Project Reference: 20995

Revision A

14/03/2025

C/- Scott Wilkinson Planning
Attention: Mr R Scott

Dear Robert

A Proposed Private Plan Change for 70, 70A and 70B Lisle Farm Drive, Pukekohe.

1 Scope

This report contains a preliminary overview of the geological setting of the setting of the above site (comprising land legally described as Lot 1 DP 169148, Lot 1 DP 143272 and Lot 2 DP 143272) to identify perceived geotechnical constraints for a proposed Private Plan Change for residential intensification of the land. Our work involved:

- Reviewing published geological maps and available aerial photographs
- Visiting the site to inspect the landform and mapping geomorphological features.
- Drilling four hand auger boreholes to depths of up to 3.0m.

2 SITE DESCRIPTION AND DEVELOPMENT PROPOSAL

The study area includes approximately 19.2 Ha of land, generally sloping to the east and south. A ridgeline flanked by arcuate depressions, hummocky features and soil creep form the edges and heads of various incised gullies in the centre, eastern and southern portions of the site.

There are no existing council service lines shown on the Auckland Council GIS system at this site. There is one existing residential dwelling located in the north-east portion of the site, with two farm structures located across the site. The remainder of the site is grassed pasture.

Scheme Plans have not been provided at this stage; however, we understand that the client is requesting the land currently zoned Future Urban Zone (FUZ), rezoned to Mixed Housing Urban in accordance with Plan Change 78.

3 GEOLOGY OVERVIEW

A review of GNS digital QMAP's indicated the site if underlain by the South Auckland Volcanic Field. The site is largely covered by ash, lapilli and lithic tuff, with basalt lava flows in the north-east portion (although these are expected to be at depth under a thick soil mantle).

4 AERIAL PHOTOGRAPH INTERPRETATION (API)

A review of historic aerial photographs indicated that the site has been in pasture with some pockets of bush since at least 2001 (earliest aerial image from Auckland GIS Maps). It is apparent that vegetation may have been planted between 2003/2004 (see insert A below) and 2010/2011 (see insert B below) in the gully to the east of the site.

Insert A (left): Aerial image from 2003/2004 showing northeast portion of site. *Image retrieved from Auckland Council Geomaps on 10.03.22*

Insert B (below): Aerial image from 2010/2011 showing northeast portion of site. *Image retrieved from Auckland Council Geomaps on 10.03.22*

Features indicative of slope instability are notable with the 2001 images and are consistently present through the imagery into the present day, and there are no obvious signs of active large scale land sliding over that period.

5 SUMMARY OF GROUND CONDITIONS

Four preliminary hand auger boreholes (records attached) were undertaken on the competent ridgeline, in the locations shown on Figure 1 (attached).

5.1 Topsoil

Topsoil was encountered to depths of 0.1m.

5.2 Ash Deposits

South Auckland Volcanic Field ash soils were encountered in all boreholes. These deposits generally comprised of very stiff to hard, orange, brown, yellow, grey and red clays and silts. Undrained shear strength readings ranged from 68kPa to 206+kPa, indicating stiff to hard soils, occasionally with the shear vane unable to penetrate the soil.

5.3 Groundwater

Groundwater was not encountered in any of the boreholes drilled to the depths drilled at the time of drilling.

5.4 Liquefaction

The Auckland Council Geomaps Viewer indicates that the site has 'Very Low Liquefaction Vulnerability' based on Level A Basic Assessment and Level B Calibrated Assessment.

6 GEOMORPHOLOGICAL OBSERVATIONS

In conjunction with the API, a walkover of the site was undertaken on the 16 February 2022 to observe and map geomorphology (Refer Figure 02) and assess any perceived constraints to the proposed development.

Our findings are summarised as follows:

6.1 Overview

The broad main dividing ridgeline runs generally south-east to east through the site. This is generally comprised of relatively flat land and is considered to be geotechnically competent. Four large instability features are inferred on the northern and southern flanks of the ridge, with several minor circular (arcuate) failures observed on the banks of the many tributary gullies associated with these slips. Each of these larger features extend from just below the ridgeline (i.e. the heads of the tributary gullies) to the main watercourse below and comprise a large portion of the site.

6.2 North-Eastern Portion of the Site

The north-eastern portion of the site, located east of the ridgeline and comprises elevated steep slopes (generally greater that 1(v) in 4(h), with evidence of larger scale land movement (deeper seated) east of the ridgeline and gully flanks.

Within the south-western portion of this area, a large arcuate (relict) landslide is present with soil creep (gradual, shallow seated movements of the steeper slopes. Soil creep is a function of expansive soil movements caused by shrink-swell between seasons and gravity, exacerbated by the movement of livestock (commonly referred to as 'sheep tracks').

Within the north-eastern portion of this area, a large arcuate landslide is present, with a large associated debris flow. A large debris lobe was identified here.

Landform within the southern portion of this area is hummocky, likely caused by historic land movements, and/or groundwater springs / overland flow erosion. Reeds identified near the southern most slip indicative of a high groundwater and subsequently an active slip area.

These features will present constraints to development and are outlined further in Section 7 below.

