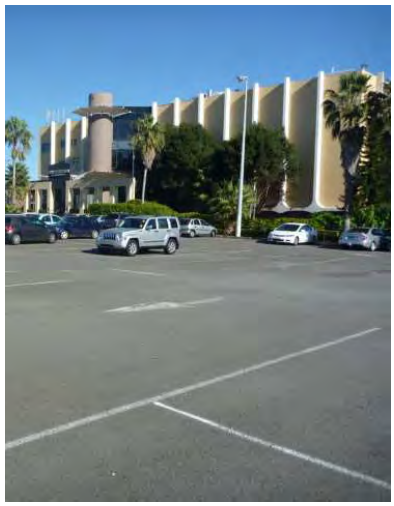
Godden Mackay Logan
Heritage Consultants



Cronulla Sharks Redevelopment
461 Captain Cook Drive, Woolooware
Archaeological Assessment Addendum

Report prepared for Bluestone Capital Ventures
February 2013

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Report Register

The following report register documents the development and issue of the report entitled Cronulla Sharks Redevelopment, 461 Captain Cook Drive, Archaeological Assessment Addendum, undertaken by Godden Mackay Logan Pty Ltd in accordance with its quality management system. Godden Mackay Logan operates under a quality management system which has been certified as complying with the Australian/New Zealand Standard for quality management systems AS/NZS ISO 9001:2008.

Job No.	Issue No.	Notes/Description	Issue Date
11-9631	1	Draft	January 2013
11-9631	2	Final Report	February 2013

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1.0 Introduction

1.1 Preamble

Godden Mackay Logan Pty Ltd (GML) has been engaged by Bluestone Capital Ventures to prepare an Addendum to accompany the Archaeological Assessment, prepared by GML in July 2011, for a proposed development at 461 Captain Cook Drive, Woolooware (the study area). This addendum addresses comments regarding Aboriginal Cultural Heritage received from the Office of Environment and Heritage (OEH) on 22 November 2011, following the submission of the Environmental Assessment (EA) accompanying the Concept Plan for the proposed development.

The purpose of this addendum is to:

1. identify registered Aboriginal sites and/or places across a wider area surrounding the study area using the OEH Aboriginal Heritage Information Management System (AHIMS);
2. provide GIS mapping of the AHIMS data;
3. provide an evaluation of existing geotechnical information for the study area, to determine the nature and extent of the deposits across the study area;
4. provide GIS based plans of the pre-land reclamation landforms and the extent of consequential land reclamation;
5. prepare GIS based section profiles through the study area; and
6. re-evaluate the archaeological potential of the study area based on the findings of this investigation.

The La Perouse Local Aboriginal Land Council (LPLALC) has been contacted through the course of the preparation of this addendum to discuss the project, and to ask for opinions and comments regarding the cultural heritage value of the study area and wider region for inclusion within this addendum.

1.2 The Study Area

The study area is located at 461 Captain Cook Drive, Woolooware, and comprises of Lot 20 of DP 529644, and Lot 11 of DP 526492 (Figure 1.1). The study area comprises of approximately 10ha of land owned by the Cronulla Sharks. The study area is bounded by Captain Cook Drive to the south, a sporting field to the west, mangroves and Botany Bay to the north, and an existing development to the east.

The study area consists of three areas: the Toyota Stadium (also known as Endeavour Field and Shark Park) and Sharks club house located in the centre of the study area; sporting grounds and limited car parking to the west (referred to here as the Western Land); and a larger car parking area to the east of Toyota Stadium (referred to here as the Approved Site) (Figure 1.2).

1.3 The Proposed Development

The proposed development is the redevelopment of the Cronulla Sutherland Leagues Club (Cronulla Sharks) site including neighbourhood retail use, residential development, and upgrades to the sports facilities, including the Sharks stadium.

The development proposal would require disturbance of the ground surface for the installation of footings and services associated with commercial and residential properties. No bulk excavation

would be undertaken, however, in some locations piling would occur to bedrock. The exact locations at which piling would take place across the site had not yet been determined. The installation of all other footings and services would take place at grade levels or within the layer of fill and would therefore not have an impact on soil horizons below the existing level of fill.

This development is to be assessed under Part 3A of the Environmental Planning and Assessment Act 1979 (EP&A Act 1979). Director General Requirement's (DGR's) for the development were received and addressed in an Environmental Assessment (EA). The Concept Plan, accompanied by the EA for this development, was submitted to the Department of Planning and Infrastructure (DoPI) and placed on public exhibition from 5 October 2011 to 5 December 2011. The Concept Plan was approved on 27 August 2012, with the condition that future applications would demonstrate that the OEH requirements would be met. This addendum addresses those requirements detailed in the OEH letter dated 22 November 2011.

1.4 GML 2011—Archaeological Assessment

In August 2011, GML prepared an Archaeological Assessment to accompany the EA for the development. This assessment included both Aboriginal and historical archaeological resources of the study area, and assessed the archaeological significance and potential impact of the development on any archaeological resources. An inspection of the study area was undertaken—informed by historical evidence, site plans and aerial photographs.

