Western Bay of Plenty District Council

Change to the District Plan – First Review

Plan Change 71
Changes to District Plan Map U64, Lynley Park, Omokoroa

Section 32 Report

Prepared by: AECOM Consulting Services (NZ) Ltd

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21 August 2015

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TAURANGA

Dear Andries

Proposed Plan Change 71 to Western Bay of Plenty District Plan for Lynley Park, Omokoroa

1.0 EXECUTIVE SUMMARY

Durham Property Investments Limited (DPIL) is seeking a plan change under the Resource Management Act 1991 (RMA) to the Western Bay of Plenty District Plan (WBOPDP) to remove the Hazard Zoning from those stages of Lynley Park, Omokoroa, now subdivided and under development.

DPIL engaged URS New Zealand Limited (URS) to assist with the plan change during 2014. Since then, URS has recently been bought by AECOM, hence AECOM is acting on behalf of DPIL for the Lynley Park related plan change matters.

Historically, when Lynley Park development first commenced, the whole ridge area and immediate hill-side areas around what is now Holyoake Terrace and Haden Place were all included within the hazard zone, prior to any earthworks commencing. Since then, the ridge has been significantly lowered and the land re-contoured; with residential development now well established. Much of the hazard zoning has been removed through an earlier plan change, recognising how the hazard had been addressed through earthworks and stabilisation measures.

A portion of the Hazard Zone was retained within the WBOPDP on the district plan maps, for the steeper area across the ridge side, located to the south of residential development along Holyoake Terrace, as well as along some of the other areas of Lynley Park, where former steep areas have more recently been stabilised through additional earthworks. Further geotechnical assessments have also been undertaken by Coffey Engineering and by Tonkin & Taylor to advise on stabilisation works and Building Restriction Lines (BRLs) applicable to dwelling locations near the top of hillside areas.

The BRL requirements are on the titles for each property to address the hazard and ensure each allotment has a safe building platform, in accordance with the engineering reports.

The Coffey Engineering report also required a debris fence to be constructed along the ridge-side below the residential area along Holyoake Terrace; and this was completed at the end of 2014. The Coffey report also noted how ongoing maintenance of the slope will be required, as well as a review of the stormwater management for properties along Holyoake Terrace. In this regard, the planting required above the debris wall is now well established and continues to be maintained with replacement planting as required. Stormwater systems for the individual properties have also been maintained by DPIL initially and then by the respective residents as they took ownership of each property. DPIL has continued to keep residents informed about such maintenance requirements.

A meeting was held with Pirirakau on 16 July 2015 to discuss the various plan change aspects; and written confirmation was received from Julie Shepherd on 6 August 2015 to confirm that Pirirakau supported the plan change aspects relating to removing the hazard zoning.

The location of the residential areas where DPIL has requested removal of the Hazard Zoning from the WBOPDP maps is shown on the Plan Change Request Plan 1B in **Attachment A** of this report; now that the earthworks have been completed, geotechnical assessments undertaken, BRLs provided and covenants required on the titles. A section 32 RMA evaluation is also provided in this report.

AECOM

2.0 INTRODUCTION

URS New Zealand Ltd (URS) has recently been bought by AECOM; and is now trading as AECOM Consultancy Services (NZ) Ltd. All previous URS reports relating to Proposed Plan Change 71and contact details for URS now become AECOM reports and contacts respectively. AECOM is acting on behalf of Durham Property Investments Limited (DPIL) for Lynley Park related development matters.

DPIL is seeking a plan change to remove the Hazard Zoning from those stages of development at Lynley Park now subdivided and under development. The proposed plan change also includes amendments to the residential boundaries shown on the planning maps for the Western Bay of Plenty District Plan where more recent survey information has become available in relation to the Rural Residential boundary. The plan change sought by DPIL for Lynley Park is recognised as Proposed Plan Change 71 to the Western Bay of Plenty District Plan.

The Lynley Park residential development is located in Omokoroa, within the Mangawhai Bay catchment of the Tauranga Harbour, within Western Bay. DPIL has been developing the Lynley Park residential subdivision in recent years, since consent was originally granted by the Bay of Plenty Regional Council (BOPRC) in 2001 for earthworks, temporary stormwater discharges and for stormwater infrastructure. Consents were also granted by Western Bay of Plenty District Council (WBOPDC) for subdivision as a staged development.

Historically, when Lynley Park development first commenced, the whole ridge area and immediate hill-side areas around what is now Holyoake Terrace and Haden Place were all included within the hazard zone, prior to any earthworks commencing. Since then, the ridge has been significantly lowered and the land re-contoured. The first stages of residential development commenced after consents were all in place; and then by way of the first plan change requested by DPIL, much of the Hazard Zone was removed from the top ridge area in recognition of this hazard being addressed through earthworks and stabilisation measures.

A portion of the Hazard Zone was retained by WBOPDC on the district plan maps, for the steeper area across the ridge side, located to the south of residential development along Holyoake Terrace, recognised as Stage 1a. This remnant Hazard Zone covered the ridge side below Holyoake Terrace and above a future stage of residential subdivision, known as Stage 3; and straddled land vested in council as reserve, comprising the walkway linking local roads and ridge top reserves for connectivity. Refer to the Plan Change Request Plan 2 in **Attachment A** showing the extent of Stages 1a, 3, 7 and 8 for ease of reference.

The residential subdivision along Holyoake Terrace ridge top now has a Building Restriction Line (BRL) for each allotment to ensure that houses are set back an appropriate safe distance from the steeper ridge side edge (based on the geotechnical assessment undertaken). The BRL requirement is on the titles for each property to address the hazard and ensure each allotment has a safe building platform.

More recently, further geotechnical investigations have been undertaken by both Tonkin & Taylor and also Coffey Engineering, with recommendations for a debris wall/fence to be constructed along the council walkway reserve. The Coffey Engineering report (Lynley Park Residential Subdivision Stage 3, Omokoroa – Slope Stability Assessment, dated 18 November 2014) stated in section 5.5.4:

"*The debris fence is intended to be the main method for reducing the slope instability hazard, such that the existing hazard zone shown on the slope in the district plan maps can be removed. Although there*

may be some instability on the upper part of the slope, the building restriction line in the upper properties and debris fence are considered to mitigate this hazard."

The report also noted how ongoing maintenance of the slope will be required, as well as a review of the stormwater management for properties along Holyoake Terrace. In this regard, the debris wall was completed at the end of 2014, and signed off by Coffey Engineering and WBOPDC. The planting required above the debris wall is now well established and maintained. DPIL has undertaken further advice from the ecologist on appropriate planting species for the upper slopes, including further research on deep rooted tussock/grasses to add to the list of replacement plants for the upper slopes. Replacement planting has been required as part of the ongoing maintenance. Stormwater systems for the individual properties have also been maintained by DPIL initially and then by the respective residents as they took ownership of each property. DPIL has continued to keep residents informed about such maintenance requirements.

There are three other residential areas within Lynley Park where the Hazard Zoning is to be removed, now that the earthworks have been completed, geotechnical assessments undertaken, BRLs provided and covenants required on the titles. These are shown on the Plan Change Request Plan 1B in **Attachment A** of this report.

A meeting was held with Pirirakau on 16 July 2015 to discuss the various plan change aspects; and written confirmation was received from Julie Shepherd on 6 August 2015 to confirm that Pirirakau supported the plan change aspects relating to removing the hazard zoning.

Accordingly DPIL now seek a plan change to the WBOPDC district panning maps as shown on Plan Change Request Plan 1B (in **Attachment A**). This is in accordance with the Coffey Engineering report describing how the debris wall and BRL provisions now mitigate the slope instability hazard; and is titled, "*Lynley Park Residential Subdivision Stage 3, Omokoroa – Slope Stability Assessment*", and dated 18 November 2014. All such supporting details are attached with the Section 32 RMA report, seeking the plan change to provide for the correct alignment for surveyed residential boundaries and removal of the Hazard Zone where BRL, completed earthworks and other mitigation measures are now provided. At the time of preparing the original URS report in 2014, the plan change request was recognised as number 69, and we have since been advised that this is now plan change 71 to the WBOPDC district plan.

3.0 PROPOSED PLAN CHANGES

Durham Property Investments Limited (DPIL) is seeking a Plan Change, pursuant to Section 73(2) and the First Schedule of the Resource Management Act 1991 (RMA or the Act), for their property at Lynley Park, Omokoroa. The provisions of Part 2 of the First Schedule of the RMA apply to this request, in particular Clauses 21(1) and 22 are relevant for the Section 32 RMA evaluation and Fourth Schedule requirements. However, Council may wish to adopt this Proposed Plan Change and the provisions of Part 1 of the First Schedule RMA would apply.

The Plan Change entails the following changes for WBOPDP Planning Map 'Urban U64' as shown in **Attachment A**. These changes are also indicated on the Plan entitled, '*Plan Change Request Plan 1B*', with further supporting details in **Attachment A;** and correspond numerically with the items identified below. The changes involve more accurate boundary locations being adopted for zoning and

hazard zone boundary positions now that much of the subject site has been surveyed for Certificate of Title purposes and Building Restriction Lines have been surveyed. These boundaries are shown more accurately on Plan Change Request Plan 1B and the supporting plans, also in **Attachment A.**

Table 3-1: Plan Change Details

Plan Change Sought	Description/Comments/Reasons
1. Residential Boundary Adjustment (removal of Rural Residential zoning on eastern most boundary Lot 630 LT 475690 It is intended to subdivide this area as Stage 3 Lynley Park in the future; and create new residential allotments, with proposed Lots 352, 353 and 349 being the eastern most lots along the common boundary with the Rural Residential Zone.	Refer to *Plan Change Request Plan 1B* and supporting details in **Attachment A** for details showing correct alignment of the Residential Zone boundary. Refer also to CT details Title Plan LT475690 in **Attachment C** for survey location of property boundaries. <u>Reasons:</u> A previous plan change in 2006 sought to reduce the extent of the Rural Residential Zone based on indicative residential subdivision and proposed re-contouring of the site. More accurate information is now available after re-contouring of the site, including: • Stabilisation works. • Building Restriction Line (BRL) alignment. • Additional Geotechnical details. • Proposed residential subdivision for Stage 3. The boundary of the Residential Zone should be based on such recent and accurate information; thereby reducing the Rural Residential Zone accordingly. Refer to T&T details and Coffey Engineering report in **Attachment B** for geotechnical details.
2. Remove Hazard Zone on Stage 1A and Stage 3 along ridge side based on location of Building Restriction Lines (top and bottom of ridge, including residential land adjacent to the Rural Residential Zone and the stormwater pond designation). A debris wall has been constructed along the side ridge reserve boundary as well.	Refer to T&T details and Coffey Engineering report in **Attachment B**; and Strata Group plan DUR1786-C02-C in **Attachment A** for details showing correct alignment of BRL's and debris wall location. Refer also to CT details Title Plan LT475690 in **Attachment C** for survey location of property boundaries. <u>Reasons:</u> There is now an accurate surveyed BRL both at the top and bottom of the ridge. Refer to Coffey report and details for subsoil drains and the debris wall location. The BRL approach achieves the same community outcome for

Plan Change Sought	Description/Comments/Reasons
	safety sought by the current hazard zoning; however the BRL's are more accurately shown since further geotechnical work has been completed; and the BRL's are based on up to date survey data. This is further enhanced by provision of the debris wall along the side ridge reserve boundary as well. This avoids unnecessary consenting issues where the planning map shows the hazard zoning in the incorrect location.
3. Remove Hazard Zone to south of D191 at the rear of the lots adjoining Lot 301 and fronting Lynley Park Drive between Greystone Place and Mangawhai Place.	Note BRL on plan DUR1786-C02-C in **Attachment A.** Refer also to CT details Title Plan LT475690 **in Attachment C** for survey location of property boundaries. <u>Reasons:</u> The residential lots fronting Lynley Park Drive have been subdivided in recent years and a BRL has been identified to prevent development within the steeper hazard prone areas. This information was provided to Council at the time of subdivision and creation of the lots. The BRL approach achieves the same community outcome for safety sought by the current hazard zoning; however the BRL's are more accurately shown on the survey plans. This avoids unnecessary consenting issues where the planning map shows the hazard zoning in the incorrect location.
4. Remove Hazard Zone to Stage 7 at Mangawhai Place.	Note BRL on plan M1180 Rev S6 Page 2 of 3 in **Attachment A** and also engineering details in in **Attachment B.** Refer also to CT details Title Plan LT475690 **in Attachment C** for survey location of property boundaries. <u>Reasons:</u> Stage 7 has been re-contoured and subdivided for residential development. At the time of creating the residential allotments, details were provided on the location of the BRL being located 7m from the crest of the finished slope. The BRL approach achieves the same community outcome for safety sought by the current hazard zoning; however the BRL's are more accurately shown since further geotechnical work has been completed; and the BRL's are based on up to date survey data. This avoids unnecessary consenting issues where the planning map shows the hazard zoning in the incorrect location.
5. Remove Hazard Zone from eastern most extent of Residential Zone land in Stages 7 and 8; and in the land between Stages 7	Refer to *Plan Change Request Plan 1B* and *Plan 2* in **Attachment A,** as well as to the scheme plans for Stages 7 and 8 (also in **Attachment A**) for details showing the correct

Plan Change Sought	Description/Comments/Reasons
and 8 (Stage 2a) with access from Lynley Park Drive Extension. Amend extent of Significant Ecological Feature U14/143 by moving the boundary beyond BRL to align with the top of the escarpment. This is beyond the domestic yard space, mowed lawns and garden planting.	alignment of the Residential Zone boundary. Refer to engineering details in **Attachment B** and to plan M1180 Rev S6 Page 2 of 3, as well as plan 2364-8 SP01 rev B & C in **Attachment A** for details on BRL alignment. Refer also to CT details Title Plan LT475690 **in Attachment C** for survey location of property boundaries. <u>Reasons:</u> Stage 7 has been re-contoured and subdivided for residential development. At the time of creating the residential allotments, details were provided on the location of the BRL being located 7m from the crest of the finished slope. A similar approach to set backs using the BRLs has also been adopted in Stage 8 as set out in the T & T reports and shown on the scheme plan details. The BRL approach achieves the same community outcome for safety sought by the current hazard zoning; however the BRL's are more accurately shown since further geotechnical work has been completed; and the BRL's are based on up to date survey data. This avoids unnecessary consenting issues where the planning map shows the hazard zoning in the incorrect location. Refer to engineering details in **Attachment B**. The plan change sought is to more accurately fix the position of the Significant Ecological Feature U14/143 boundary in relation to the final contouring of the site. Since the re-contouring of the site and identification of the BRL location (7m from the crest of the slope), the extent of the escarpment is more accurately known. This escarpment has been planted with native vegetation and forms the buffer area for the wetlands at the base of the slope. The Significant Ecological Feature U14/143 overlay should include the steep escarpment but not the flat area which has been re-contoured for residential development. This is generally in the vicinity of the 40m offset line from the "Vegetation Line" used to demarcate MHWS. An Ecological Assessment report is available upon request.

4.0 RESOURCE MANAGEMENT ACT 1991

4.1 Section 32

Before a proposed plan change can be publicly notified the Council is required under section 32 ("s.32") of the Act to carry out an evaluation of alternatives, costs and benefits of the proposed review. With regard to the Council's assessment of the proposed plan change s.32 requires the following:

1. An evaluation report required under this Act must:
    a) Examine the extent to which the objectives of the proposal being evaluated are the most appropriate way to achieve the purpose of this Act.
    b) Examine whether the provisions in the proposal are the most appropriate way to achieve the objectives by:
        (i) identifying other reasonably practicable options for achieving the objectives;
        (ii) assessing the efficiency and effectiveness of the provisions in achieving the objectives;
        (iii) summarising the reasons for deciding on the provisions.
    c) Contain a level of detail that corresponds to the scale and significance of the environmental, economic, social, and cultural effects that are anticipated from the implementation of the proposal.
2. An assessment under subsection (1)(b)(ii) must:
    a) identify and assess the benefits and costs of the environmental, economic, social, and cultural effects that are anticipated from the implementation of the provisions, including the opportunities for:
        (i) economic growth that are anticipated to be provided or reduced;
        (ii) employment that are anticipated to be provided or reduced;
    b) If practicable, quantify the benefits and costs referred to in paragraph (a).
    c) Assess the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions.
3. If the proposal (an amending proposal) will amend a standard, statement, regulation, plan, or change that is already proposed or that already exists (an existing proposal), the examination under subsection (1)(b) must relate to:
    a) The provisions and objectives of the amending proposal.
    b) The objectives of the existing proposal to the extent that those objectives:
        (i) are relevant to the objectives of the amending proposal; and
        (ii) would remain if the amending proposal were to take effect.

4.2 Section 74

Section 74 of the Act sets out the requirements for Council and the matters to be considered for a plan change. In accordance with Section 74(2A) of the Act, Council must take into account any relevant planning document recognised by an iwi authority lodged with Council.

No specific regard has been had to any iwi management plan; however, there has been considerable consultation with representatives of Pirirakau during the development of Lynley Park; and more recently with regards to the plan change seeking to remove the hazard zoning.

5.0 CONSULTATION

The majority of the subject land is owned by Durham Property Investments Limited: therefore no public consultation is required. There has been considerable consultation with tangata whenua in the past to establish the location for the stormwater pond, Pa Site, residential areas and esplanade reserves. The plan change sought is a refinement of the boundaries now that much of the subdivision has been surveyed more accurately. There has been further consultation with Pirirakau during July and August 2015, and Pirirakau have confirmed their support for the plan changes sought to remove the hazard zoning.

The properties impacted by the hazard zoning along the Holyoake Terrace ridge side are now owned by various parties. Many of these property owners are aware of this plan change proposal, as it seeks to remove the resource consent trigger no longer required since implementation of the surveyed BRL. It is anticipated that this plan change request will be approved by these parties.

6.0 Issue 1 - Hazard Zoning, RESIDENTIAL Zoning, and Significant Ecological Feature U14/143 boundaries

The current hazard line as indicated on planning map U64 (in **Attachment A**) does not accurately reflect updated Building Restriction Lines (BRL) as determined through recent geotechnical investigations; and as already indicated on the Title for Stage 1a and 2a. Recent development in Lynley Park for other subdivision stages (both for re-contouring and subdividing of the site) has provided more up to date survey data for the correct alignment of property boundaries; which differ from those shown on planning map U64. The realignment of these property boundaries will have the consequential effect of amending the boundaries relating to the Residential Zone.

Refer to Table 3-1 in Section 3.0 of this report for Plan Change details required.

6.1 Option 1 – Status Quo

Under the Status Quo or 'do-nothing' option, no updates to the identified boundaries would be undertaken.

Table 6-1: Option 1

Advantages	• N/A
Disadvantages	• Hazard area incorrectly overlays a larger proportion of the underlying land. As such, the hazard zoning for development of the land (e.g. for residential/building purposes) is unnecessarily restrictive given that the BRL's mitigate any risk in terms of the instability hazard. • Boundary of the Significant Ecological Feature U14/143 incorrectly encroaches onto residential properties which have been re-contoured for development; i.e. there is no ecological value to be protected and yet resource consent would be triggered for development proposed in this vicinity.
Effectiveness/ Efficiency	• Effectiveness = the hazard zoning for the affected land will remain unnecessarily restrictive. • Efficiency = Taking no action will lead to restrictive resource consents and designation alterations which are time consuming processes incurring unnecessary costs, delays and uncertainty.
Risks of Acting/ Not Acting if there is uncertain or insufficient information about the subject matter	• The risk of not acting is that future development of correctly surveyed properties may still require resource consent where hazard zones are incorrectly shown.