Photo 1: Typical steep hillside with soil creep with gully.

Photo 2a &b: Typical large scale slope instability features with reeds indicative of high groundwater.

Photo 3a & 3b: Typical soil creep on steeper portions and inferred instability (leaning trees) on hummocky ground.

6.3 Southern Portion of the Site

The southern portion of the site comprises elevated steep slopes (steeper than 1(v) in 4(h), south of the ridgeline, with large scale land movement near the ridgeline and gully flanks, becoming steeper towards the base of the gully.

A large arcuate slip (likely to be relict) is located in the south-western portion of the site, with minor circular failures below. Soil creep is more prevalent on the western portion of the slip and becomes more widespread as the terrain becomes steeper. A larger active slip is located east of the slip discussed above, with soil creep below. Minor slips are located downslope with steepening of the topography. An area of reed growth was identified towards the low-lying south portion of this area, indicating possible high groundwater.

Photo 4: Typical steep slope with arcuate slip beneath ridgeline.

Photo 5a & b: Typical of soil creep and gully with large scale slope instability.

6.4 Central Portion of the Site

The central portion of the site comprises elevated steep slopes (approximately 1(v) in 3(v), with large scale land movement near the ridgeline and gully flanks.

A large active arcuate slip is located west of the gully, beneath the existing residential dwelling. Soil creep is noted across the slopes, additionally numerous smaller active and relic slips downslope of the large arcuate slip and an associated debris flow. Three drainage pipes associated with the existing dwelling were observed upslope of crest of the slip, creating associated overland flow paths scouring the area directly below. Reeds were observed at the base of the slope near the tributary gully indicating high groundwater.

Photo 6: Arcuate slip located west of the gully, below the ridgeline.

Photo 7a & b: Typical soil creep and shallow instability on steeper portion of the site.

7 GEOTECHNICAL ENGINEERING CONSIDERATIONS

7.1 General

Based on our site observations and as depicted on the attached Geomorphic Hazard Map (see Figure 03). The main geotechnical constraints to the development on this site relates to slope instability. We have used a ‘traffic light’ system to show identified areas of inferred low (Area A; green) and medium (Area B; yellow) geotechnical risk of slope instability, with the remainder of the site (Area C; red) being classified as containing ground that is inherently steep, and/ or already contains geomorphic signs of slope instability, and/ or is in close proximity to such ground. Further details are given on Figure 03, which is summarised as follows:

- Area A (Low Risk): Suitable for build NZS3604-type structures with little to no geotechnical inputs required on account of slope instability; slope gradients flatter than 1(v) in 4(h) and no obvious geomorphic signs of slope instability.
- Area B (Medium Risk): Generally containing slope gradients steeper than 1(v) in 4(h) and/ or close proximity to steeper slopes and/or geomorphic instability features and/ or displays evidence of soil creep; requires geotechnical site investigations and analyses on account of slope stability.
- Area C (High Risk): Considered too steep and/or contains obvious signs of larger scale slope instability that would likely preclude economical residential development.

8 TYPICAL GEOTECHNICAL ENGINEERING

8.1 Foundations for Buildings

Where inorganic and competent (firm to stiff) natural ground is present, bearing capacity is expected to be in accordance with the limitations imposed by NZS3604 (i.e. 300 kPa geotechnical ultimate). This assumes portions of the land will be modified during subdivision development to ease slope gradients to less than 1(v) in 4(h), thereby minimising the propensity for soil creep, etc. It also assumes development upon (or near) land displaying geomorphic signs of slope instability will be geotechnically investigated and remediated where required to deal with on-going slope stability risks.

- The soils are likely to fall within AS2870 Class H1 (high) to Class M (medium) expansive site class, and this is subject to laboratory testing of soil samples collected during later more intensive investigations for the Resource Consent phase(s). Foundation design for end users will need to mitigate adverse effects from expansive soils.

8.2 Ground Stability

Significant portions of the site are steeply incised by gully features or steep sided ridgelines which display signs of shallow seated soil creep, slumping and large-scale instability, and some places are low lying and associated with watercourses, which will contain soft and saturated sedimentary infill. Outside of such areas the land is defined by a broad competent ridgeline, and this shows no obvious geomorphic signs of ground instability.

- Consideration to development setbacks from incised gully flanks and areas displaying signs of slope instability will need to be assessed during detailed geotechnical site investigations of the land for Resource Consent.

- Areas that may be at risk from falling debris from any steep slopes above will need to be identified and risks to development below such areas established.

- Low lying area and/ or areas containing soft sedimentary infill generally comprise gully inverts and should be avoided to reduce ground stability risks from consolidation settlement or potential liquefaction. However, it is envisaged such areas will not be developed upon and will be preserved for ecological and stormwater management aspects.

- Where adequate setbacks cannot be achieved to mitigate slope instability risks, engineering intervention such as bulk earthworks (e.g. shear keys or buttress fills, and/ or remediation of slip areas), counterfort drains, palisade pile walls (i.e. in-ground retaining) can be designed and employed to mitigate slope instability. In soft ground areas, drainage and/ or ground improvements techniques (such as removing soft soils and reinstatement with stronger materials, drainage and pre-loading, etc). Refer attached Figure 4 for illustration of these concepts.

