GUMBOOTS
CONSULTING ENGINEERS

Geotechnical Appraisal Report

20 Waianga Place, Omapere

For

Michelle French

Ground and site feasibility for proposed development
Gumboots Consulting Engineers reference 1057

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Revision History

Revision Nº	Prepared By	Description	Date
A	Kelly Wright	Geotechnical Appraisal Report	02 June 2020

On behalf of Gumboots Consulting Engineers Ltd

Reviewed/Approved by:

Akira Kepu

Geotechnical/Civil Engineer

MEngNZ (1160185)

Member of NZGS & ISSMGE

CONTENTS

Executive Summary

The subsoil conditions on the subject site (Proposed to be deposited - legal description Lot 8 DP 409674) comprise expansive soil characteristics. In accordance with AS 2870, the site (based on soil reactivity under normal moisture conditions) can be classified as, Class H1 (highly-reactive).

The site can be deemed generally suitable for its intended purpose and land can be applicable for a building development and design in accordance with NZS 3604. On the contrary, Expansive Soils are OUTSIDE the provisions of the aforementioned standard.

Consequently, it is recommended that one of the options below can be utilised to fulfill the aforementioned;

1. All structural foundation designs shall be verified/revised by a Chartered Structural Engineer with due regard to the site conditions and environmental settings.
2. Foundation designs can be adopted from B1 Acceptable Solutions - Section 7.5.13.3 Foundation Details.

AS 2870 may be adopted as informative guidance for foundation designs in this case.

Professional opinions and recommendations within this report are based on in-situ field and lab test results, empirical relationships and local experiences.

Introduction

This report has been prepared for Michelle French in accordance with the brief given to us. Where appropriate, it is in accordance with the recommendations of NZS 4404 and Auckland Council - Code of practice for land development and Subdivision; Section 2 - Earthworks and Geotechnical Requirements and related documents.

- Objective and Scope

  The scope of work is to assess the general site suitability and good foundation ground for the proposed minor development. General objectives through our investigations were to ascertain possible construction difficulties, identify land hazards and applicability of land for building in accordance with NZS 3604.

  Limited Liability

  This report has been prepared solely for the benefit of Michelle French our Client with respect to the brief and their intended use thereof. Reliance or use of this report by other parties without prior review and agreement in writing by Gumboots Consulting Engineers Ltd, be at such parties sole risk.

  Field data used in this report were ascertained from limited test positions. The nature and continuity of subsoils away from test locations are inferred and it must be appreciated that actual conditions could vary from those modelled within.

It is recommended that we are notified immediately if final development plans and conditions encountered onsite/(nominated building location) vary from that of this report.

Accordingly, further investigations/observations should then be undertaken as appropriate.

Site Description

The subject property (legal description Lot 8 DP 409674[1]*) is a rectangular shaped block (0.12 ha) located approximately 0.89 km north of Omapere township.

General land is situated at the point of a west trending ridgeline. Hokianga Harbour constitutes the western aspect with Opononi settlement north and Omapere south. The Tangihua Masif provides a sheltering land belt prominently easterly/south easterly.

The property was predominantly grass covered land with generally moderately gentle (~ Avg 5^0) to moderate (~ Avg 14^0) gradients further onto south adjoining lots. The landscapes which are typical of the sedimentary formation within the northland area constitutes the natural land layout as it stands.

Figure 1 and Figure 2 below depicts the site features and site location (respectively) pertaining to the immediate and surrounding environment of the subject lot vicinity.

Hokianga Harbour Drive bounds the wider western aspect (northbound towards Opononi). Access from this point, eastbound at ~ 290m to reach the site. An existing metalled/concreted R.O.W 2 comprises complementary open drain features of which manages stormwater runoff as designated.

Power lines were noted overhead and therefore should be carefully considered when trucking in construction materials.

[1]**Title had not been deposited at the time of the appraisal.*

Figure 1 - Site Features Plan (maps adapted from Quick Map Enterprises and Google Earth Maps)**.**

During the site walkover inspection, NO boggy and/or saturated ground was encountered. During intense rainfall events, it is anticipated that surface water will be absorbed in moderate volumes with the majority as sheetflow east and north bound.

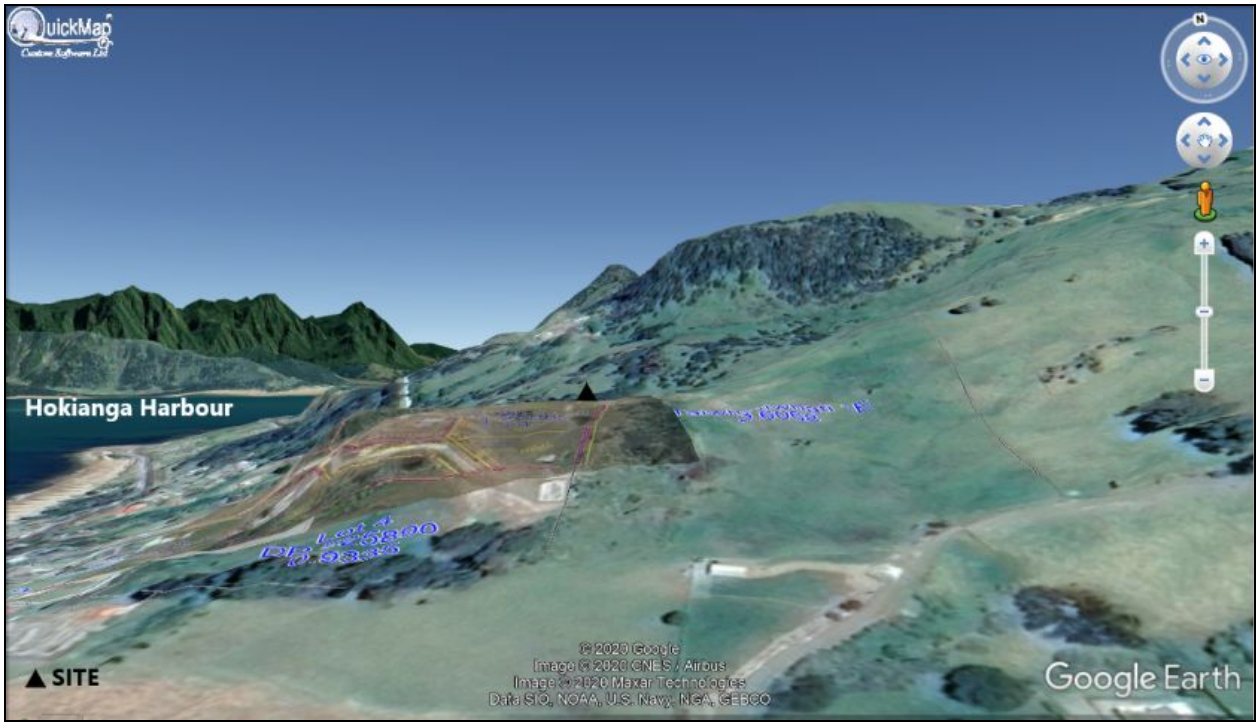


Figure 2 - Site Location Plan (map adapted from NRC Natural Hazards Map)**.**

Site Background

Earthworks had commenced at the time of our site visit. Specifically to the southern half of the Lot, initial site clearing was observed within the wider lot save the proposed new shed platform, as designated by four pegs Indicative of the proposed footprint. Depicted in Figure 3 below.