6.2 Option 2 – Remove and realign hazard zoning, amend Residential zoning, and Significant Ecological Feature U14/143 boundaries.

Table 6-2 : Option 2

Advantages	• Removing the hazard zoning where there is a more accurately surveyed BRL has the advantage of achieving the same outcome for community safety, without the risk of unnecessary or restrictive resource consents. This has improved social and economic outcomes through improved development potential of Residential Zoned lots. • Appropriate reduction of extent of hazard area allowing for more permissive development potential given that the BRL's mitigate any risk in terms of the instability hazard. • Increased Residential zoned land.
Disadvantages	• There may be a perception that the Significant Ecological Feature U14/143 extent is being reduced, however, this too is a result of more accurate information being

	available, particularly for the contouring of the land as a result of site preparation for development. The Significant Ecological Feature U14/143 for the wetland area is at the base of the escarpment. The buffer area remains within the Significant Ecological Feature U14/143 extent, with a more accurately identified position for the boundary along the top of this escarpment.
Effectiveness/ Efficiency	• Effectiveness = the realigned boundaries will solve the issue of the Hazard area being unnecessarily restrictive and accurately reflect the BRL as indicated on the Titles (refer **Attachment C**) and as assessed in the reports attached (refer **Attachment B**). • Efficiency = The changes proposed will avoid the time delays, costs and uncertainties associated with any unnecessary resource consents or designation alterations that may be triggered under the current zoning regime. Amending the planning maps to reflect the more accurate surveyed boundaries for zones, designations and reserves is a much more efficient approach under the RMA.
Risks of Acting/ Not Acting if there is uncertain or insufficient information about the subject matter	• The risk of taking no action is to leave potential consenting triggers for future development proposed in those areas where the boundaries are not correctly shown for zoning and hazard overlay.

6.3 Preferred Option

The preferred option is:

Option 2 – Remove and realign hazard zoning, amend Residential zoning, and Significant Ecological Feature U14/143 boundaries.

6.4 Reasons

Option 2 is chosen as the most appropriate option as it will accurately indicate the Building Restriction Lines (BRL) as determined through recent geotechnical investigations. The BRL approach achieves the same community outcome for safety sought by the current hazard zoning; however the BRLs are more accurately shown since further geotechnical work has been completed; and the BRLs are based on up to date survey data. This avoids unnecessary consenting issues where the planning map currently shows the hazard zoning in the incorrect location. There is also the safety benefit afforded by the construction of the debris wall along the ridge side, as described in the Coffey Engineering report (in Attachment B).

The accurate survey details for residential zoning, and Significant Ecological Feature U14/143 should all be included in the updated planning maps to avoid future confusion, errors and unnecessary consenting procedures in the future. This approach is more effective, efficient and appropriate to achieve accurate zoning boundaries using up to date survey data.

More specific detail on the "Reasons" is provided in Table 3-1 above.

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7.0 ENVIRONMENTAL EFFECTS

No further environmental effects are anticipated by the changes sought to correct the boundaries for the zoning, hazard overlay, and Significant Ecological Feature U14/143. Accordingly, no further assessment is required under Schedule 4 of the Act, and Clause 22(2) of Part 2 Schedule 1 of the Act.

On behalf of DPIL, we have provided all the information required to proceed with the plan changes sought by DPIL to remove the Hazard Zone and to make any other consequential changes to the WBOPDC district plan provisions and maps as appropriate in recognition of recent subdivision approvals, completed earthworks and geotechnical assessments for the Lynley Park residential area. Please do not hesitate to contact us if you require any further clarification in this regard.

Yours faithfully

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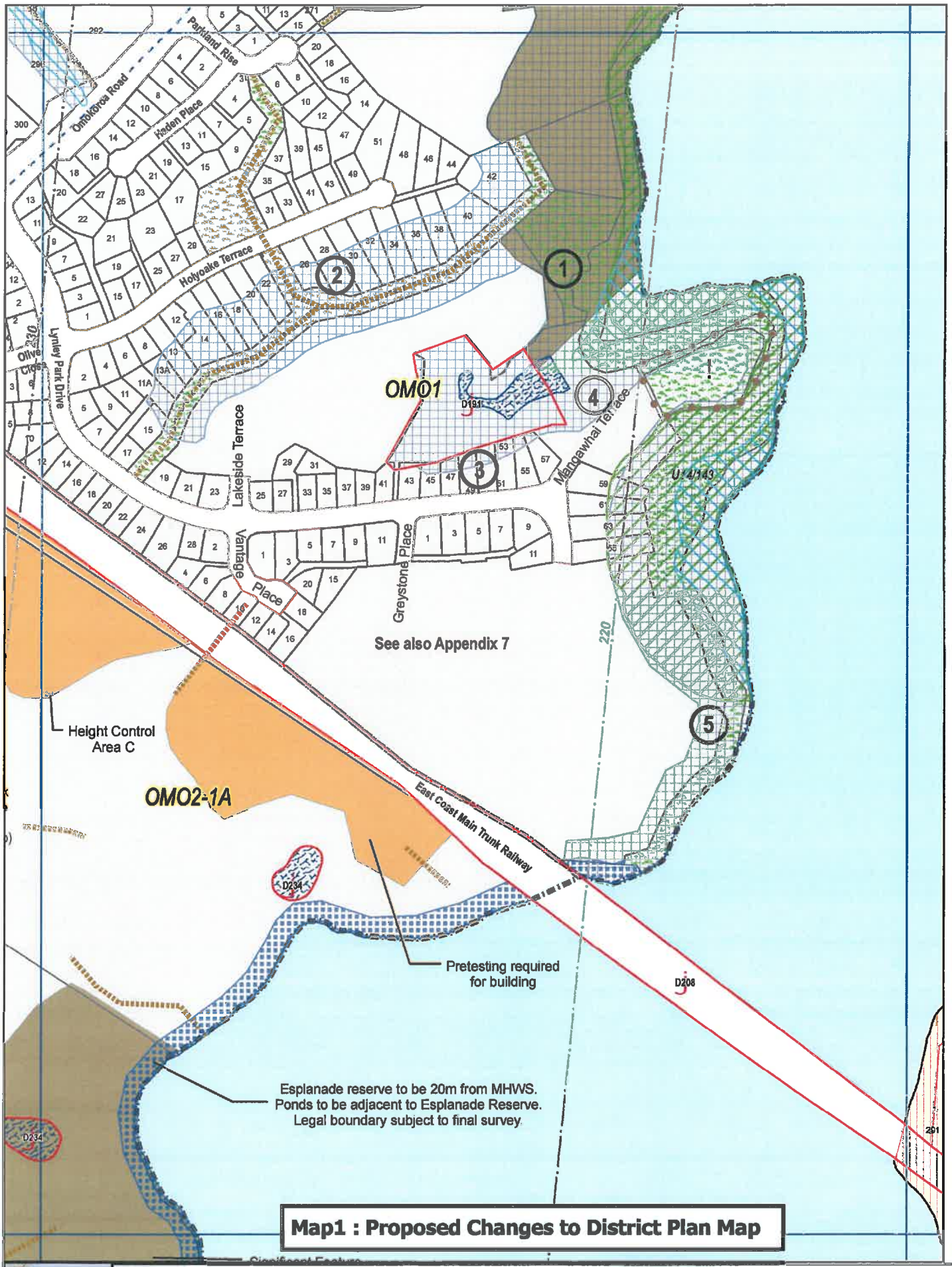
cc: Phillip Palmer, Durham Property Investments Ltd

Attachments:

- Attachment A: Plan Change Request Plans
- Attachment B: Engineering Reports
- Attachment C: Certificate of Title details

AECOM

Attachment A: Plan Change Request Plans



Map1 : Proposed Changes to District Plan Map

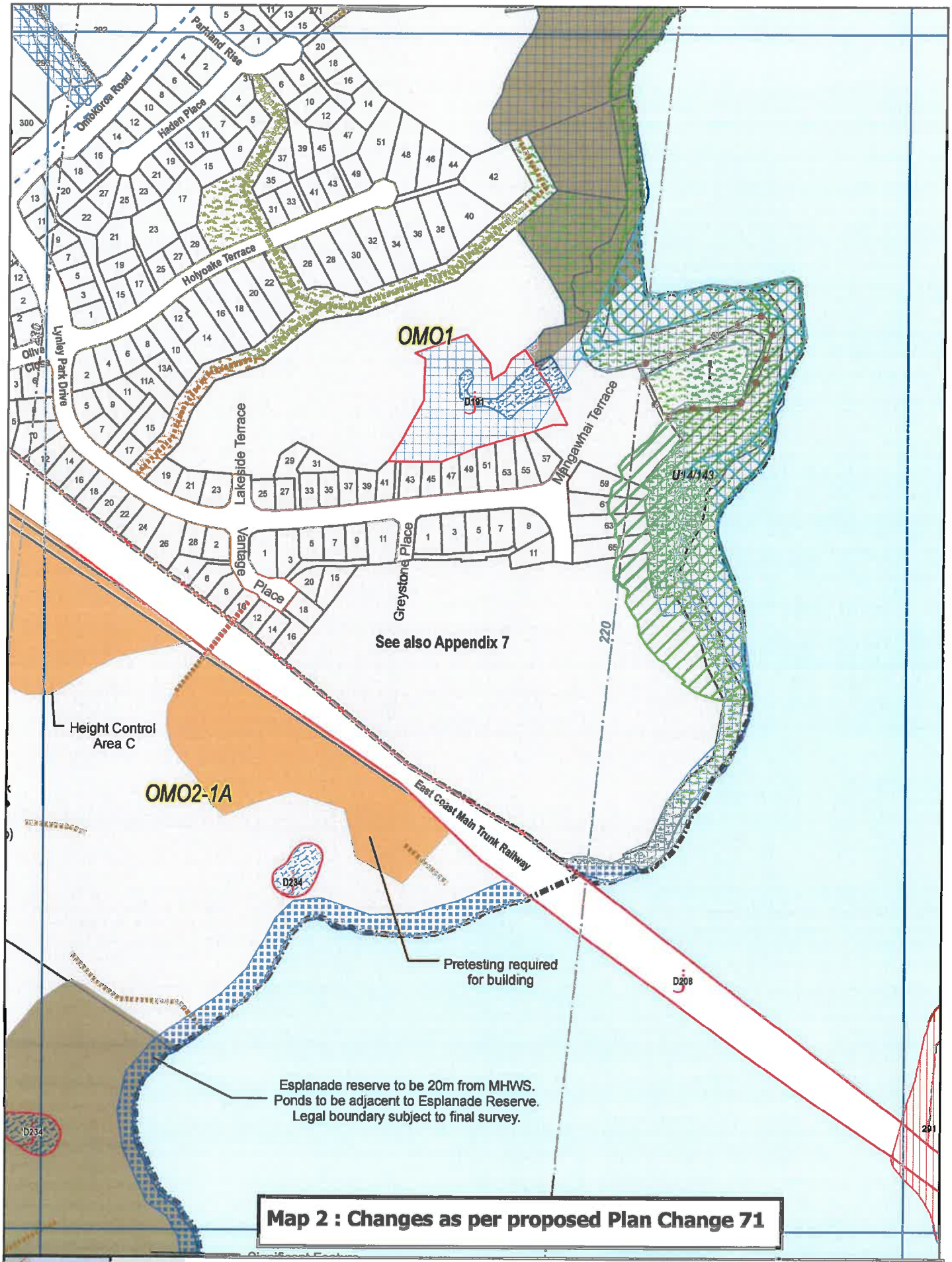
U64 — **Omokoroa**

Scale 1:5000 (A4)

0 50 100 150 200 250m

Western Bay of Plenty District Council

Revision : PC71
16 September 2015



Map 2 : Changes as per proposed Plan Change 71

U64 **Omokoroa**

0 50 100 150 200 250m

Scale 1:5000 (A4)

Western Bay of Plenty District Council

Revision : PC71
16 September 2015

Email: gis@westernbay.govt.nz
Date: 23/09/2015
Operator: mlb
Map: E:\Shape\DistrictPlan\District Plan - Plan Changes-New Format\GIS\PC71 - Map 3.mxd

Scale A4 - 1:1,250

0 5 10 20 30 40 50 60 Meters

Western Bay of Plenty District Council

MAP 3
PROPOSED NEW SIGNIFICANT ECOLOGICAL FEATURE BOUNDARY - PC71

AECOM

Attachment B: Engineering Reports

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coffey.com

18 November 2014

Our ref: GENZTAUC15909AB-AA

Durham Properties Limited
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Attention: Mr P Palmer

Dear Phillip,

RE: Lynley Park Residential Subdivision Stage 3, Omokoroa – Slope Stability Assessment

1. Introduction and Scope of Report

In accordance with your instructions, we are pleased to confirm that we have now completed our stability assessment for the section of slope in the north-west portion of Lynley Park subdivision Stage 3.

The scope of this report is specifically limited to the development of a geological model for the subject slope to enable an assessment of its stability to be made, and if required, provide advice on appropriate measures to reduce the risk of slope instability affecting the future proposed lots across the lower portion of the slope in proposed Stage 3.

This report has been completed in general accordance with the agreed Coffey services proposal dated 20 June 2014. It supersedes our previous report dated 30 September 2014, with some minor revisions to Section 5.5.4 having been incorporated in this version.

This report is intended to accompany previous geotechnical reports that address other geotechnical issues in support of Resource Consent and Building Consent applications for the development of Stage 3 of the Lynley Park subdivision.

2. Site Description

The subject site encompasses the section of slope forming the south-eastern flank of the prominent ridge line that contains Holyoake Terrace in Stage 1A of the Lynley Park subdivision, and grades down into proposed Stage 3, located to the north of Lynley Park Drive in Omokoroa.

The pre-development slope profile had an overall slope gradient of around 20 to 25 degrees, with parts of the upper slope being significantly steeper, representing areas of previous instability. The geomorphology indicated that several historic shallow slips had occurred on the slope in the past.

Filling has been placed on the slope as part of the Stage 1A earthworks, which has created a more uniform profile along the slope, suppressing the slip features. The bulk of the filling has been placed on the lower part of the slope, where a 3 metre wide access track was formed within the 20 metre wide Council reserve that is present between Stage 1A and Stage 3. The overall slope profile is now generally around 18 degrees, with the lower parts of the slope (within Stage 3) being around 11 degrees.

Several counterfort (buttress) drains have been installed in the upper part of the slope as part of Stage 1A works to control groundwater below critical levels and reduce water pressures, and the upper part of the slope has been planted with native shrubs to help reduce shallow seated instability. The access track in the reserve and the lower portions of the slope in Stage 3 are currently grass covered.

Stage 1A is now essentially fully developed and dwellings have been built on most of the lots at the ridge crest. It is understood that stormwater from these developments are connected to the piped reticulated system. Several shallow slips have occurred on the upper portion of the slope, some of which appear to have been caused at least partially by poor management of stormwater, others by placement of filling and natural causes.

3. Related Reports

3.1. List of Reports

Various geotechnical reports have previously been prepared on the Lynley Park residential subdivision, as follows:

1. *Preliminary Geotechnical Investigation Report on Lynley Park Residential Subdivision* by Foundation Engineering Consultants Limited (FEL) dated 19 May 1999, reference 8425.
2. *Supplementary Geotechnical Investigation Report on Lynley Park Residential Subdivision Stage 1* by FEL dated 15 April 2002, reference 8425.
3. *Stage 1, Lynley Park Omokoroa – Geotechnical Issues Report* by Tonkin and Taylor Limited (T&T) dated March 2004, reference 60619.
4. *Lynley Park, Omokoroa, Tauranga – Stage II Geotechnical Assessment Report* by T&T dated December 2004, reference 60619.
5. *Lynley Park Subdivision, Omokoroa – Stage 1a – Geotechnical Completion Report* by T&T dated February 2006, reference 60619.
6. *Lynley Park Buttress Drain Design* letter report by T&T dated 12 April 2006, reference 60619.
7. *Lynley Park Hazard Zones* letter report by T&T dated 4 August 2006, reference 850895.300.
8. *Stage 3, Lynley Park – Building Restriction Line* letter report by T&T dated 8 November 2010.
9. *Lynley Park, Stage 3 – Building Restriction Line* letter report by T&T dated 26 March 2014, reference 850895.400.
10. *Lynley Park, Stage 3 – Building Restriction Line, Revision 1* letter report by T&T dated 17 April 2014, reference 850895.400.

A limited number of ground investigations have been undertaken on the subject slope, including seven test pits (TP01 to TP06 inclusive and TP08) and four window sample boreholes (WS1 to WS4 inclusive). Extensive CPT testing, machine boreholes and test pits have been completed on the ridge top above the slope, and some data is also available within the Stage 3 area below the slope (presented in report 4 referenced above for what was previously called Stage II).

3.2. Report Findings

The findings and recommendations of the existing reports have been reviewed during preparation of this report. The salient findings or comments from each of the existing reports with reference to the stability of the slope are as follows:

1. "... on the ridge sidling slopes there is evidence of shallow soil creep (...) Historic shallow seated slump features were also identified. (...) The areas of instability identified on the ridge and gully sidling slopes and the coastal cliff areas can be readily remediated by a combination of earthworks, drainage reticulation, subsoil drainage and building restriction lines and should present no significant problems with respect to land development."
2. "It is apparent that the larger scale instability on the northern and eastern sides of the main ridge are controlled by the very soft sensitive clay substrate encountered beyond approximately 5 metres depth. This layer is very weak and appears to be prone to initiating instability especially under highly saturated ground conditions. Where it is established that only marginal factors of safety exist following the bulk earthworks, retaining walls and/or the incorporation of subsoil drainage will be needed to establish long term factors of safety..."
3. "...the occurrence of slope failures is also likely to be related to increased pore water pressures developed within the overlying coarse grained tephra and channelled by the paleotopography, causing a 'blow-out' within the slope face. (...) (Slope analysis) results indicate that under existing subsurface conditions (...) slopes have an adequate factor of safety (FOS) against failure which improve post-earthworks. Results also show that under elevated pore water pressure conditions the FOS for the south-eastern slope reduces significantly and is below the FOS of 1.2 required. In considering these results the main criteria for preventing failure within the upper section of ash would be to ensure the Pahoia Ash is adequately drained."
4. "The stability analysis results confirm the judgement that there is a reasonable possibility for land slippage to occur within upper parts of the ridge flank between Stages I and II areas. (...) The following options for mitigation measures can be considered:
   - Stabilise the slope. This is not considered practical;
   - Specify that a debris interception system is installed along the upslope boundary of potentially at-risk properties. Not considered desirable or particularly practical;
   - Increase the size of the proposed public footpath along the lower-middle part of this slope to make it into a fully detailed accumulation bench. This would assist in the control of stormwater runoff from the slope into the properties, and so has merit. Unlikely to be sufficient for all of the properties;
   - Specify a BRL [building restriction line] for each at-risk property;
   - Adjust the lot boundaries to increase the setback distance to the slope. (...)

   The best practical approach appears to be a combination of increasing the size of the public footpath (Option C) and a BRL for any remaining "at risk" lot."

5. "In order to minimise the affects [sic] of instability or the potential for it to occur the pore water pressures within the Pahoia Ash will need to be controlled and minimised to reduce the risk of instability. This has been undertaken by buttress drains cut into the subsoil in the upper part of the slope..."

   "Landscape fill has been placed along the south-eastern face of the main ridge (...). This fill has been placed to achieve three purposes;

   - To form a track within the reserve area
   - To provide buttressing to lower areas of the main slopes
   - To provide a debris catch bench below the upper slopes of the ridge (...)