- Figure 5 attached shows a concept arrange where some of the measures described above (i.e., buttress fills, shear keys, underfill and counterfort drains) can be formed in the heads of incised gully features, sympathetically to the ecological features (identified in the Wildlands Limited report), to improve global stability and effectively arrest long term retrogressive movements of the gully head. Such measures will improve global stability of development above and minimise the long-term potential for sedimentation of the downstream receiving environment from the ongoing retrogressive erosion that would otherwise occur if the buttress fills were not constructed.

- In any event, engineering measures will be dependent on the findings of a detailed geotechnical site investigation that is commensurate with the subdivision scheme and earthworks proposals, and therefore subject to detailed design.

8.3 Earthworks and Infrastructure

The natural deposits encountered across the site (saturated gully sedimentary infill aside) are typically expected to have relatively high strength and have good engineering characteristics for foundations and earthwork handling, as has been experienced during the development of various Pukekohe subdivisions nearby.

- The materials can be sensitive to disturbance during earthworks and repetitive trafficking from heavy machinery, and this is particularly relevant where works are in gully bases or near such areas (i.e. where the water table is expected to be relatively high, and sedimentary infill soils may prevail – however as mentioned in section 8.2 above, it is unlikely that earthworks will extend into such areas). Careful site management, subsoil drainage and drainage blankets / underfill drains have been effective in dealing with these issues at the nearby Pokeno subdivisions under construction (or recently completed). If there are deeper cuts, it is likely to require conditioning prior to placement as filling, since insitu moisture contents will likely be higher than those required for optimum compaction.

- Deep trenches are prone to collapse especially where ground water conditions change rapidly, and the materials are less cohesive, but this risk can be minimised by appropriate shoring or battering as required by legislation and safe construction practices.

- It is anticipated that “shallow” cuts for bulk earthworks required to facilitate future residential intensification of the land would not encounter rock, but “deep” cuts might and should therefore be specifically investigated as part of a Resource Consent application.

- Road subgrades are prone to degradation once exposed to the elements but is normally dealt with by engineering design (e.g. subgrade improvement via undercutting and replacement, or lime stabilising, construction sequencing to reduce subgrade exposure time, etc.).

- High allophane content is associated with the surficial ash derived soils and appropriate earthworks methodologies specific to subsequent subdivisional plans should be recommended to mitigate any problems associated with the placement and compaction of these soils.

- Underfill drainage is usually adopted to control natural groundwater seepages in the various drainage features that may be modified during development. They generally pose no constraints to end use if they are buried deep within engineered fills, or if this is not possible, they can be aligned to site boundaries to avoid future building platforms.

- If slip areas are to be remediated during the subdivision, then they may contain weak ground at residual strength and special measures are normally required to minimise localised short term instability during construction (e.g. benching out to reduce destabilising loads and/ or special geotechnical drainage to relieve insitu porewater pressures).

9 FURTHER WORK

This report is intended to provide an initial geotechnical overview to advance a submission of the Proposed Private Plan Change, by highlighting perceived geotechnical constraints. In due course earthworks and construction plans will be developed, if the project progresses to Resource Consent application stage.

Once the ground model is proven commensurate with a development / earthworks scheme, engineering solution concepts for prevailing instability areas can be established. As already mentioned in section 8.2, a range of geotechnical solutions (dependant on ground proving results) to treat perceived slope stability constraints are depicted on Figure 04 and a concept design illustrating buttress fills / shear key / drainage solutions at the gully heads is also given on Figure 5 (both attached).

10 CONCLUSIONS

In summary, the site comprises topography and ground conditions that is steep in places and shows evidence of slope instability and of lesser concern is likely prone to settlement in other places such as the low-lying areas and inverts of watercourses.

Provided there is consideration to prevailing or perceived geotechnical issues during detailed site investigations for Resource Consent, then the study area as defined herein is considered suitable for residential intensification.

11 RECOMMENDATIONS

The assessments presented in this report are based on a desktop review and preliminary visual inspections, plus a limited number of shallow borehole tests on the prevailing landform.

It is recommended that:

- To support future development (i.e. Resource Consent / Subdivision design), further physical geotechnical site investigations that are commensurate with subdivision and earthworks scheme(s) should be undertaken to substantiate ground conditions and address any geotechnical constraints. Such investigations are expected to comprise (but are not limited to) detailed geomorphic mapping, hand auger boreholes, trial pits, rotary cored machine boreholes, CPT or DMT soundings, and soil sampling for laboratory testing.

- Appropriate laboratory soil testing is undertaken to characterise engineering and earthworks handling properties. In addition, effective stress tri-axial testing may be warranted to support design assumptions for slope stability analyses and/ or any engineering remediation design that may result.

12 LIMITATIONS

This letter has been prepared exclusively for with respect to the brief given to us. Information, opinions, and recommendations contained in it cannot be used for any other purpose or by any other entity without our review and written consent. LDE Ltd accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report by any third party.

This report was prepared in general accordance with current standards, codes, and practice at the time of this report. These may be subject to change.