The assessment found that the study area remained largely undeveloped until the late twentieth century, following which it was used as a rubbish dump in the 1960s, and subsequently for sporting facilities and associated infrastructure from the 1970s.

The report concluded that:

- The study area had little or no potential to contain significant archaeological material associated with the historical development of the area.
- The study area did not have previously recorded Aboriginal sites.
- No landscape features associated with Aboriginal archaeological objects or potential archaeological deposits were identified within the study area.
- Natural ground levels are likely to have remained intact and sealed beneath the introduced fill material across the site.
- The potential for Aboriginal sites or objects to be buried below the current surface level within subsurface deposits was considered to be low.

However, considering that there is a potential for intact original land surfaces beneath fill layers across the study area, further assessment has been undertaken to accurately ascertain the nature of the deposits beneath the fill layer, and define the study area's potential to possess intact archaeological deposits.

A representative from the LPLALC accompanied archaeologists on the study area inspection, however, no comment was received at that time regarding the Aboriginal cultural heritage value of the study area. This current report has sought the opinion of the LPLALC with respect to their knowledge of cultural heritage values and the archaeological potential of the study area. However, at the time of report finalisation, despite constant contact attempts, no comment had been received.

1.5 OEH Requirements

The OEH submitted a letter on 22 November 2011 (attached as Appendix B) detailing further requirements for the project. Included within this letter were further conditions that needed to be met with regarding Aboriginal cultural heritage. The further conditions were stated as follows:

> *OEH recommends incorporation of the conditions be considered for incorporation in any approval that may be granted to confirm no Aboriginal objects, especially burials, are located on the site:*
>
> 16. *An evaluation of the geotechnical testing results to confirm the nature of the deposits below the introduced fill.*
> 17. *Mapping of the distribution of any original land surface area below the fill to determine whether there are likely to be any areas where Aboriginal objects could occur.*
> 18. *Profiling of the old land surface below the fill to show whether the landform adjacent to the swamp lands was suitable for occupation in the past.*
> 19. *A cultural assessment of the area by the Aboriginal community.*

It was stated in the OEH letter that although no Aboriginal sites have been registered with OEH directly within, or within 1km of, the study area, that 'the wider Kurnell peninsular area is known for its extensive middens, burials, and other evidence of Aboriginal occupation'. A wider assessment of the archaeological evidence present in the wider region would help to indicate whether or not the study area would have been a likely Aboriginal occupation location.

Aerial photos presented in GML 2011 indicated that the original shoreline of the study area had not changed substantially since early European settlement, and that therefore much of the study area would be likely located on or over original soil profiles.

1.6 Limitations

This addendum does not provide an assessment of the Aboriginal Cultural heritage other than any comments received from the LPLALC and only addresses OEH comments 16–19 (letter 22 November 2011) as reproduced above. This Addendum does not adhere to the OEH guidelines *Aboriginal cultural heritage consultation requirements for proponents 2010*.

No field inspection was undertaken during the preparation of this addendum.

This addendum only addresses the comments received from the OEH regarding Aboriginal heritage values and archaeological potential within the study area.

1.7 Authorship

This report was prepared by Sam Cooling, GML Consultant Archaeologist. GIS mapping was undertaken by Ben Anderson. This report was reviewed by Dr Tim Owen (GML Associate Archaeologist).

