CRACKING:	no
CRUMBLING:	no

REMARKS:



APPENDIX D

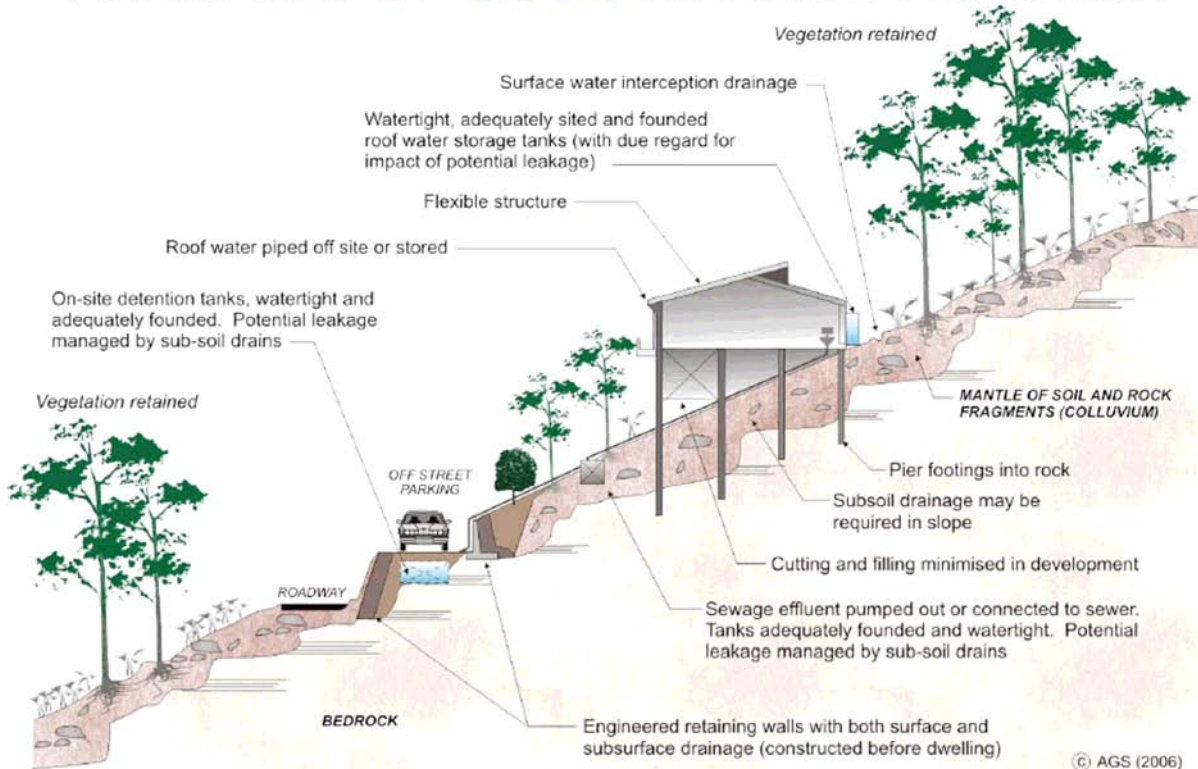
GUIDELINES FOR HILLSIDE CONSTRUCTION

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

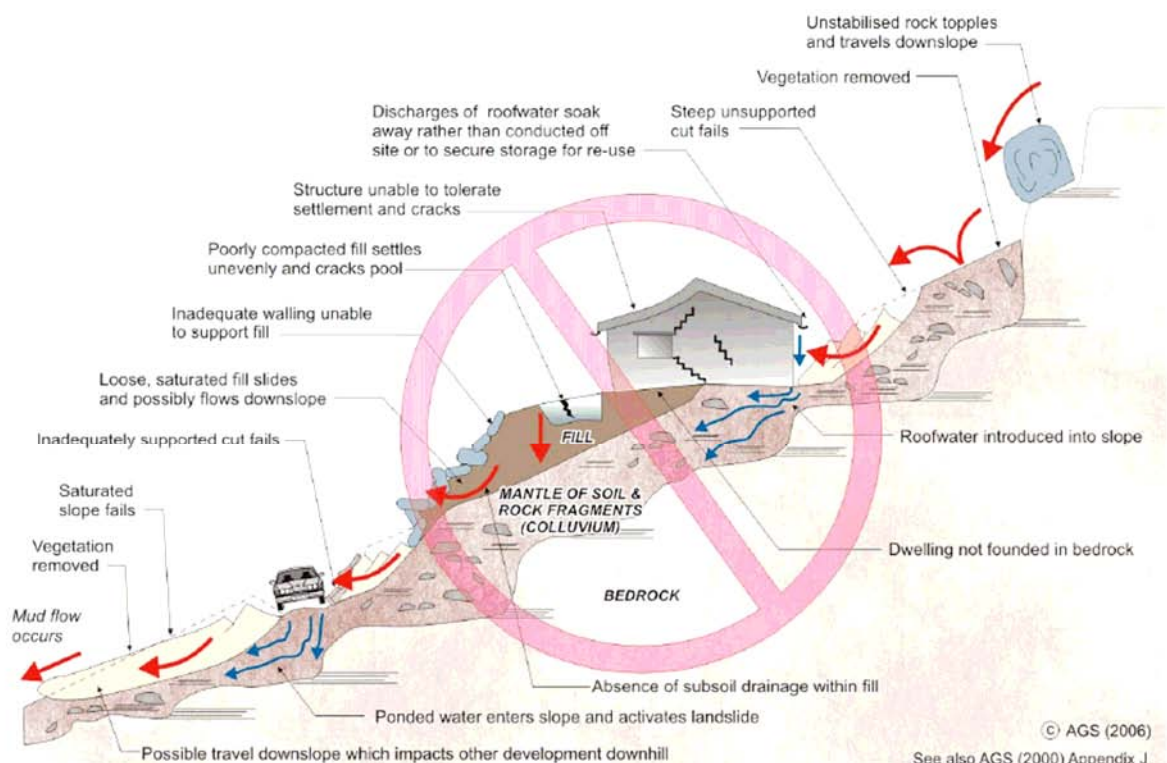
APPENDIX G - SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

ADVICE		GOOD ENGINEERING PRACTICE	POOR ENGINEERING PRACTICE
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical practitioner at early stage of planning and before site works.		Prepare detailed plan and start site works before geotechnical advice.
PLANNING			
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.		Plan development without regard for the Risk.
DESIGN AND CONSTRUCTION			
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.		Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.		Indiscriminately clear the site.
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.		Excavate and fill for site access before geotechnical advice.
EARTHWORKS	Retain natural contours wherever possible.		Indiscriminatory bulk earthworks.
CUTS	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.		Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements
FILLS	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.		Loose or poorly compacted fill, which if it fails, may flow a considerable distance including onto property below. Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble etc in fill.
ROCK OUTCROPS & BOULDERS	Remove or stabilise boulders which may have unacceptable risk. Support rock faces where necessary.		Disturb or undercut detached blocks or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on rock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.		Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weepholes.
FOOTINGS	Found within rock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing excavations to exclude ingress of surface water.		Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.		
DRAINAGE			
SURFACE	Provide at tops of cut and fill slopes. Discharge to street drainage or natural water courses. Provide general falls to prevent blockage by siltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slope and/or direction.		Discharge at top of fills and cuts. Allow water to pond on bench areas.
SUBSURFACE	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.		Discharge roof runoff into absorption trenches.
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.		Discharge sullage directly onto and into slopes. Use absorption trenches without consideration of landslide risk.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.		Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION			
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant		
SITE VISITS	Site Visits by consultant may be appropriate during construction/		
INSPECTION AND MAINTENANCE BY OWNER			
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident see advice. If seepage observed, determine causes or seek advice on consequences.		

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE



APPENDIX E

**STANDARD PROFORMA FOR GEOTECHNICAL CERTIFICATION
AND LANDSLIDE SUSCEPTIBILITY ANALYSIS FORM**

**Standard Pro-forma for
Geotechnical Certification**

City of Gold Coast Council file reference:

PROPOSED WORKS AT (LOCATION): **End of Courtney Drive, Upper Coomera**

for (proposed development): **Proposed Residential Subdivision**

I, Peter ELKINGTON, RPEQ No. 7226, of Pacific Geotech Pty Limited (Consulting Engineers), being duly authorised on this behalf, do certify that:-

The Lots for the proposed new residential subdivision at the end of Courtney Drive, Upper Coomera can achieve a Landslide Susceptibility Rating of 'Low' or better for the long term (70 years minimum) and will therefore be sustainable and not cause any adverse effects on the stability and integrity of the neighbouring buildings, properties, utility services and infrastructures providing the advice and construction recommendations made in the Pacific Geotech report "Broadscale Geotechnical Investigation and Slope Stability Assessment For Proposed Residential Subdivision – End of Courtney Drive, Upper Coomera" dated 10th January 2023 Job No. PG-4116A have been followed and implemented and that no other development adversely affects the subject development.

I am aware that the City of Gold Coast Council will rely upon this certificate and any associated geotechnical reports, maps, graphs, tables, attachments etc. produced as a consequence of commissioning this development proposal.

