



# Geotechnical Assessment

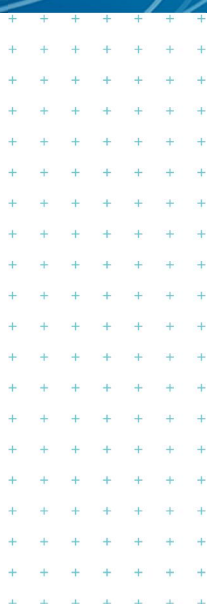
48 Esmonde Road, Takapuna

Prepared for  
Kingstone Ltd

Prepared by  
Tonkin & Taylor Ltd

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## 1 Introduction

Kingston Ltd engaged Tonkin & Taylor Ltd (T+T) to undertake a geotechnical assessment for their site at 48 Esmonde Road, Takapuna, Auckland.

The site context and coastal hazard setting, based on Auckland Council's proposed standard templates for the coastal hazard assessment, is set out in the Coastal Hazards and Geotechnical Assessment Report by Tonkin + Taylor dated April 2020.

This report includes the information provided in that assessment report, and provides further elaboration on particular geotechnical aspects following a discussion with Council. Accordingly, this report provides a stand-alone geotechnical assessment of the site and in particular addresses its suitability for the proposed land use and building construction as discussed with Council.

This report is provided to support applications for land use and resource consents for the proposed development. A geotechnical investigation (including field and lab testing) will be undertaken at a later stage to support future building consent application(s) and basement design(s).

The proposed development is at an initial stage but developed sufficiently for resource consent application. Therefore, our geotechnical review and comments are considered preliminary. As such we understand that additional geotechnical queries and requirements may be raised at the time of resource consent assessment following a detail review of the lodged information. For example, additional, information may be required to demonstrate that the proposed basement excavation work is a permitted activity under E7 of the AUP.

## 2 Geomorphological and Geological Setting

The site at 48 Esmonde Road, Takapuna, is located within the estuary of Shoal Bay adjacent to Esmonde Road just east of the Northern Motorway, as shown in Figure 1 below.

The site was once the tip of a peninsula extending out into Shoal Bay, and prior to the construction of Esmonde Road would have been an island at high tide. Shoal Bay is open to the Waitemata Harbour between Northcote Point and Stanley Point, but the site is largely protected by wind waves from most directions.

To the north of the site, the land consists of estuarine deposits which become overlain by volcanic deposits going north towards Lake Pupuke. The subject site is, however, composed of in-situ interbedded siltstone and sandstone, with residual soils at the ground surface.