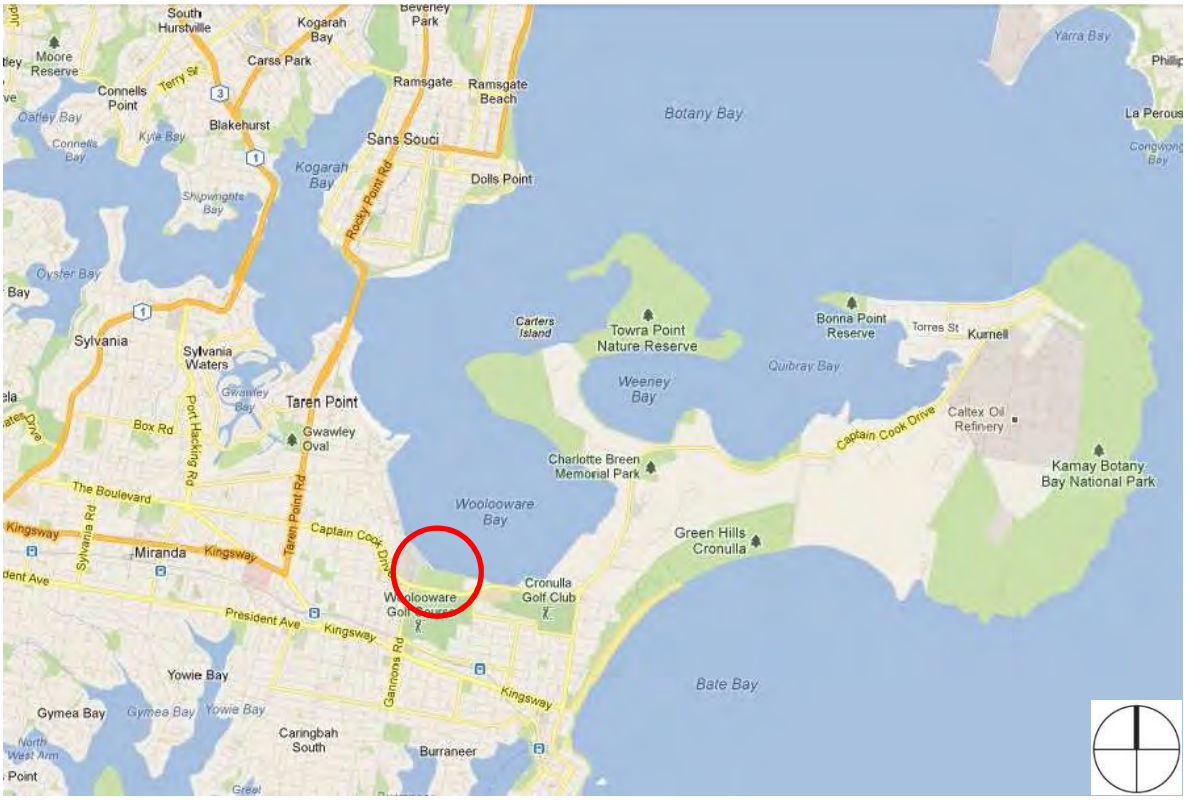


Figure 1.1 General location of study area (circled in red). (Google Maps with GML additions, 2013)

Figure 1.2 Current aerial photograph, showing property boundary (outlined in orange) and areas of proposed development (outlined in red). (Department of Lands with GML additions, 2013)

2.0 Archaeological Context

This section presents a regional archaeological context for the study area. Through an understanding of the wider archaeological context of the study area, in combination with an analysis of the geotechnical data for the study area (Section 4.0), a better understanding of the level of archaeological potential across the study area can be acquired.

Although a search of the OEH AHIMS database was undertaken in 2011 for the preparation of the Archaeological Assessment to accompany the EA for the development, a wider search of the region surrounding the study area was deemed appropriate for this addendum to provide more of an understanding of common site types and locations in the region.

2.1 AHIMS Search

A search of the OEH AHIMS database for a wide zone surrounding the study area of approximately 7km length by 5km width was undertaken on 10 January 2013. This wider search was undertaken with an aim to capture know Aboriginal sites of significance to the east of the study area, particularly in association with the Kurnell Peninsula. These known sites predominantly include middens and burials on established sand dunes. The results of the search are shown in Table 2.1.

The search identified 64 recorded Aboriginal sites and one Aboriginal place (Towra Point Resting Place) (Figure 2.1). Two sites on the AHIMS results were annotated as 'Not a Site' (52-3-1971 and 52-3-1972) and one site 52-3-1947 had information restrictions. Therefore these three sites have not been included in the AHIMS results summary below.

This AHIMS search indicated that the predominant Aboriginal site types that have been recorded in this area are midden sites. It should also be noted that burials are present in the wider region in association with sand dunes.

Table 2.1 Results of AHIMS search

Site Feature	Frequency	Percentage (%)
Burial	1	1.6
Burial with midden	1	1.6
Midden	36	59
Open camp site	12	19.7
Midden/open camp site	7	11.5
Midden/mound	1	1.6
Midden/Aboriginal resource	1	1.6
Potential Archaeological Deposit (PAD)	1	1.6
Isolated artefact	1	1.6
Total	**61**	**100**

None of the recorded Aboriginal sites and/or places were identified within the study area. The general patterning of Aboriginal sites in the local area shows a strong association with shell middens/camp sites along and within coastal sand dunes. Burials sometimes can occur in

association with similar locations and/or middens. No sites are located within mangrove zones, and very few sites are located adjacent to mangrove zones. There is a concentration of registered sites on the southern tip of the Kurnell Peninsula.

