APPENDIX F

Waitarere Beach Road Curves Project
Preliminary Geotechnical Assessment of Effects

Prepared for The New Zealand Transport Agency

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MWH

BUILDING A BETTER WORLD

QUALITY STATEMENT

PROJECT MANAGER	PROJECT TECHNICAL LEAD
Jon England	Phil Peet

PREPARED BY		
Alex Naylor		20/11/2015
CHECKED BY		
Christopher Robson		20/11/2015
REVIEWED BY		
Carlos Amante		20/11/2015
APPROVED FOR ISSUE BY		
Jon England		20/11/2015

WELLINGTON
Level 13, 80 The Terrace, Wellington 6011
PO Box 9624, Te Aro, Wellington 6141
TEL +64 4 381 6700, FAX +64 4 473 1982

NZTA

Waitarere Beach Road Curves Project

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1 Introduction

This short report provides a brief discussion of some construction and environmental risks associated with geological materials found at the Waitarere Beach Road Curves project.

It draws on geotechnical information found within previous body of reporting (MWH report: North of Otaki to North of Levin – Preliminary Geotechnical Assessment Report, “PGAR” (March 2014)) and combines it with additional information from a brief desktop study and geotechnical observations from a short walkover reconnaissance exercise.

The purpose of the report is to provide geotechnical background information relating to a Notice of Requirement (NoR) to designate additional land as part of the Waitarere Beach Road Curves project (the Project) for the improvement of State Highway 1, some 7km north of the Levin town centre. The Project is fully described in the NoR documentation.

The report describes the main geological units found within the vicinity of the Project area by correlating preliminary field observations during a short walkover conducted on the 23rd April 2015 with information provided by GNS in Qmaps publications and Begg et.al. (2000). It offers preliminary guidance on how to manage the risks and effects associated with these materials.

Lastly the scope of the project also includes general treatment comments of a low height slope found adjacent to the Poroutawhao School where minor earthworks will be required to allow the formation of a right turning lane.

2 Regional Geology

Published geological mapping of the Project area indicates the northern section comprises primarily of Aeolian sand deposits, the central section comprises alluvium, and the southern section comprises raised beach deposits. The longitudinal shaped undulating topography of the project area, particularly evident in the northern section in aerial photography, suggests the presence of sand dunes.

The main geological units as described by GNS in the QMap Wellington Area, Scale 1:250,000, Map 10 found near the Project area are:

[Q5b] - Widespread gravels and gravelly sands with some silt. These are marginal marine deposits of the last interglacial. Windblown loess caps these gravelly sands.

[Q1ds] - Aeolian sand dunes consisting of fine grained uniform sands. Swamp deposits of clay, silt and peat occurring in the lower areas between the sand dune sequences.

[Q1al] - Alluvial / swamp deposits which include clay, silt, sand, peat and some minor gravels, found extensively in the lower lying areas adjacent to the coast.

Polygon shapes for the known mapped regional geological materials have been sourced from the GNS QMAP Map 10 dataset and imported as a GIS layer into Google Earth Pro as a base layer. Additional information such as the project route alignment and topographic contours have also been added to provide project context of the areas affected by these materials. Please refer to Appendix A for preliminary geological maps of the project area.

3 Field Observations

3.1 Materials

Materials exposed in the roadside cuttings include silty sands, sandy organic soils, fine silts and some gravelly silts. Observations broadly correlate and confirm those made and referenced within the Project PGAR including the GNS QMAP Map 10 Wellington publication.

Materials found exposed in road cuttings during the walkover reconnaissance trip have been described according to the 2005 NZGS Soil and Rock description as: *light brown yellow speckled white, fine sand with some silt, very loose to loose, dry – moist, uniform [Aeolian Beach Dunes].*

These sandy exposures correlate with the previously described **[Q1ds]** unit by GNS. No direct observation of **[Q5b]** or **[Q1al]** was made during the field visit and it is inferred that the Aeolian sand covers most the project area surface, obscuring all visible geological contacts or material changes.