Figure 3 - Existing Site Plan (adapted from the DroneX Survey)**.**

Additional Fill[2]* material is notably present along the southern portion of the property. The natural land fall within this aspect is generally lower to that of the northern side.

Consequently, the placed fill in this instance created a flattish gradient in contrast to the original land grade.

[2]**Fill - non engineered.*

Figure 4 - Existing Site Plan (adapted from the DroneX Survey)**.**

All in all, the precedent works are outside of the critical area considered within this appraisal. Therefore, the aforementioned is considered as informative within this context. However, subject to critical attention within a development context.

Development Proposal

The proposed development is to erect a steel framed workshop - (L1) Non habitable based on a concrete slab.

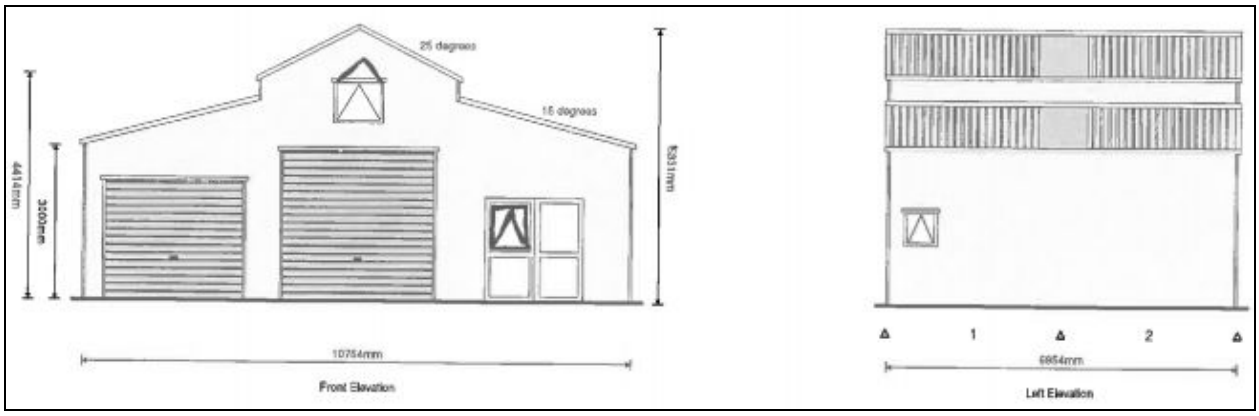


Figure 5 - Development Plan (adapted from Total Span Plans, dated 27/03/2020).

Overall Proposal Outcome

The OPO in this case is the Sustainability of LIFE through Minimal Impact Footprint (MIF) of developments in all aspects.

Geology

The geological information on hand indicates that the site is underlain by Waitiiti Formation - massive to poorly bedded mudstone and sandstone (Mot).

Reference:
Geology of the Kaitaia Area. Institute of Geological & Nuclear Sciences; 1: 250,000 geological map 1.

Lithology

The underlain lithology is Conglomerate ($G5_4$) i.e. rounded, gravel to boulder sized fragments of muddy limestone and basalt in a matrix of volcanic sandstone and interbedded with brown sandstone in places; widely fractured, in places with moderately hard to hard. Weathered to soft reddish brown clay containing moderately soft cores to depths of 20m.

Reference:
NZMS Sheet 290 P 04/05, 1:100,000 scale map, Edition 1, 1982: "*Whangaroa-Kaikohe"* (Rocks).

Subsoils

LandCare Research indicates the soils encountered here as Orthic Brown (BO) which have stable topsoils with well developed polyhedral or spheroidal structure. They cover 43% of New Zealand and are the most extensive soils.

Brown Soils (B)

Occur in places where summer drought is uncommon and that are not water logged in winter. Subsoils are brown (red brown) and yellow-brown underlying dark grey-brown topsoil. The dark colours derive from thin coating of iron oxides weathered from the parent material.

Soils have large active populations of soil organisms, particularly earthworms. Mica, Illite and Vermiculite are the dominant minerals. The soils are *slow to imperfectly drained*.

More reference can be noted that these soils are of the Rolling and Hilly Land comprising, Omanaia clay loam with coarse structured subsoil - *imperfectly to very poorly drained*.

All in all it can be concluded that the soils encountered here, more greatly reflect the historical effects of local conditions.

Reference

Manaaki Whenua LandCare Research: New Zealand Soil Classification (NZSC) - Soil Order.

New Zealand Land Inventory - NZMS Sheet 290 O 06/07, 1:100,000 scale map, Edition 1, 1980: "*Waipoua-Aranga"* (Soils).

Fieldwork

Our fieldwork for this report was commenced on the 19th May 2020 and involved the drilling of two hand augered boreholes down to 3.00m.

In addition, Vane Shear tests were conducted at 0.30m increments down to full depth of the boreholes to provide preliminary soil strengths of the subsoils onsite.

Results of the in-situ soil tests together with detailed descriptions and depths of strata encountered during the drilling of the boreholes are appended. Soil descriptions included on the exploratory hole records are compliant with New Zealand Geotechnical Society (NZGS) publication 'Field Description of Soil and Rock', 2005.

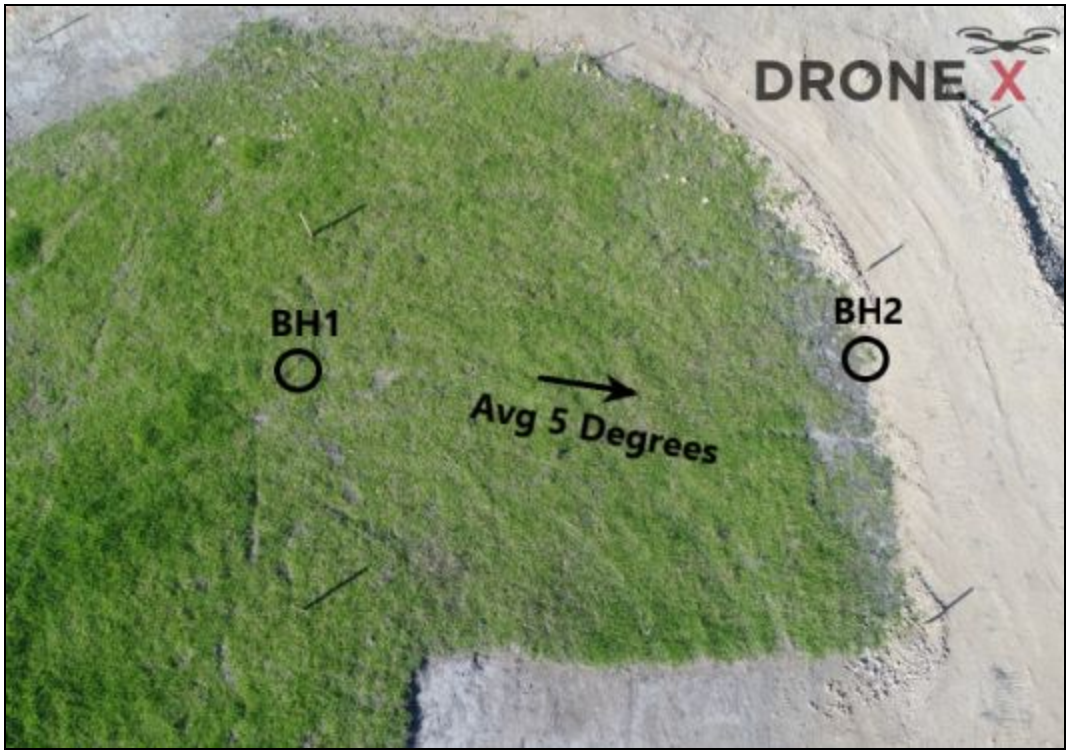


Figure 6 - Boreholes Location Plan (adapted from the DroneX Survey)**.**

The depths of strata and groundwater (where encountered) in the boreholes are recorded from ground levels at each exploratory hole.