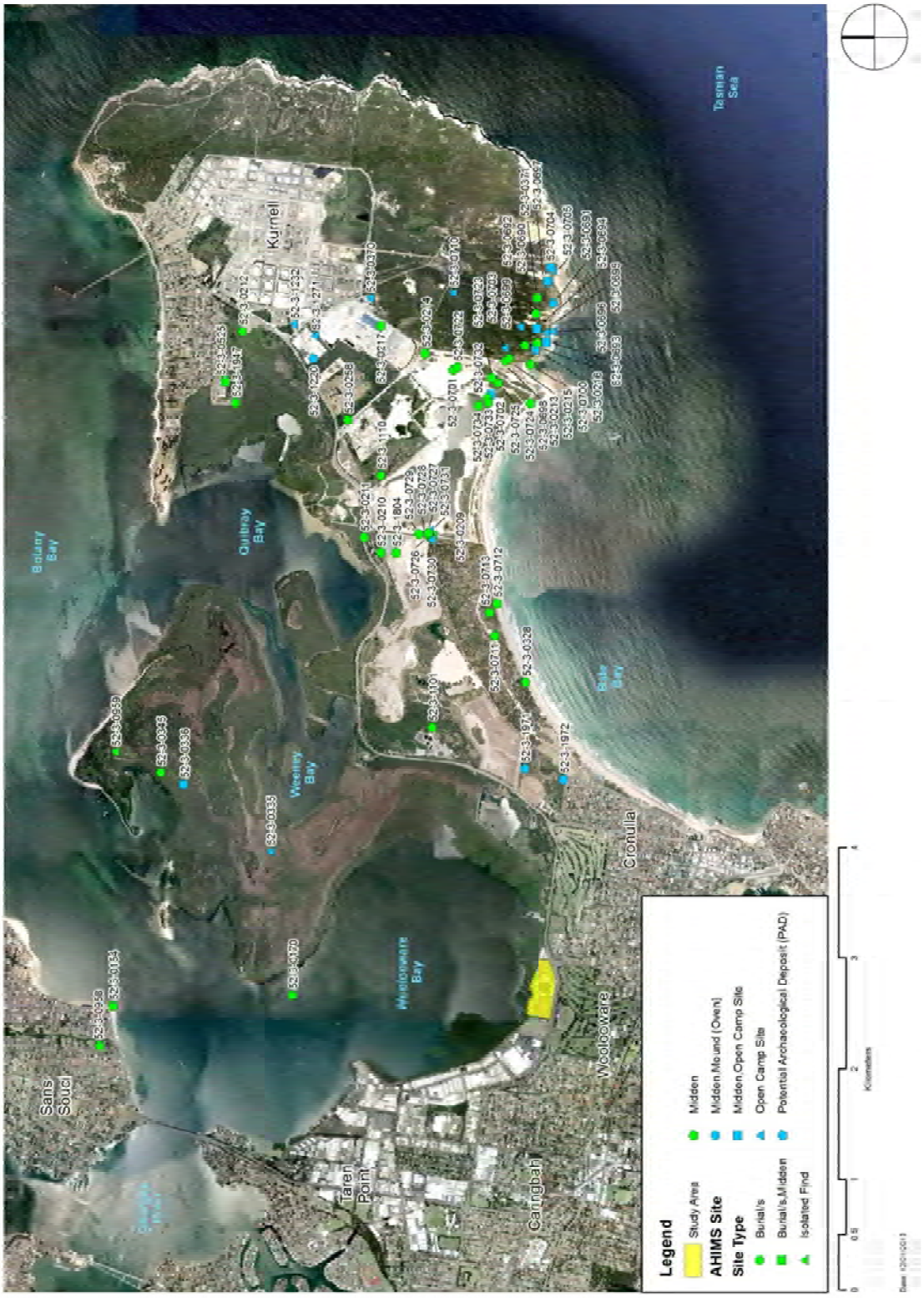


Figure 2.1 AHIMS Sites in the wider region of the study area. (GML 2013)

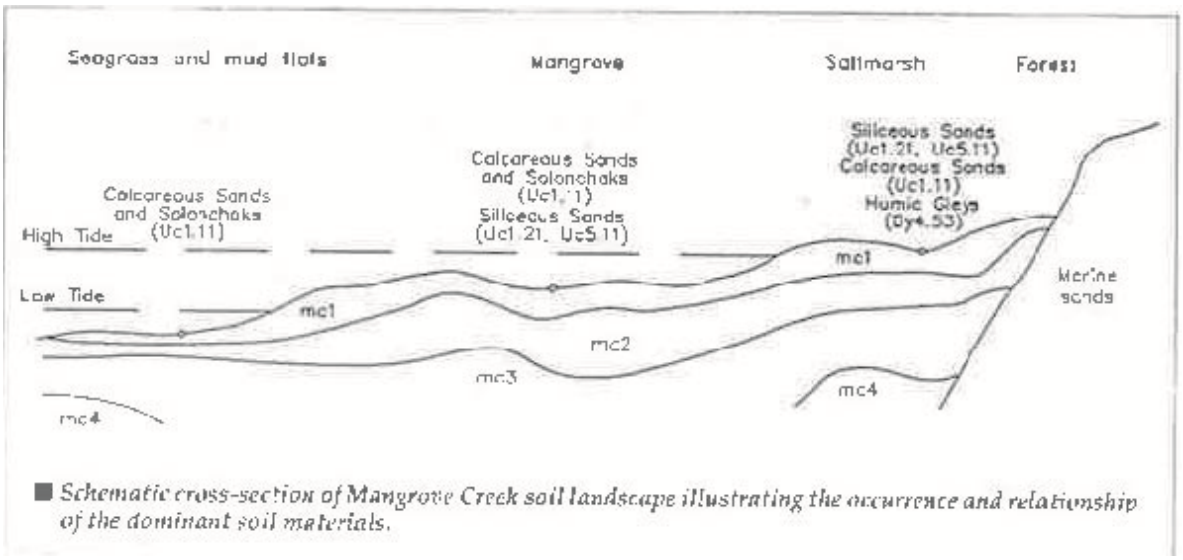
2.2 Environmental Context

2.2.1 Geology and Soils—Study Area

The geology of the study area is Hawkesbury Sandstone, overlain by acid sulphate soils. The study area is located across two soil landscapes; Mangrove Creek, and Disturbed Terrain (Hazelton and Tille 1990).