3.2 Minor Structures

Two existing road cuttings comprised of unreinforced concrete block walls have been constructed to retain the silty dune sands and maintain the property above the highway within the Project Area (refer to Figure 3-1). These walls are up to 3m high and are approximately 50m long. They appear unreinforced and show signs of settlement, deflection and degradation. If these walls are required to maintain these boundaries, they are likely to require replacement to the level suitable for the state highway environment as outlined in version 3 NZTA Bridge Manual.

Figure 3-1: Pre-existing large concrete block retaining wall placed to stabilise sand dune slope cut adjacent to SH1.

3.3 Drainage

Topographic modification in some areas has seen earthworks removing dunes in order to create flat farmland suitable for crops and pasture.

Natural drainage systems within the area appear minor, with no major streams or rivers crossing or passing through the immediate Project area. The site area does have a gentle downwards gradient towards the south and east. The majority of the drainage systems appear artificial, constructed for the purpose of creating or draining farmland.

4 Risks

The following section provides a general assessment of environmental risks associated with construction with the geological materials found at the Project site. This assessment is only based on the information stated in the sections previous.

4.1 Slope Stability

The majority of the slopes observed on site are sand dunes **(Q1ds)**. These dunes are considered completely cohesion-less other than that developed as part of soil aging process. They are very loose to loose, fine and uniformly graded, providing low friction angles only. Table 1 below is a summary of the slope stability observed from the site walkover for the existing sand dunes in the Project area.

Table 4-1: Sand dune slope stability summary

Slope angles	Stability summary
10 - 15º	Generally stable with only surficial stability issues
17 - 18º	Unstable and show signs of sliding, slope creep, soil creep, erosion and rilling
20º +	Unstable, ground deformation prevalent, erosion, sliding, rotation and slope creep

Figure 4-1: Large sand dune generally stable at approximately ~10^{0} - 15^{0}.

A number of cut slopes are proposed for this project. During construction, modification of the sand dunes through over-steepening or disturbance of the toe in order to meet design geometry and/or property boundary requirements may result in dune destabilisation. Removal of the vegetation and topsoil cover will expose the slopes to surface stability issues during rain events, such as rilling and slope failure. Due to the inherently poor material characteristics, large slope failure is a risk if more geotechnical information is not acquired prior to detailed design.

4.2 Sediment Runoff

As soon as the ground surface is broken and disturbed, sediment control will be a high risk environmental issue due to the very loose sandy/silty nature of the majority of the underlying soils throughout the Project area.

4.3 Dust

The Aeolian sand dune deposits were formed by wind transportation processes; therefore, if the dune sands are left exposed on dry windy days, there is a risk that the material will be eroded away. Dust will also be a risk following rain events where sediment runoff has occurred, leaving fine clay, silt and sand on the road and which then dries on the next fine day.

4.4 Settlement

Unknown amounts of soft clay, silt and organic materials may be present in the lower areas between sand dunes **[Q1ds]**, and soft alluvial swamp deposits **[Q1al].** These materials will be subject to settlement when surcharged by pavement, embankments and gravity retaining walls. Although settlement is not a direct environmental risk, it may cause issues with overland drainage performance resulting in unintended water run-off.

4.5 Drainage

The predominantly granular nature of the soil materials found throughout the site indicates that drainage on the site will be acceptable where natural gradients exist.

5 Risk Mitigation Measures

The following recommendations are provided for consideration during the next stage of project development.

5.1 Maximum Cut Angles

Preliminary field slope stability observations of existing cut slopes in similar sandy materials indicate that the slopes become unstable if cut too steeply; therefore, it is recommended that 10º be adopted as a maximum cut slope angle at this preliminary stage of the project. Should this cut angle not be possible, options such as retaining structures should be considered.

5.2 Slope Face Protection

All attempts should be made to limit degradation of the freshly re-profiled slopes with surface protection in the form of biodegradable or cellular plastic/non-woven geotextiles and topsoil replacement to allow grass strike as early as possible. Special attention should be placed on appropriate control and mitigation of the effects of surface water flow and drainage control during construction by placing impermeable plastic lining over exposed slope faces until work is complete.