   There is expected to be a moderate risk of shallow slumping in the fill above the track where the slopes are relatively steep. This would be likely to happen in periods of high rainfall. We would expect that debris from this slumping would be mostly trapped by the formed track and would not present a significant risk lower on the slope. We expect that the relatively flat slopes of the landscape fill below the track location will mean the risk of significant failure is low. Any slumping would be expected to be surficial with little or no run-out. This fill is not expected to provide additional risk to building platforms identified for lots. However, consideration should be taken of this fill when constructing any structures across the BRL." (Note this is the GCR for Stage 1a, so last two sentences are inferred to be referring to the building platforms and BRL in Stage 1a).

6. "The design analysis for the building restriction line on these lots [Lots 30-54 in Stage 1a] did not allow for the effect of the buttress drains on groundwater levels."
7. Report discusses the existing hazard zones and the works undertaken to mitigate hazards. The proposed building restrictions lines are used to justify revising the hazard zone "to exclude areas where land stability risk has been mitigated by the use of building restriction lines".
8. "The BRL running through the western Stage 3 lots was defined in [reference 4]. It was positioned due to the risk of the lots being inundated with landslip debris. In its current state, buildings constructed upslope of the line in Stage 3 would be considered at risk of inundation by slope debris, below the line they would not. (...) The position of the BRL shown in our December 2004 report was provisional and dependent on the final form of earthworks, exposed ground conditions and any mitigation measures constructed." The report presents a preliminary bund design incorporating a timber pole wall, which would allow the position of the BRL to be adjusted.
9. This report is similar to reference 8, but discusses stability analyses which did not achieve satisfactory FOS under either normal, elevated and seismic conditions, although no results are appended. In addition to the retaining wall/bund option from reference 8, a preliminary earth bund design is presented.
10. This report is nearly identical to reference 9, with the addition of an alternative option which comprises a lower bund with a trench/ditch upslope, and the requirement for drainage measures to be installed upslope of the debris catch structures.

Overall, the position of the proposed building restriction line (BRL) has not changed since the report reference 4, even though the report specifically states: "it is important to appreciate that the BRL shown on Figure 2 are provisional, as the final position will depend on factors such as (1) the amount of earthworks undertaken, (2) the exposed ground conditions, and (3) whether specific slope stabilisation measures are used to increase the FOS of the slope.".

Although this is referred to in reference 8, the location of the BRL was not reassessed after the earthworks, even though this included excavations at the top of the slope, placement of filling on the slope, and the installation of subsoil drains. The stability analyses discussed in references 9 and 10 resulted in unsatisfactory FOS for all three scenarios (normal, elevated and seismic). This would suggest that the earthworks and drainage measures have reduced the stability of the slope, since the original stability analysis discussed in reference 3 did achieve satisfactory results under normal conditions, and predicted the FOS to improve post-earthworks.

4. Ground Model

4.1. Regional Geology

The site is located on the eastern side of the Omokoroa Peninsula, which is one of the terraces located within the Tauranga basin, a Pleistocene, predominantly fluvial/estuarine basin partially infilled with terrestrial and estuarine volcaniclastic sediments and non-welded or partially welded distal ignimbrites and airfall tephras[1].

The most recent geological map[2] indicates that the site is underlain by a relatively small area of the Waiteariki Formation, a welded ignimbrite, which is consistent with the observations made by FEL (reference 1) in exposures around the coastal fringes of the site. The remainder of Omokoroa Peninsula comprises more recent Tauranga Group alluvium, which includes the Matua Subgroup.

The sensitive Pahoia Tephra and more recent volcanic ashes including the Hamilton Ash, Rotoehu Ash and youngest 'post-Rotoehu' ashes generally overly these older geological units.

4.2. Site Investigations

Site investigations were undertaken as part of the previous geotechnical assessments of the site by FEL and T&T. Additional site investigations have recently been completed by Coffey to improve the level of detail in the geological model for the slope taking the Stage 1a earthworks into account, and to assess the quality of the landscape filling. Our recent investigations included the following:

- Site walkover by an Engineering Geologist; and,
- Fourteen hand auger boreholes (HA01 to HA14 inclusive) up to 4.5m depth with shear vane strength testing at regular depth intervals.

Test locations of the previous investigations (only those used directly in developing the ground model described herein) and the recent investigations are shown on the appended Site Plan (Figure No. 1). Representative site profiles were generated from the investigation results and topographical data supplied by CKL Surveys Limited (CKL), as presented on appended cross-sections A to E (Figure No.'s 2 to 4).

Results of all relevant insitu soil tests and investigation summary logs are also attached.

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[1] Briggs et al. 1996: *Geology of the Tauranga Area*. Department of Earth Sciences, University of Waikato Sheet U14 1:50 000 geological map.

[2] Leonard, G.S.; Begg, J.G.; Wilson, C.J.N. (compilers) 2010: Geology of the Rotorua area. Institute of Geological & Nuclear Sciences 1:250 000 geological map 5. 1 sheet + 102 p. Lower Hutt, New Zealand. GNS Science.

4.3. Investigation Findings

The materials encountered at the site are generally consistent with the general geology described in Section 4.1 above.

The results of the site investigations are summarised as follows:

- Clayey organic silt fill was encountered at all hand auger borehole locations, inferred to be the recently placed landscape fill, comprising mostly of topsoil. Measured undrained shear strengths in this material ranged from 35 kPa to greater than 210 kPa (the upper limit on the direct reading scale of our shear vane), the average value being approximately 115 kPa.
- In boreholes HA02 and HA12 clean (inorganic) fill and/or colluvium was encountered below the landscape fill, with measured undrained shear strengths ranging from 95 kPa to greater than 200 kPa, the average value being 135 kPa.
- In boreholes HA05, HA07, HA09 the landscape fill was underlain by an organic silt, which was inferred to be buried topsoil. Measured undrained shear strengths in this material ranged from 45 kPa to 135 kPa, average value being 90 kPa.
- Borehole HA13 encountered fill, underlain by coarse angular gravel from 2.7metres depth. Considering the location of the borehole and the materials encountered, this is inferred to be the backfill of one of the buttress drains.
- In all boreholes (except HA06 and HA13) the surficial materials were underlain by a dark brown clayey organic silt, inferred to be a paleosol. The depth to the top of the paleosol varied between 0.6 metres (in HA01) to 3 metres depth (in HA02 and HA05), and the thickness of the paleosol layer varied between 0.2 metres (in HA12) to 1.1 metres (HA09). Measured undrained shear strengths of the paleosol layer ranged from 70 kPa to greater than 200 kPa, the average value being 110 kPa.
- The paleosol forms the top of the Matua Subgroup deposits, which comprised clayey to sandy silt with measured undrained shear strengths of between 45 kPa and greater than 200 kPa, average 130 kPa.
- The recent site investigations correspond well with the previous site investigation data from FEL and T&T, although the coarse grained tephra that they encountered above the paleosol was not encountered during the recent investigations, possibly due to this layer and some of the original paleosol layer having been removed or disturbed as part of the recent earthworks to place the landscape filling.
- Groundwater was not encountered in the recent site investigations. In the previous site investigations groundwater was only encountered in MH1 (at 11.2 metres depth), MH3 (9.9 metres depth) and MH5 (9.6 metres depth). The groundwater level was not recorded in the CPT tests.

5. Stability Assessment

5.1. Existing Stability

5.1.1. Failure Mechanism

There is evidence on site of both recent and historic instability having occurred on the subject slope.

Based on our knowledge of the local soils and comments given in the previous reports, slope instability generally occurs along the coarse-grained volcanic ash on top of the Matua Subgroup deposits, and overlying Pahoia Ash. Slope failure is often related to elevated groundwater pressures, either due to natural or man-made causes.

5.1.2. Historic Instability

The geomorphological assessment undertaken by FEL and T&T of the original ridge slope (references 1 and 3) identified two major scarps and two less distinct scarps, along with active soil creep along the upper parts of the slope and some tension cracks.

Previous instability is also evident from the presence of colluvium on the slope. The colluvium typically comprises disturbed volcanic ashes.

5.1.3. Recent Instability

Several shallow (typically 1 metre deep) slips have occurred in Stage 1a on the upper part of the subject slope in recent years, mainly in the eastern part of the slope. The recent slips were relatively shallow, comprising mostly topsoil and vegetation. The influence of groundwater was apparent from the fluidised nature of the slip materials, and consequently the relatively long run-out distance.

In 2008, a landslip occurred on the boundary between Lots 35 and 36.

In 2011, two landslips occurred below Lots 30 and 31, near or beyond the boundary with Stage 4 at the end of the ridge. It is understood that this slip was caused by a combination of uncontrolled filling and mis-management of stormwater flows.

5.2. Stability Analyses

An assessment of slope stability was conducted using the proprietary software package Slide[3] based on the ground model developed above.

The soil parameters used were based on the results of the site investigations and experience with the local soils. A sensitivity analysis was undertaken to assess the influence of the different soil parameters, and conservative values were chosen where the stability was sensitive to a particular parameter.

Although subsoil drains and vegetation have been put in place on the upper part of the slope, the effects of these measures is difficult to quantify in the numerical analyses. These measures have therefore been excluded from the analyses, but will be considered in the overall slope stability assessment.

The degree of stability of a slope can be expressed as the factor of safety (FoS), which is the ratio of the forces resisting failure to the driving forces causing instability. Theoretical failure of a slope occurs when the FoS is less than 1.0. For permanent slopes, minimum FoS values greater than or equal to 1.0 are typically required such that the risks of slope instability are acceptable. The FoS was analysed for three scenarios as listed in Table 1 below; also shown are the typical minimum FoS values considered to be appropriate for engineered slopes.

Table 1: Typical Required Minimum Factors of Safety for Global Stability

Design scenario	Factor of safety
Prevailing	1.5
Elevated	1.2
Seismic (ULS)	1.0

For the seismic analysis, a horizontal ground acceleration of 0.11g was applied. This pseudo-static coefficient was calculated by taking half[4] of the design peak ground acceleration assessed using NZS1170.5:2004[5] for a 1 in 500 year earthquake (equivalent to an Ultimate Limit State earthquake for an Importance Level 2 structure).

It should be noted that the seismic scenario is calculated using a pseudo-static analysis, and may therefore not be representative of the actual behaviour of the slope during an earthquake.

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[3] Rocscience Inc. 1998 - 2013: *Slide 6.0* (Version 6.025)

[4] Hynes-Griffin, M.E. and Franklin, A.G. (1984). Rationalizing the seismic coefficient method, Miscellaneous Paper GL-84-13, U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi, 21 pp.

[5] New Zealand Standards 2004. NZS1170.5:2004 Structural design actions - Part 5: Earthquake actions - New Zealand.

5.3. Analysis Results

The results of the analyses are appended and are summarised below in Table 2.

Table 2: Assessed Minimum Factors of Safety

Design Scenario	Cross Section B-B	Cross Section E-E
Prevailing	1.33	1.10
Elevated	1.13	0.91
Seismic	0.98	0.84

The analyses indicate that the upper parts of the slope are marginally stable, especially under elevated groundwater conditions. This result is not unexpected considering the historical and recent instability (refer Sections 5.1.2 and 5.1.3).

The seismic analysis indicates that the slope may become unstable as a result of strong earthquake shaking.

5.4. Discussion on Analysis Results

Although the analyses indicate that the factors of safety of the slope are below acceptable minimum values, the failure surfaces that do not achieve the required minimum values are all located on the upper, steeper part of the slope, while for the lower part of the slope (i.e. below the access track) factors of safety appear to be generally satisfactory.

In the current situation, the lots below the slope would be considered to be at risk of inundation from a debris slide originating at the upper part of the slope. This is generally consistent with the observed failures and findings from previous reports.

Mitigation measures will therefore be required which focus on improving the stability of the upper part of the slope.

5.5. Remedial Measures

5.5.1. General

In general, methods for mitigating the impact of a debris slide on development downslope can be categorised as follows:

- Methods that reduce the potential for a debris slide occurring
- Methods that manage the debris slide after it has occurred

Implementation of methods that reduce the potential for the debris slide occurring are the preferred option to implement. Put simply, it is "good practice" to eliminate a hazard rather than manage the consequence of the hazard. Generally, these methods also involve limited maintenance.

5.5.2. Reducing Likelihood of Hazard

Methods to reduce the potential for the debris slide occurring include:

- Stormwater Management – This requires management of runoff, overland flow and stormwater discharges from the properties with Stage 1A at the top of the slope (ie. accessed off Holyoake Terrace).

  It is understood that stormwater flows are already reticulated, however, improving the management of runoff and overland flow could be difficult given that all of the upslope lots are now privately owned and fully developed.

- Vegetation of the Slope – An effective means of stabilising any slope is to plant it with appropriate vegetation, preferably with (relatively) deep-rooted plants but low-height growth. The observed instability issues at this site are relatively shallow, primarily related to debris flows occurring as a result of saturation of the surface soils (up to approximately 1 metre deep).

  The upper part of the slope has already been planted with native shrubs, which are now well established. Although the plants were not selected specifically for being deep-rooted, they will nevertheless help to reduce the porewater pressures in the shallow soils.

  The issue of vegetating the slope is that the effect of the vegetation process is difficult to quantify. Furthermore, some on-going management of a vegetated slope will be required.

- Drainage – Several 'buttress drains' have been installed on the upper part of the slope to help control groundwater pressures. The drains were located by T&T during the Stage 1a works in areas of high regression rates (i.e. areas of previous slippage) where groundwater flows were expected to concentrate.

The available measures to reduce the potential for land slippage have already been adopted as much as practical. Nevertheless, the properties at the toe of the slope may still be at risk of debris inundation from instability on the upper parts of the slopes. Some form of debris protection measure will therefore be required above the building platforms to provide some additional protection in case of slippage on the slopes above.

5.5.3. Reducing the Consequences of Hazard

Methods to manage a potential debris slide include:

- Supported Debris Catch Fence – References 8 to 10 (see Section 3.1) include details for a debris catch fence with engineered fill placed downslope, presumably to support the fence. The proposed location of the fence was along the boundary between the Stage 3 lots and the Council reserve, with the engineered fill being placed within the lots and the BRL being located at the toe of the fill. The cost and impact on the useable size of the lots has made this option unfavourable.
- Earth Bund – The earth bund system is discussed in the aforementioned T&T reports (references 8 to 10). This option would restrict development on a large amount of land and is therefore not preferred.
- Debris Reducing Fence – This fence is a stand-along embedded timber fence which would be located on the upslope side of the existing access track. In the event of a landslip event, the debris is expected to either collect upslope of the fence or flow on with reduced energy and become deposited on the track and lower parts of the slope.

- Convenants – The lots along the toe of the slope in Stage 3 could have restrictions on development, such as a conservative BRL or requiring buildings to have a solid back wall (i.e. no windows/doors) on the lower floor.

For all options, removal of landslip materials should be completed as soon as possible after the event to maintain the pre-event ground profile.

5.5.4. Proposed Solution

The proposed solution for lots within Stage 3 is to use a debris reducing fence located on the upslope side of the existing track, being in addition to the BRL requirement in place for lots fronting Holyoake Terrace situated above the track. This approach will be supported with a maintenance programme including a new planting regime and review of the stormwater management on the upslope properties.

The debris reducing fence option appears to be the most favourable because of the following factors:

- its location along the track (separating the track from the vegetated slope) would make it fit better within the landscape;
- the access track would allow for easy access for construction of the fence and any future clean up works;
- the useable size of the lots within Stage 3 is not affected; and,
- the embedment of the poles would provide some additional resistance against instability.

As noted, the debris fence is located below the upper part of the slope, to mitigate the potential debris inundation hazard to the lower part of the slope, which will contain the future Stage 3 lots. As the lower parts of the slope (below the track) currently have acceptable factors of safety no additional mitigation is required for the lower slopes of the main ridge within Stage 3.

Since the recent site investigations and analyses allow estimates of the potential slip mass and soil parameters of the embedment soils, the detailed design of the debris reducing fence could be undertaken using Coffey's in-house spreadsheets that were developed for similar projects.

The proposed extent of the debris reducing fence is shown on the attached site plan and geological cross-sections (Figure No.'s 1 to 4). Detailed design of the fence is presented in the Coffey Geotechnical Design Report dated 10 October 2014 (reference GENZTAUC15909AB-AB).

The debris fence is intended to be the main method for reducing the slope instability hazard, such that the existing hazard zone shown on the slope in the district plan maps can be removed. Although there may be some instability on the upper part of the slope, the building restriction line in the upper properties and debris fence are considered to mitigate this hazard.

In addition to the debris fence, ongoing maintenance of the slope will be required. This would include engaging an arborist to assess the existing vegetation and develop a planting regime to supplement the planting with the intention of transitioning to a situation where the slopes (both above and below the track) are covered with deep rooting plants. The aim would be for specifically selected plants to improve the stability of the slope in the long term by reducing groundwater pressures and reinforcing the slope above and below the walkway by their root systems.

Another ongoing requirement will be to review the stormwater management of the properties along Holyoake Terrace to confirm all stormwater is reticulated and no uncontrolled stormwater (or wastewater, e.g. from pools) is being discharged onto the slope. Should unsuitable practices be identified, the property owners and/or Council would be notified so the situation can be rectified before it leads to failure on the slope below. It is understood that a letter will shortly be sent to the owners to remind them of their responsibilities in this regard.

It should be noted that the solution presented in this report only addresses the slope stability hazard. As part of a future subdivision of the Stage 3 area, a geotechnical completion report would normally be prepared which discusses the geotechnical suitability of the completed subdivisional works and present recommendations on any restrictions/requirements/limitations on development (e.g. foundation and retaining requirements, maximum cut or fill heights and maximum gradients before retention is required, etc.).

6. Limitations

This report has been prepared solely for the use of our client, Durham Properties Limited, in relation to the specific project described herein. No liability is accepted in respect of its use for any other purpose or by any other person or entity. All future owners of this property should seek professional geotechnical advice to satisfy themselves as to its ongoing suitability for their intended use.

The opinions, recommendations and comments given in this report result from the application of normal methods of site investigation. As factual evidence has been obtained solely from boreholes and site investigation data obtained by others, which by their nature only provide information about a relatively small volume of subsoils, there may be special conditions pertaining to this site which have not been disclosed by the investigation and which have not been taken into account in the report. If variations in the subsoils occur from those described or assumed to exist then the matter should be referred back to us immediately.