This report should be read in its entirety to understand the context of the opinions and recommendations given.

For and on Behalf of Land Development and Engineering Ltd

Report prepared by:

Marina Burton
Engineering Geologist

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S. G Lander
Principal Geotechnical Engineer
CMEngNZ, CPEng, IntPE(NZ)

Rev A updated by Jasmine Lam 14/03/2025.

<u>Attachments</u>

- Hand Auger Borehole Records
- Figure 01: Site Investigation Plan
- Figure 02: Geomorphic Map
- Figure 03: Geomorphic Hazard Map
- Figure 04: Geotechnical Engineering Concepts
- Figure 05: Concept Design – Buttress Fill / Shear Key

Client : STEPHEN SMITH

Project Location : 70, 70A & 70B LISLE FARM DRIVE, PUKEKOHE

Job Number: 20995

Auger Borehole No. HA 01

Sheet 1 of 4

Vane Head:	Logged By:	Processor :	Date:
2784	MB / JL	MB	16.02.22

Borehole Location:	mN	mE	Ground R.L.
	Description: Refer to site plan		

SOIL DESCRIPTION	Legend	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL						
clayey SILT with trace fine sand, yellow/brown. Very stiff, dry to moist, low plasticity, moderately sensitive [ASH]						
becoming orange streaked yellow/brown, with trace limonite		0.5		124/60	2.1	
		1.0		68/37	1.8	
silty CLAY, brown/orange and light grey mottled. Stiff, moist, medium to high plasticity, insensitive						
clayey SILT, red streaked orange and light grey mottled. Very stiff, moist, low plasticity, moderately sensitive						
		1.5		171/59	2.9	
becoming light brown						
becoming wet, medium plasticity						
becoming orange/brown, low plasticity		2.0		108/43	2.5	
		2.5		140/50	2.8	
becoming red and grey streaked orange/brown						
at 3.0m, becoming hard						
EOB at 3.0m. Target depth.		3.0		206+		
		3.5				
		4.0				
		4.5				
		5.0				
		5.5				
		6.0				

LAND DEVELOPMENT & ENGINEERING

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: SL

Topsoil	Sand	Sandstone	Plutonic
Fill	Gravel	Siltstone	No Core
Clay	Organic	Limestone	
Silt	Pumice	Volcanic	

Client : STEPHEN SMITH

Project Location : 70, 70A & 70B LISLE FARM DRIVE, PUKEKOHE

Job Number: 20995

Auger Borehole No. HA 02

Vane Head:	Logged By:	Processor :	Date:
2784	MB / JL	MB	16.02.22

Borehole Location:	mN	mE	Ground R.L.
	Description: Refer to site plan		

SOIL DESCRIPTION	Legend	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL						
clayey SILT, orange/brown. Very stiff to hard, dry to moist, low plasticity [ASH]						
becoming hard		0.5		UTP		
becoming very stiff, moist, with trace fine sand						
becoming red streaked orange/brown, hard		1.0		206+		
becoming red/orange						
becoming very stiff, insensitive		1.5		131/85	1.5	
becoming wet						
		2.0		119/62	1.9	
becoming moderately sensitive		2.5		148/66	2.2	
		3.0				
EOB at 3.0m. Target depth.						
		3.5				
		4.0				
		4.5				
		5.0				
		5.5				
		6.0				

LAND DEVELOPMENT & ENGINEERING

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: SL

Topsoil	Sand	Sandstone	Plutonic	
Fill	Gravel	Siltstone	No Core	
Clay	Organic	Limestone		
Silt	Pumice	Volcanic		

Client :	STEPHEN SMITH	**Auger Borehole No.**	HA 03
Project Location :	70, 70A & 70B LISLE FARM DRIVE, PUKEKOHE	Sheet	3 of 4
Job Number:	20995		

Vane Head:	Logged By:	Processor :	Date:
2784	MB / JL	MB	16.02.22

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
clayey SILT with trace fine sand, yellow/brown. Hard, dry to moist, low plasticity, with trace rootlets to 0.4m [ASH]					
becoming orange mottled light brown					
	0.5		206+		
becoming brown/orange, moist, low to medium plasticity					
becoming light yellow streaked brown/red	1.0		UTP		
becoming black and light grey streaked brown/red					
becoming very stiff, moderately sensitive	1.5		152/74	2.1	
becoming wet					
becoming stiff, insensitive	2.0		80/43	1.9	
becoming moderately sensitive	2.5		80/38	2.1	
at 3.0m, becoming insensitive	3.0		71/40	1.8	
EOB at 3.0m. Target depth.					
	3.5				
	4.0				
	4.5				
	5.0				
	5.5				
	6.0				

LAND DEVELOPMENT & ENGINEERING

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: SL

Topsoil	Sand	Sandstone	Plutonic
Fill	Gravel	Siltstone	No Core
Clay	Organic	Limestone	
Silt	Pumice	Volcanic	