Laboratory Testing

Two samples of Linear Shrinkage with two Atterberg Limits test samples were taken from the site, generally within the zone of likely influence of shallow foundations. These tests were in accordance with NZS 4402 - Sections 2.2 & 2.6 , "Methods of Testing Soils for Civil Engineering purposes".

These index tests primarily seek to give an indication of the likely subsoil behaviour, characteristics and conditions at its natural undisturbed state. Lab test results were not ready at the time of writing. Where appropriate however, further commentary can be provided with due regard to the former on a later date.

All results are IANZ (International Accreditation New Zealand).

Summary of Ground Conditions

It can be viewed that the natural land layout and soils, comprise sedimentary formation constituents transported away from their parent geological unit and deposited here historically primarily through water, as a result of natural tectonic processes such as overthrusting. These are atypical and common within the far north area.

As depicted in Figure 8, erratic soil compositions can be expected as a consequence of the former. Further reference can be made from Photos 40 - 41.

- Topsoil
  Observed as clayey silt and brown with minor rootlets (approximately) 0.20 metres thick.

  Natural Ground
  The natural (cohesive) subsoils encountered generally comprise very stiff, grey with orangish brown streaks within shallow depths down to 1.00 metre. As depicted in Figure 7 and Figure 8 respectively.

Figure 7 - Natural Soils Onsite (adapted from the DroneX Survey).

Beneath this, soils became more clayey, stiff, moist to very moist and creamy with varying concentration pockets of fine subangular gravel inclusions.

More likely soil mantle stratification specific to the property are depicted in Photos 40 - 41.

Vane Shear Readings

Corrected vane shear readings recorded, were in the range of 133 kPa to 194 kPa.

Figure 8 - Natural Soils Stratification Onsite (adapted from the DroneX Survey)

Groundwater

Groundwater was not encountered during our investigation. It would be prudent to note that water levels are likely to fluctuate with the seasons/peak rainfall events.

Discussion on Subsoil Classification

- Expansive Soils

  Plastic soils found throughout this region have an expansive nature and tendency to shrink and swell. This phenomenon is common with these soils (where encountered) throughout the Northland region, particularly when these soils are subject to seasonal volume changes caused by wetting and drying.

  Technically, expansive soils are defined in NZS 3604 as those soils having a liquid limit of more than 50% and a linear shrinkage of more than 15%. The site can be designated as a Class H1 site. Accordingly, foundation design guidance may be adopted in accordance with A.S 2870.

  Reference

  A.S. 2870, “Residential Slab and Footings - Construction”.

  NZS 3604, “Timber Framed Buildings”

  Manaaki Whenua LandCare Research: New Zealand Soil Classification (NZSC) - Soil Order.

Geological Considerations

Early Miocene sedimentary rocks overlie the Northland Allochthon north and south of the mouth of Hokianga Harbour and extend 30km inland in the Waimamaku valley.

The land mass which comprise the subject lot constitutes the lower beds of the land formation. The soil bedding accumulated in a 'piggy-back' basin is widely viewed as in association with allochthon emplacement.

The Waitiiti Formation is understood to have been deposited in bathyal depths i.e. the marine zone that is deeper than the continental shelf but shallower than the deep ocean floor. The sequence is regressive for the upper parts of the Omapere Conglomerate were deposited in shelf and nonmarine environments.

As a consequence, irregularities within the subsoil stratification can be expected.

All in all, the existence of these partial alterations should carefully be considered and accounted for when designing foundations.

Reference:

Geology of the Kaitaia Area. Institute of Geological & Nuclear Sciences; 1: 250,000 geological map 1.

Specific Comments and Recommendations

Structural Engineering Review of Foundation Designs

Expansive soils are outside the provisions of NZS 3604 and therefore foundations for this project shall be reviewed by a chartered structural engineer to verify the foundation designs to establish appropriate reinforcement and bracing configurations with due regard to the onsite soil conditions and loadings.

Table 1 below presents the bearing strengths for vertical loads (only) for foundation designs. All topsoil and deleterious materials shall be cleared away from the new shed platform prior commencing Works.

Table 1 - Bearing Strength Design Parameters	
Ultimate Bearing Capacity	300 kPa
Soil Classification (AS 2870)	H1

Subsequently, where overland flow paths onto the building site are encountered, control applications shall be implemented for the purpose of directing all surface water away from the founding ground so as to minimise adverse effects of surface water influences with respect to the former.

Foundation Design Considerations

For foundations founded on expansive soils. It is prudent for the designing structural engineer to consider that one or more of the following criterias are met:

1. Sufficient dead-load pressure is exerted on the foundations.
2. The structure is rigid enough so that differential heaving will not cause cracking, or
3. The swelling potential of the foundation soils can be eliminated or reduced.

Based on the concept plans provided to us, it is understood that the proposed new shed can be founded on a concrete strip footing foundation system.

All limit states must be considered in design to ensure adequate safety and serviceability.

Pre-Construction Foundation Check

To ensure that the founding ground is sound and foundation system is adequately rigid, it is prudent to check the following conditions before construction i.e.

1. Determine if there are soft pockets in the excavation or final subgrade level which may influence settlement.
2. Ensure that there is sufficient continuous reinforcement in the foundation to provide rigidity, and
3. Ensure that the foundation ground is appropriately safeguarded from influence of surface water onto the building platform during and after construction.

Earthworks and Construction

- Topsoil Stripping

  Topsoil should be stripped from all cut and fill areas (where proposed), stripping operations should extend well beyond the cut/fill lines to avoid peripheral fill contamination.

  Stockpiles of topsoil and unsuitable materials should be sited well clear of the works.

Stormwater

It shall be noted that, stormwater runoff from the collective subdivision i.e. access roads and others had been accounted for by way of neutrality applications implemented during the recent subdivision stage.

Considering the intimate lot arrangements and the former, it can be viewed that minimal potential for substantial home developments is true in this case. On the contrary, the governing stormwater runoff model adopted via Resource Consent granted, presents plentiful capacity in this case.

Accordingly, specific peak stormwater runoff analysis shall be concentrated to roof areas as considered appropriate to address at this instance. The former is viewed most critical to induce more adverse effects and shall be managed at its origin point. This shall be fulfilled sustainably through the use of water tanks.

Consequently, roof water can viably be collected in one 15,000L Water Tank primarily as passive source runoff management in support of the proposed development.