For and on behalf of Coffey Geotechnics (NZ) Limited

Report Prepared By:

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Project Engineering Geologist

Report Reviewed/Authorised By:

Peter Bosselmann
Senior Principal

Figures
- Site Plan (Figure No. 01)
- Geological Cross Sections A and B (Figure No. 02)
- Geological Cross Sections C and D ((Figure No. 03)
- Geological Cross Section E (Figure No. 04)

Appendices:
Slope Stability Analysis Results
Site Investigation Data
- Soil Description Sheets
- Hand Auger Borehole Logs
- Relevant Existing Site Investigation Data

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Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

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Important information about your **Coffey** Report

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment.
Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

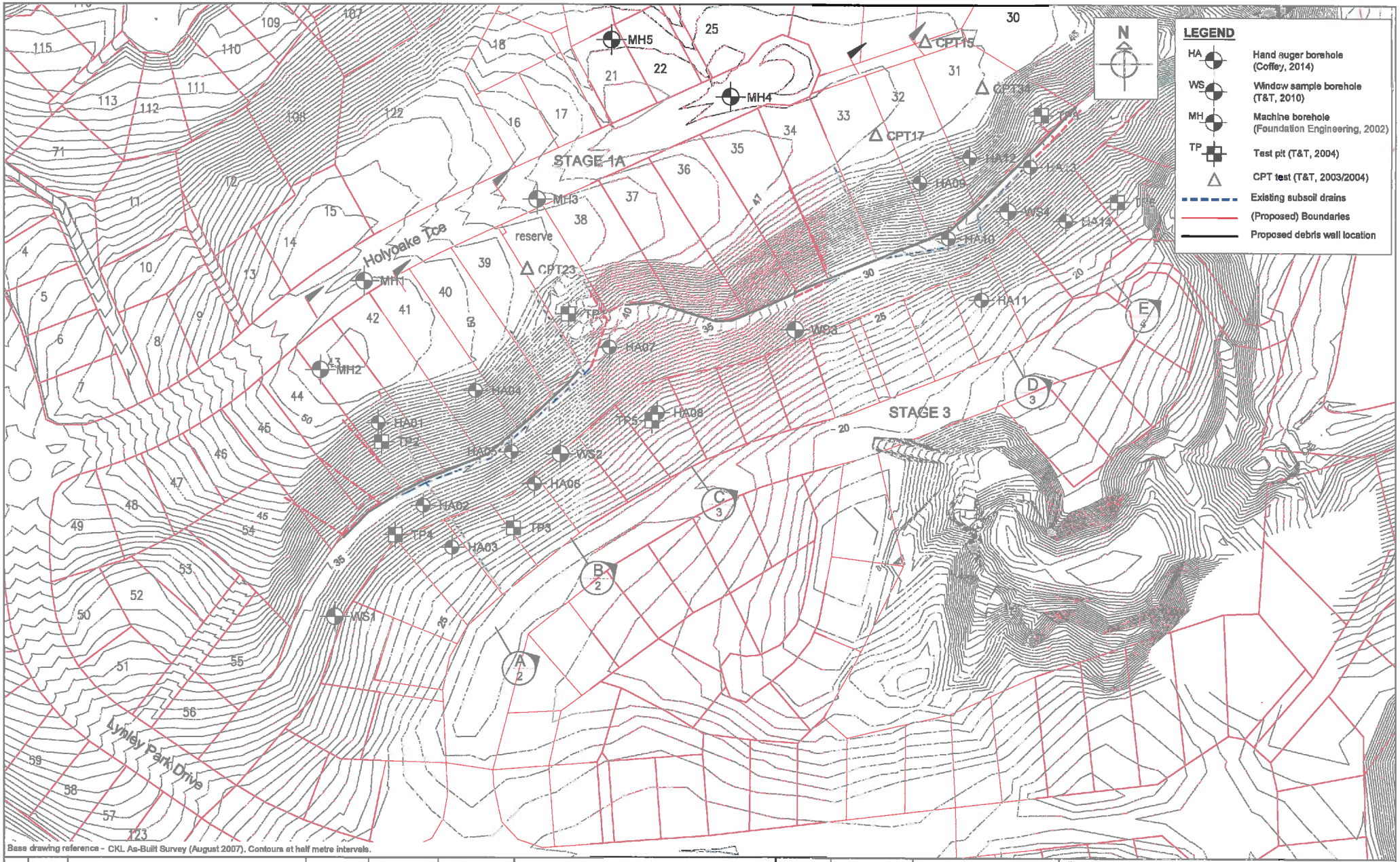
Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical Information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.



Base drawing reference - CKL As-Built Survey (August 2007). Contours at half metre intervals.

revision	rev	description	drawn	approved	date

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Horizontal Scale (metres)
0 30.0 60.0 90.0
Vertical Scale (metres)

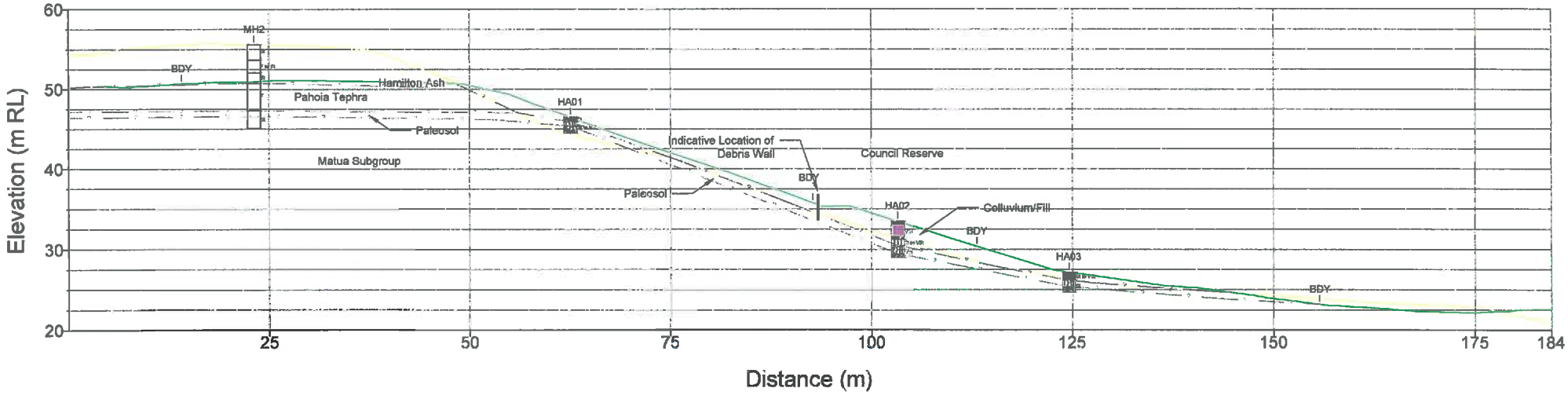
drawn	EPD
approved	PB
date	29/09/2014
scale	1:1500
original size	A3

coffey

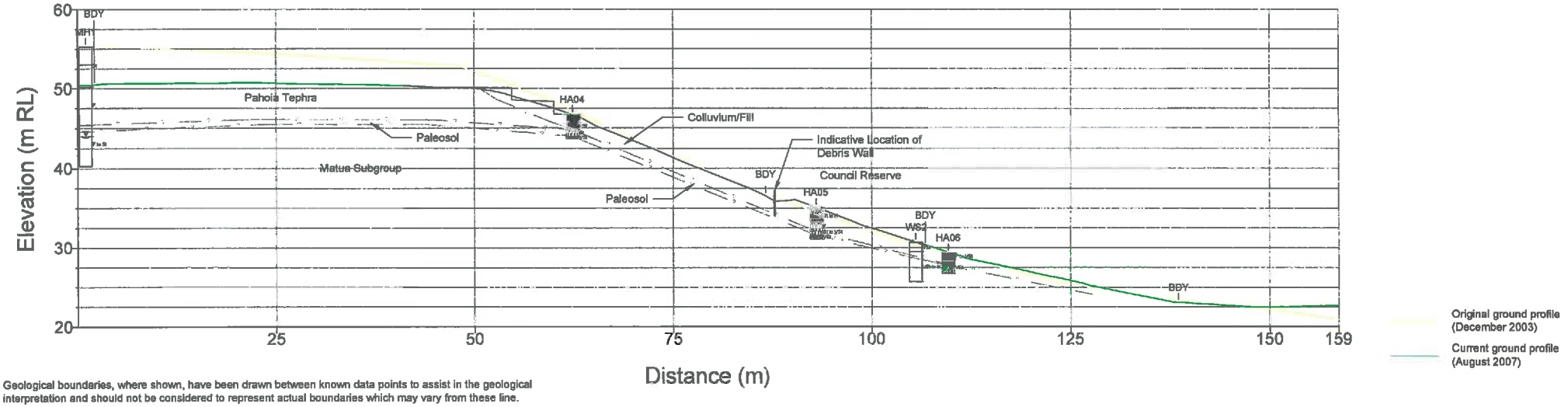
client: Durham Properties Ltd
project: Slope Stability Assessment Stage 3, Lynley Park Omokoroa
title: Site Plan
project no: GENZTAUC15909AB
figure no: 1
rev: 0

23/09/2014F:\1.GENZ\1.GEOTECHNICS PROJECTS\15909AA-AB LYNLEY PARK OMOKOROA'S. DRAWINGS\CGL DRAWINGS\WORKING\15909AB PLAN 220914.DWG

Cross Section A



Cross Section B



Geological boundaries, where shown, have been drawn between known data points to assist in the geological interpretation and should not be considered to represent actual boundaries which may vary from these line.

revision	rev	description	drawn	approved	date

Horizontal Scale (metres): 0, 10.0, 20.0, 30.0

Vertical Scale (metres): 0, 10.0, 20.0, 30.0

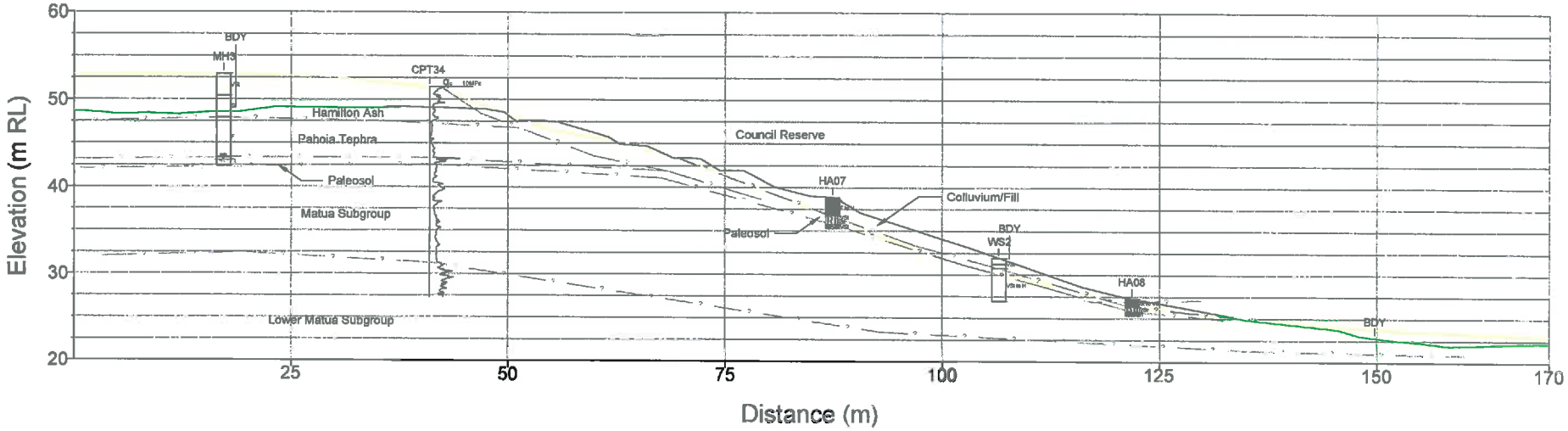
drawn	EPD
approved	PB
date	29/09/2014
scale	1:500
original size	A3

coffey

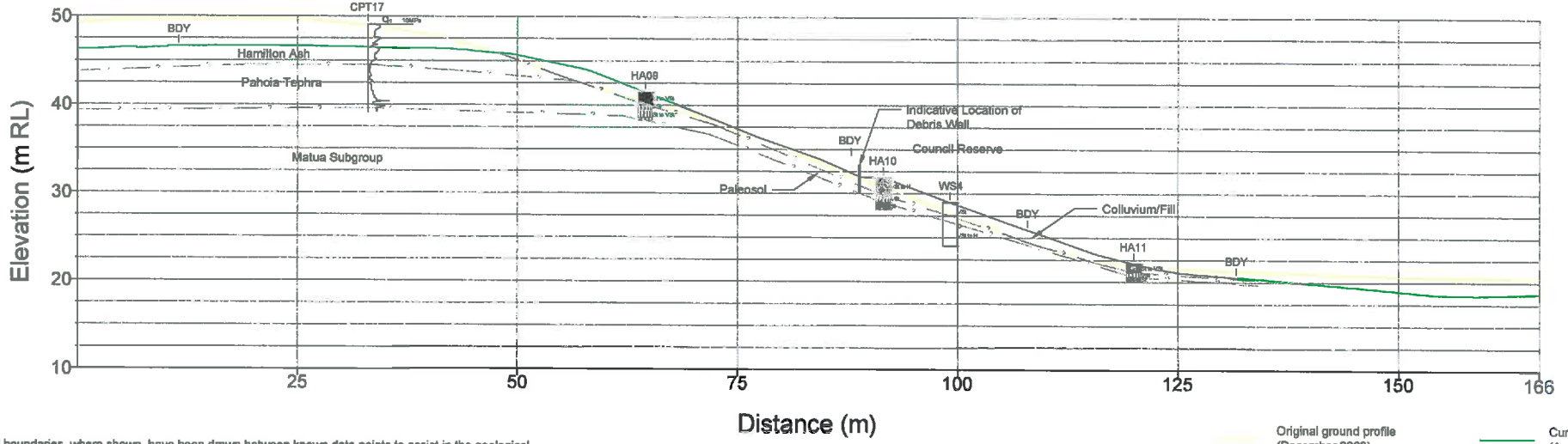
client:	Durham Properties Ltd
project:	Slope Stability Assessment Stage 3, Lynley Park Omokoroa
title:	Geological Cross Sections A and B
project no:	GENZTAUC15909AB
figure no:	2
rev:	0

23/09/2014F:\1.GENZ\1.GEOTECHNICS PROJECTS\15909AA-AB LYNLEY PARK OMOKOROA\6. DRAWINGS\CGL DRAWINGS\WORKING\15909AB PLAN 230914.DWG

Cross Section C



Cross Section D



Geological boundaries, where shown, have been drawn between known data points to assist in the geological interpretation and should not be considered to represent actual boundaries which may vary from these line.

Original ground profile (December 2003)

Current ground profile (August 2007)

revision	rev	description	drawn	approved	date

0 10.0 20.0 30.0
Horizontal Scale (metres)
0 10.0 20.0 30.0
Vertical Scale (metres)

drawn	EPD
approved	PB
date	29/09/2014
scale	1:500
original size	A3

coffey

client: Durham Properties Ltd

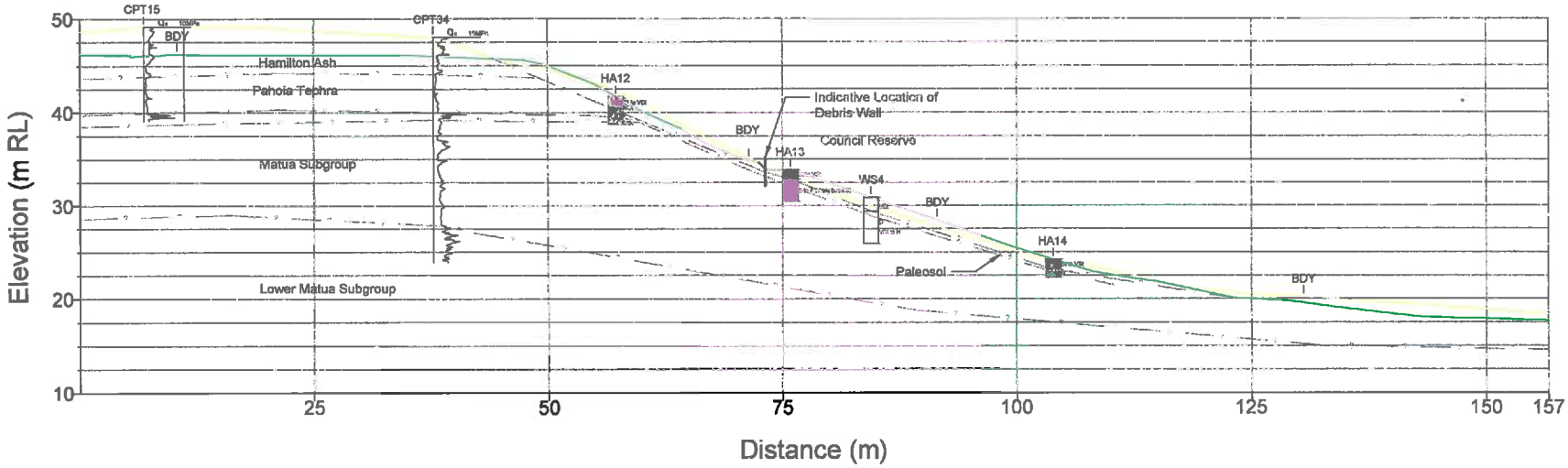
project: Slope Stability Assessment
Stage 3, Lynley Park
Omokoroa

title: Geological Cross Sections C and D

project no: GENZTAUC15909AB | figure no: 3 | rev: 0

23/09/2014 F:\1.GENZ\1.GEOTECHNICS PROJECTS\15909AA-AB LYNLEY PARK OMOKOROA\9. DRAWINGS\CGL DRAWINGS\WORKING\15909AB PLAN 230914.DWG

Cross Section E



Original ground profile (December 2003)

Current ground profile (August 2007)

Geological boundaries, where shown, have been drawn between known data points to assist in the geological interpretation and should not be considered to represent actual boundaries which may vary from these line.

revision	rev	description	drawn	approved	date

0 10.0 20.0 30.0
Horizontal Scale (metres)
0 10.0 20.0 30.0
Vertical Scale (metres)

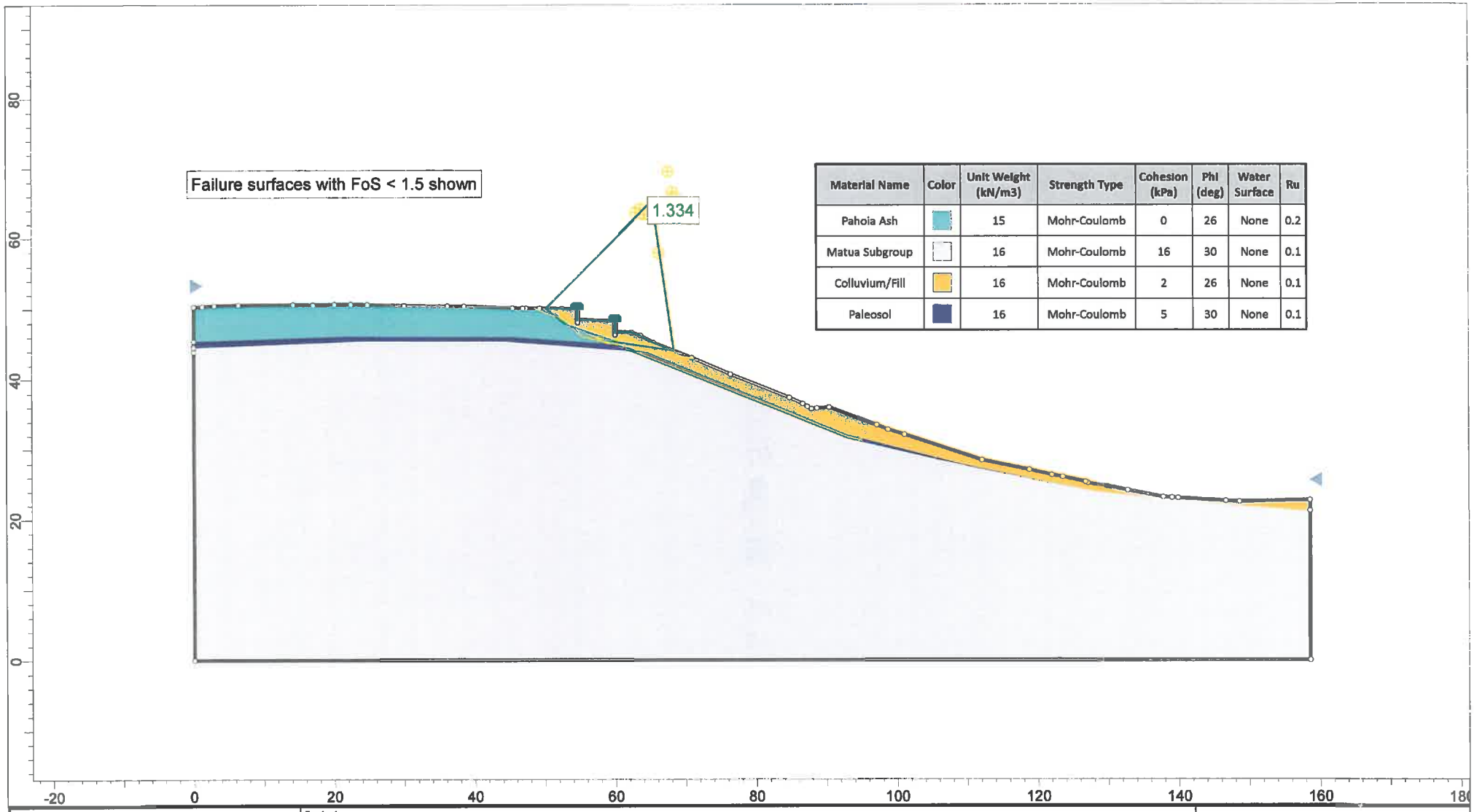
drawn	EPD
approved	PB
date	29/09/2014
scale	1:500
original size	A3

coffey

client:	Durham Properties Ltd
project:	Slope Stability Assessment Stage 3, Lynley Park Omokoroa
title:	Geological Cross Section E
project no:	GENZTAUC15909AB
figure no:	4
rev:	0