Signed:



PETER ELKINGTON (RPEQ No. 7226)

Designation: **GEOTECHNICAL ENGINEER**

Certified this: **Tenth Day of January, 2023.**

File: PG-4116A proforma

LANDSLIDE SUSCEPTIBILITY ANALYSIS FORM - Lots within Dams

1 Natural Slope Surface			
Site		Level	Factor
☐	Less than 5 degrees	L	0.1
☒	Between 5 and 15 degrees	M	0.5
☐	Between 15 and 30 degrees	M	0.8
☐	Between 30 and 45 degrees	H	1.2
☐	More than 45 degrees	M	1.5
☐	Custom		1

2 Slope Shape			
Site		Level	Factor
☐	Crest or ridge	L	0.7
☐	Planar / Convex	M	0.9
☐	Rough / Irregular	H	1.2
☒	Concave	H	1.5
☐	Custom		1

3 Site Geology			
Site		Level	Factor
☐	Volcanic Extrusive Rock	H	1.1
☒	Sedimentary Rock	M	1
☐	Low Grade Metamorphic Rock	M	1
☐	High Grade Metamorphic Rock	L	0.9
☐	Volcanic Intrusive Rock	M	1
☐	Custom		1

4 Soils			
Site		Level	Factor
☐	Rock at Surface	VL	0.1
☐	Residual Soil < 1m deep	L	0.5
☐	Residual Soil 1-3m deep	M	0.9
☐	Residual Soil >3m deep	H	1.5
☐	Colluvial Soil < 1m deep	H	1.5
☒	Colluvial Soil 1-3m deep	VH	2
☐	Colluvial Soil >3m deep	VH	4
☐	Custom		0.5

5 Fill Height			
Site		Level	Factor
☒	None	L	1
☐	Less than 1m	M	1.1
☐	Between 1 and 3m	M	1.3
☐	Between 3 and 6m	H	1.7
☐	More than 6m	VH	2.5
☐	Custom		1

6 Evidence of Groundwater			
Site		Level	Factor
☐	None apparent	L	0.7
☐	Minor moistness	M	0.9
☒	Generally wet	H	1.5
☐	Surface springs	VH	3
☐	Custom		0.7

7 Cut Height			
Site		Level	Factor
☒	None	L	1
☐	Less than 1m	M	1.1
☐	Between 1 and 3m	M	1.3
☐	Between 3 and 6m	H	1.7
☐	More than 6m	VH	2.5
☐	Custom		2.5

8 Slope of Cut Face			
Site		Level	Factor
☒	NA	NA	1
☐	Less than 30 degrees	L	0.5
☐	Between 30 and 45 degrees	M	1
☐	Between 45 and 60 degrees	H	1.5
☐	More than 60 degrees	VH	3
☐	Custom		1.5

9 Material in Cutting			
Site		Level	Factor
☒	NA	NA	1
☐	High Strength Rock	L	0.5
☐	Medium Strength Rock	L	1
☐	Low Strength Rock	M	1.2
☐	Very Low Strength Rock and Soil	V	1.5
☐	Soil	VH	2
☐	Custom		1

10 Cut Slope Support			
Site		Level	Factor
☒	NA	NA	1
☐	Concrete Wall	L	0.5
☐	Crib Wall	M	0.9
☐	Gabion Wall	M	1
☐	Rock Wall	H	1.5
☐	Unsupported	H	2
☐	Custom		1

11 Concentration of Surface Water			
Site		Level	Factor
☐	Ridge	L	0.7
☐	Crest	M	0.8
☒	Upper Slope	M	0.9
☐	Mid Slope	H	1.2
☐	Lower Slope	H	1.5
☐	Custom		1

12 Wastewater Disposal			
Site		Level	Factor
☒	Fully Sewered	M	1
☐	Onsite disposal - Surface	M	1.2
☐	Onsite disposal - Soak Pits / Trenches	H	1.5
☐	Custom		1

13 Stormwater Disposal			
Site		Level	Factor
☒	All stormwater piped into road drainage	L	0.7
☐	Rain water tanks with overflows	M	1
☐	Stormwater Discharge on site	H	1.5
☐	Custom		1

14 Evidence of Instability			
Site		Level	Factor
☐	No sign of instability	L	0.8
☐	Soil Creep	H	1.2
☒	Minor irregularity	VH	2
☐	Major irregularity	VH	5
☐	Active instability	VH	10
☐	Custom		1

Summary

		Factor
1	Natural Slope Surface	2 0.5
2	Slope Shape	4 1.5
3	Site Geology	2 1
4	Soils	6 2
5	Fill Height	1 1
6	Evidence of Groundwater	3 1.5
7	Cut Height	1 1
8	Slope of Cut Face	1 1
9	Material in Cutting	1 1
10	Cut Slope Support	1 1
11	Concentration of Surface Water	3 0.9
12	Wastewater Disposal	1 1
13	Stormwater Disposal	1 0.7
14	Evidence of Instability	3 2
		2.8350

LANDSLIDE SUSCEPTIBILITY ANALYSIS FORM - Lot within Drainage Feature

1 Natural Slope Surface			
Site		Level	Factor
☐	Less than 5 degrees	L	0.1
☒	Between 5 and 15 degrees	M	0.5
☐	Between 15 and 30 degrees	M	0.8
☐	Between 30 and 45 degrees	H	1.2
☐	More than 45 degrees	M	1.5
☐	Custom		1

2 Slope Shape			
Site		Level	Factor
☐	Crest or ridge	L	0.7
☐	Planar / Convex	M	0.9
☐	Rough / Irregular	H	1.2
☒	Concave	H	1.5
☐	Custom		1

3 Site Geology			
Site		Level	Factor
☐	Volcanic Extrusive Rock	H	1.1
☒	Sedimentary Rock	M	1
☐	Low Grade Metamorphic Rock	M	1
☐	High Grade Metamorphic Rock	L	0.9
☐	Volcanic Intrusive Rock	M	1
☐	Custom		1

4 Soils			
Site		Level	Factor
☐	Rock at Surface	VL	0.1
☐	Residual Soil < 1m deep	L	0.5
☐	Residual Soil 1-3m deep	M	0.9
☐	Residual Soil >3m deep	H	1.5
☐	Colluvial Soil < 1m deep	H	1.5
☒	Colluvial Soil 1-3m deep	VH	2
☐	Colluvial Soil >3m deep	VH	4
☐	Custom		0.5

5 Fill Height			
Site		Level	Factor
☒	None	L	1
☐	Less than 1m	M	1.1
☐	Between 1 and 3m	M	1.3
☐	Between 3 and 6m	H	1.7
☐	More than 6m	VH	2.5
☐	Custom		1

6 Evidence of Groundwater			
Site		Level	Factor
☐	None apparent	L	0.7
☐	Minor moistness	M	0.9
☒	Generally wet	H	1.5
☐	Surface springs	VH	3
☐	Custom		0.7

7 Cut Height			
Site		Level	Factor
☒	None	L	1
☐	Less than 1m	M	1.1
☐	Between 1 and 3m	M	1.3
☐	Between 3 and 6m	H	1.7
☐	More than 6m	VH	2.5
☐	Custom		2.5

8 Slope of Cut Face			
Site		Level	Factor
☒	NA	NA	1
☐	Less than 30 degrees	L	0.5
☐	Between 30 and 45 degrees	M	1
☐	Between 45 and 60 degrees	H	1.5
☐	More than 60 degrees	VH	3
☐	Custom		1.5

9 Material in Cutting			
Site		Level	Factor
☒	NA	NA	1
☐	High Strength Rock	L	0.5
☐	Medium Strength Rock	L	1
☐	Low Strength Rock	M	1.2
☐	Very Low Strength Rock and Soil	V	1.5
☐	Soil	VH	2
☐	Custom		1

10 Cut Slope Support			
Site		Level	Factor
☒	NA	NA	1
☐	Concrete Wall	L	0.5
☐	Crib Wall	M	0.9
☐	Gabion Wall	M	1
☐	Rock Wall	H	1.5
☐	Unsupported	H	2
☐	Custom		1

11 Concentration of Surface Water			
Site		Level	Factor
☐	Ridge	L	0.7
☐	Crest	M	0.8
☒	Upper Slope	M	0.9
☐	Mid Slope	H	1.2
☐	Lower Slope	H	1.5
☐	Custom		1

12 Wastewater Disposal			
Site		Level	Factor
☒	Fully Sewered	M	1
☐	Onsite disposal - Surface	M	1.2
☐	Onsite disposal - Soak Pits / Trenches	H	1.5
☐	Custom		1

13 Stormwater Disposal			
Site		Level	Factor
☒	All stormwater piped into road drainage	L	0.7
☐	Rain water tanks with overflows	M	1
☐	Stormwater Discharge on site	H	1.5
☐	Custom		1

14 Evidence of Instability			
Site		Level	Factor
☐	No sign of instability	L	0.8
☒	Soil Creep	H	1.2
☐	Minor irregularity	VH	2
☐	Major irregularity	VH	5
☐	Active instability	VH	10
☐	Custom		1

Summary

		Factor
1	Natural Slope Surface	2 0.5
2	Slope Shape	4 1.5
3	Site Geology	2 1
4	Soils	6 2
5	Fill Height	1 1
6	Evidence of Groundwater	3 1.5
7	Cut Height	1 1
8	Slope of Cut Face	1 1
9	Material in Cutting	1 1
10	Cut Slope Support	1 1
11	Concentration of Surface Water	3 0.9
12	Wastewater Disposal	1 1
13	Stormwater Disposal	1 0.7
14	Evidence of Instability	2 1.2
		1.7010

LANDSLIDE SUSCEPTIBILITY ANALYSIS FORM - Lots within Mild Sloping Terrain

1 Natural Slope Surface			
Site		Level	Factor
☐	Less than 5 degrees	L	0.1
☒	Between 5 and 15 degrees	M	0.5
☐	Between 15 and 30 degrees	M	0.8
☐	Between 30 and 45 degrees	H	1.2
☐	More than 45 degrees	M	1.5
☐	Custom		1

2 Slope Shape			
Site		Level	Factor
☐	Crest or ridge	L	0.7
☒	Planar / Convex	M	0.9
☐	Rough / Irregular	H	1.2
☐	Concave	H	1.5
☐	Custom		1

3 Site Geology			
Site		Level	Factor
☐	Volcanic Extrusive Rock	H	1.1
☒	Sedimentary Rock	M	1
☐	Low Grade Metamorphic Rock	M	1
☐	High Grade Metamorphic Rock	L	0.9
☐	Volcanic Intrusive Rock	M	1
☐	Custom		1

4 Soils			
Site		Level	Factor
☐	Rock at Surface	VL	0.1
☐	Residual Soil < 1m deep	L	0.5
☐	Residual Soil 1-3m deep	M	0.9
☐	Residual Soil >3m deep	H	1.5
☒	Colluvial Soil < 1m deep	H	1.5
☐	Colluvial Soil 1-3m deep	VH	2
☐	Colluvial Soil >3m deep	VH	4
☐	Custom		0.5