The adopted view philosophy derives truly from the accepted Site Suitability Report recommendations appointed. The Proposal Outcome[3]* (PO) is in balancing support to sustain LIFE in all aspects.

Lots 7-13

(i) In conjunction with the construction of any building >50m2 or construction of any impermeable surface > 250m2, the lot owner shall install a stormwater detention system with an appropriate flow attenuated outlet directed towards the existing stormwater infrastructure. The stormwater detention system shall be at least 15,000l in size as outlined in the Site Suitability Report prepared by LDE, Project 17225, Revision 1, dated 11 December 2019.

As clearly stipulated above, Impermeable Surfaces Limits (IML), Allowable Attenuation Reserve Storage (AARS) - (15m^3) and ΣAllowable Storage Capacity (ASC) - 60m^3 designated shall be in the order of;

1. Min < Max + ΣASC - ARS = Equilibrium. Therefore, 50m^2 < 250m^2 + 60m^3 - 15m^3 = 0.
2. The proposed Input of 73m^2 out of the Max equates to 30% of the former.

Subsequently, the Output can be concluded to fall well within the aforementioned modelled Maximum limits.

All in all, the proposed and complementary stormwater application can adequately manage peak stormwater runoff by utilising the designated storage volume in line with the recommended LDE report.

Table 2.0 below provides a summary pertaining to the precedent motion.

Area (m^2)	ARI (yr)	Pre Development (l/s)	*Post Development (l/s)	Attenuated Post Development (l/s)
73m^2	2	0.51	1.18	0.47
	10	1.03	1.86	0.97
	100	1.15	3.08	1.66

**Not Attenuated*

The property is established with a rich presence of lucious native bush within the property boundaries and supporting prominent waterbodies (identified flow paths), these existing features readily provide a natural Green Stormwater Management Approach (GSMA) in this instance.

[3] **PO - Honour in conditioned Consent*

Native bush and vegetation is considered to have the very least stormwater runoff and provide natural sustainability to LAND in all (stormwater management) aspects. It is important that due care is paid to incorporate the established stormwater management system as the governing PC[4]*.

These systems should serve to collect excess stormwater runoff from house roofs, driveways and other paved areas, together with discharges from retaining wall drains and other subsoil drains (where appropriate) and shall connect directly into the stormwater management system proposed to serve the collective subdivision.

It shall be noted that the control water tank shall be located in a manner that allows applicable/sustainable discharge to the existing stormwater management system established.

All in all, stormwater management options as stipulated within the Council approved Site Suitability Report can be adopted in this case.

Reference

LDE - Site Suitability Report, Project Reference #17225, Dated 6 December 2019.

Vegetation Cover

Wherever possible, purpose tree/vegetation (planting) shall be sustained/regenerated throughout the Occupational Living (OL) with the ongoing goal of sustainability to all aspects of LIFE.

Natural Hazards

Coastal Flood Hazard

Upon review of the Northland Regional Council Hazards maps, it indicates the subject property as being outside the flood prone area. Map appended to this report.

Conclusion

Based on our review of the Council Approved - Site Suitability Report, our site observations, field data and the general residential developments surrounding the subject property. It is our professional opinion that the subject site (legal description Lot 8 DP 409674) can sustain the new minor shed proposed to be erected here.

Reference

LDE - Site Suitability Report, Project Reference #17225, Dated 6 December 2019.