23/09/2014F:\1.GENZ\1.GEOTECHNICS PROJECTS\15909AA-AB LYNLEY PARK OMOKOROA\6. DRAWINGS\CGL DRAWINGS\WORKING\15909AB PLAN 230914.DWG

Appendix A - Slope Stability Analysis Results

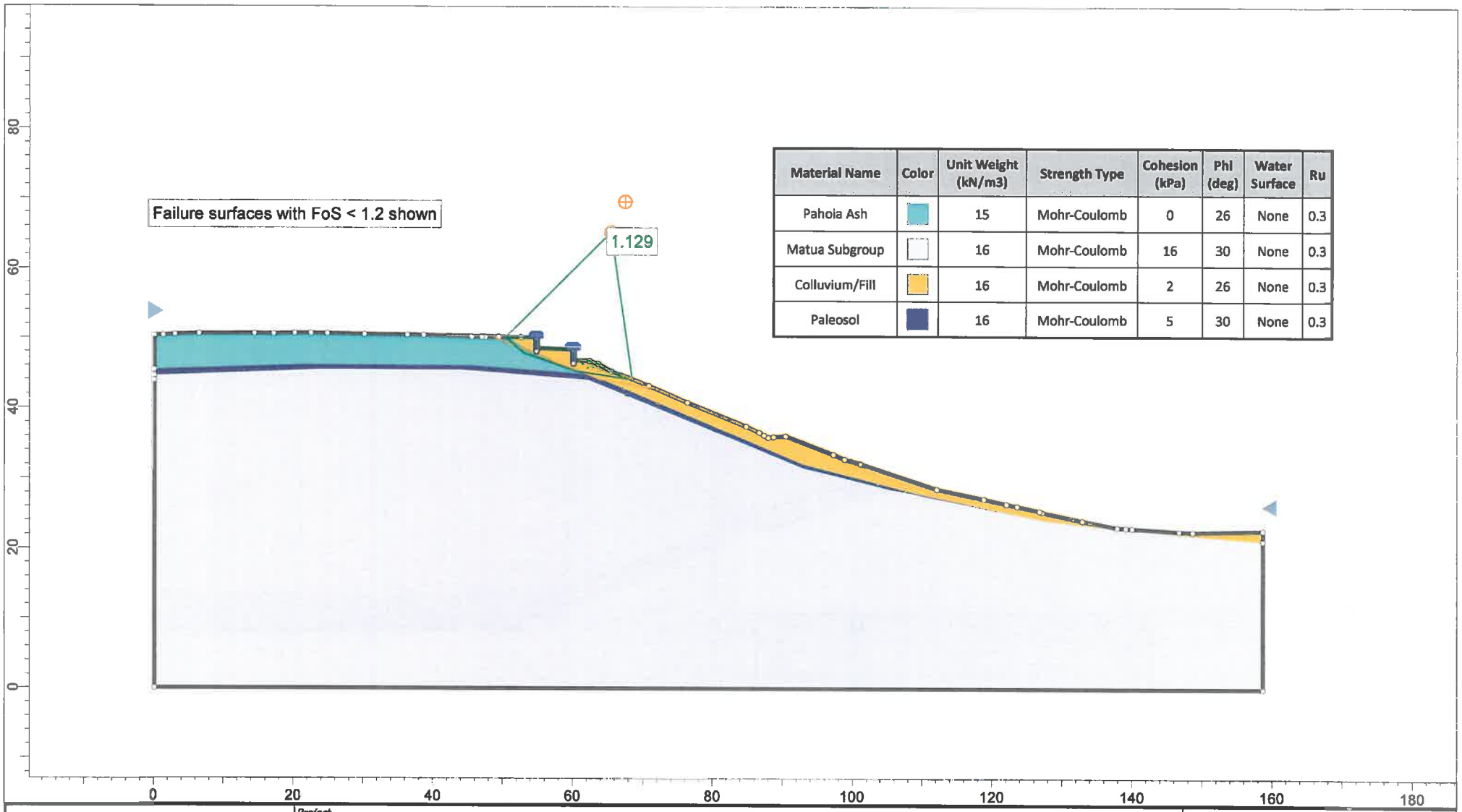


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Pahoia Ash		15	Mohr-Coulomb	0	26	None	0.2
Matua Subgroup		16	Mohr-Coulomb	16	30	None	0.1
Colluvium/Fill		16	Mohr-Coulomb	2	26	None	0.1
Paleosol		16	Mohr-Coulomb	5	30	None	0.1

coffey

SLIDEINTERPRET 6.029

Project: Stage 3, Lynley Park, Omokoroa				Section B-B
Analysis Description: Prevailing groundwater conditions			Project Number: GENZTAUC15909AB	
Drawn By: E Pearse-Danker	Date: 15/07/2014	Scale: 1:750	Client: Durham Properties Ltd	
Analysis Method Used: Morgenstern-Price		Surface Type: Non-circular	Search Method: Path Search	

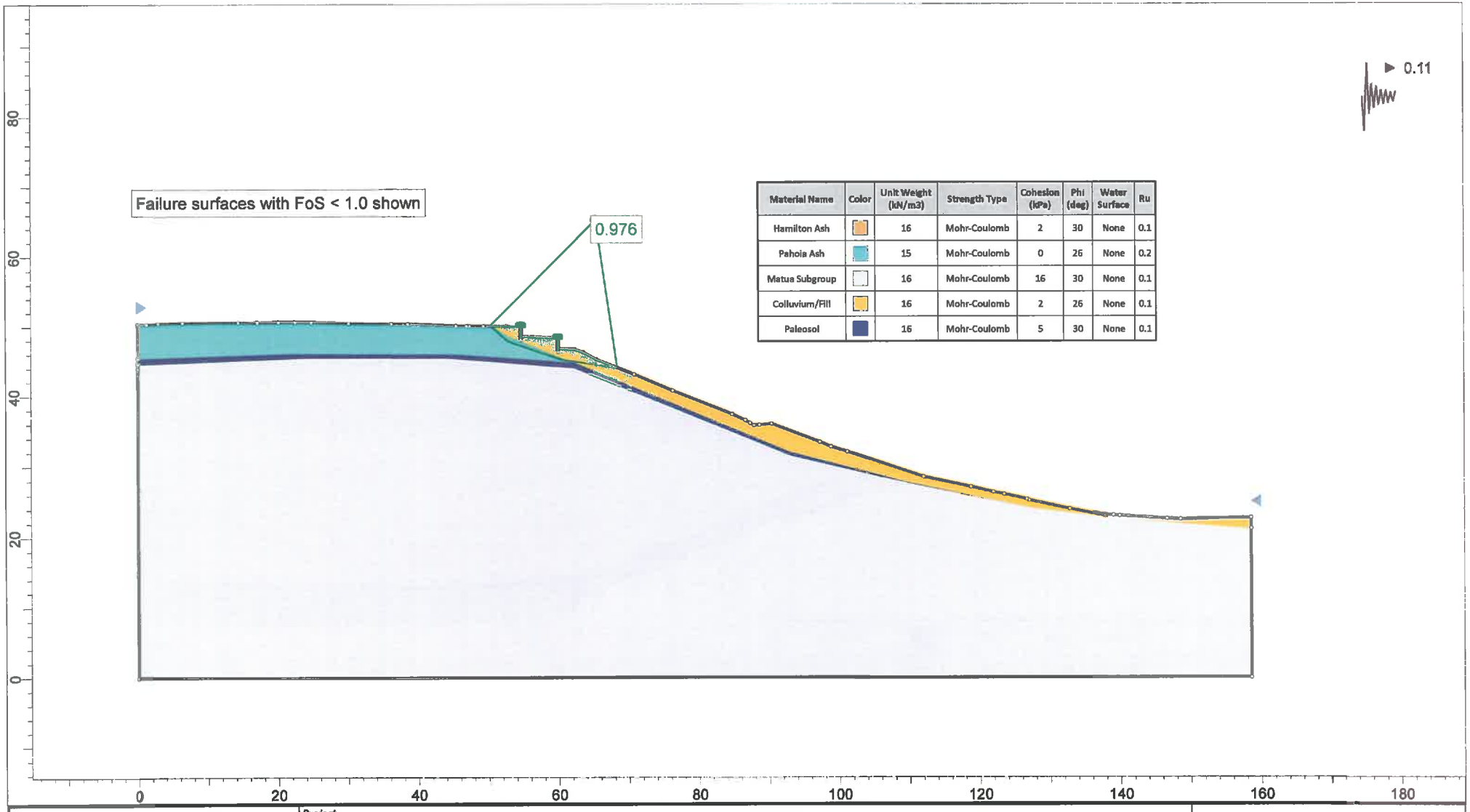


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Pahoia Ash		15	Mohr-Coulomb	0	26	None	0.3
Matua Subgroup		16	Mohr-Coulomb	16	30	None	0.3
Colluvium/Fill		16	Mohr-Coulomb	2	26	None	0.3
Paleosol		16	Mohr-Coulomb	5	30	None	0.3

coffey

SLIDEINTERPRET 6.029

Project: Stage 3, Lynley Park, Omokoroa				Section B-B
Analysis Description: Elevated groundwater conditions				Project Number: GENZTAUC15909AB
Drawn By: E Pearse-Danker	Date: 15/07/2014	Scale: 1:750	Client: Durham Properties Ltd	
Analysis Method Used: Morgenstern-Price		Surface Type: Non-circular		Search Method: Path Search



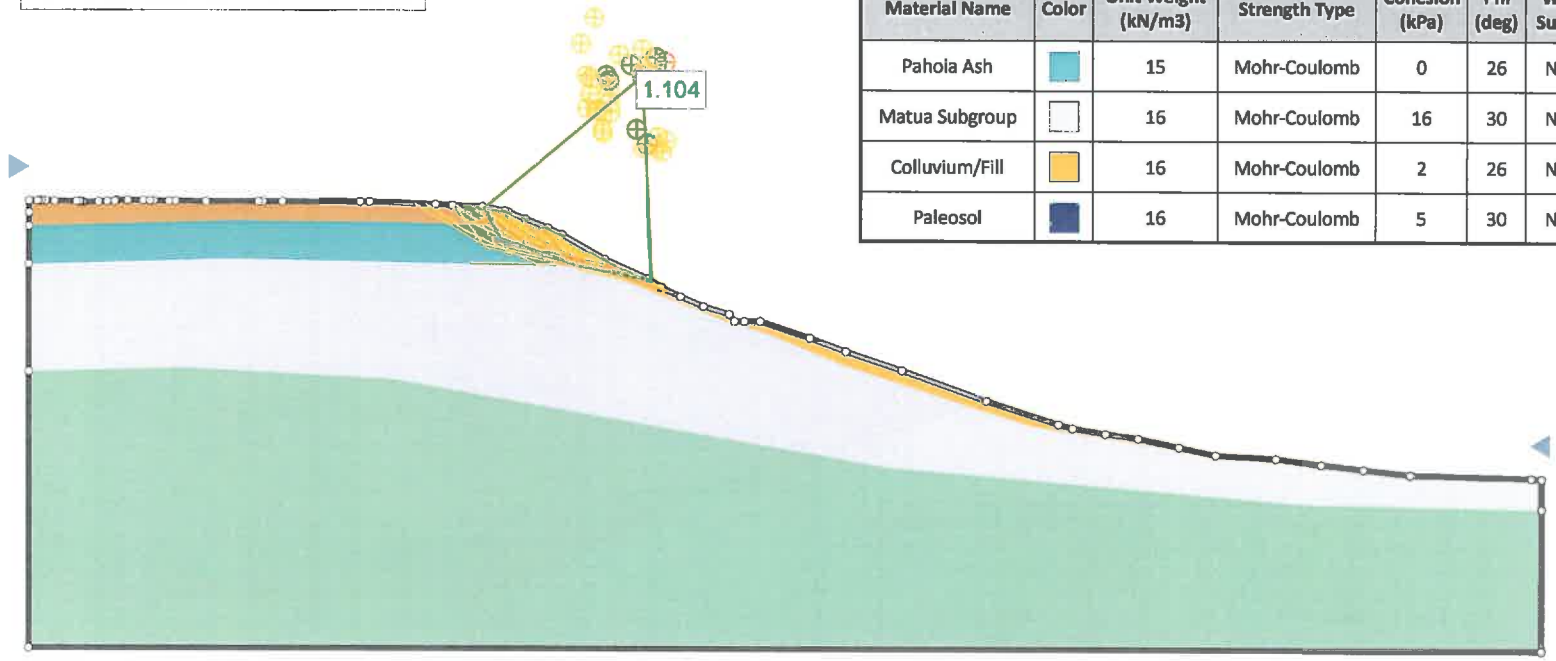
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Hamilton Ash		16	Mohr-Coulomb	2	30	None	0.1
Pahoia Ash		15	Mohr-Coulomb	0	26	None	0.2
Matua Subgroup		16	Mohr-Coulomb	16	30	None	0.1
Colluvium/Fill		16	Mohr-Coulomb	2	26	None	0.1
Paleosol		16	Mohr-Coulomb	5	30	None	0.1

coffey

SLIDEINTERPRET 6.029

Project: Stage 3, Lynley Park, Omokoroa				Section B-B
Analysis Description: Seismic conditions			Project Number: GENZTAUC15909AB	
Drawn By: E Pearse-Danker	Date: 26/08/2014	Scale: 1:750	Client: Durham Properties Ltd	
Analysis Method Used: Morgenstern-Price		Surface Type: Non-circular	Search Method: Path Search	

Failure surfaces with FoS < 1.5 shown



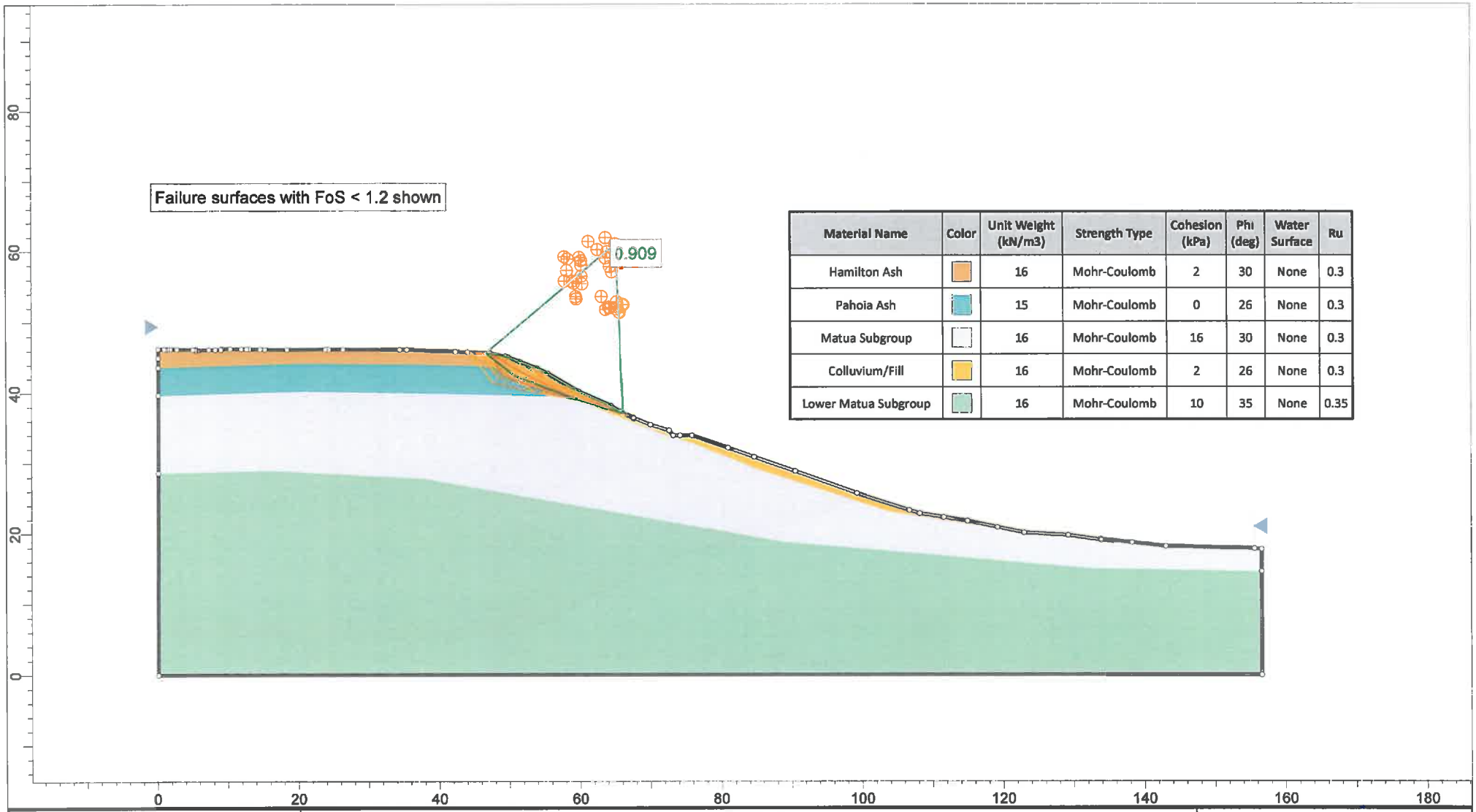
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Pahoia Ash		15	Mohr-Coulomb	0	26	None	0.2
Matua Subgroup		16	Mohr-Coulomb	16	30	None	0.1
Colluvium/Fill		16	Mohr-Coulomb	2	26	None	0.1
Paleosol		16	Mohr-Coulomb	5	30	None	0.1

coffey

SLIDEINTERPRET 6.029

Project: Stage 3 Lynley Park, Omokoroa				Section E-E
Analysis Description: Prevailing groundwater conditions				Project Number: GENZTAUC15909AB
Drawn By: E Pearse-Danker	Date: 15/07/2014	Scale: 1:750	Client: Durham Properties Ltd	
Analysis Method Used: Morgenstern-Price		Surface Type: Non-circular	Search Method: Path Search	