5 Fill Height			
Site		Level	Factor
☒	None	L	1
☐	Less than 1m	M	1.1
☐	Between 1 and 3m	M	1.3
☐	Between 3 and 6m	H	1.7
☐	More than 6m	VH	2.5
☐	Custom		1

6 Evidence of Groundwater			
Site		Level	Factor
☒	None apparent	L	0.7
☐	Minor moistness	M	0.9
☐	Generally wet	H	1.5
☐	Surface springs	VH	3
☐	Custom		0.7

7 Cut Height			
Site		Level	Factor
☒	None	L	1
☐	Less than 1m	M	1.1
☐	Between 1 and 3m	M	1.3
☐	Between 3 and 6m	H	1.7
☐	More than 6m	VH	2.5
☐	Custom		2.5

8 Slope of Cut Face			
Site		Level	Factor
☒	NA	NA	1
☐	Less than 30 degrees	L	0.5
☐	Between 30 and 45 degrees	M	1
☐	Between 45 and 60 degrees	H	1.5
☐	More than 60 degrees	VH	3
☐	Custom		1.5

9 Material in Cutting			
Site		Level	Factor
☒	NA	NA	1
☐	High Strength Rock	L	0.5
☐	Medium Strength Rock	L	1
☐	Low Strength Rock	M	1.2
☐	Very Low Strength Rock and Soil	V	1.5
☐	Soil	VH	2
☐	Custom		1

10 Cut Slope Support			
Site		Level	Factor
☒	NA	NA	1
☐	Concrete Wall	L	0.5
☐	Crib Wall	M	0.9
☐	Gabion Wall	M	1
☐	Rock Wall	H	1.5
☐	Unsupported	H	2
☐	Custom		1

11 Concentration of Surface Water			
Site		Level	Factor
☐	Ridge	L	0.7
☐	Crest	M	0.8
☒	Upper Slope	M	0.9
☐	Mid Slope	H	1.2
☐	Lower Slope	H	1.5
☐	Custom		1

12 Wastewater Disposal			
Site		Level	Factor
☒	Fully Sewered	M	1
☐	Onsite disposal - Surface	M	1.2
☐	Onsite disposal - Soak Pits / Trenches	H	1.5
☐	Custom		1

13 Stormwater Disposal			
Site		Level	Factor
☒	All stormwater piped into road drainage	L	0.7
☐	Rain water tanks with overflows	M	1
☐	Stormwater Discharge on site	H	1.5
☐	Custom		1

14 Evidence of Instability			
Site		Level	Factor
☐	No sign of instability	L	0.8
☒	Soil Creep	H	1.2
☐	Minor irregularity	VH	2
☐	Major irregularity	VH	5
☐	Active instability	VH	10
☐	Custom		1

Summary

		Factor
1	Natural Slope Surface	2 0.5
2	Slope Shape	2 0.9
3	Site Geology	2 1
4	Soils	5 1.5
5	Fill Height	1 1
6	Evidence of Groundwater	1 0.7
7	Cut Height	1 1
8	Slope of Cut Face	1 1
9	Material in Cutting	1 1
10	Cut Slope Support	1 1
11	Concentration of Surface Water	3 0.9
12	Wastewater Disposal	1 1
13	Stormwater Disposal	1 0.7
14	Evidence of Instability	2 1.2
		0.3572

LANDSLIDE SUSCEPTIBILITY ANALYSIS FORM - Lots on Ridge Line

1 Natural Slope Surface			
Site		Level	Factor
☒	Less than 5 degrees	L	0.1
☐	Between 5 and 15 degrees	M	0.5
☐	Between 15 and 30 degrees	M	0.8
☐	Between 30 and 45 degrees	H	1.2
☐	More than 45 degrees	M	1.5
☐	Custom		1

2 Slope Shape			
Site		Level	Factor
☒	Crest or ridge	L	0.7
☐	Planar / Convex	M	0.9
☐	Rough / Irregular	H	1.2
☐	Concave	H	1.5
☐	Custom		1

3 Site Geology			
Site		Level	Factor
☐	Volcanic Extrusive Rock	H	1.1
☒	Sedimentary Rock	M	1
☐	Low Grade Metamorphic Rock	M	1
☐	High Grade Metamorphic Rock	L	0.9
☐	Volcanic Intrusive Rock	M	1
☐	Custom		1

4 Soils			
Site		Level	Factor
☐	Rock at Surface	VL	0.1
☐	Residual Soil < 1m deep	L	0.5
☐	Residual Soil 1-3m deep	M	0.9
☐	Residual Soil >3m deep	H	1.5
☒	Colluvial Soil < 1m deep	H	1.5
☐	Colluvial Soil 1-3m deep	VH	2
☐	Colluvial Soil >3m deep	VH	4
☐	Custom		0.5

5 Fill Height			
Site		Level	Factor
☒	None	L	1
☐	Less than 1m	M	1.1
☐	Between 1 and 3m	M	1.3
☐	Between 3 and 6m	H	1.7
☐	More than 6m	VH	2.5
☐	Custom		1

6 Evidence of Groundwater			
Site		Level	Factor
☒	None apparent	L	0.7
☐	Minor moistness	M	0.9
☐	Generally wet	H	1.5
☐	Surface springs	VH	3
☐	Custom		0.7

7 Cut Height			
Site		Level	Factor
☒	None	L	1
☐	Less than 1m	M	1.1
☐	Between 1 and 3m	M	1.3
☐	Between 3 and 6m	H	1.7
☐	More than 6m	VH	2.5
☐	Custom		2.5

8 Slope of Cut Face			
Site		Level	Factor
☒	NA	NA	1
☐	Less than 30 degrees	L	0.5
☐	Between 30 and 45 degrees	M	1
☐	Between 45 and 60 degrees	H	1.5
☐	More than 60 degrees	VH	3
☐	Custom		1.5

9 Material in Cutting			
Site		Level	Factor
☒	NA	NA	1
☐	High Strength Rock	L	0.5
☐	Medium Strength Rock	L	1
☐	Low Strength Rock	M	1.2
☐	Very Low Strength Rock and Soil	V	1.5
☐	Soil	VH	2
☐	Custom		1

10 Cut Slope Support			
Site		Level	Factor
☒	NA	NA	1
☐	Concrete Wall	L	0.5
☐	Crib Wall	M	0.9
☐	Gabion Wall	M	1
☐	Rock Wall	H	1.5
☐	Unsupported	H	2
☐	Custom		1

11 Concentration of Surface Water			
Site		Level	Factor
☐	Ridge	L	0.7
☐	Crest	M	0.8
☒	Upper Slope	M	0.9
☐	Mid Slope	H	1.2
☐	Lower Slope	H	1.5
☐	Custom		1

12 Wastewater Disposal			
Site		Level	Factor
☒	Fully Sewered	M	1
☐	Onsite disposal - Surface	M	1.2
☐	Onsite disposal - Soak Pits / Trenches	H	1.5
☐	Custom		1

13 Stormwater Disposal			
Site		Level	Factor
☒	All stormwater piped into road drainage	L	0.7
☐	Rain water tanks with overflows	M	1
☐	Stormwater Discharge on site	H	1.5
☐	Custom		1

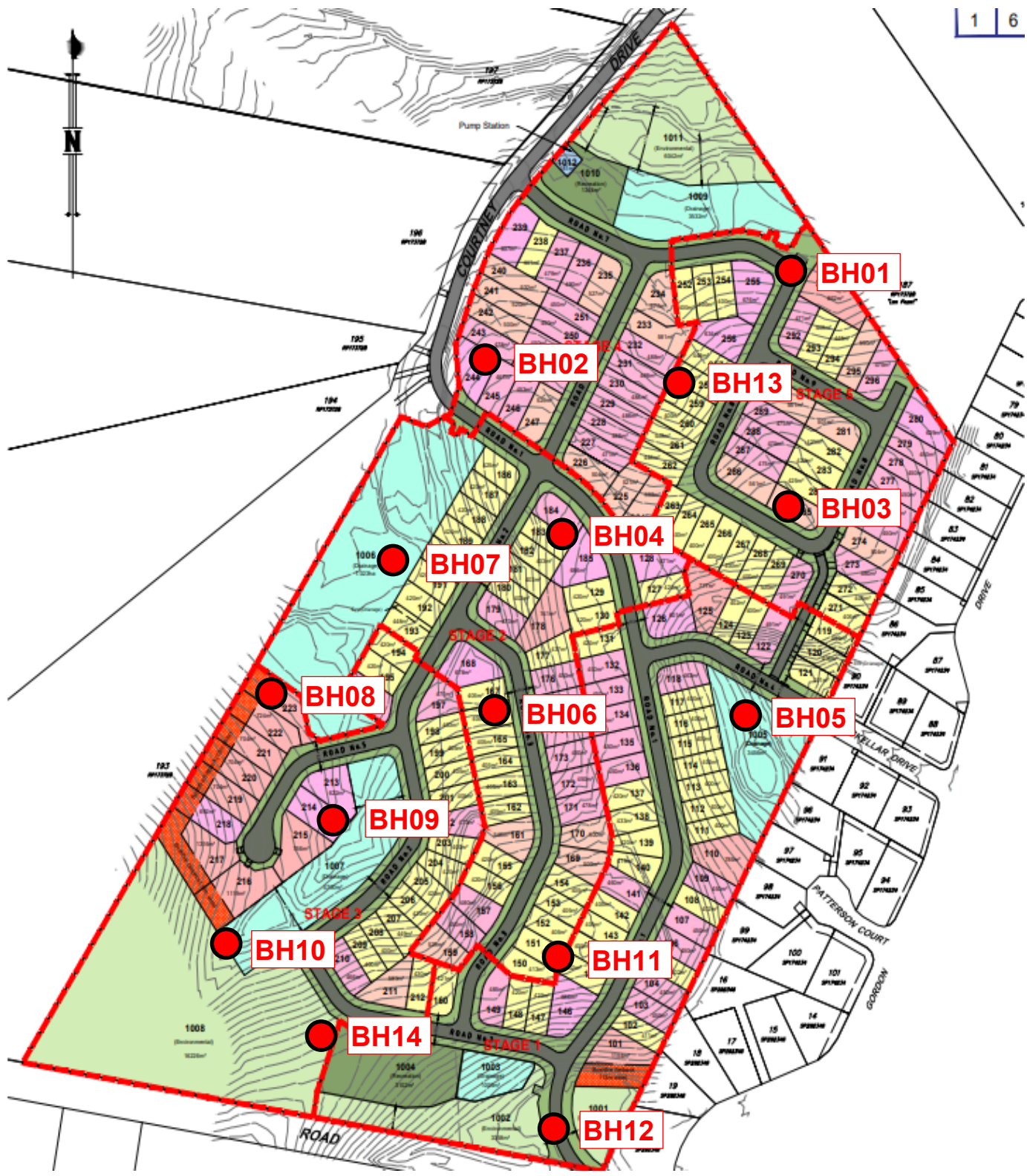
14 Evidence of Instability			
Site		Level	Factor
☒	No sign of instability	L	0.8
☐	Soil Creep	H	1.2
☐	Minor irregularity	VH	2
☐	Major irregularity	VH	5
☐	Active instability	VH	10
☐	Custom		1