Client : STEPHEN SMITH

Project Location : 70, 70A & 70B LISLE FARM DRIVE, PUKEKOHE

Job Number: 20995

Auger Borehole No. HA 04

Vane Head:	Logged By:	Processor :	Date:
2784	MB / JL	MB	16.02.22

Borehole Location:	mN	mE	Ground R.L.
	Description:	Refer to site plan	

SOIL DESCRIPTION	Legend	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL	Topsoil					
clayey SILT, yellow/brown. Very stiff to hard, moist to dry, low plasticity [ASH]	Silt					
becoming hard		0.5		206+		
becoming yellow mottled orange/brown, moist						
becoming red mottled orange/brown		1.0		206+		
		1.5		UTP		
becoming red						
becoming yellow streaked red		2.0		UTP		
		2.5		UTP		
EOB at 3.0m. Target depth.		3.0		UTP		
		3.5				
		4.0				
		4.5				
		5.0				
		5.5				
		6.0				

LAND DEVELOPMENT & ENGINEERING

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: SL

Topsoil		Sand		Sandstone		Plutonic	
Fill		Gravel		Siltstone		No Core	
Clay		Organic		Limestone			
Silt		Pumice		Volcanic			

Legend and/or Notes:

3m Hand Auger Borehole

BASEMAP FROM AUCKLAND COUNCIL GIS. RETRIEVED ON 02.03.22.

revision	description	drawn	approved	date

Horizontal Scale (metres): 0, 30.0, 60.0, 90.0, 120.0

Vertical Scale (metres): 0, 30.0, 60.0, 90.0, 120.0

drawn	MB
approved	SL
date	02/03/22
scale	1:2500
original size	A3

LAND DEVELOPMENT & ENGINEERING

client: STEPHEN SMITH

project: 70, 70A & 70B LISLE FARM DRIVE, PUKEKOHE

title: SITE INVESTIGATION PLAN

project no: 20995 | figure no: 01

Template revision: 1:2000 (10/12/14)

Legend and/or Notes:

- Scarp
- Active Scarp
- Bench
- Soil Creep
- Hummocky Ground
- Reeds

BASEMAP FROM AUCKLAND COUNCIL GIS. RETRIEVED ON 02.03.22.

revision	description	drawn	approved	date

0 30.0 60.0 90.0 120.0
Horizontal Scale (metres)

0 30.0 60.0 90.0 120.0
Vertical Scale (metres)

drawn	MB
approved	SL
date	02/03/22
scale	1:2500
original size	A3

LDE LAND DEVELOPMENT & ENGINEERING

client: **STEPHEN SMITH**

project: **70, 70A & 70B LISLE FARM DRIVE, PUKEKOHE**

title: **GEOMORPHIC MAP**

project no: **20995** figure no: **02**

Template revision: 1:2000 (10/12/14)

Legend and/or Notes:

Area A:
Definition: Ground generally having slope gradients flatter than 1(v) in 4(h) and without obvious signs of slope instability or inferred moeified ground.
Implication: Minimal further geotechnical engineering works anticiptaed to form suitable building platforms for NZGS3604 type development.

Area B:
Definition: Ground generally having slope gradients greater than 1(v) in 4(h) but flatter than 1(v) in 2(h) and/or ground with inferred shallow or small scale slope instability and/or ground immediately upslope of inferred slope stability, and/or containing inferred ground modified features such as overland flow paths.
Implication: Further geotechnical investigation required to confirm likely extends of modified ground and/or prevailing slope stability conditions. Geotechnical engineering works anticipated to form suitable building platforms for NZGS3604 type development may include geotechnical (counterfort drainage) and/or palisade walls etc. which are subject to specific geotechnical investigation and design.

Area C:
Definition: Ground generally having slope gradients greater than 1(v) in 2(h) and/or inferred deep seated slope instability features.
Implication: Significant further geotechnical investigation required to confirm prevailing slope stability conditions. Geotechnical engineering works anticiptaed to form suitable building platforms for NZGS3604 type development will likely be substantial and extensive, and may include shear keys, bulk earthworks, and geotechnical drainage and will be subject to specific geotechnical investigation and design.

Note: All zoning subject to reevaluation based on further geotechnical investigation and assessment.

Geomorphology:

Scarp
Soil Creep
Active Scarp
Hummocky Ground
Bench
Reeds

BASEMAP FROM AUCKLAND COUNCIL GIS. RETRIEVED ON 02.03.22.