Failure surfaces with FoS < 1.2 shown

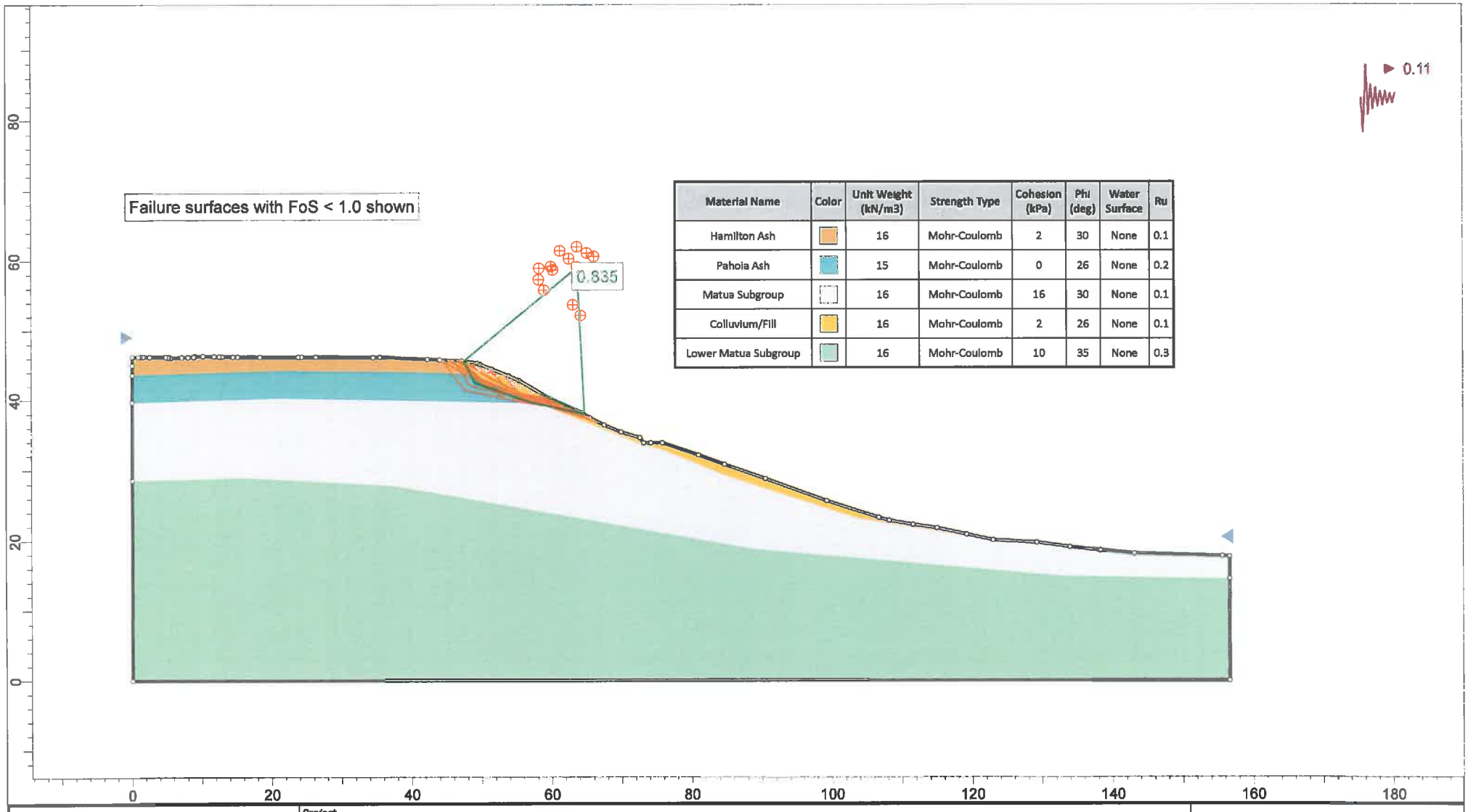


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Hamilton Ash		16	Mohr-Coulomb	2	30	None	0.3
Pahoia Ash		15	Mohr-Coulomb	0	26	None	0.3
Matua Subgroup		16	Mohr-Coulomb	16	30	None	0.3
Colluvium/Fill		16	Mohr-Coulomb	2	26	None	0.3
Lower Matua Subgroup		16	Mohr-Coulomb	10	35	None	0.35

coffey

SLIDEINTERPRET 6.029

Project: Stage 3 Lynley Park, Omokoroa				Section E-E
Analysis Description: Elevated groundwater conditions			Project Number: GENZTAUC15909AB	
Drawn By: E Pearse-Danker	Date: 15/07/2014	Scale: 1:750	Client: Durham Properties Ltd	
Analysis Method Used: Morgenstern-Price		Surface Type: Non-circular	Search Method: Path Search	



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Hamilton Ash		16	Mohr-Coulomb	2	30	None	0.1
Pahoia Ash		15	Mohr-Coulomb	0	26	None	0.2
Matua Subgroup		16	Mohr-Coulomb	16	30	None	0.1
Colluvium/Fill		16	Mohr-Coulomb	2	26	None	0.1
Lower Matua Subgroup		16	Mohr-Coulomb	10	35	None	0.3

coffey

SLIDEINTERPRET 6.029

Project: Stage 3 Lynley Park, Omokoroa				Section E-E
Analysis Description: Seismic conditions			Project Number: GENZTAUC15909AB	
Drawn By: E Pearse-Danker	Date: 26/08/2014	Scale: 1:750	Client: Durham Properties Ltd	
Analysis Method Used: Morgenstern-Price		Surface Type: Non-circular	Search Method: Path Search	

Tonkin & Taylor

T&T Ref: 850895.400
22 September 2014

Durham Property Investments Ltd
P.O. Box 17052
Omokoroa

Attention: Phillip Palmer

Dear Phillip

Lynley Park, Omokoroa - Stage 7 Earthworks

1 Introduction

Tonkin & Taylor Ltd (T&T) has been engaged by Durham Property Investments Ltd (DPI) to provide geotechnical advice and part-time monitoring of earthworks for the Lynley Park subdivision at Omokoroa. Stage 7 of this development is an area to the northeast of Stage 1 and southeast of the main stormwater pond. A large portion of Stage 7 is currently included within a hazard zone identified as having 'general' stability issues in the Western Bay of Plenty District Council (District Plan). This hazard zone encroaches both the southeastern and northwestern portions of the Stage.

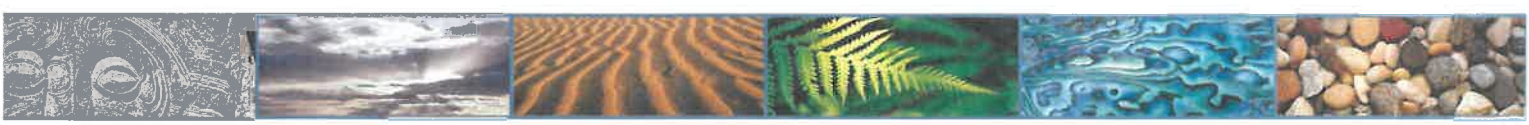
The development of Stage 7 has included the infilling of an old gully in order to create building platforms. The approximate extent of these earthworks are shown on Figure 1 in Appendix A. The development of Stage 7 is yet to be completed, however, DPI has requested that T&T provide some commentary with respect to the earthworks and measures undertaken to mitigate slope stability issues within the Stage.

2 Scope of Works

Works within Stage 7 commenced during the 2007/2008 earthworks season. Prior to these works Tonkin & Taylor provided:

1) Advice regarding ground preparation prior to fill placement;
2) Sub-fill bench, shear key and drainage design;
3) Part-time construction observations; and
4) Stability modelling of the slope in the southeast of the Stage and formulation of a Building Restriction Line (BRL) in this area.

With regard to the gully fill earthworks, our design for the sub-fill drainage, benching and shear key were provided on the drawings 850895.400-101 and 102. These drawings have been reproduced in Appendix B. Drawing 850895.400-102 shows a general cross section through the earthworks proposed at that time. We note that the layout of the earthworks may change prior to completion, however, the design principals and earthworks requirements remain the same.



Our proposed BRL on the southeast margin of Stage 7 is shown on Figure 1. It is located 7 to 8 m behind the crest of the coastal slope. The final location of the BRL will be confirmed on site by survey. The surveyed line will supersede that shown on Figure 1.

The fill compaction criteria used elsewhere in the subdivision was also used for the Stage 7 earthworks.

3 Slope Stability Mitigation

Within the Stage 7 area of the earthworks (gully fill) the possible issues associated with slope stability have been mitigated in the following ways:

a) Construction of a shear key at the toe of the gully;
b) Benching of the ground surface prior to fill placement;
c) Installation of sub-fill drainage to control porewater pressures. We note that this includes bench and slope drains all of which feed into a central collector pipe; and
d) Construction of fill slopes no steeper than 1 m vertical to 2 m horizontal.

Elsewhere in Stage 7 the slope stability issues have been mitigated by the implementation of the BRL. Behind the BRL shallow foundations are likely to be appropriate to support buildings constructed in accordance with NZS3604:2011 *"Timber-framed Structures"*. Beyond the line specific engineering design will be required.

4 Discussion

The earthworks within Stage 7 are yet to be completed, however we consider that the issues regarding slope stability within the area of earthworks are suitably mitigated by Items a) to d) above and the BRL. Within the area of earthworks we consider it would be appropriate to remove the 'General Stability' hazard zonation and elsewhere it should be made coincident with the BRL.

5 Applicability

This report has been prepared for the benefit of Durham Property Investments Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

We trust that the above clarifies your query with regard to the hazard zonation within Stage 7. Please do not hesitate to contact us if you have any queries regarding this letter report.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:

.....

David Milner
Senior Engineering Geologist

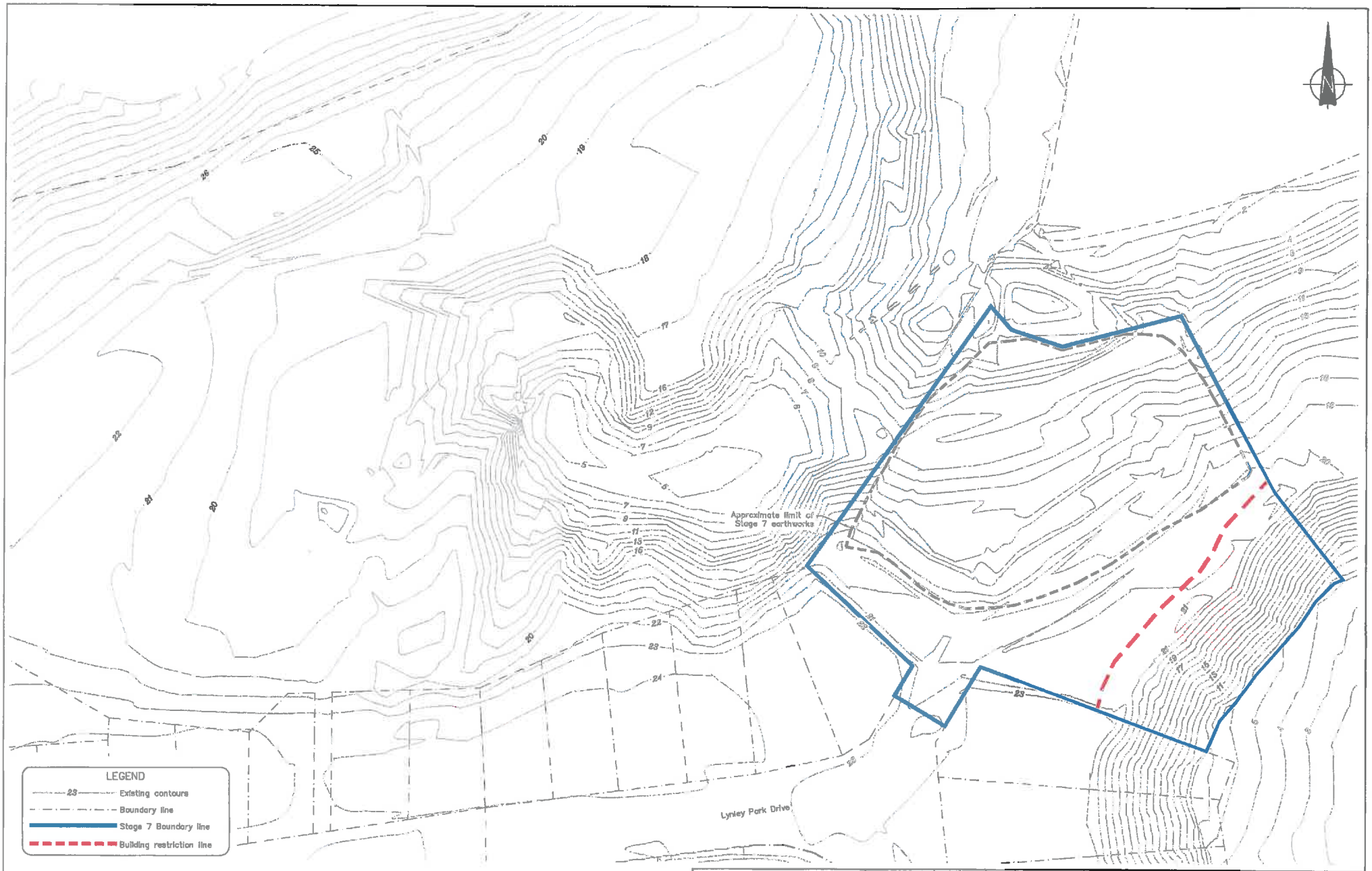
Authorised for Tonkin & Taylor Ltd by:

.....

P.P. Chris Bauld
Project Director

22-Sep-14
\\ttgroup.local\corporate\tauranga\projects\850895\850895.400\issueddocuments\stage 7\140910.dmmm.stage 7 hazard zone.letrop.docx

Appendix A: **Figure 1**



1. Base drawing supplied by CKL Surveying and Planning 5 March 08.
2. Coordinates in terms of Bay of Plenty 2000.

A3 SCALE 1: 1000
0 5 10 15 20 30 40 50 (m)

Tonkin & Taylor
Environmental and Engineering Consultants
Level 1, 525 Cameron Road, Tauranga
www.tonkin.co.nz

DRAWN	AMC	Sep.14
DRAFTING CHECKED	LDO	Sep.14
APPROVED	Dunn	Sep.14
CADFILE : \\850895.400-F01.dwg		
SCALES (AT A3 SIZE)	1: 1000	
PROJECT No.	850895.400	

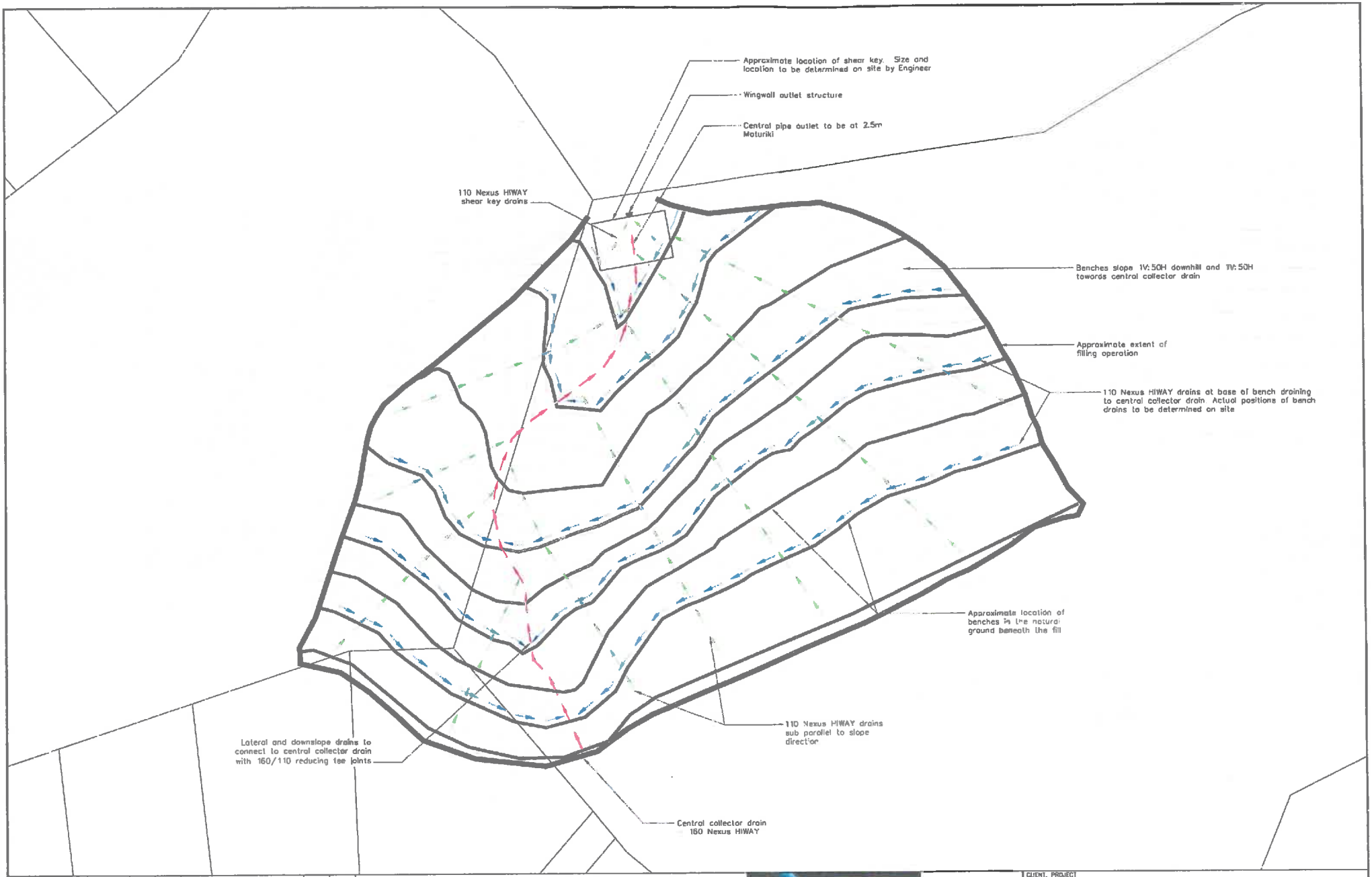
DURHAM PROPERTY INVESTMENTS LTD
LYNLEY PARK SUBDIVISION
OMOKOROA
Stage 7 Limit of Earthworks

FIG. No. Figure 1 REV. 0

T:\Tauranga\Projects\850895\850895.400\WorkingMaterial\CAD\Stage 7\850895.400-F01.dwg, F01, 22/09/2014 3:22:30 p.m., dwm, 1:1

Appendix B: Stage 7 (Gully Fill) Bench and Drainage Drawings

- Drawing 850895.400 – 101 – Slope Bench and Drainage Layout
- Drawing 850895.400 – 102 – Sub Fill Drainage



P:\850895\850895.400\WorkingMaterial\CAD\850895.400.100-101.dwg, 101, 20/03/2008 12:24:43 p.m., smbj, 1:1

B	Revised Drainage Plan	DAB	20/3/08
A	Construction Issue	DAB	Mar 08
REVISION	DESCRIPTION	BY	DATE

DESIGNED :	DMM	Mar.08
DRAWN :	SMBJ	Mar.08
DESIGN CHECKED	[illegible]	20/3/08
DRAFTING CHECKED :	[illegible]	20/3/08
CADFILE : \\850895.400. 100- 101.dwg		
APPROVED : [illegible]		20/3/08

This drawing is not to be used for construction purposes unless signed as approved