Summary

		Factor
1	Natural Slope Surface	1 0.1
2	Slope Shape	1 0.7
3	Site Geology	2 1
4	Soils	5 1.5
5	Fill Height	1 1
6	Evidence of Groundwater	1 0.7
7	Cut Height	1 1
8	Slope of Cut Face	1 1
9	Material in Cutting	1 1
10	Cut Slope Support	1 1
11	Concentration of Surface Water	3 0.9
12	Wastewater Disposal	1 1
13	Stormwater Disposal	1 0.7
14	Evidence of Instability	1 0.8
		0.0370

APPENDIX F

SITE PLAN AND PLAN OF PROPOSED SUBDIVISION



Drawn LB	Project:	Proposed Subdivision	Drawing No. PG-4116A-01	A4
Date January 2023	Location:	Courtney Drive, Upper Coomera		
Checked	Client:	HB Qld Pty Ltd		

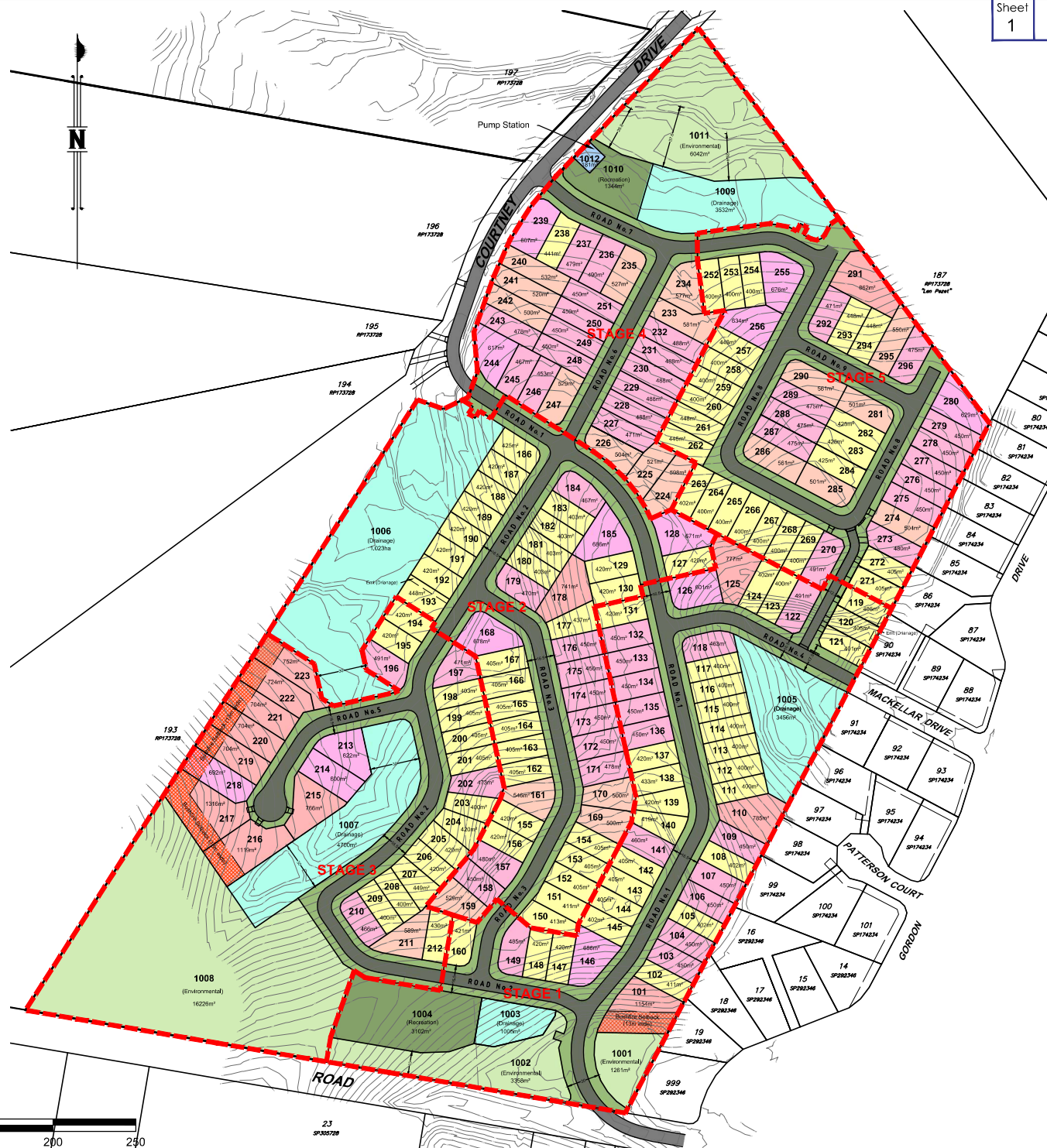
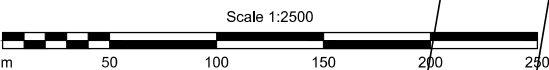
Residential Lots	196
Open Space Lots (Environmental)	4
Open Space Lots (Drainage)	5
Open Space Lots (Recreation)	2
Pump Station Lots	1
Total Lots	208

Total Site Area	18.851ha
Open Space (Environmental)	2.689ha
Open Space (Drainage)	2.292ha
Open Space (Recreation)	0.445ha
Pump Station	0.018ha
Area of New Road	3.989ha
Net Developable Area	13.499ha
Net Ha	9.510ha
Net Residential Density	20.6 / d/ha

CW Precinct	
Net Ha	1,490ha
Precinct Lots	25
Net Residential Density	16.8 d/ha

CSE Precinct	
Net Ha	8.020ha
Precinct Lots	171
Net Residential Density	21.3 d/ha

	Size	Number	%
	400m ² - 449m ²	94	48%
	450m ² - 499m ²	55	28%
	500m ² - 599m ²	21	11%
	600m ² - 699m ²	13	7%
	700m ² +	13	7%



Sheet	of
1	6

mail@bennettandbennett.com.au

www.bennettandbennett.com.au

NOTES:

1. Drawn to scale on an A3 sheet.
2. All dimensions and areas are subject to final survey and approval by G.C.C.C.
3. Dimensions shown are to the nearest decimeter.

D	Pump Station Added	HK	21/09/2022
C	Staging Updated	HK	14/09/2022
B	Staging Updated	DJR	13/04/2022
A	Original Issue	DJR	11/05/2020
Issue	Revision	Int	Date

Issue	Revision	Ink	Date
Title:			

Plan of Proposed Subdivision Overall

Courtney Drive, Upper Coomera
(Described as Lots 188-192 on
RP173728)

Client: **GALLERY HOMES**

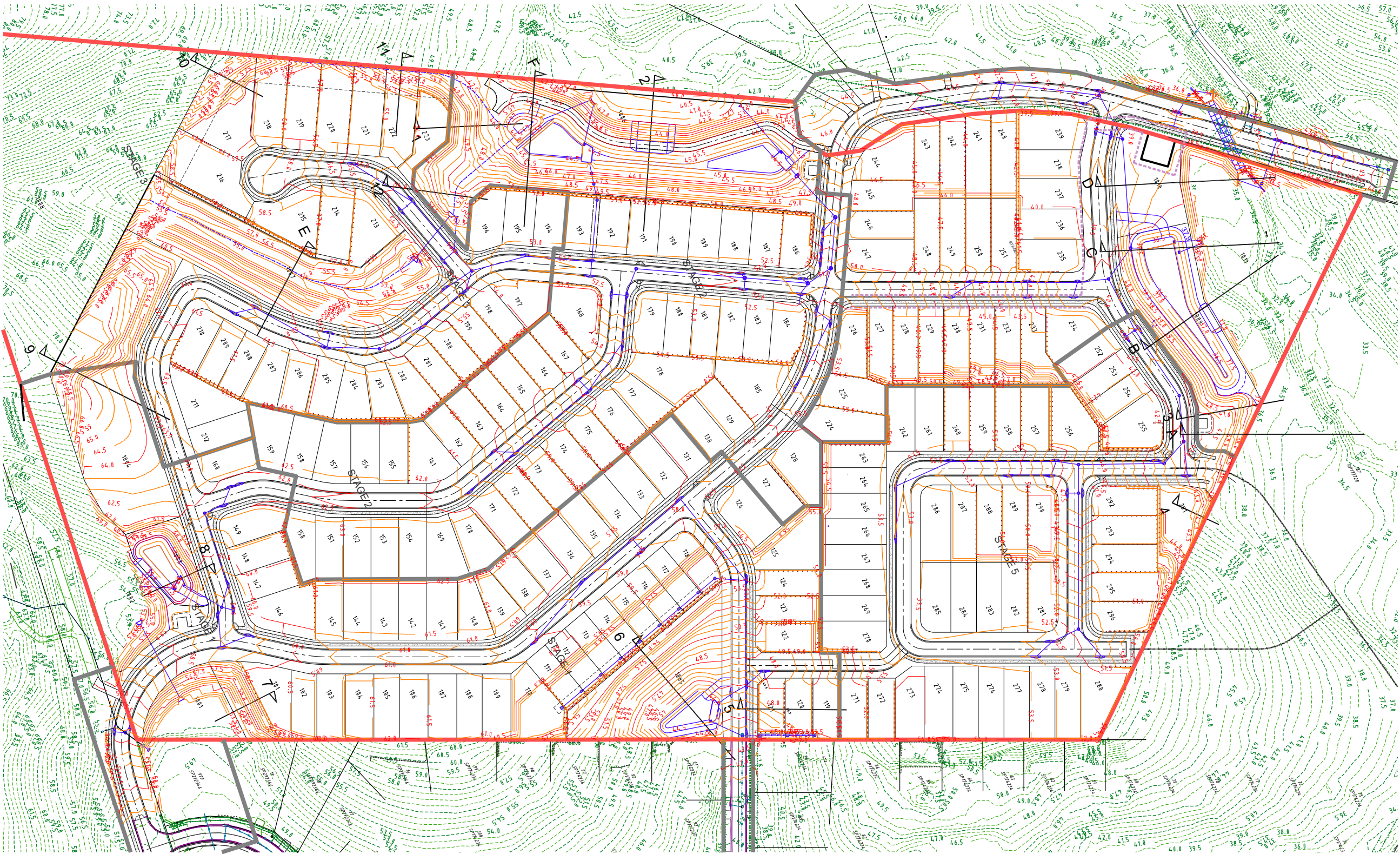
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Local Gov:	GCCC	Prepared By:	HK
Surveyed By:		Approved:	DF
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Plan No:	171101 021 PRO		