The Mangrove Creek soil landscape is characterised by level to very gently undulating tidal flats, mudflats, mangrove and saltmarsh on Quaternary marine sediments (organic rich, muddy, mostly 'marine' quartz sand and clean to muddy, shelly, 'marine' sands) and is regularly inundated by tidal waters. Soils are generally deep (>200cm) and generally consist of waterlogged and siliceous sands on mangrove flats and occasional siliceous sands and humic gley soils on saltmarsh and forest flats. Mangrove Creek soils have a high acid sulphate soil potential, high salinity and very low soil fertility. The pH levels for this soil profile vary between moderately acidic (pH 5.0), to moderately alkaline (Hazelton and Tille 1990). Whilst moderately alkaline soil conditions can conserve the Calcium Carbonate ($CaCO_3$) of shell, it should be noted that acidic and alkaline conditions do not lead to the conservation of bony material, as both the collagen and hydroxyapatite components can rapidly dissolve in conditions other than neutral (ie pH 7).

Four shore parallel zones are identified within this soil profile; mudflats, mangrove, saltmarsh, and littoral forest zone. Minor differences in topography can result in a number of these zones occurring sequentially at the same location (see Figure 2.2 for depiction of these zones in combination).



Schematic cross-section of Mangrove Creek soil landscape illustrating the occurrence and relationship of the dominant soil materials.

Figure 2.2 Schematic cross-section of Mangrove Creek soil landscape. (Source: Hazelton and Tille 1990, p 96)

Table 2.1 Dominant soil materials of the Mangrove Creek soil landscape (adopted from Hazelton and Tille 1990, p 97)

Soil Type	Description
mc1	***Dark brown organic silty loam***: spongy, plastic, very sticky greasy sludge of decomposing and saturated organic matter. Usually silty loam or silty clay loam. Commonly dark brown but ranges between black and yellowish grey. Shell and shell fragments can often be found. Has an anaerobic smell. (pH 7.0–8.5)
mc2	***Shelly black organic sandy loam***: saturated, shelly, organic rich, dark brown sandy loam to sandy clay

	loam. Colour varies from black to olive black with abundant organic matter, but can range to dull yellowish brown. Roots, shells and shell fragments are common. Frequently has an anaerobic smell. (pH 5.0–8.5)
mc3	***Shelly greyish yellow sand***: permanently saturated, shelly, greyish yellow brown, coarse sand. Dark greyish yellow often with grey mottles. Shell fragments and quartz pebbles common, roots and faunal channels rare. (pH 6.5–9.0)
mc4	***Mottled gleyed sandy clay***: saturated, mottled grey, light sandy clay loam to heavy clay. Grey in colour, orange brown mottles often present. Roots absent. (pH 7.5–9.0)

A soil profile report retrieved from the NSW Soil and Land Information System, sampled from within the mangrove zone approximately 700m east of the Cronulla Leagues Club, further demonstrates the veracity of this soil profile within the mangrove zone. The sample was taken on a 'tidal flat on marine, sand, clay lithology with nil rock outcrop'. This report describes the soils as acid sulphate soils, with peat layers to 1.3m in depth, overlying silty clay (1.3m–2.2m), over sandy clay (2.2–2.95m).

Although the study area is located immediately adjacent to the Mangrove Creek soil landscape (as depicted on the soils landscape 1:100,000 map), it is highly likely (and also shown through historical aerials) that the Mangrove Creek soil profile originally extended further into the study area (possibly across the entire study area) prior to any historical ground disturbance (see Figure 2.3).

2.2.2 Geology and Soils—Regional

The majority of the sites identified on the AHIMS register across the wider region are located on the Kurnell Peninsula in association with sand dunes. These sand dunes are components of the Kurnell soil landscape. The Kurnell soil landscape does not occur within the study area (Hazelton and Tille 1990).

The Kurnell soil landscape is an aeolian landscape characterised by gently undulating to rolling coastal dune fields and relict dunes. Local relief is to 15m, with slope gradients 1–10%. The landscape consists of transgressive north-south oriented dunes with convex narrow crests, broad (1000m–2000m) gentle inclined concave swales, and isolated swamps. Soils are generally deep (>200cm), with podzols on dunes and in swales, and organic acid peats in swamps (Hazelton and Tille 1990). The dominant soil materials of the Kurnell soil landscape are detailed in Table 2.2.

Table 2.2 Dominant soil materials of the Kurnell soil landscape (adopted from Hazelton and Tille 1990, p 87)

Soil Type	Description
kn1	***Loose brown sand*****:** this material occurs as topsoil.
kn2	***Grey brown mottled sand***
kn3	***Brown soft sandy iron pan***: brown soft (wet) iron-stained sand to loamy sand. Generally occurs as subsoil and commonly known as coffee rock.
kn4	***Loose yellowish brown sand***
kn5	***Black sticky peat***: saturated black organic rich silt loam to silty clay loam. Occurs as subsoil in poorly drained swales.

On sand dunes, up to 80cm of brown sand (kn1 and kn2) overlies up to 15cm of coffee rock (kn3) and up to 130cm of yellow brown sand (kn4). In swales, up to 25cm of brown sand (kn1 and kn2) overlies up to 25cm of black sticky peat (kn5).