[4]**PC - Principal Control*

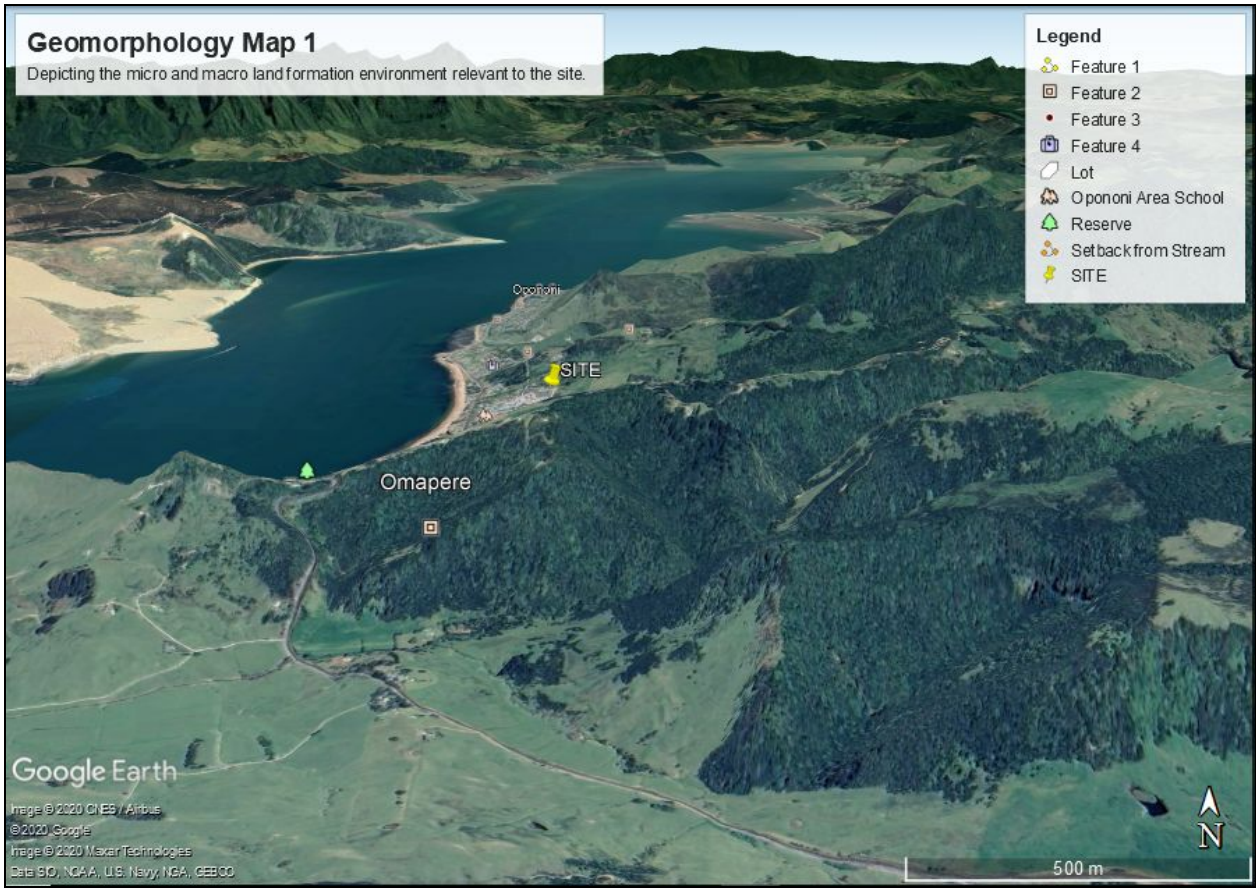
Appendix A

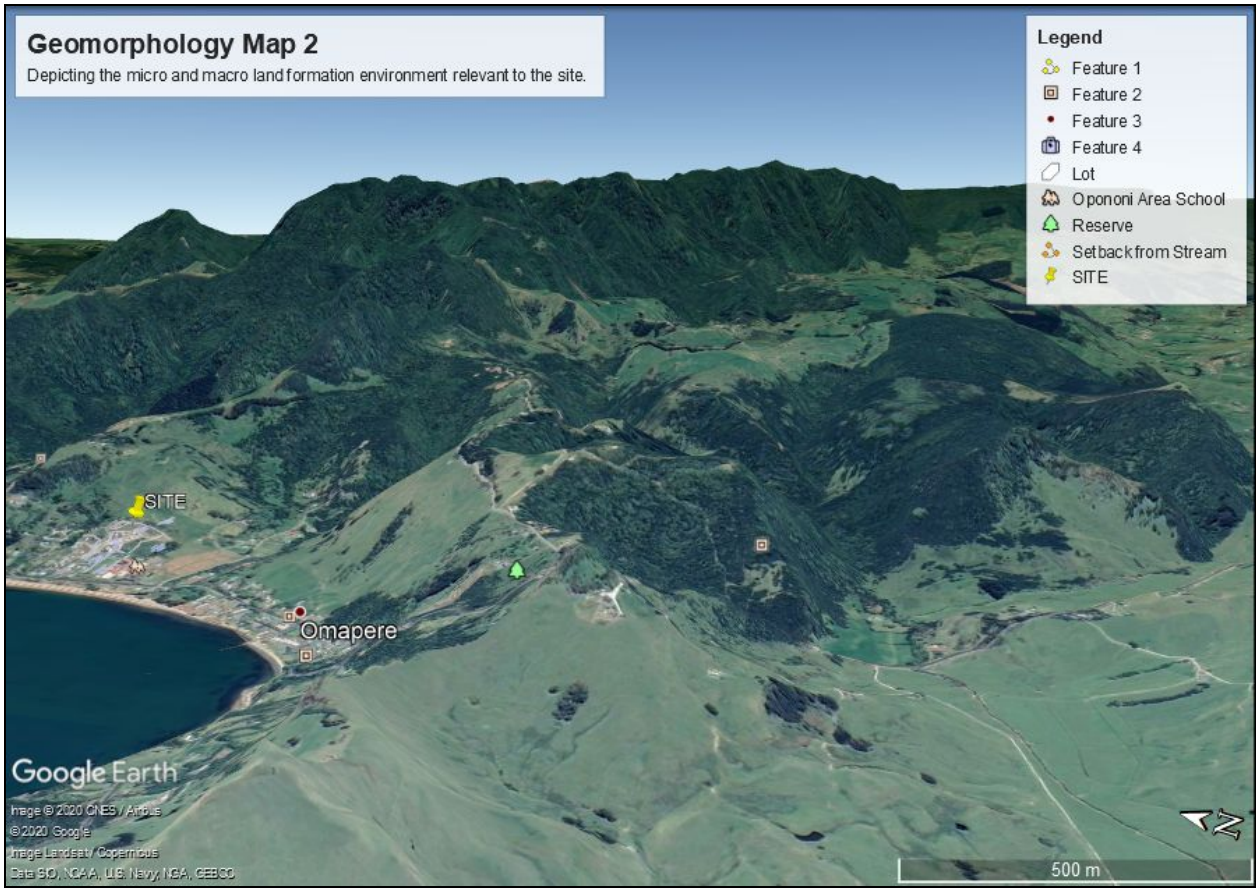
Attachments	Scale
Natural Hazard Map	NTS
Geomorphology Overview Maps 1 - 6	NTS
Borehole Log 1	-
Borehole Log 2	-
Concept Plans - Provided by Client	-
Photos 1 - 41	-

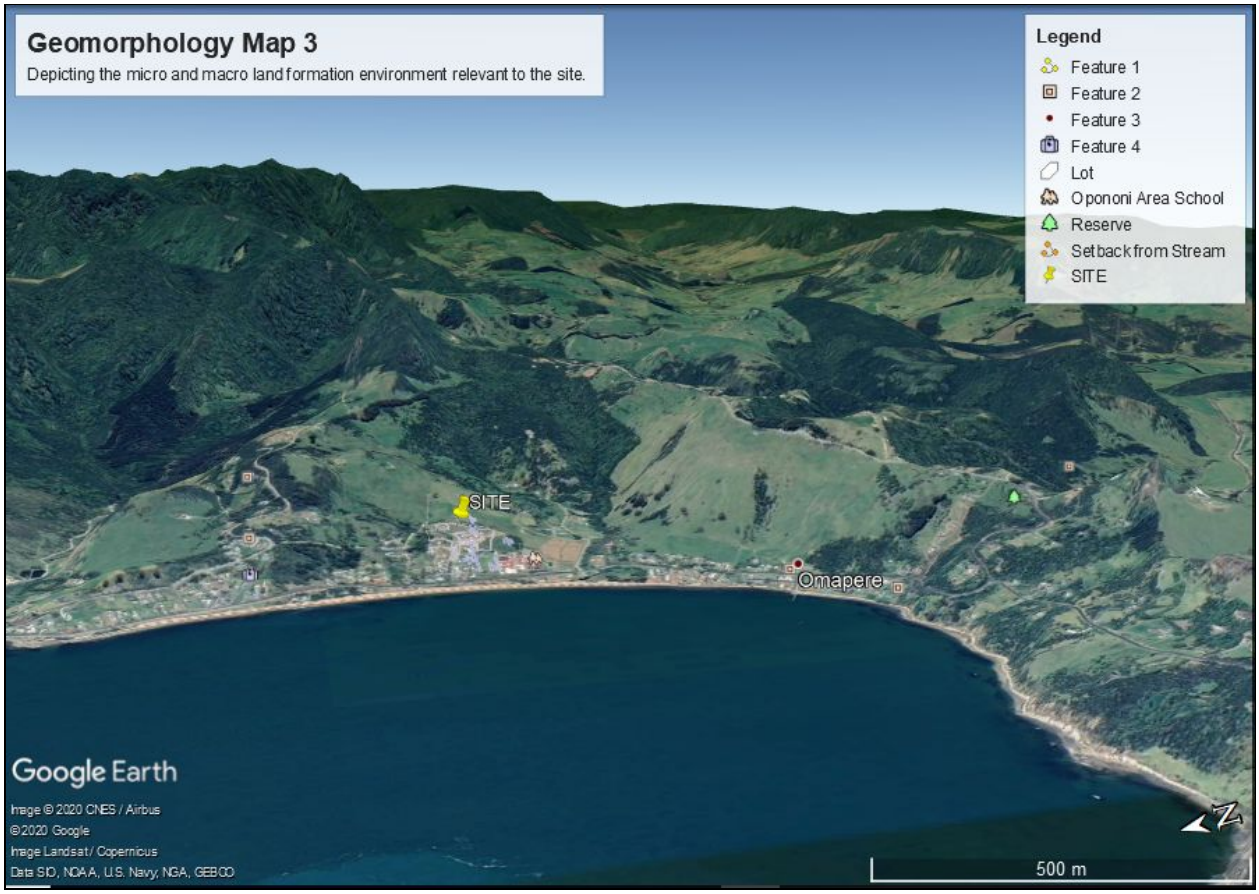
Natural Hazard Map: (Adapted NRC Maps)