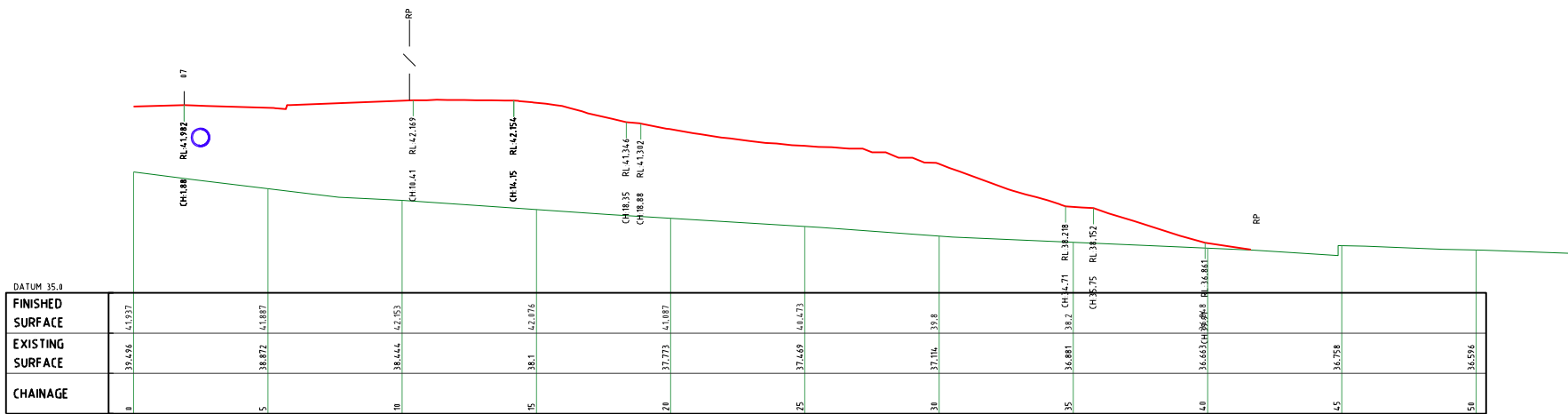
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APPENDIX G

SECTION PLAN AND LONGITUDINAL SECTIONS

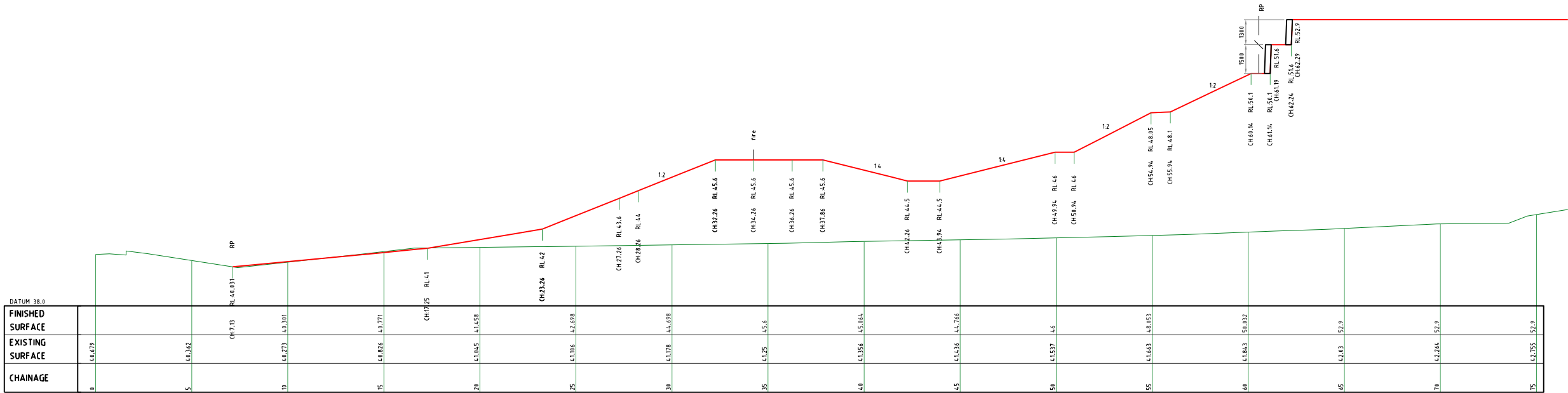
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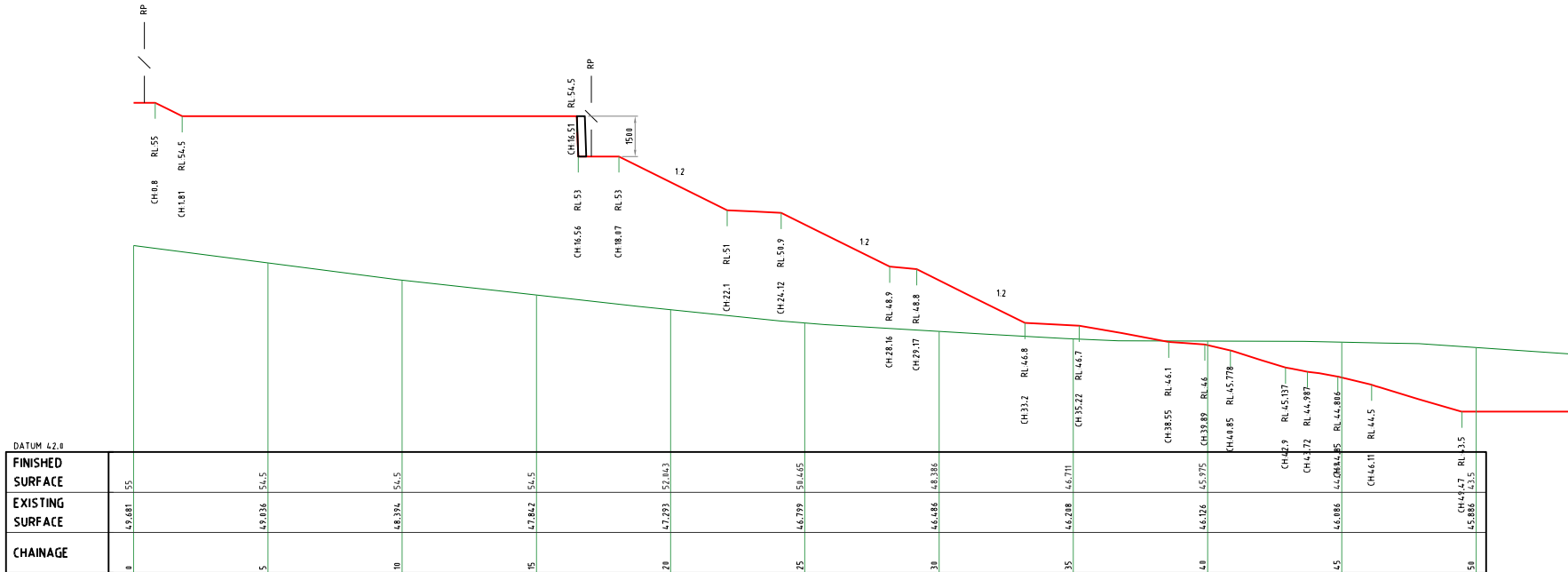
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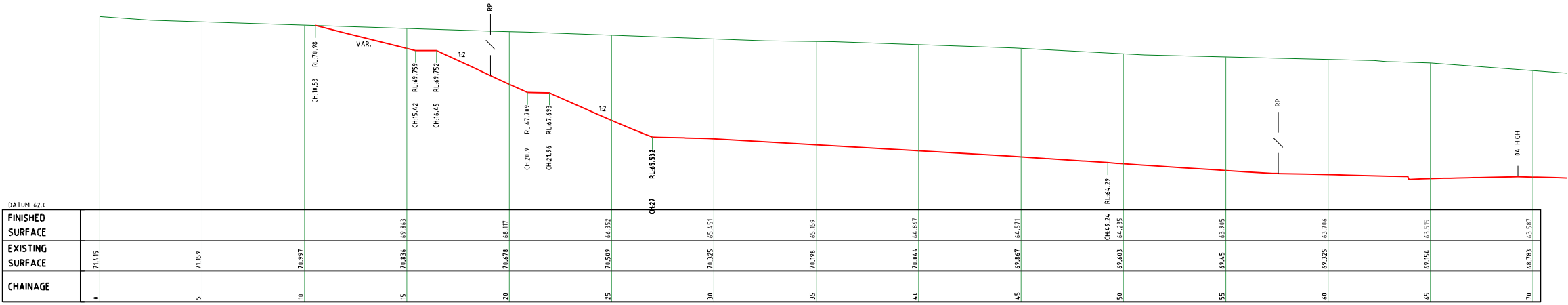
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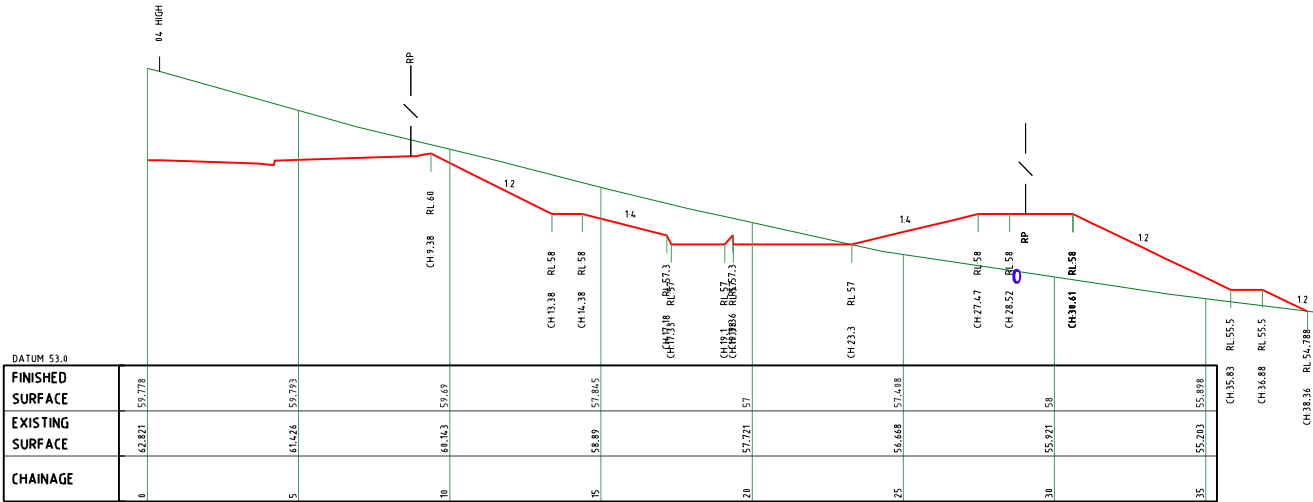