NOTES :
1. All dimensions are in millimetres unless noted otherwise
2. One main gully to be filled
3. Drains required parallel to slope direction and along the back of the benches
4. Contours taken from Dezignworks draft drawing 16, sheet No G100 dated January 2007, received by T&T on 15 February 2008.
5. End caps to be fitted to top end of every drain

REFERENCE -

Tonkin & Taylor
Environmental & Engineering Consultants
Tauranga, Level 1, 12 Elizabeth Street
Tel. (07) 571 3570 Fax. (07) 571 5508
Email : tge@tonkin.co.nz
Auckland Wellington Christchurch Hamilton Whangarei Nelson

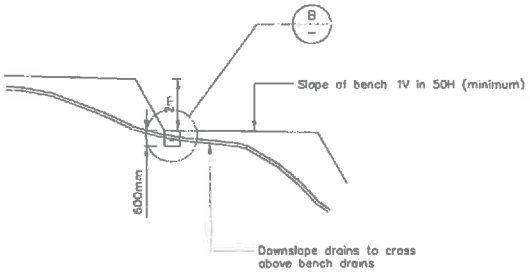
CLIENT, PROJECT
DURHAM PROPERTY INVESTMENTS
LYNLEY PARK, OMOKOROA

TITLE
GULLY FILL LOTS
Slope and Bench Drainage Layout

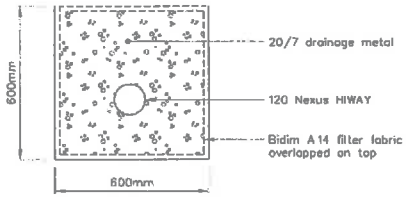
SCALES (AT A3 SIZE) 1:500

DWG No 850895.400– 101

REV. B



DETAIL (A) BENCH & SLOPE DETAIL
SCALE 1:200



DETAIL (B) BENCH & SLOPE DRAINS
SCALE 1:20

SCALE 1:20
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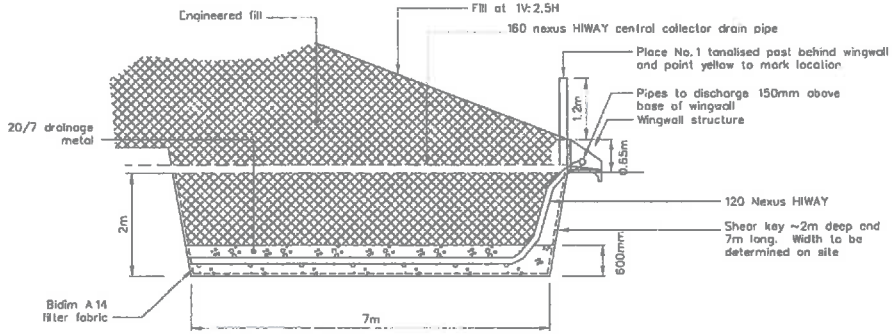
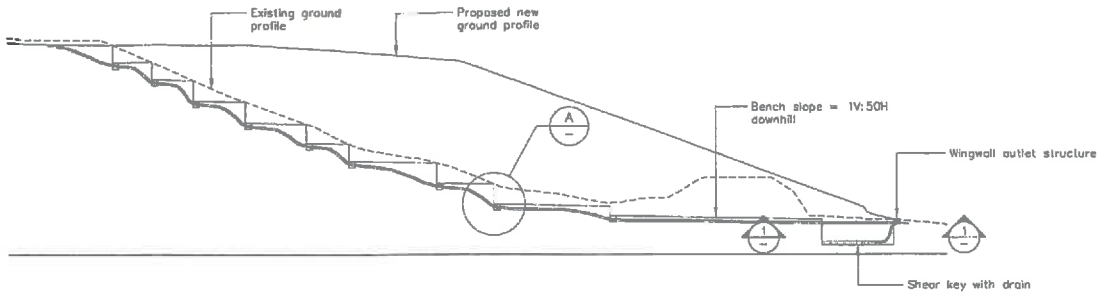


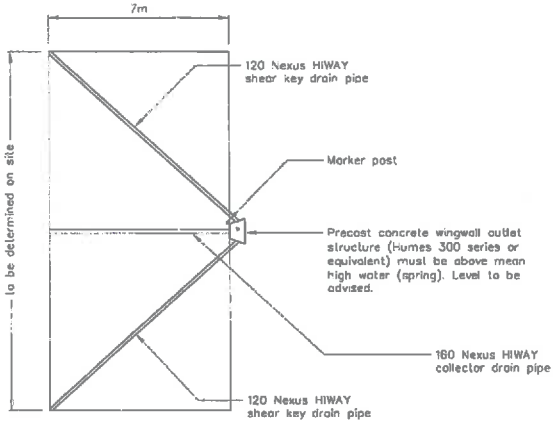
SECTION (1) CROSS SECTION THROUGH SHEAR KEY
SCALE 1:100

SCALE 1:100
0 1 2 3 4 5 (m)



TYPICAL CROSS SECTION THROUGH AREA OF FILL
SCALE 1:500

SCALE 1:500
0 5 10 15 20 25 (m)



PLAN VIEW: SHEAR KEY
SCALE 1:200

NOTE: Wing wall structure to be marked by painted wooden post. Pipe outlet to be maintained and kept clear of silt and other debris.

SCALE 1:200
0 2 4 6 8 10 (m)

		DESIGNED	OMMM Mar.08
		DRAWN	SMBJ Mar.08
		DESIGN CHECKED	
		DRAFTING CHECKED	
		CADFILE : \\850895.400 100-101.dwg	
		APPROVED	5.3.08
A	Construction Issue		5/3/08
REVISION DESCRIPTION		BY	DATE

This drawing is not to be used for construction purposes unless signed as approved

REFERENCE :

NOTES :
1. All dimensions are in millimetres unless noted otherwise
2. Cross section based on contours taken from Dezignworks draft drawing G100 dated January 2007, received by T&T on 15 February 2008

Tonkin & Taylor
Environmental & Engineering Consultants
Tauranga, Level 1, 12 Elizabeth Street
Tel. (07) 571 3570 Fax. (07) 571 5508
Email : tga@tonkin.co.nz
Auckland Wellington Christchurch Hamilton Whangarei Nelson

CLIENT, PROJECT
DURHAM PROPERTY INVESTMENTS
LYNLEY PARK, OMOKOROA

TITLE
GULLY FILL LOTS
Sub Fill Drainage

SCALES (AT A3 SIZE)	DWG. No.	REV
AS SHOWN	850895.400-100	A

Tonkin & Taylor

T&T Ref: 850895.400
26 September 2014

Durham Property Investments Ltd
P.O. Box 17052
Omokoroa

Attention: Phillip Palmer

Dear Phillip

Lynley Park, Omokoroa - Stage 8 Building Restriction Line, Revision 1

1 Introduction

Tonkin & Taylor Ltd (T&T) has been engaged by Durham Property Investments Ltd (DPI) to provide geotechnical advice and part-time monitoring of earthworks for the Lynley Park subdivision at Omokoroa. Stage 8 of this development comprises the area beyond the end of Stage 2 to the southern corner of the site adjacent to the railway line. The location of Stage 8 is shown on Figure 1 in Appendix A.

The eastern and southern edges of Stage 8 are located above a steep coastal slope which drops down to Tauranga Harbour. This slope is included within a hazard zone identified as having 'general' stability issues in the Western Bay of Plenty District Council's (WBOPDC) District Plan.

T&T has previously undertaken stability assessments of the coastal slope in order to define a Building Restriction Line (BRL) beyond which specific engineering design is required.

WBOPDC is in the process of revising portions of the District Plan. During this process DPI would like to have the stability hazard zone in the District Plan altered within Stage 8 to make it consistent with the BRL assessed by us.

2 Stage 8 Earthworks

Earthworks within Stage 8 have included the removal of soil immediately behind the coastal slope for placement elsewhere to create raised building platforms. These earthworks have resulted in a reduction in elevation of up to 7 m behind the crest of the coastal slope. The elevation of the crest of the coastal slope now varies between 14 and 23 mRL within Stage 8.

Earthworks within Stage 8 also included the removal of debris within an old landslip at the southern corner of the site. It was proposed to fill this landslip in a similar fashion to Stage 7. This filling work is yet to be completed.

We understand that the earthworks in Stage 8 are now complete with the exception of the area around the old landslip at the southern corner of the subdivision.

3 Slope Stability Modelling and the Building Restriction Line

T&T has made field observations of the coastal slope and modelled its stability using the software Slope/W[1]. The ground model for the slope assessment was created using data from cone penetration tests and boreholes undertaken as part of the subdivision geotechnical investigations. Based on our observations and modelling we positioned a BRL 7 to 8 m behind the crest of the slope. The approximate position of this BRL is shown on Figure 1 in Appendix A. This extends on from BRLs identified for Stage 2 and Stage 7 (also shown on Figure 1 in Appendix A).

Behind the BRL shallow foundations are likely to be appropriate to support buildings built in accordance with NZS3604:2011 *"Timber-framed Structures"*. Beyond the line specific engineering design will be required.

We note that earthworks are still likely to be undertaken around the old landslip at the southern corner of the subdivision. Following these earthworks the position of the BRL is likely to be altered at this location.

4 Discussion

The earthworks within Stage 8 are virtually complete with the exception of the area around the old landslip at the southern corner of the subdivision. A portion of Stage 8 is currently included within a hazard zone identified as having 'general' stability issues in the District Plan. We consider that these issues are suitably mitigated by the implementation of the BRL shown on Figure 1. The final position of the BRL will be confirmed by Survey. Within Stage 8 we consider that it would be appropriate to make the hazard zone in the District Plan coincident with the surveyed BRL.

5 Applicability

This report has been prepared for the benefit of Durham Property Investments Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

[1] Geotstudio (2012) Slope/W

We trust that the above clarifies your query with regard to the WBOPDC District Plan hazard zonation within Stage 8. Please do not hesitate to contact us if you have any queries regarding this letter report.

Tonkin & Taylor Ltd

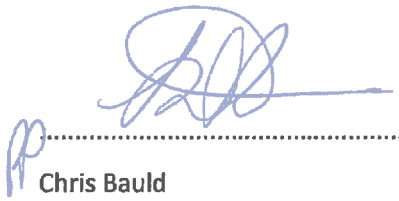
Environmental and Engineering Consultants

Report prepared by:

.....

David Milner
Senior Engineering Geologist

Authorised for Tonkin & Taylor Ltd by:

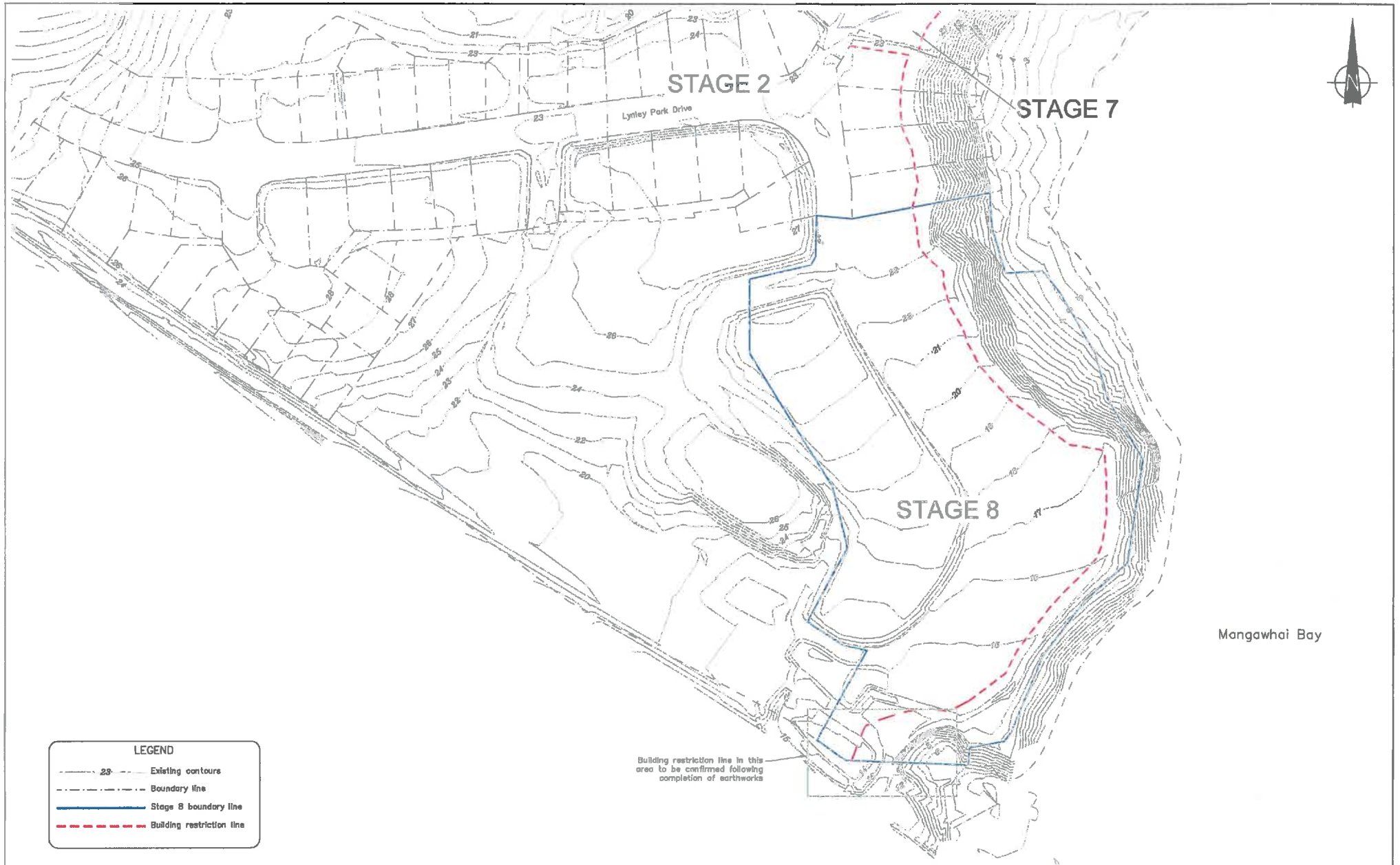


.....

Chris Bauld
Project Director

26-Sep-14
p:\850895\850895.400\issueddocuments\stage 8\140925.dmmm.stage 8 hazard zone.letrep.rev1.docx

Appendix A: **Figure 1**



1. Base drawing supplied by CKL Surveying and Planning 5 March 08.
2. Coordinates in terms of Bay of Plenty 2000.
3. Stage 8 boundary line supplied by Strata Group Consulting Engineers (23 September 2014)

A3 SCALE 1:2000
0 20 40 60 80 100 (m)

Tonkin & Taylor
Environmental and Engineering Consultants
Level 1, 525 Cameron Road, Tauranga
www.tonkin.co.nz

DRAWN	AMC	Sep.14
DRAFTING CHECKED		
APPROVED		
CADFILE : \\850895.400-F01.dwg		
SCALES (AT A3 SIZE)	1:2000	
PROJECT No.	850895.400	

DURHAM PROPERTY INVESTMENTS LTD
LYNLEY PARK SUBDIVISION
OMOKOROA
Stage 8 Building Restriction Line

FIG. No. Figure 1 REV. 1

T:\Tauranga\Projects\850895\850895.400\WorkingMaterial\CAD\Stage 8\850895.400-F01.dwg, F01, 25/09/2014 11:32:06 a.m., dwm, 1:1

AECOM

Attachment C: Certificate of Title details

Title Plan - LT 475690

Survey Number	LT 475690
Surveyor Reference	2379 - LYNLEY PARK
Surveyor	Richard Douglas Hewison
Survey Firm	Hewison Consultants
Surveyor Declaration	I Richard Douglas Hewison, being a licensed cadastral surveyor, certify that: (a) this dataset provided by me and its related survey are accurate, correct and in accordance with the Cadastral Survey Act 2002 and the Rules for Cadastral Survey 2010, and (b)the survey was undertaken by me or under my personal direction. Declared on 17 Jul 2014 08:54 AM

Survey Details

Dataset Description	Lots 630, 631, 632, 636, 637, 640 and 641 being a Subdivision of Lot 517 DP 412452		
Status	Approved as to Survey		
Land District	South Auckland	**Survey Class**	Class A
Submitted Date	17/07/2014	**Survey Approval Date**	06/08/2014
		Deposit Date	