The first occurrence of the Kurnell soil landscapes occurs approximately 2,500m to the east of the study area.

Two additional soil profiles were retrieved from the NSW Soil and Land Information System in proximity to the study area. One was located within the Cronulla Golf Course, approximately 1,250m east of the study area. The location of this sample is within the soil landscape of 'Disturbed Terrain'. The soil descriptions from this soil profile are sandy fill (30cm) over sapric peat (30-75cm), over silty (75cm-1m) and sandy clays (1m-2.8m).

The second soil profile was taken behind the Woolooware Golf Course, approximately 1000m southeast of the study area. This sample is also located within allocated soil landscape of 'Disturbed Terrain'. The soil descriptions for this soil profile are 50cm of fill over silty clay loam (50–80cm) over fine sandy clay loam (80cm–1m) overlying sandy clays (1–1.5m) and clays (1.5–1.7m).

2.2.3 Vegetation

The study area is located immediately south of and adjacent to an area of mangrove swamp that grows along the entire tidal zone of Woolooware Bay. The study area is partially located over an intertidal mudflat, particularly along its northern boundary. Aerial photographs presented in GML 2011 demonstrate that the modern land uses within the study area in the 1960s and 1970s (ie the rubbish dump and sporting facilities) encroached into part of the mangrove zone.

Mangroves are an invasive plant species that are able to establish and grow rapidly on intertidal mudflats. Sydney mangroves are largely dominated by one species, the Grey Mangrove (*Avicennia marina*), generally a small tree up to 5m in height. Mangroves require specific conditions to survive, namely mudflats with daily inundation and high salinity. However, once established, mangroves are a quick growing and hardly plant (Benson and Howell 1990).

Analysis of the 1943 aerial of the study area showing the mangrove area has been compared with a current aerial to indicate the extent of the mangroves across the study area prior to historical land development (ie land fill and sporting grounds). The extent of the mangrove zone evident in the 1943 aerial (Figure 2.3) is demonstrated across a current aerial of the study area in Figure 2.4.

The mangrove zones in other locations within Woolooware Bay remain at an average width of 500m in 2013 (Figure 2.5).

The 1943 aerial shows a 'straight' east to west 'end' to the mangroves and an 'L' shaped drainage channel. The depth of mangrove in 1943 was approximately 150–200m. It is suggested that this area of shoreline had been subject to drainage and the commencement of land reclamation. The original extent of mangrove pre-1943 could have extended further south into the study area.

Figure 2.3 1943 Aerial of the study area, displaying the commencement of land reclamation. (Department of Lands with GML Additions)

Figure 2.4 The extent of mangrove zone prior to historical land development (1943) overlaid on current aerial. (GML 2013)

Figure 2.5 Woolooware Bay existing mangrove zone in 2013. (GML 2013)

2.2.4 Geomorphological Processes

During the Last Glacial Period, Botany Bay would not have been the estuarine environment with sand dune headlands as it is today, but rather from approximately 30,000 to 18,000 years ago, Botany Bay (as well as Port Jackson and Port Hacking) would have been a deep bedrock valley with fresh water streams. Following the Last Glacial Maxiumum (LGM) approximately 21,300 years ago, sea levels rose and flooded these deep bedrock freshwater valleys. The flooding of these valleys formed estuarine environments between 11,500 and 7,000 years ago. Therefore, the estuary of Botany Bay (within which Woolooware Bay is located) would have been in its present form (ie estuarine, mangrove swamps) for the last 7000 years, following the rise of sea levels to approximately their current level (Attenbrow 2002).

As sea levels rose, sand was deposited across river mouths and on the headlands of Botany Bay, ie the Kurnell Peninsula. This commenced towards the end of the Pleistocene (approximately 13,800 years ago), with the transgressive aeolian sand dunes of the Kurnell Peninsula forming between 10,000 and 7,800 years ago (Attenbrow 2002).

Average modern tides for Botany Bay are up to 2m above sea level (BOM online data, accessed 17.1.13).

2.3 Previous Ground Disturbance

The study area was owned by Sutherland Shire Council between 1962 and 1967, when extensive amounts of fill material were introduced across the entire area. These layers of fill covered all existing ground levels, including the ground levels.

Lot 20 DP 529644 (the 'Western Land') was purchased in 1968 by Cronulla Caringbah Leagues Club Limited. Little development has occurred on this land since its purchase by the club, with part of the area being grassed and utilised for junior sporting events, and part of the lands (closest to Captain Cook Drive) being covered in a bitumen surface and utilised as an additional car park.

Lot 11 (the Toyota Stadium and the 'Approved Site') was purchased in 1971 by the club, although construction of the Endeavour Field (now known as Toyota Stadium) commenced in 1967 and was officially opened in 1969. To the east of the Toyota Stadium (the 'Approved Site'), construction of the club's Rugby League Club began in 1973. Few changes to the land and the structures on it have taken place since then.

A drainage channel exists between the 'Western Land' and Toyota Stadium (as evident in the 1943 aerial, Figure 2.3), however, it is likely that this drainage channel was 'cut' for land reclamation and mangrove drainage purposes. The path of this drainage channel as evident today (Figure 2.4) is artificially straight, reinforcing the probability of it being a recent modification to the land, rather than a palaeo-creek.