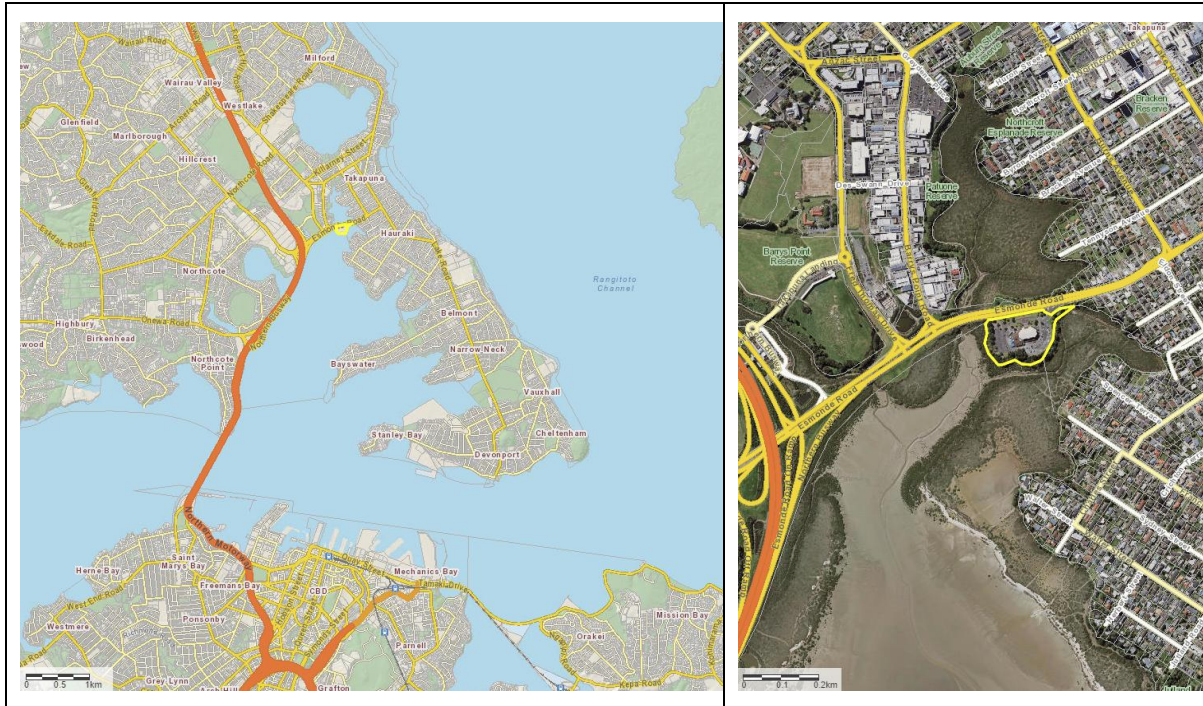


Figure 1: Location of site (in yellow). Source: Auckland Council Geomaps

## 3 Geotechnical Assessment

### 3.1 Information Sources

The geology of the site has been mapped in detail as shown on the NZ Geological Survey Industrial Series 1:25,000 geological photo overlay map. The map sheet covering the Esmond Road site (Devonport, N 42/2) also shows the site as underlain by soft sedimentary rocks of the East Coast Bays Formation, Waitemata Group, and provides detail such as the beds at the subject site dipping at a shallow angle (4 degrees) to the west.

For information on bedding dip direction to be available implies that there must be exposures of the rock at the coastal margin. Importantly the detailed map does not indicate any undifferentiated alluvium overlying the site.

T+T hold the extensive Auckland air photo print library previously held by Lands and Survey. This library includes the actual stereo paired photo prints for the flight runs in 1940, 1950, 1963, 1972 and 1981.

The geomorphic changes of the subject site have been assessed by T+T from comparative stereoscopic air photo interpretation, as part of our desktop evaluation of the site. When viewed through a stereoscope this provides 3D imagery which enables the landforms, and changes in landforms, to be evaluated in more detail.

In addition to the information on the site sourced remotely, T+T undertook a comprehensive field reconnaissance by a geotechnical specialist over all parts of the site, in particular along the base of the low cliffs and banks at the coastal margin (at low tide).

### 3.2 Geomorphology

The landform of the subject site comprises a remnant peninsula terminus composed of interbedded soft sedimentary rocks (siltstones and sandstones), formed by aerial weathering of the near surface



rocks over many hundreds of thousands of years, and progressive but slow coastal erosion at similar sea levels today over the past 9000 years.

There is evidence of shallow land slippage as a process in forming the edges of the site, but we could find no geomorphic evidence of any past large-scale instability or any actual or incipient rock mass failure.

The most significant changes to the landform since 1940 has been the excavation of the northern part of the peninsula in or about 1959 as part of the motorway construction associated with the North Shore to the City connection via the Auckland Harbour Bridge. The other significant feature has been the progressive increase in growth and extent of mangrove vegetation surrounding the remaining coastal margin of the subject site.



Photo 4-1. Mangrove vegetation and rock exposure at base of cliff at 48 Esmonde Road

### 3.3 Geology

Exposures in the intertidal area surrounding the site and at the base of the low coastal cliffs during our walk over reconnaissance confirmed that the site is underlain by interbedded siltstone and sandstone of the East Coast Bays Formation. The bedding in the exposures is sub-horizontal or dipping at a very shallow angle (less than 5 degrees) to the west north-west. This is essentially the same as that observed in the coastal cliff exposure at the southern end of Takapuna Beach, and as described on the 1:25,000 Industrial series geological map.





Photo 4-2 South coast – siltstone exposure at 48 Esmonde Road



Photo 4-3 South-east coast – sandstone exposure at 48 Esmonde Road

### 3.4 Groundwater

Being a peninsula remnant landform, it is expected that the groundwater beneath the site will be close to mean sea level. There was no evidence of any groundwater seepage at higher elevations in any of the cliff exposures, and the field reconnaissance was undertaken at the end of winter and after rainfall.

### 3.5 Land Stability

Based on comparative air photo interpretation over a period of almost 80 years, and an inspection of the banks and low coastal cliffs around the site, the land exhibits a high degree of stability. This would be expected from a site where stormwater runoff is reasonably well controlled both naturally because of the landform, and through collection and discharge at the base of the cliffs.

The existing large Pohutukawa vegetation is in no doubt contributing positively to the stability of the soils locally. There are two areas of recent and currently active instability at the western and eastern extremities of the site, but both of these areas of land slippage appear to be shallow and most likely associated with minor fill placement at the time of the Church carpark construction in the 1980's.

### 3.6 Coastal erosion

Based on comparative air photo interpretation over a period of almost 80 years, and an inspection of the banks and low coastal cliffs around the site, the rate of coastal erosion is very slow. There is evidence of localised bio-erosion at the base of the cliffs in the inter-tidal area, and some preferential weathering of the siltstone. However, compared to the cliff sections on the exposed coastal sections of Takapuna, the subject site appears to be at least five times, if not an order of magnitude, less.

Based on the available air photo and field evidence we estimate that the rate of regression of both the coastal margin and the top of the low cliffs to be about 1m per 100 years. As the soft sedimentary rocks extend to at least 2m above the current high time level, a rise of sea level of 1m would not alter the estimated erosion rate or rate of coastal regression.

### 3.7 Site Suitability

As part of its application for land use and resource consent, Council need assurance that the site is suitable for the proposed development, and that the proposed development will not have any significant adverse effects on the environment. Council also need assurance that the proposed development will not be adversely affected by natural hazards, in particular the geo-hazards of land instability and coastal erosion. The issue of coastal erosion is covered in detail in our previous (Coastal Hazards and Geotechnical Assessment) Report).