LONGITUDINAL SECTION 1

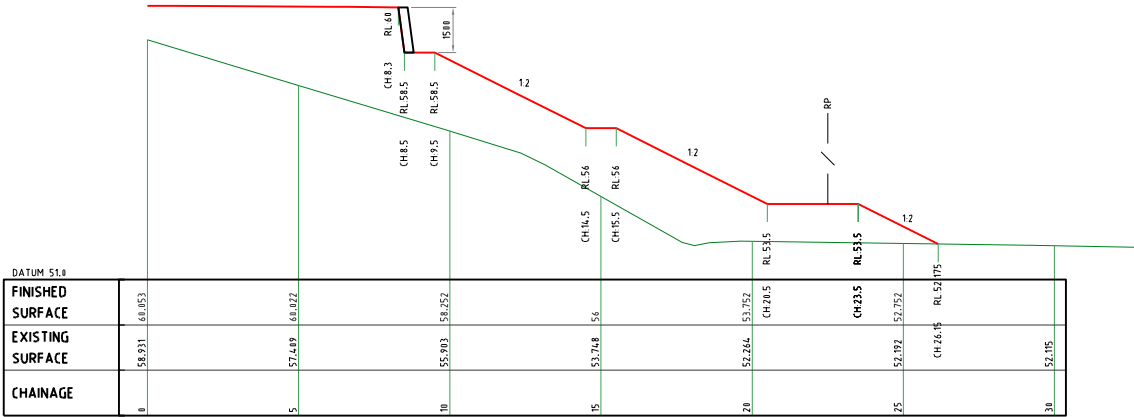
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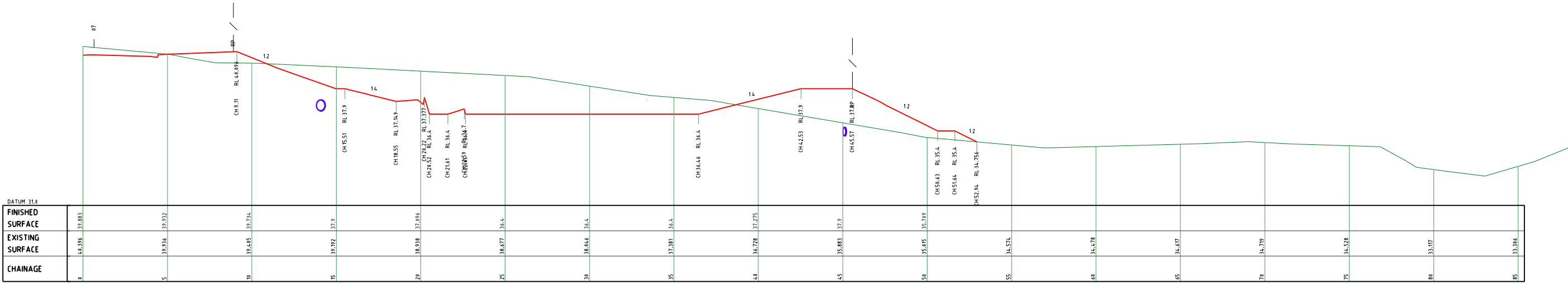
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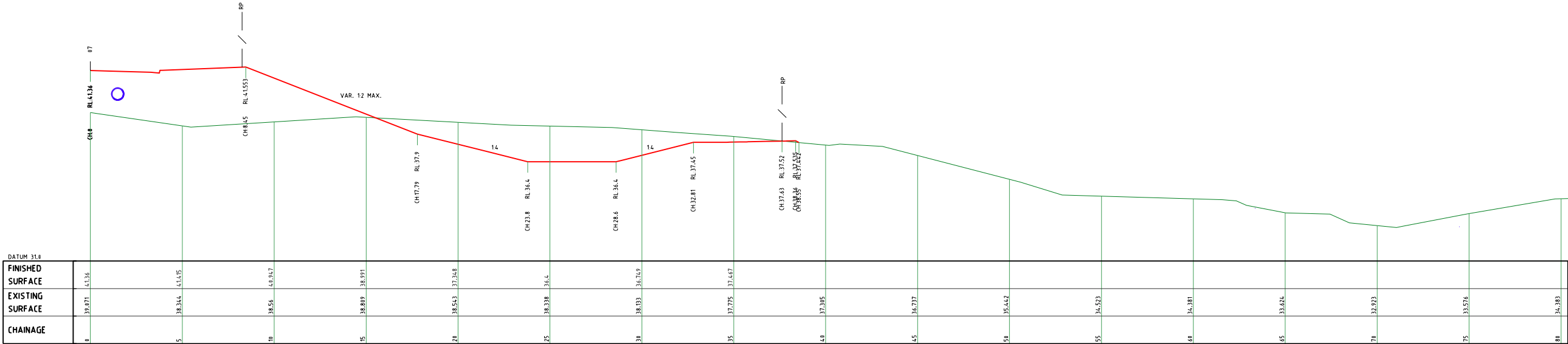
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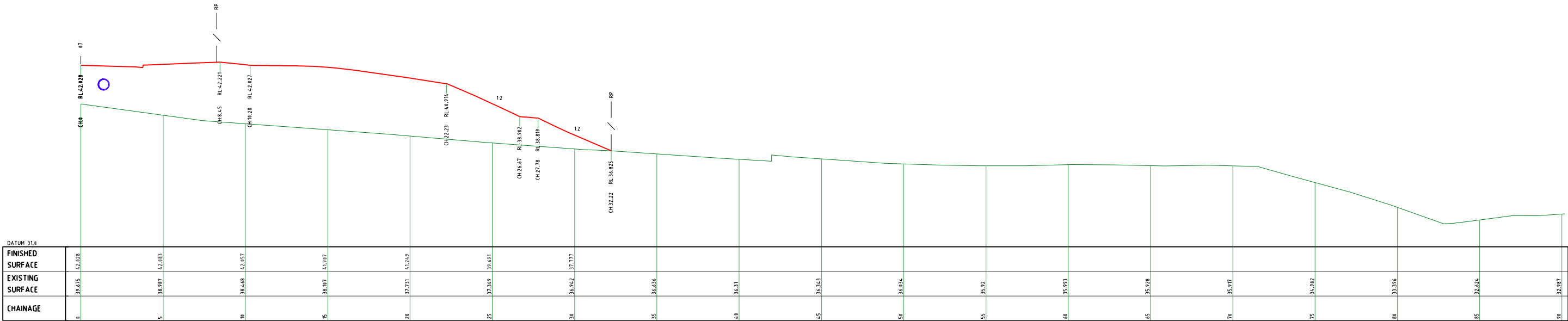
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LONGITUDINAL SECTION C
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LONGITUDINAL SECTION B
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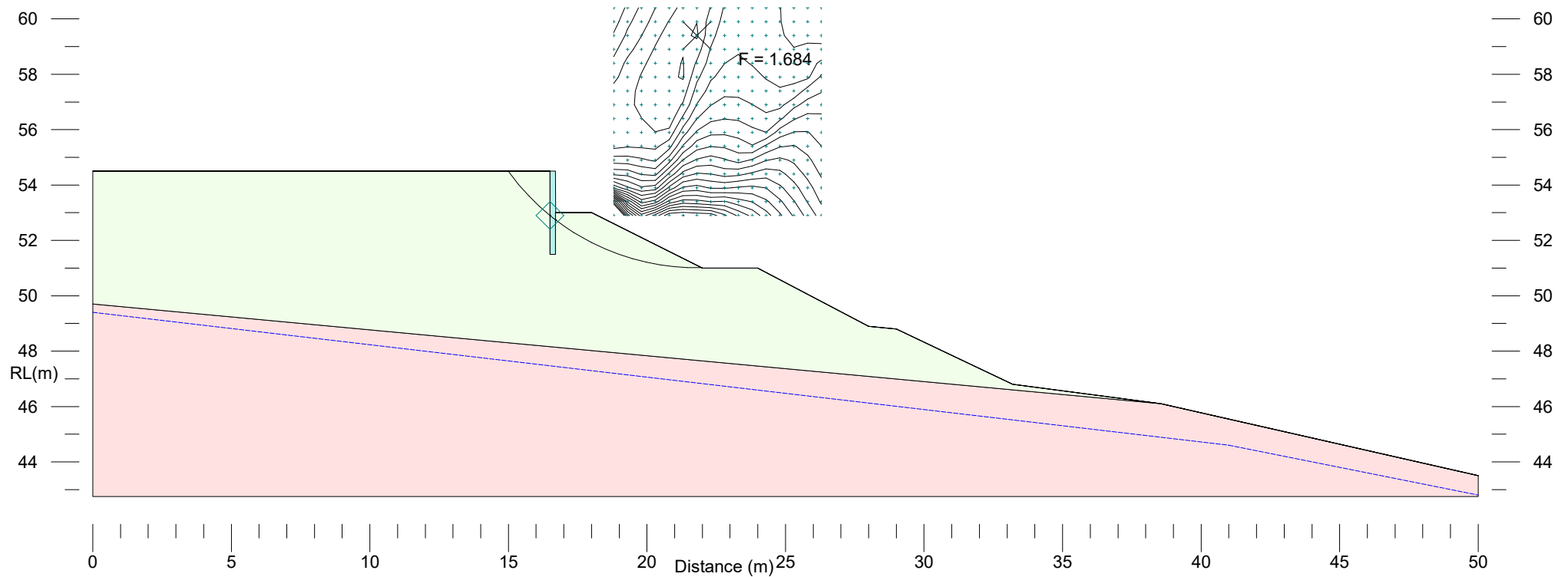
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APPENDIX H