revision	description	drawn	approved	date

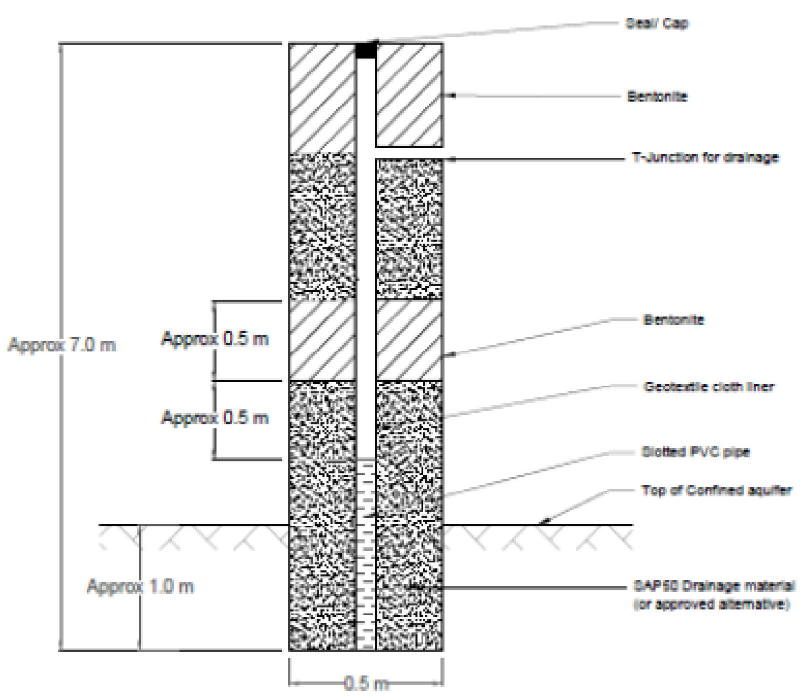
0 30.0 60.0 90.0 120.0
Horizontal Scale (metres)
0 30.0 60.0 90.0 120.0
Vertical Scale (metres)

drawn	MB
approved	SL
date	02/03/22
scale	1:2500
original size	A3

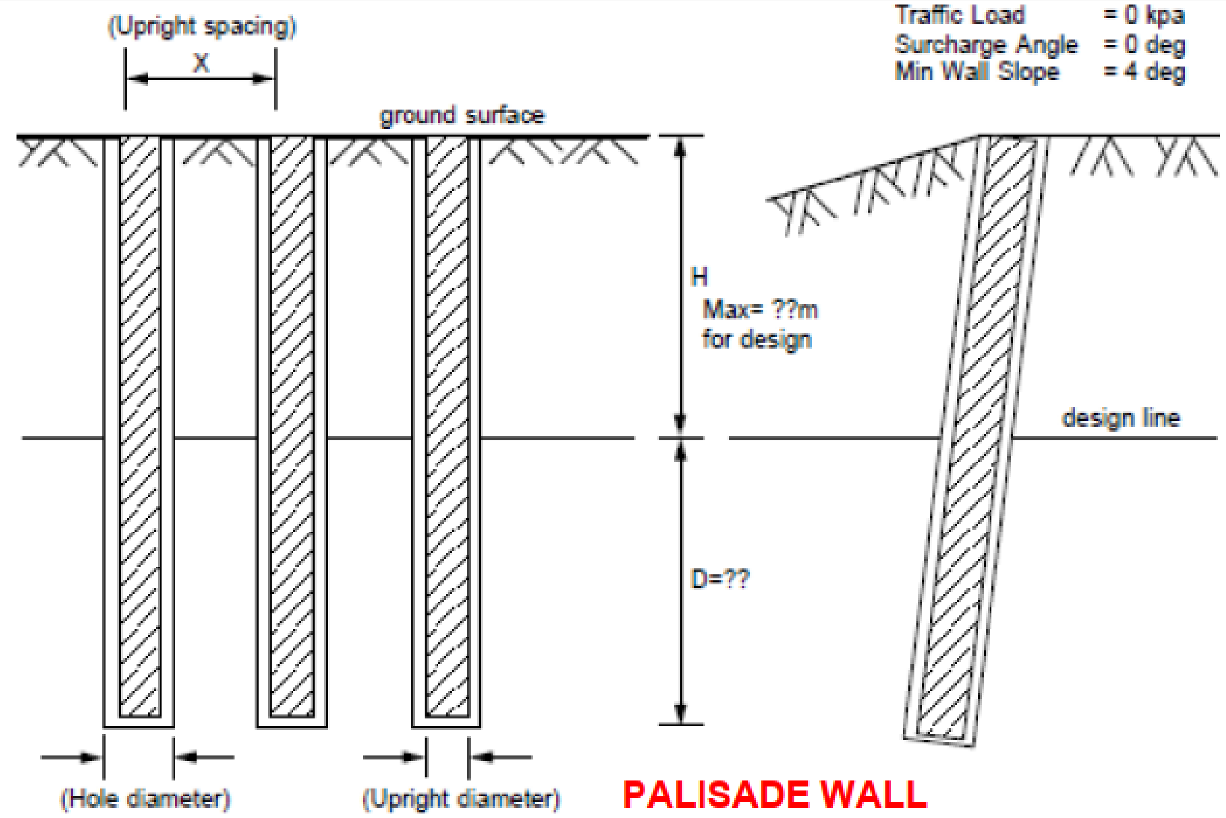
LDE LAND DEVELOPMENT & ENGINEERING

client: STEPHEN SMITH
project: 70, 70A & 70B LISLE FARM DRIVE, PUKEKOHE
title: GEOMORPHIC HAZARD MAP
project no: 20995 figure no: 03