Unlike many sites where the subsurface conditions are uncertain, the subsoils and deeper rocks at 48 Esmonde Road are exposed on three sides in the low cliffs to the east, south and west.

Accordingly, for resource consent purposes there is no need for borehole investigations as the subsurface conditions are already known with a high degree of certainty. The East Coast Bays Formation (ECBF) as a geological unit is essentially the basement rock for Auckland. That is, this unit extends down for many tens or hundreds of metres without becoming weaker.

Accordingly, the experience of T+T with sites of similar geology can be applied to the subject site (48 Esmonde Road).

The ECBF stands as relatively stable cliffs at slope angles between 55 and 70 degrees. The residual soils are relatively stable at 1 (V) in 2 (H). Accordingly, with the current cliffs are not overstep and this is reflected in their apparent performance. There have been no apparent landslips in the past 80



years. It is proposed to have a 20m buffer around the perimeter of the site, and as such minor regression of the cliffs associated with coastal erosion will be unlikely to affect the development site for many hundreds of years.

The buildings are to be located more than 20m away from the low cliffs, and as such any buildings will not decrease the stability of the land. In addition, it is currently proposed to support the buildings on piles taken down into the underlying ECBF, and hence the buildings will have no adverse effect on land stability. It is also proposed to undertake excavation of the soils to create basement areas, and hence the overall impact of development will be to increase the natural stability of the subject site.

The ECBF unit provides the most favourable foundation support to buildings in Auckland. Not only does it have high compressive strength, but it can also be readily (mostly) excavated by machine and will stand in near vertical cuts without requiring temporary support. Most of the high-rise buildings in Auckland are supported on ECBF. The exception is the commercial centre of Takapuna which is underlain by weak sediments that infill the old (paleo) channel where the Waitemata Harbour used to exit into the Hauraki Gulf.

Accordingly, based on the cliff and shore platform rock exposures at the coastal margin of 18 Esmonde Road the subject site is ideally suited for basement excavation and high-rise building development from a geotechnical perspective.

For preliminary foundation design purposes a geotechnical ultimate bearing capacity of 4,500 kPa can be assumed for founding on top of the weak rock exposed in basement excavations. For piled foundations a geotechnical ultimate bearing capacity of 6000 kPa can be assumed.

It should be possible to construct the basement using temporary cut batters. Taking a conservative approach a value of 1H:1V could be assumed for preliminary temporary cut slope design. Further investigation may allow steeper temporary slopes to be safely created.

## 4 Summary and Conclusion

T+T have undertaken a geotechnical assessment at the site based on available information and a thorough inspection of the site by a geotechnical specialist.

The banks and low coastal cliffs around the site exhibit a high degree of stability. This would be expected from a site composed of soft sedimentary rocks and where storm water runoff is reasonably well controlled, both naturally because of the landform, and through storm water collection and discharge at the base of the cliffs.

The existing large Pohutukawa vegetation is contributing positively to the stability locally. There are two areas of recent and currently active instability at the western and eastern extremities of the site, but both of these areas of land slippage appear to be shallow and most likely associated with minor fill placement at the time of the Church carpark construction in the 1980's. There is no evidence to suggest that coastal erosion is resulting in instability.

Based on comparative air photo interpretation over a period of almost 80 years, and an inspection of the banks and low coastal cliffs around the site, the rate of coastal erosion is clearly very slow. There is evidence of localised bio-erosion at the base of the cliffs in the inter-tidal area, and some preferential weathering of the siltstone. However, compared to the cliff sections on the exposed coastal sections of Takapuna, the subject site appears to be at least five times, if not an order of magnitude, less.

Based on the available air photo information and field evidence we estimate that the rate of regression of both the coastal margin and the top of the low cliffs to be about 1m per 100 years. As the soft sedimentary rocks extend to at least 2m above the current high time level, a rise of sea level

of 1m would not alter the estimated erosion rate or rate of coastal regression. Accordingly, with a buffer of 20m around the site the development area will not be affected by erosion or instability.

The stiff residual clay soils and soft sedimentary rocks that underlie the site are easily excavated by normal earth moving machinery (excavators) and will not require blasting, nor should excavation work generate significant dust.

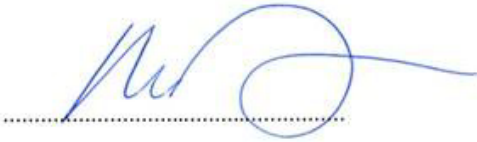
The geology of the site is particularly well suited to development of multi-storey buildings with basement car parking. With some basement excavation proposed, and the multi-storey buildings supported on piles taken down into the soft sedimentary rocks close to or below sea level, the development will not adversely impact on the natural land stability. If anything, the proposed development will improve the already naturally high degree of land stability.

## 5 Applicability

This report has been prepared for the exclusive use of our client Kingstone 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, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

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