STABILITY OUTPUT PLOTS

	Gamma kN/m ³	C kPa	Phi deg	Piezo Surf.
Retaining Wall	23	15	50	1
Structural Fill	19	3	26	1
Natural Clay	20	5	28	1

Precise Geotechnical Pty Ltd
PG-4116
Courtney Drive, Upper Coomera
10/01/23
Global Stability Analysis
Section 1



	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Retaining Wall	23	15	50	1
Select Fill	19	5	26	1
Structural Fill	19	3	26	1
Natural Clay	20	5	28	1

Precise Geotechnical Pty Ltd
PG-4116
Courtney Drive, Upper Coomera
10/01/23
Global Stability Analysis
Section 2

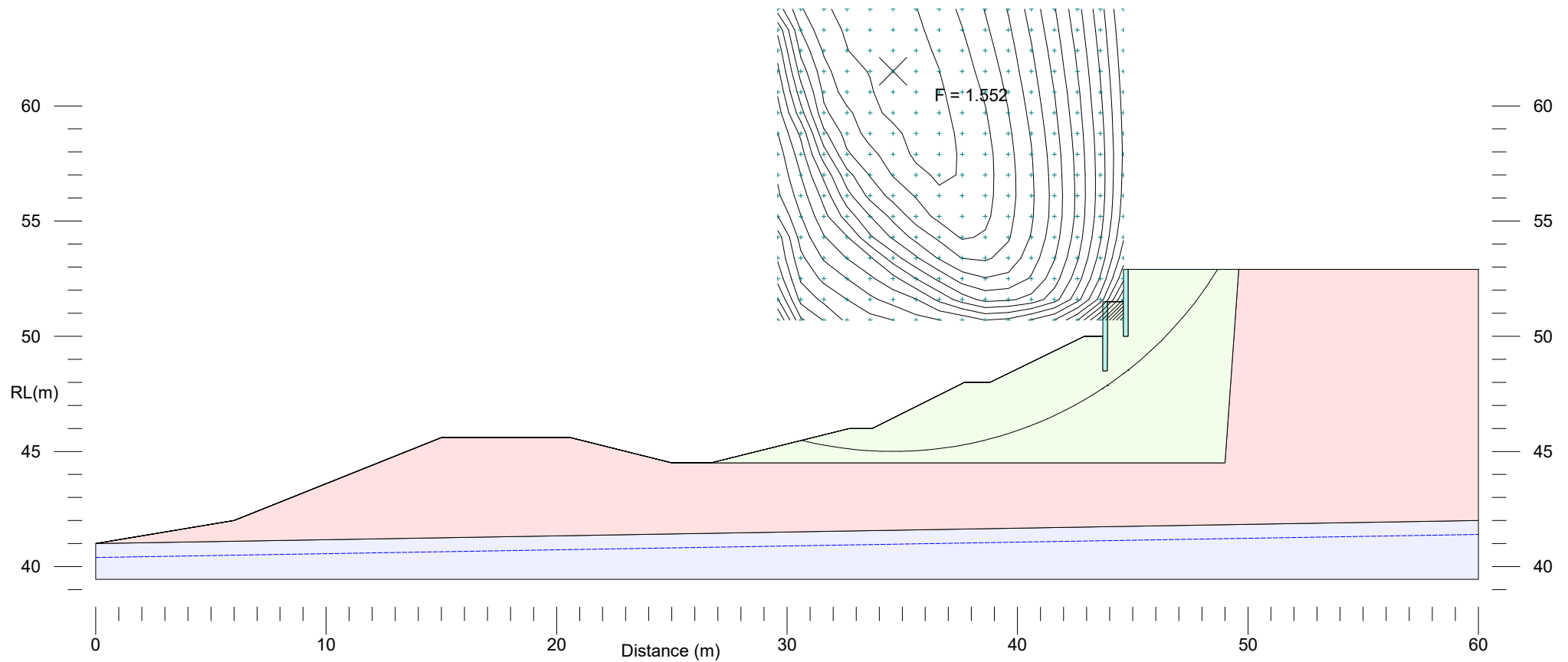


Figure 2

	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Retaining Wall	23	15	50	1
Structural Fill	19	3	26	1
Natural Clay	20	5	28	1

Precise Geotechnical Pty Ltd
PG-4116
Courtney Drive, Upper Coomera
10/01/23
Global Stability Analysis
Section 4

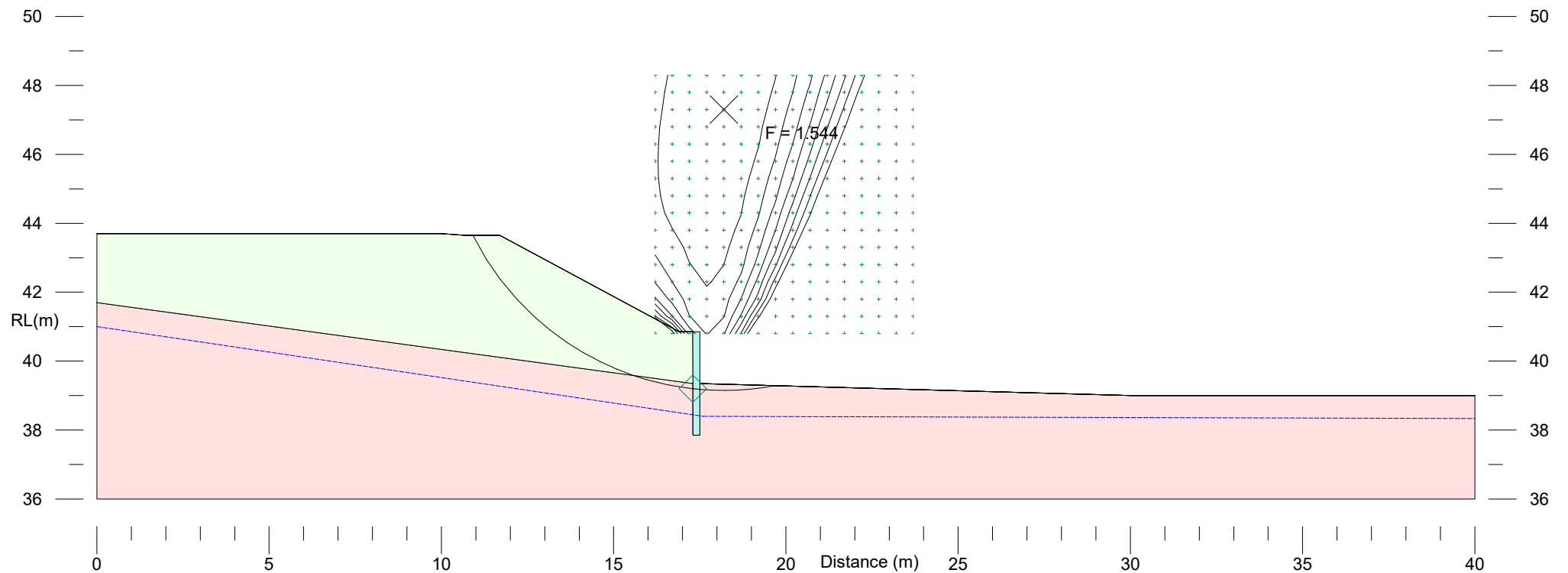


Figure 3

	Gamma kN/m ³	C kPa	Phi deg	Piezo Surf.
Retaining Wall	23	15	50	1
Structural Fill	19	3	26	1
Natural Clay	20	5	28	1

Precise Geotechnical Pty Ltd
PG-4116
Courtney Drive, Upper Coomera
10/01/23
Global Stability Analysis
Section 5