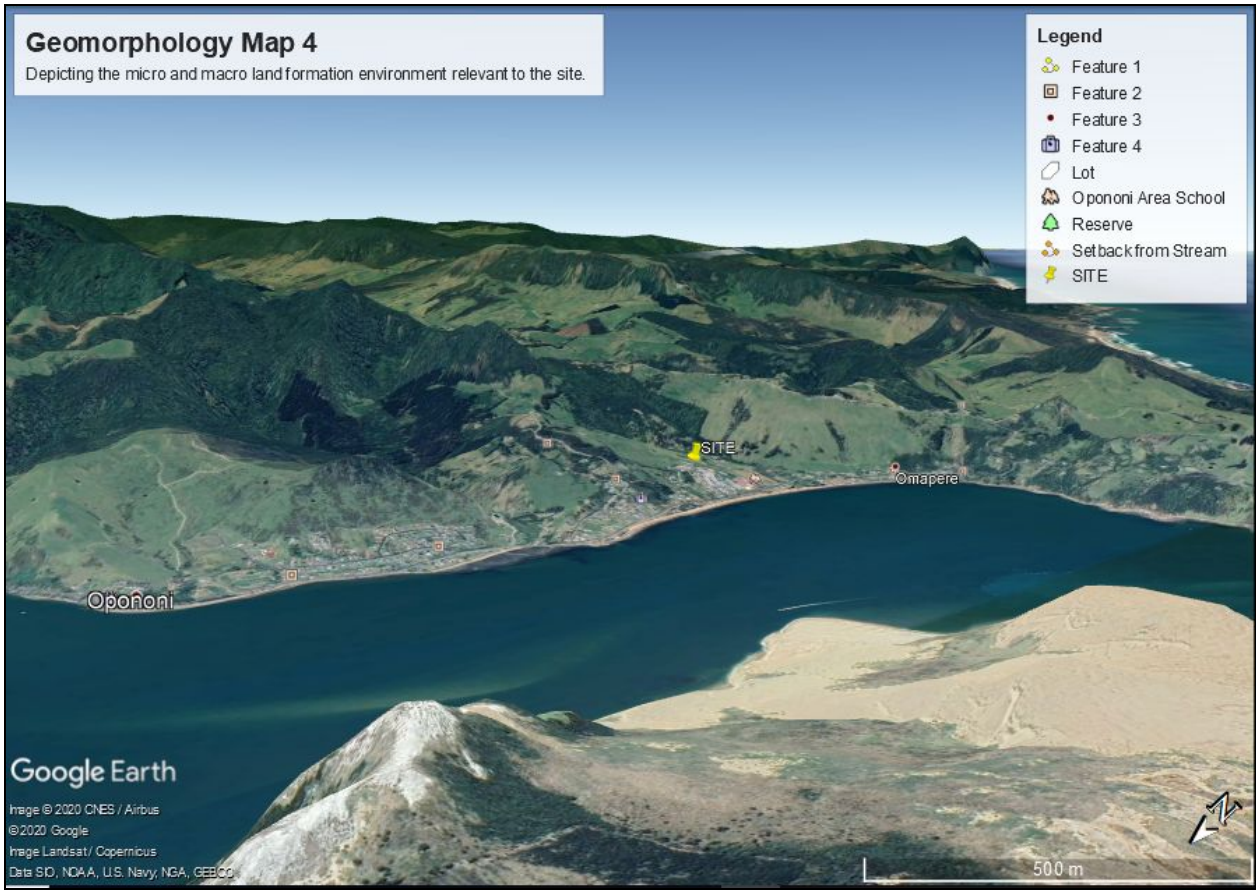
Geomorphology Maps 1-6;

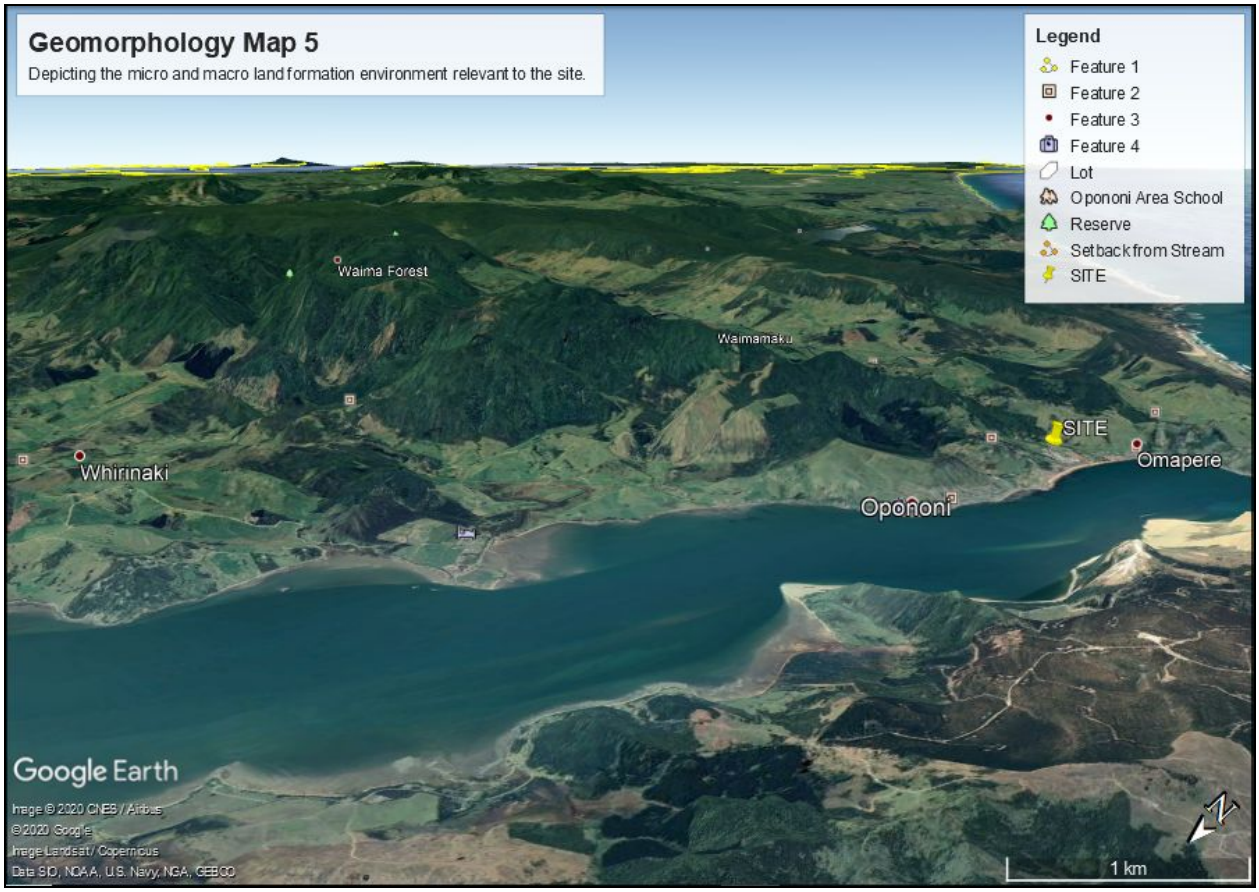
(Adapted from QuickMap Enterprises and Google Maps)