5.3 Sediment Control

5.3.1 Silt Fences

Silt fences should be installed in all major overland flow channels in order to reduce the amount of sediment entering nearby water courses or spilling across the road and depositing sediment.

5.3.2 Settlement Pond

Settlement ponds should be installed in low-lying areas during construction to capture high volumes of sediment-rich storm water and to limit unintended deposition in natural water courses or road culverts. The settlement ponds should be adequately sized to accommodate a local high intensity rainfall event, potentially include a level spillway, chemical additive and multiple staged ponds.

5.3.3 Site Maintenance

It is important not to rely solely on silt fences and settlement ponds to effectively manage sediment on the site. Therefore, it is recommended that other effective construction management techniques be used as well.

Managing the modification of slopes in stages should help prevent erosion of the exposed slopes. If working on a hot/dry day, water trucks should be used to keep dust levels at a minimum. Sweepers on the roads can be used to remove sediments from the pavement. Weather forecasts should be checked before undertaking new earthworks cuts. These types of provisions can be incorporated in a Construction Management Plan.

6 Conclusions

This preliminary assessment provides a summary of known materials and associated environmental and construction risks found at the Waitarere Beach Road Curves project.

The limited scope of this assessment means that only simple geological and geotechnical inference can be made concerning the type, parameters, position, performance and lithology of these materials but general effects and risks can be inferred even at this early stage. For example, the predominantly loose granular nature of the underlying materials in the Project area makes them highly vulnerable to the erosive effects of water, particularly concentrated overland flows when the topsoil is removed. To mitigate this risk, it is important to effectively plan the construction of project so that earthworks cuts are opened up in stages, sediment control measures are put in place before large cuts, and temporary/permanent slope face protection is adopted.

A complete understanding of these above aspects can only be achieved with a detailed geotechnical site investigation program and formation of an engineering geological ground model for use during a detailed assessment.

The following points are provided for consideration during the next stage of project development:

1. Old retaining walls within the Project area found on the existing road are unlikely to meet current design performance requirements and will require replacement. Replacement retaining walls and newly identified retaining walls will require thorough investigation and design to standards described within the 3rd edition Bridge Manual (SP/M/022).
2. Large slope failure of these dunes is a risk that requires mitigation with site investigation and detailed engineering design.
3. Settlement and pavement deformations are construction risks associated with these variable materials.
4. Hydraulic parameters of the underlying materials need to be ascertained for completion of civil/drainage design.
5. Sediment runoff and the detrimental effects of unsuppressed dust need appropriate management with site specific construction management plan.
6. Poroutawhao School Slope Treatment: A low height slope will need minor re-profiling to allow the formation of pavement and surfacing for a right turn bay to create safer access to the School and community hall. This slope is approximately 5m in height, 10m in length and currently stands at approximately 45^0 . We recommend that earthworks treatment should aim to finish this low slope in a manner no steeper than the present condition following relocation of the slope face 3.5m to the west. This slope face may need surface protection with erosion control matting and hydroseeding following the reprofiling. It should also be monitored on a regular basis following construction.

At this early stage, material information is inadequate for geotechnical, structural, civil drainage and civil pavement detailed design that will be required for the project alignment. We recommend that a detailed site investigation program is scoped and undertaken to fully inform the Waiterere Beach Curves Project