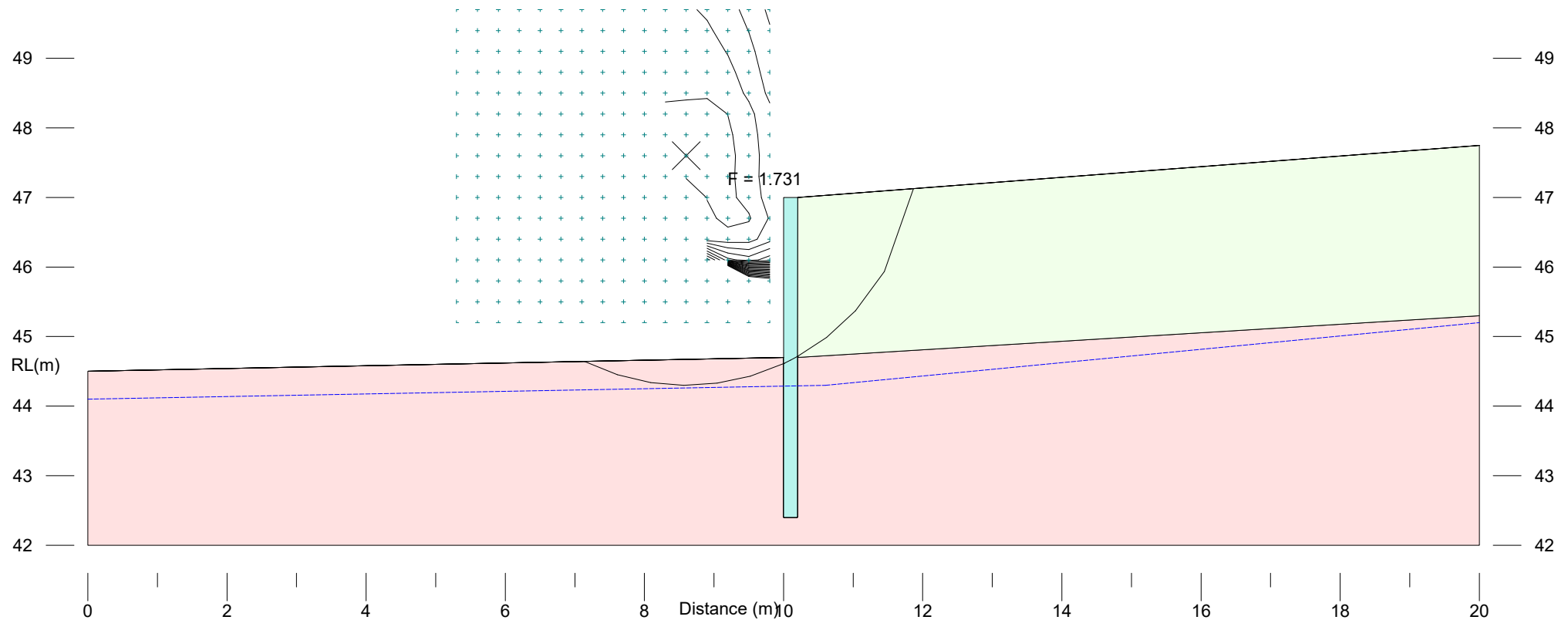


Figure 4

	Gamma kN/m ³	C kPa	Phi deg	Piezo Surf.
Structural Fill	19	3	26	1
Natural Clay	20	5	28	1

Precise Geotechnical Pty Ltd
PG-4116
Courtney Drive, Upper Coomera
10/01/23
Global Stability Analysis
Section 11

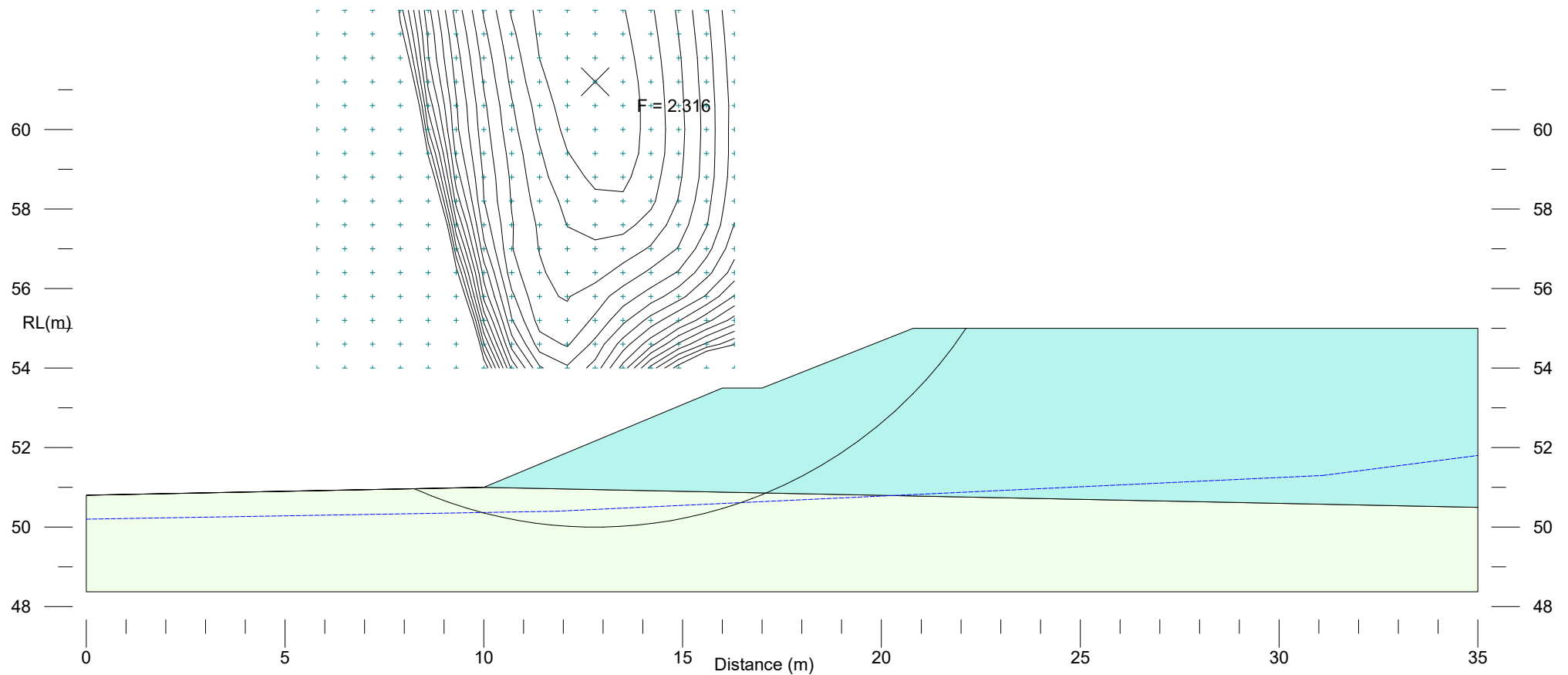


Figure 5

	Gamma kN/m3	C kPa	Phi deg	Piezo Surf.
Structural Fill	19	3	26	1
Natural Clay	20	5	28	1

Precise Geotechnical Pty Ltd
PG-4116
Courtney Drive, Upper Coomera
10/01/23
Global Stability Analysis
Section B

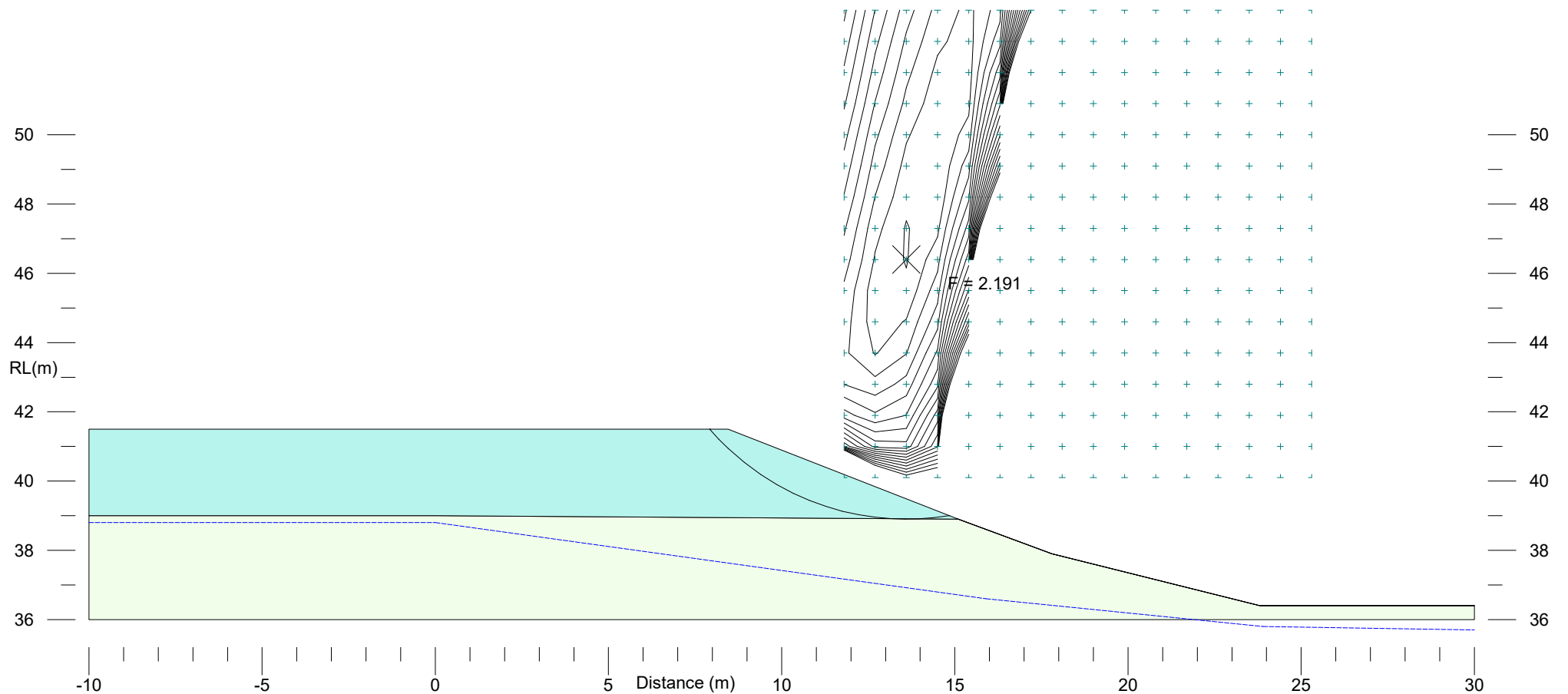


Figure 6