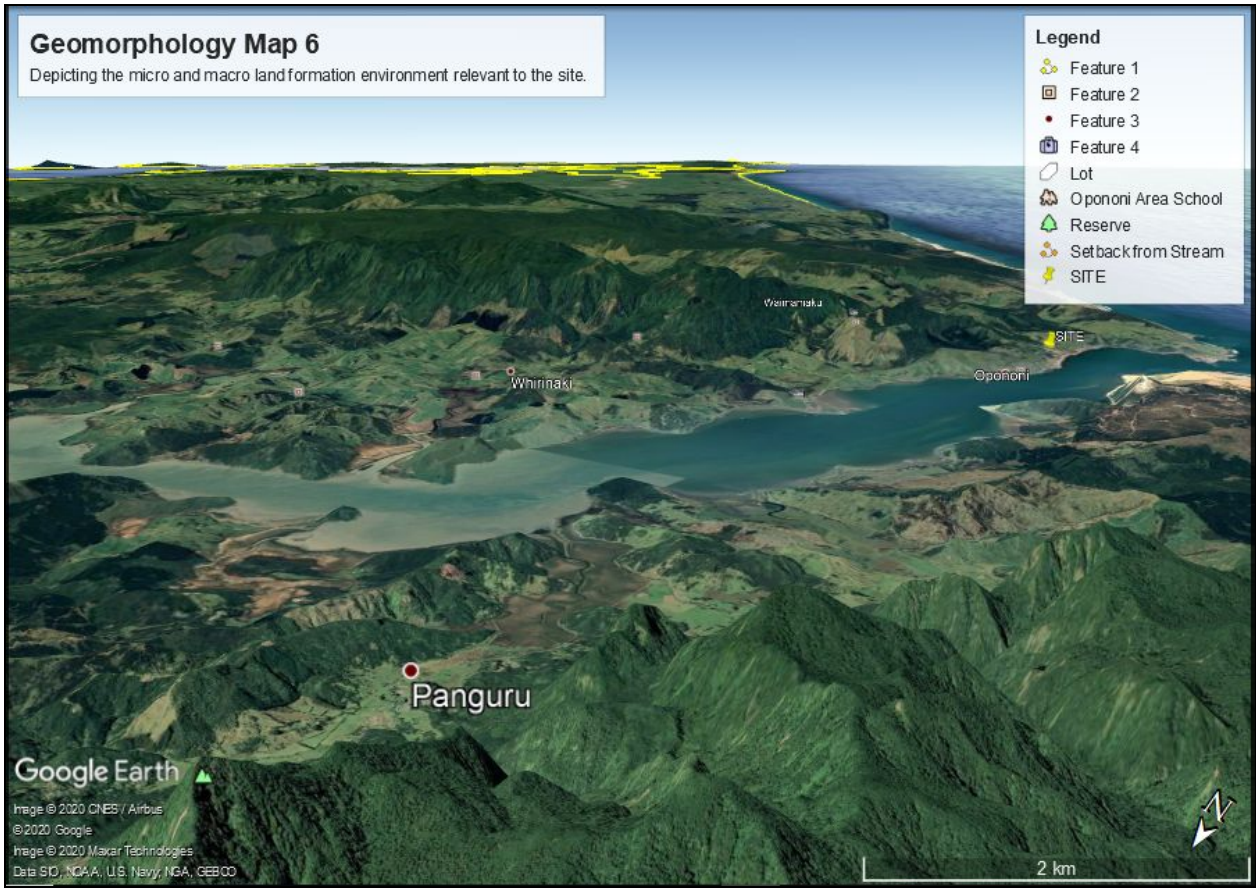












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BOREHOLE LOG No. 1

Hole Location: Refer to Site Plan

JOB No. 10 57

CLIENT:	Michelle French	SITE:	Lot 8 Waianga Plc, Omapere.		
Date Started:	20/05/2020	DRILLING METHOD:	Hand Auger	LOGGED BY:	AK
Date Completed:	20/05/2020	HOLE DIAMETER (mm)	50mm	CHECKED BY:	KW

Soil Description (Based on NZGS Logging Guidelines 2005)	Depth (m)	Graphic Log	Geology	Water Level	Sensitivity	Corrected Shear Vane Strength (kPa)	Dynamic Cone Penetrometer (blows/100mm drop)
TOPSOIL, clayey silt, brown and damp with rootlets.							
Silty CLAY, grey with orangish brown streaks, very stiff, dry, very stiff, damp and high plasticity.	0.5		Waititi Formation (Mot).	No Groundwater Encountered.		194	
dry	1.0				5	177 (48)	
					3	167 (75)	
damp, light brownish grey and high plasticity.	1.5					194	
speckled orange	2.0					194	
					4	183 (64)	
moist	2.5				4	138 (53)	
moderately moist	3.0				3	133 (55)	
					3	152 (61)	
EOBH @ 3.00m.	3.5					194	
	4.0						
	4.5						
	5.0						

LEGEND

TOPSOIL | CLAY | SILT | SAND | GRAVEL | FILL

Corrected shear vane reading
Remoulded shear vane reading
Scala Penetrometer

Average Scala Blows	0.0
Average Soil Sensitivity	3.8

UTP - Unable to Penetrate
DCP - Dynamic Cone Penetrometer
EOBH - End of Borehole
EODCP - End of DCP

Notes -

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BOREHOLE LOG No. 2

Hole Location: Refer to Site Plan

JOB No. 10 57

CLIENT:	Michelle French	SITE:	Lot 8 Waianga Plc, Omapere.		
Date Started:	20/05/2020	DRILLING METHOD:	Hand Auger	LOGGED BY:	AK
Date Completed:	20/05/2020	HOLE DIAMETER (mm)	50mm	CHECKED BY:	KW

Soil Description (Based on NZGS Logging Guidelines 2005)	Depth (m)	Graphic Log	Geology	Water Level	Sensitivity	Corrected Shear Vane Strength (kPa)	Dynamic Cone Penetrometer (blows/100mm drop)
TOPSOIL, clayey silt, brown and damp with rootlets.							
Silty CLAY, orangish brown, very stiff, damp and high plasticity.	0.5		Waititi Hormation (Mot).	No Groundwater Encountered.		194	
damp	1.0					194	
						194	
						194	
damp to moist, very stiff and high plasticity	1.5					194	
	2.0					194	
damp and very stiff	2.5				3	171 / 68	
damp, light creamy colours and highly sticky	3.0				3	155 / 55	
					4	149 / 41	
EOBH @ 3.00m.	3.5						
	4.0						
	4.5						
	5.0						