2.4 Aboriginal Regional Occupation

Radiometric dating of archaeological deposits in the Cronulla area have returned dates of around 4000 years BP (Attenbrow, 2002), with other dates retrieved from across the Kurnell Peninsula mainly dating to the mid to late Holocene (up to 5,000 years ago).

Estuarine mudflats such as that located at Woolooware Bay generally provide habitats for large numbers and varieties of shellfish, as well as plentiful bird life, game and bush tucker. This environment would have been accessed as a food resource by Aboriginal people in the area, particularly during the Holocene where the extent of the mangrove swamp would have been similar to that today. However, mudflats and intertidal regions are not locations that Aboriginal people used as temporary or permanent 'campsites'. Aboriginal sites located within the wider region of the study area confirm the preferential use of coastal sand dunes (and not inter-tidal mudflat environments) for occupation sites, evidenced by midden deposits, open camp sites and burials. Additionally, the bi-daily tidal inundation of the mangrove zone is not a favourable taphonomic factor in archaeological site formation.

2.5 Synthesis of Archaeological Context

The majority of registered Aboriginal sites in the region, particularly midden sites and burials, are located in association with the Kurnell Aeolian soil landscape; a soil landscape that does not occur within the study area. However, the lack of archaeological survey within and in the immediate vicinity of the study area (ie around Woolooware Bay) should be acknowledged to have a consequence on the number of recorded Aboriginal sites in the area.

The study area is located predominantly within a mangrove zone, a soil landscape which is unlikely to retain any archaeological deposit. This is due to the low likelihood of the Aboriginal use of this kind of swamp soil area for activities which could culminate in an archaeological deposit, and due to

the bi-daily inundation of the tidal zone, which would limit the potential for any archaeological deposits to remain intact.

The geomorphological processes that shaped the landscape within which the study area is located, differs from those that shaped the Kurnell Peninsula.

Further investigation of the possibility of Aboriginal occupation behind the mangrove zone will be explored through the analysis of geotechnical data and modelling of the original land surface, as is presented in Section 4.0.

3.0 Aboriginal Community Consultation

The La Perouse Local Aboriginal Land Council (LPLALC) were provided with the draft of this addendum report, as well as a copy of the GML 2011 report for reference via registered post on 4 February 2013, and were invited to comment on any known Aboriginal cultural heritage values associated with the study area.

Mr Chris Ingrey, Chief Executive Officer of the LPLALC contacted Sam Cooling (GML) via phone on 13 February 2013 to discuss the project and to confirm that he had received both reports.

Mr Ingrey provided an initial verbal response regarding the cultural significance of the general area in which the study area is located and offered to provide formal comments on the cultural significance of the general area, in writing by Friday 15 February 2013. Mr Ingrey noted that the area is culturally significant due to past land use by local Aboriginal people, of which he provided a brief verbal summary as is noted below. He also noted that he could only provide general comment on the cultural significance of the area and recommended that should further detailed information regarding Aboriginal land use and cultural significance of the area be required, consultation should be undertaken with the Aboriginal communities and families local to the area, and not just the LPLALC. Mr Ingrey noted that although Aboriginal people in La Perouse would have accessed Woolooware Bay, it would be more appropriate to seek further information regarding Aboriginal land use and cultural heritage significance values from the Aboriginal families and communities directly local to the land of the study area and its surrounds.

Mr Ingrey stated that Woolooware Bay was used as an area for traditional fishing by the Aboriginal people up until the late 1970s and early 1980s, for both spear and line fishing. He described how local Aboriginal families would also have collected wood for making boomerangs and fishing spears from the mangroves in Woolooware Bay. Holt's farm, which was historically located next door to the current study area, had Aboriginal families working and camping on the estate.

Historically, Aboriginal families camped on Towra Point, up until the 1860s, where men would have worked on Oyster farms in that area. Quibray Bay (located nearby) had fresh water springs that the local Aboriginal people would swim in.

Additionally, Mr Ingrey recommended that interpretation of the cultural significance of the region to the local Aboriginal people should be included in an appropriate location within the Sharks Development (eg along a walking trail) if possible.

Mr Ingrey also noted that he understood that in accordance with the NPWS Act 1974 there are no registered Aboriginal sites or objects located within the study area, and that there is a low potential for such sites and/or objects, to be located within the study area.

A formal letter detailing this correspondence as summarised above, and providing official written comment regarding the cultural significance of the area was received by GML from Mr Ingrey on 15 February 2013. This correspondence is attached to this addendum in Appendix A.

A consultation log of all communication with the LPLALC is included as Appendix A of this addendum. The LPLALC should be sent a copy of the final report of this addendum for their reference.

4.0 Geotechnical Investigations

Extensive geotechnical investigations were undertaken across the study area between 1978 and 2002. These are presented in a report by Jeffery & Katauskas (2002).

These geotechnical investigations are analysed in this section to determine the depth of fill layers across the site, the extend of original land surfaces under the fill layer, and to determine if the soil profiles beneath the fill within the study area possess the potential to contain intact archaeological deposits.