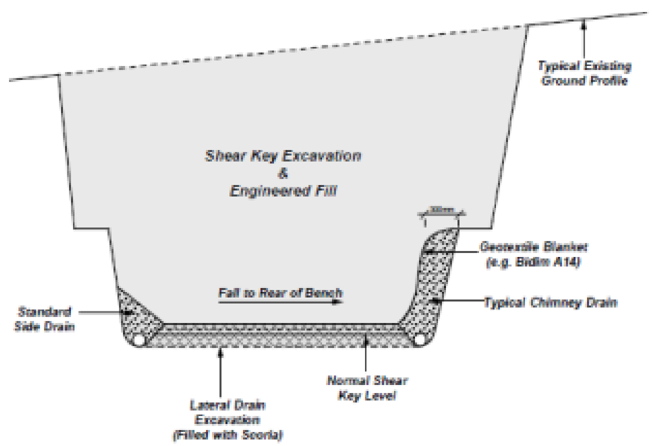
Template revision: 1:2000 (10/12/14)



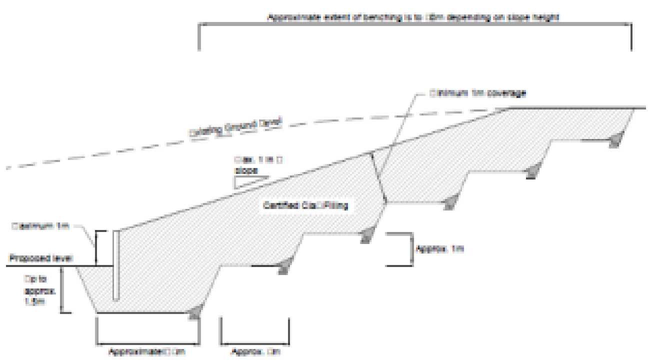
VERTICAL PRESSURE RELIEF WELL



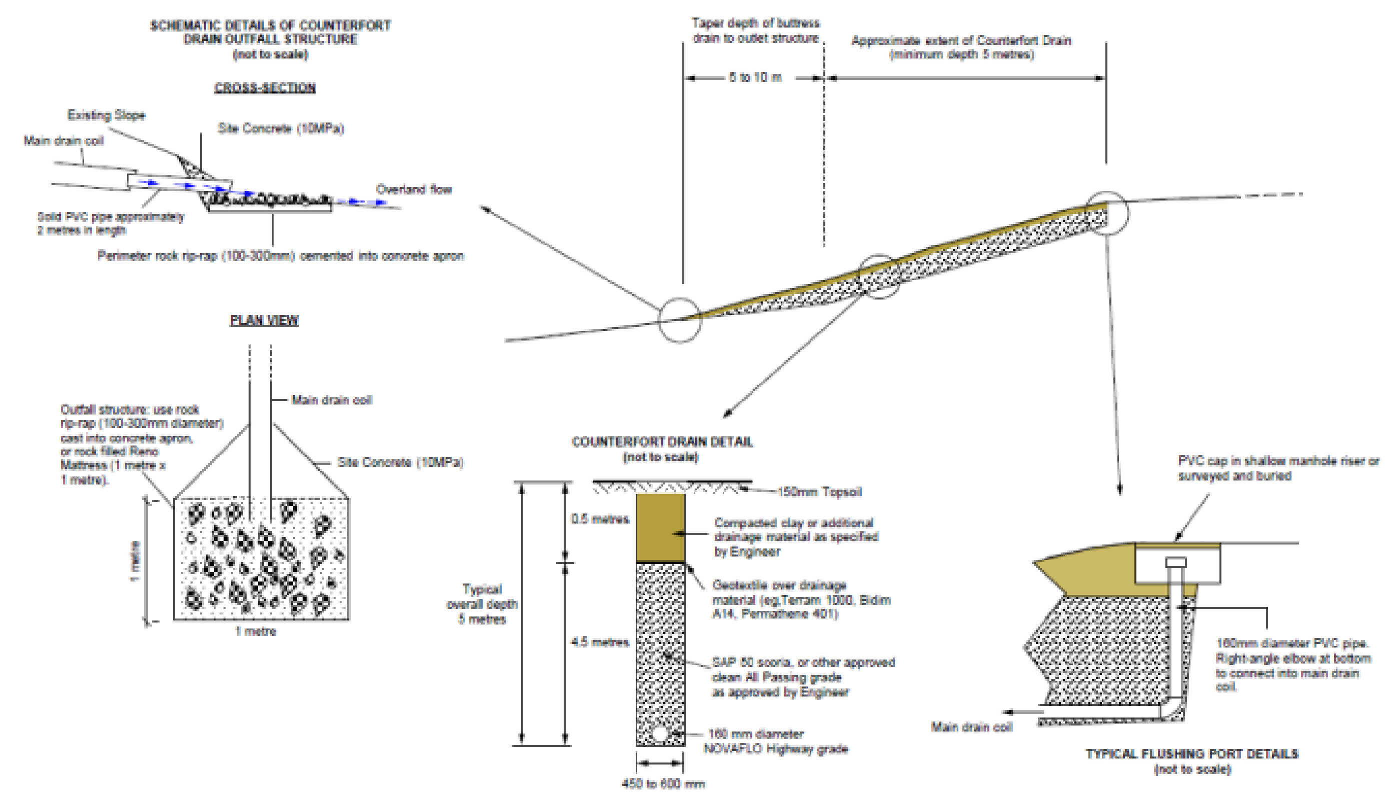
PALISADE WALL



SHEAR KEY



BUTTRESS FILL



COUNTERFORT DRAIN

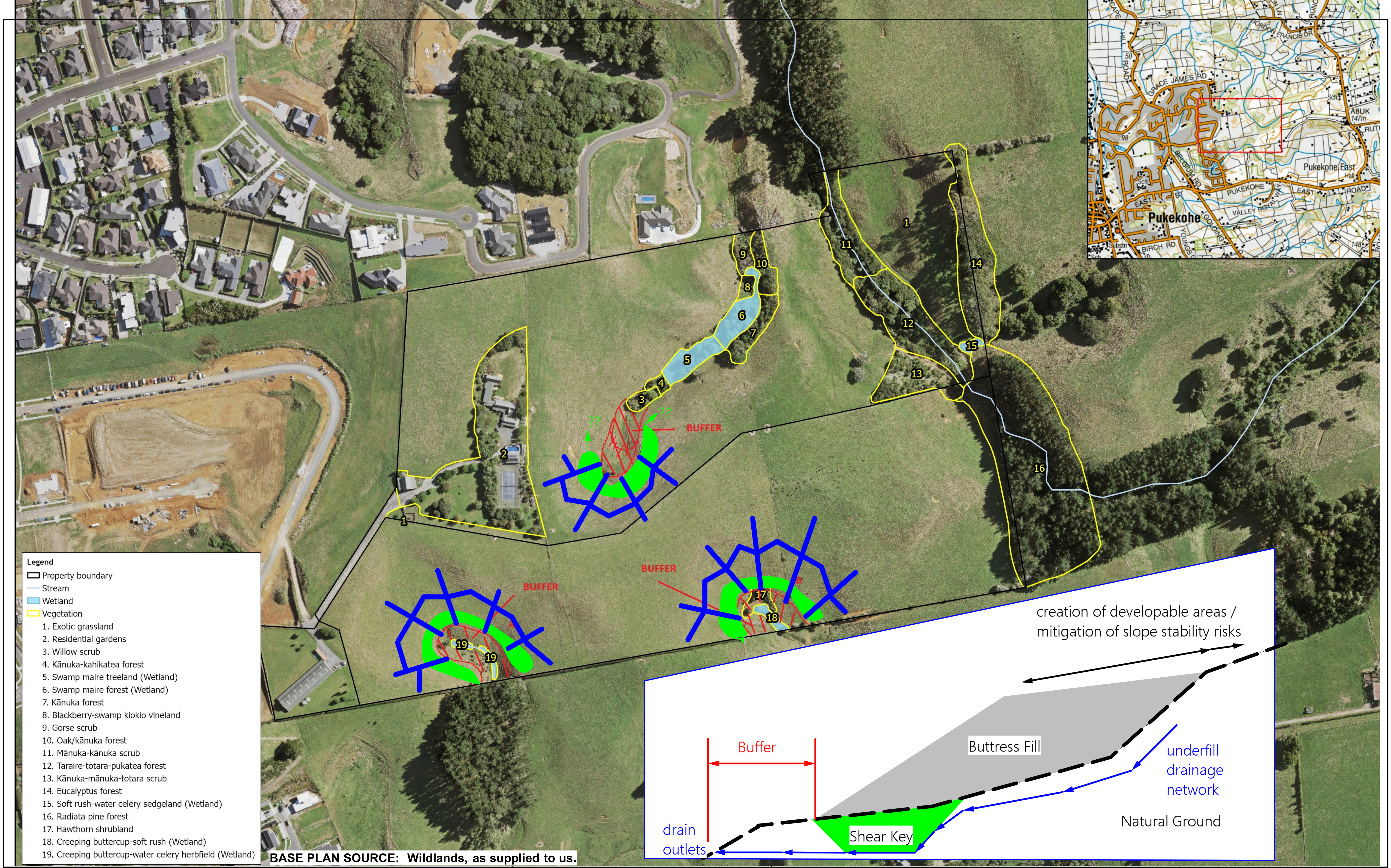
revision	description	drawn	approved	date

FOR DISCUSSION

drawn	MB
approved	SL
date	10/03/22
scale	NTS
original size	A3

LAND DEVELOPMENT & ENGINEERING

client:	STEPHEN SMITH
project:	70, 70A & 70B LISLE FARM DRIVE, PUKEKOHE
title:	GEOTECHNICAL ENGINEERING CONCEPTS
project no: 20995	figure no: 04



BASE PLAN SOURCE: Wildlands, as supplied to us.

revision	description	drawn	approved	date

0 45.0 90.0 135.0 180.0
Horizontal Scale (metres)

0 45.0 90.0 135.0 180.0
Vertical Scale (metres)

drawn	SL
approved	SL
date	13/04/22
scale	1:3000
original size	A3

LAND DEVELOPMENT & ENGINEERING

client: **STEPHEN SMITH**

project: **70, 70A & 70B LISLE FARM DRIVE, PUKEKOHE**

title: **CONCEPT DESIGN - BUTTRESS FILL / SHEAR KEY**

project no: **20995** figure no: **5**

Template revision: 1:2000 (10/12/14)