Territorial Authorities

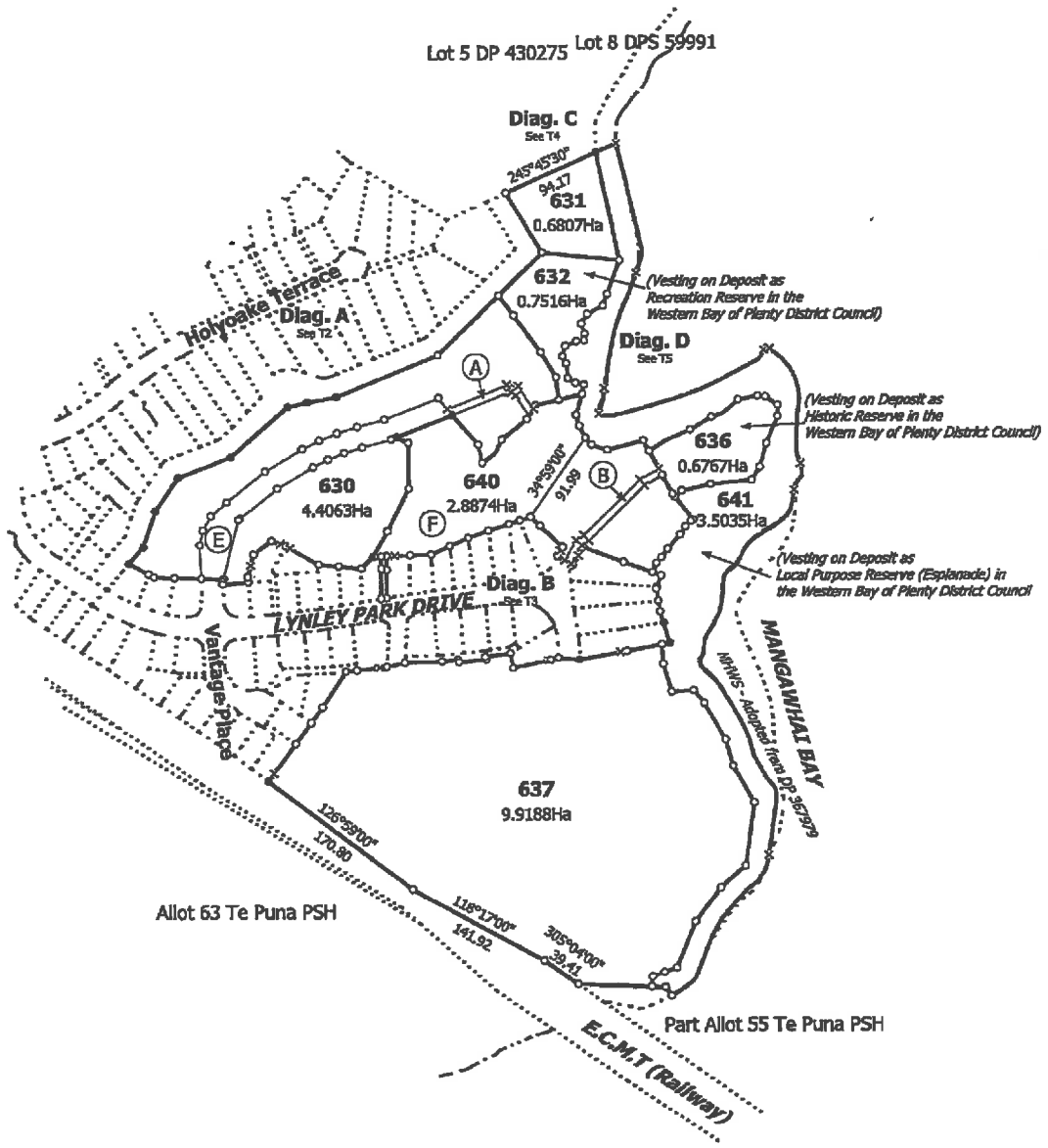
Western Bay of Plenty District

Comprised In

CT 479928

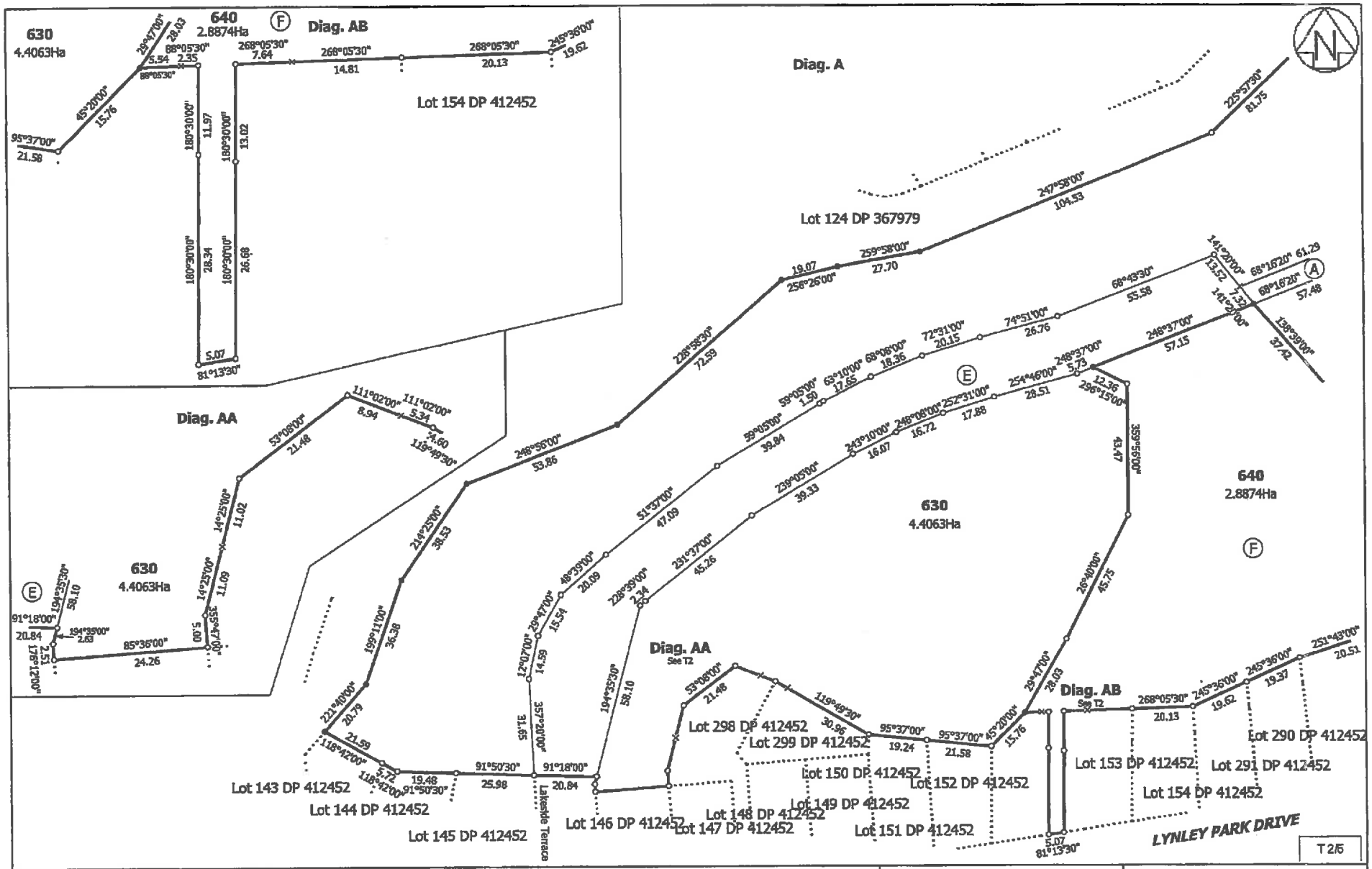
Created Parcels

Parcels	Parcel Intent	Area	CT Reference
Lot 630 Deposited Plan 475690	Fee Simple Title	4.4063 Ha	655843
Lot 631 Deposited Plan 475690	Fee Simple Title	0.6807 Ha	655844
Lot 632 Deposited Plan 475690	Vesting on Deposit for Recreation Reserve (Territorial Authority)	0.7516 Ha	655845
Lot 636 Deposited Plan 475690	Vesting on Deposit for Historic Reserve (Territorial Authority)	0.6767 Ha	655846
Lot 637 Deposited Plan 475690	Fee Simple Title	9.9188 Ha	655847
Lot 640 Deposited Plan 475690	Fee Simple Title	2.8874 Ha	655850
Area A Deposited Plan 475690	Easement		
Area B Deposited Plan 475690	Easement		
Area E Deposited Plan 475690	Easement		
Area F Deposited Plan 475690	Easement		
Lot 641 Deposited Plan 475690	Vesting on Deposit for Local Purpose Reserve	3.5035 Ha	655849
Total Area		22.8250 Ha	

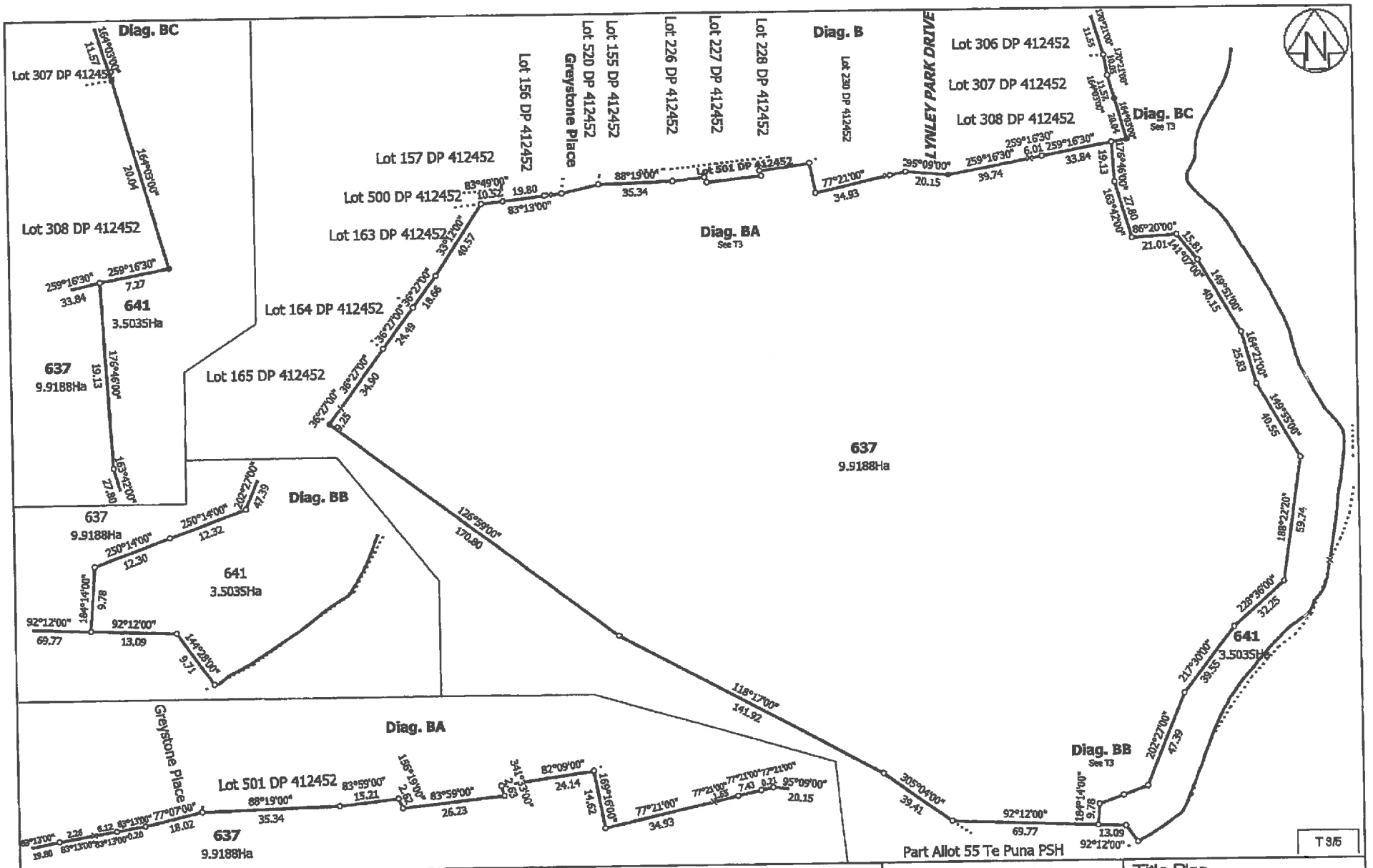


T1/5

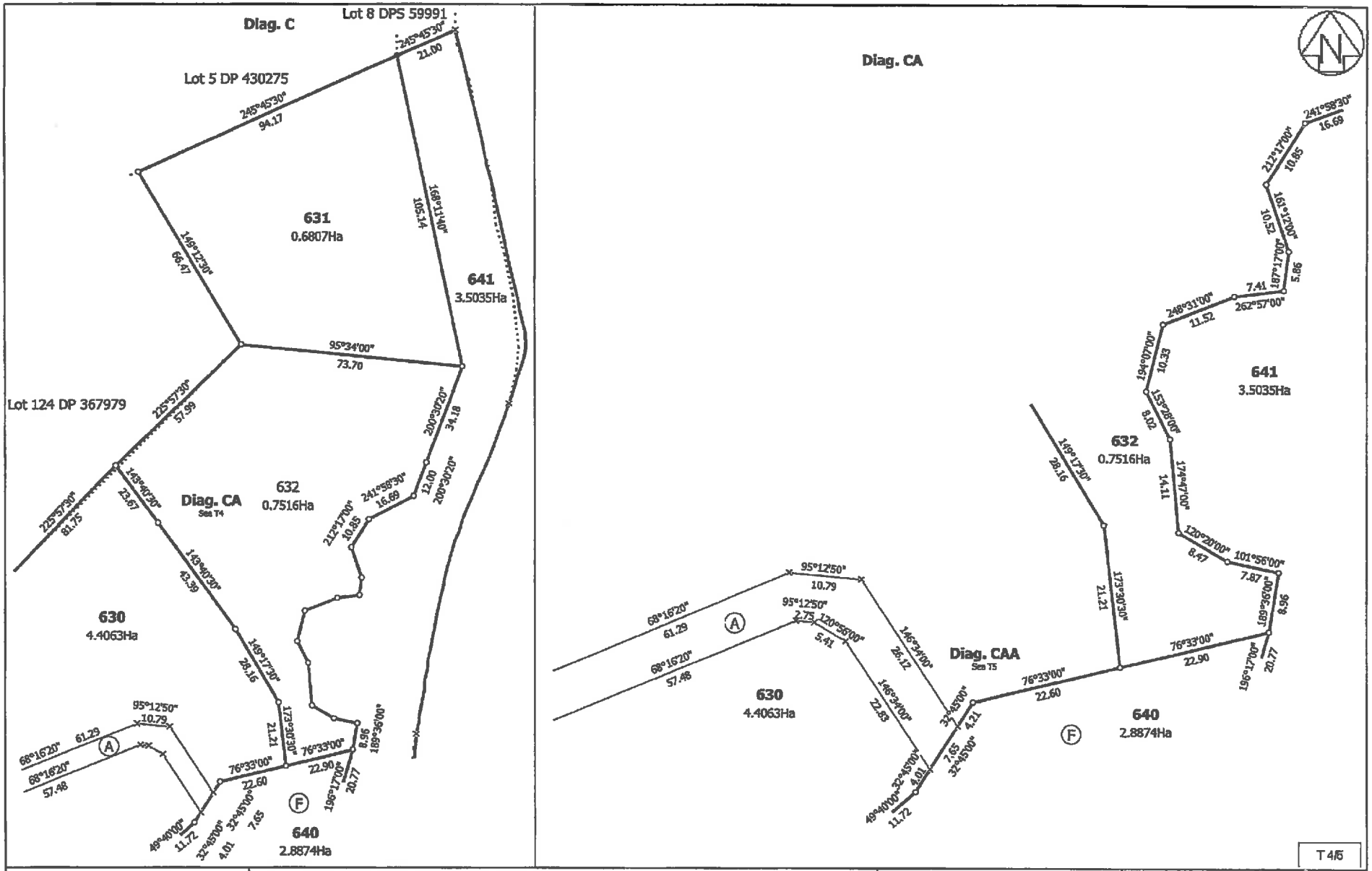
Land District: South Auckland Digitally Generated Plan Generated on: 06/08/2014 09:46am Page 3 of 7	Lots 630, 631, 632, 636, 637, 640 and 641 being a Subdivision of Lot 517 DP 412452	Surveyor: Richard Douglas Hewison Firm: Hewison Consultants	Title Plan LT 475690 Approved on: 6/08/2014



Land District: South Auckland Digitally Generated Plan Generated on: 08/08/2014 09:46am Page 4 of 7	Lots 630, 631, 632, 636, 637, 640 and 641 being a Subdivision of Lot 517 DP 412452	Surveyor: Richard Douglas Hewison Firm: Hewison Consultants	Title Plan LT 475690 Approved on: 6/08/2014



Land District: South Auckland Digitally Generated Plan Generated on: 06/08/2014 09:46am Page 5 of 7	Lots 630, 631, 632, 636, 637, 640 and 641 being a Subdivision of Lot 517 DP 412452	Surveyor: Richard Douglas Hewison Firm: Hewison Consultants	Title Plan LT 475690 Approved on: 6/08/2014


Diag. C
Lot 8 DPS 59991
Lot 5 DP 430275
Lot 124 DP 367979
631
0.6807Ha
641
3.5035Ha
632
0.7516Ha
630
4.4063Ha
640
2.8874Ha
Diag. CA
See T4
Diag. CAA
See T5
245°45'30"
21.00
94.17
168°11'40"
105.14
149°12'30"
66.41
95°34'00"
73.70
225°57'30"
57.99
81.75
149°40'30"
23.67
43.39
149°17'30"
26.16
173°30'30"
21.21
95°12'50"
10.79
68°16'20"
61.29
57.48
76°33'00"
22.90
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8.96
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11.72
32°45'00"
4.01
7.65
200°30'20"
34.18
12.00
241°58'30"
16.69
212°17'00"
10.85
241°58'30"
16.69
212°17'00"
10.85
191°12'00"
10.52
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22.83
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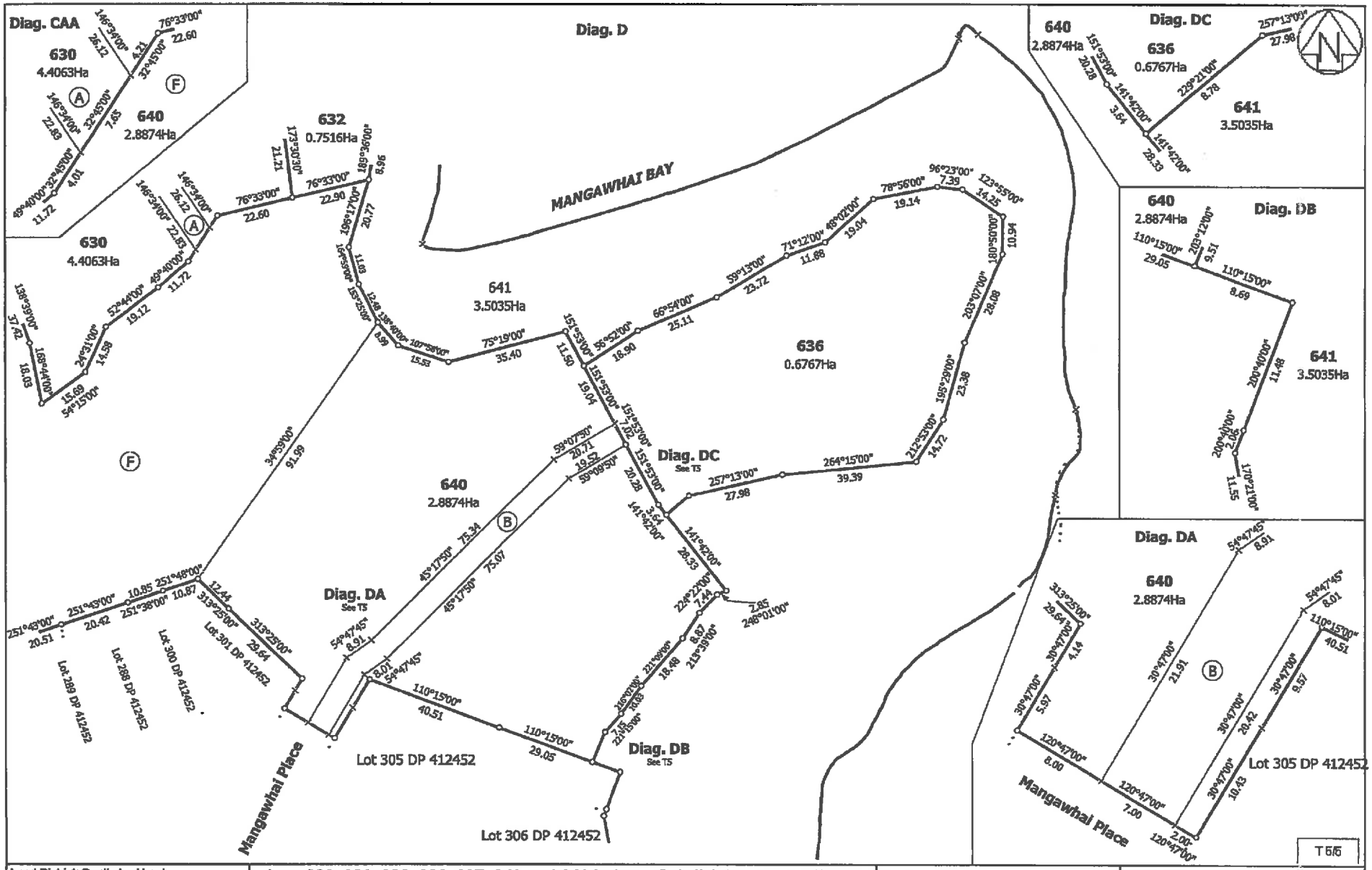
120°56'00"
4.21
Land District: South Auckland
Digitally Generated Plan
Generated on: 06/08/2014 09:48am Page 6 of 7
Lots 630, 631, 632, 636, 637, 640 and 641 being a Subdivision of Lot 517 DP 412452
Surveyor: Richard Douglas Hewison
Firm: Hewison Consultants
Title Plan
LT 475690
Approved on: 6/08/2014
T 4/5



Land District: South Auckland Digitally Generated Plan Generated on: 06/08/2014 09:48am Page 7 of 7	Lots 630, 631, 632, 636, 637, 640 and 641 being a Subdivision of Lot 517 DP 412452	Surveyor: Richard Douglas Hewison Firm: Hewison Consultants	Title Plan LT 475690 Approved on: 6/08/2014