LEGEND

TOPSOIL | CLAY | SILT | SAND | GRAVEL | FILL

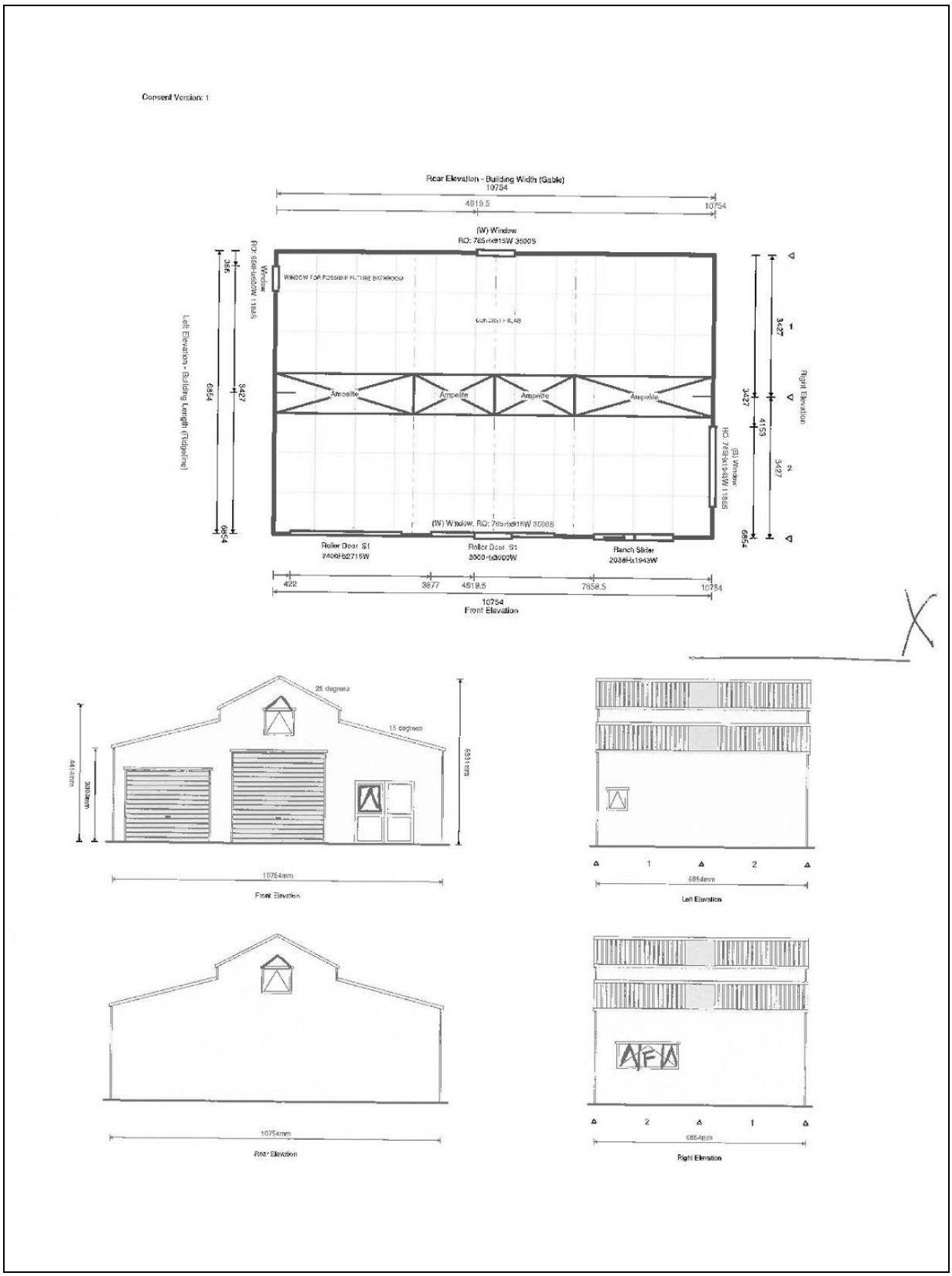
Corrected shear vane reading
Remoulded shear vane reading
Scala Penetrometer

UTP - Unable to Penetrate
DCP- Dynamic Cone Penetrometer
EOBH - End of Borehole
EODCP - End of DCP

Notes -

Average Scala Blows	0.0
Average Soil Sensitivity	3.0

Concept Plans;



District Plan Zoning: General Coastal

Wind Zone as per AS/NZS 1170.2	= 40.95 m/s
Site Area	= 1200m2
Existing Driveways	= 15 m²
Proposed Building	= 73.71 m²
Total Site Coverage	= 88.71 m²
Impermeable Surfaces (%)	= 7.5 %
Building Use	= Storage

Earthworks =
200mm site scrape of top soil only of less than 20 cubic Meters. All soil to remain on site

Stormwater =
To be direct through 80mm dia PVC DPs and led to tank as shown with 1:100 fall via storm water pipe to comply with E1.

= Proposed Building

= Down pipes leading to water tank

= Boundary distance indicators

= Boundary line indicators

N

SITEPLAN

TOTALSPAN. STEEL BUILDINGS WHO CAN? TOTALSPAN!

Dekka Int Trading Ltd T/A Totalspan
Bay of Islands/Hokianga

1235B State Highway 10, RD3,
Kerikeri 0293 New Zealand.
Phone: 09 4077875
E: Kirsty.fisher@totalspan.co.nz

Building Proposed For:
Michelle French

Customer Site Address:
Waianga Place, Omapere

LOT 8 DP 409674

Date: 27.03.2020

NOT TO SCALE

ALL DIMENSIONS IN METRES
UNLESS STATED:

Appendix D - Photos (1 - 41);

Photo 1 - Omapere & Hokianga Harbour wider outlook (subject site centre).

Photo 2 - Western aspect showing Waianga Rd and Hokianga Harbour.

Photo 3 - Hokianga Harbour

Photo 4 - Hokianga Harbour Drive south bound (site bottom right).

Photo 5 - As above

Photo 6 - View over Hokianga Harbour and wider southern aspect.

Photo 7 - Southern aspect

Photo 8 - Panning (left) eastward.

Photo 9 - Omapere Area School and rugby fields located south of the property.

Photo 10 - Subject property middle of photo with wider eastern aspect in distance.

Photo 11 - As above, panning further north.

Photo 12 - North facing showing Hokianga Harbour.

Photo 13 - Waianga Road from Hokianga Harbour Drive.

Photo 14 - As above, showing ROW 1 & ROW 2.

Photo 15 - Close up of ROW leading to subject property.

Photo 16 - As above, also showing concrete T junction .

Photo 17 - As above, also featuring eastern neighbouring aspect.

Photo 18 - South facing showing subject property.

Photo 19 -Northwest facing depicting entrance from ROW and neighbouring dwelling.

Photo 20 - Subject property, west facing.

Photo 21 - Nominated shed site pegged in lower grassed area.

Photo 22 -North facing showing immediate surrounding flora life.

Photo 23 - Close up of the flora life to the east of the property.

Photo 24 - As above

Photo 25 - Wider eastern aspect showing neighbouring farmland and native bush.

Photo 26 - As above, Lot 9-11 right.

Photo 27 - East facing showing adjoining farm land wider east.

Photo 28 - As above looking south.

Photo 29 - As above, adjoining eastern aspect.

Photo 30 - As above bird's eye view.

Photo 31 - Close up of site, east facing.

Photo 32 - As above elevated.

Photo 33 - As above circling towards south (right).

Photo 34 - Following from above.

Photo 35 - North facing the property.

Photo 36 - North facing the Site.

Photo 37 - West facing panning right.

Photo 38 - Following from above panning right.

Photo 39 - As above.

Photo 40 - Site cut depicting sub soil bedding.

Photo 41 - As above.