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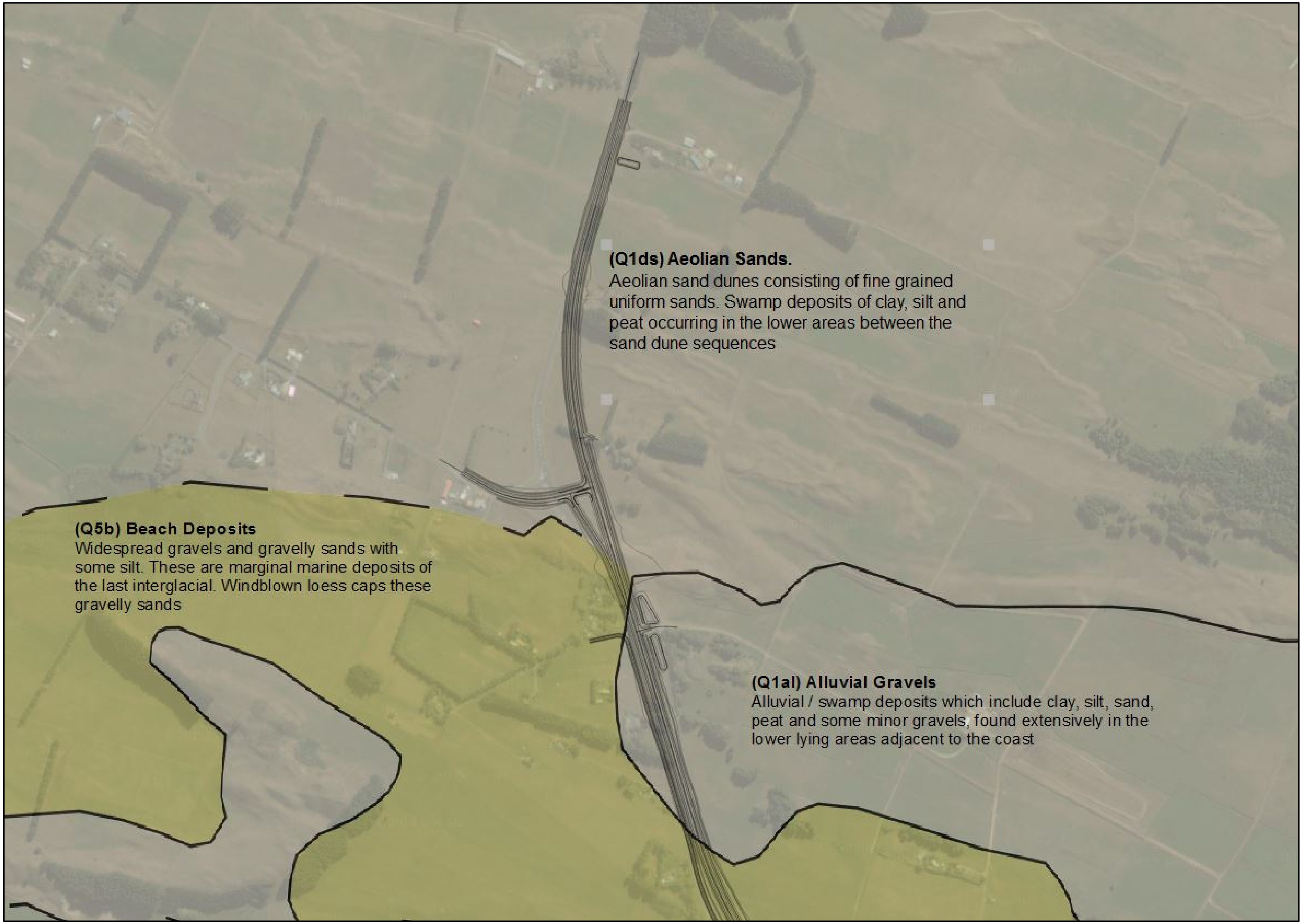
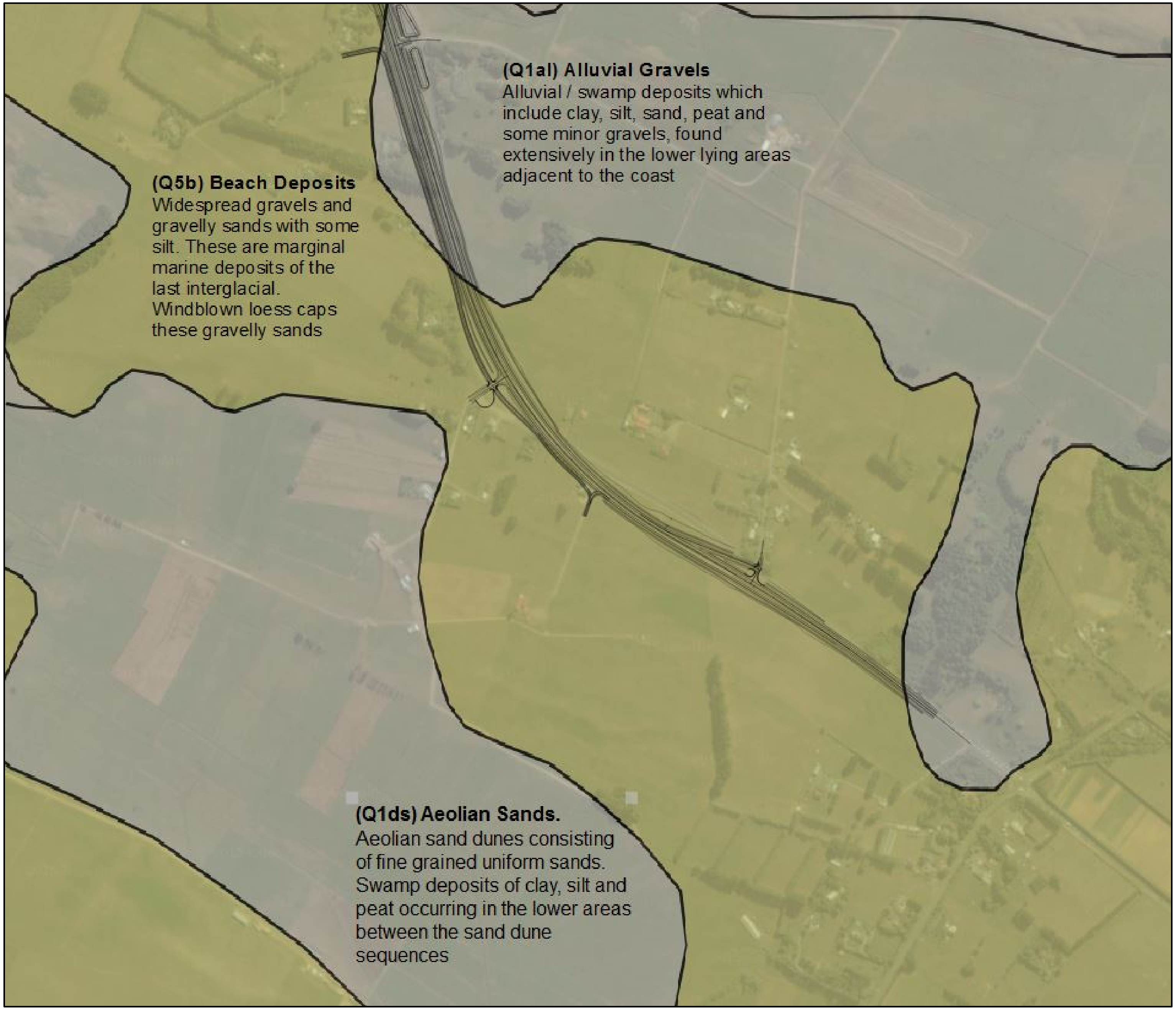
Appendix A Preliminary Geological Map (3 sheets)

(shows surficial and covering geological sequence only as referenced from GNS QMAP 10 Wellington)


(Q1ds) Aeolian Sands.
Aeolian sand dunes consisting of fine grained uniform sands. Swamp deposits of clay, silt and peat occurring in the lower areas between the sand dune sequences
(Q5b) Beach Deposits
Widespread gravels and gravelly sands with some silt. These are marginal marine deposits of the last interglacial. Windblown loess caps these gravelly sands
(Q1al) Alluvial Gravels
Alluvial / swamp deposits which include clay, silt, sand, peat and some minor gravels, found extensively in the lower lying areas adjacent to the coast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