An effort has been made to reconcile current ground levels across the study area. However, where RLs were not recorded, or the location of the borehole cannot be accurately geo-referenced, the borehole has been located as best possible based on geotechnical maps as well as on a current survey plan of the study area.

Only boreholes of significant depth (ie those that sample all or most of the soil profile to bedrock), and those that can be located with relative accuracy across the site have been included in this analysis. Those of a very shallow depth (ie only through the fill layer), or that cannot be located within the study area, have been disregarded for this analysis.

It should be noted that variation in the detail of soil descriptions exists between the different geotechnical investigations. Soil descriptions have been standardised to conform to Hazelton and Tille (1990) (Table 2.1).

4.1 Borehole Summary

Generally across the study area, the testing revealed:

> *poorly compacted fill over soft and very soft bay deposits of organic silty clays over stiff to very stiff clayey soils and medium dense to very dense sandy soils.* (Jeffrey & Katauskas 2002:5)

Sandstone bedrock (or inferred bedrock) was encountered from 12m to 20.6m below the existing ground surface. Fill was encountered in all boreholes, with the depth of fill across the study area ranging between 2m to 4.8m.

Forty borehole logs were analysed to provide an indication of the subsurface soil profile across the study area. The boreholes analysed ranged in depth from 3.8m to 20.5m.

This data was analysed using ArcGIS10 GIS software, and from this analysis, section profiles across the study area showing the subsurface profile of the deposits were produced. A Digital Elevation Model (DEM) of the RLs across the study area was created using a recent survey plan, and an Inverse Distance Weighing interpolation algorithm which assigned unknown elevations with an average of the known elevations around them (Figure 4.2).

Three section profiles were generated: one running north south to the east of the 'Approved Site' (Figure 4.3); one running north south between the 'Western Land' and Toyota Stadium (Figure 4.4); and one running east-west through the centre of the study area (Figure 4.5). The locations of these section profiles can be seen in Figure 4.2.

Figure 4.1 Location of boreholes across the study area . (GML 2013)

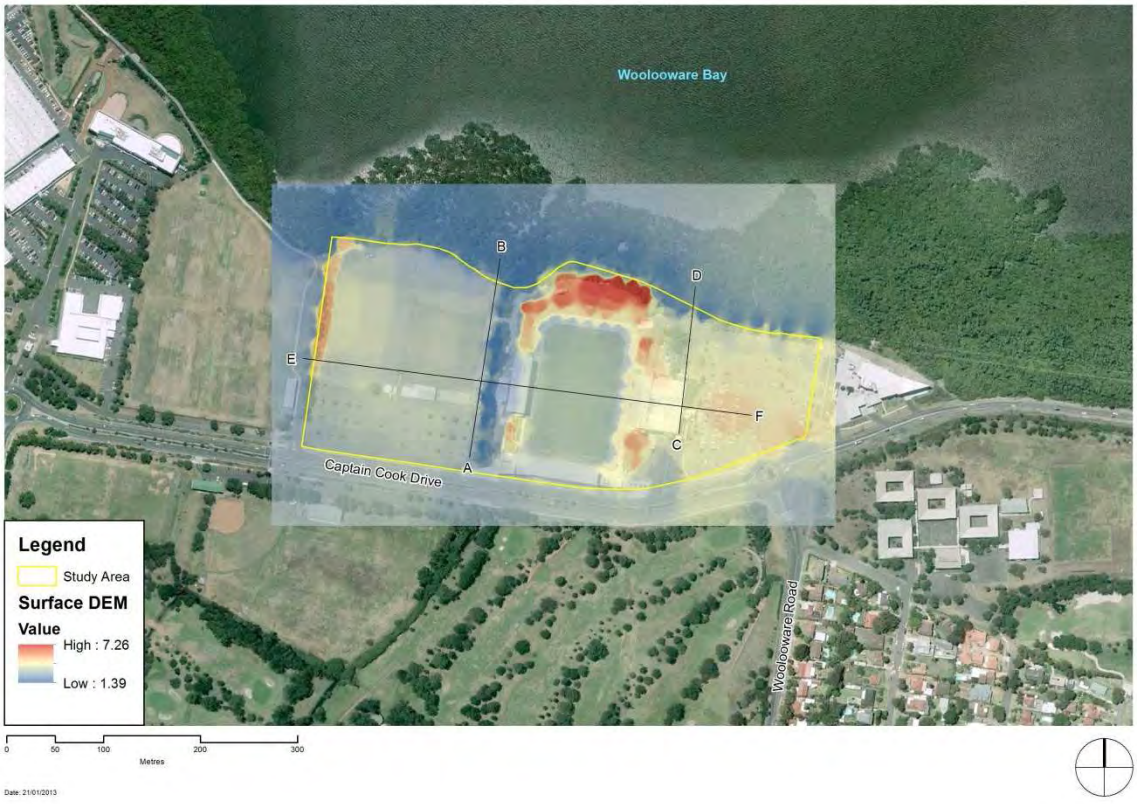


Figure 4.2 Subsurface profile locations and DEM of current ground surface. (GML 2013)

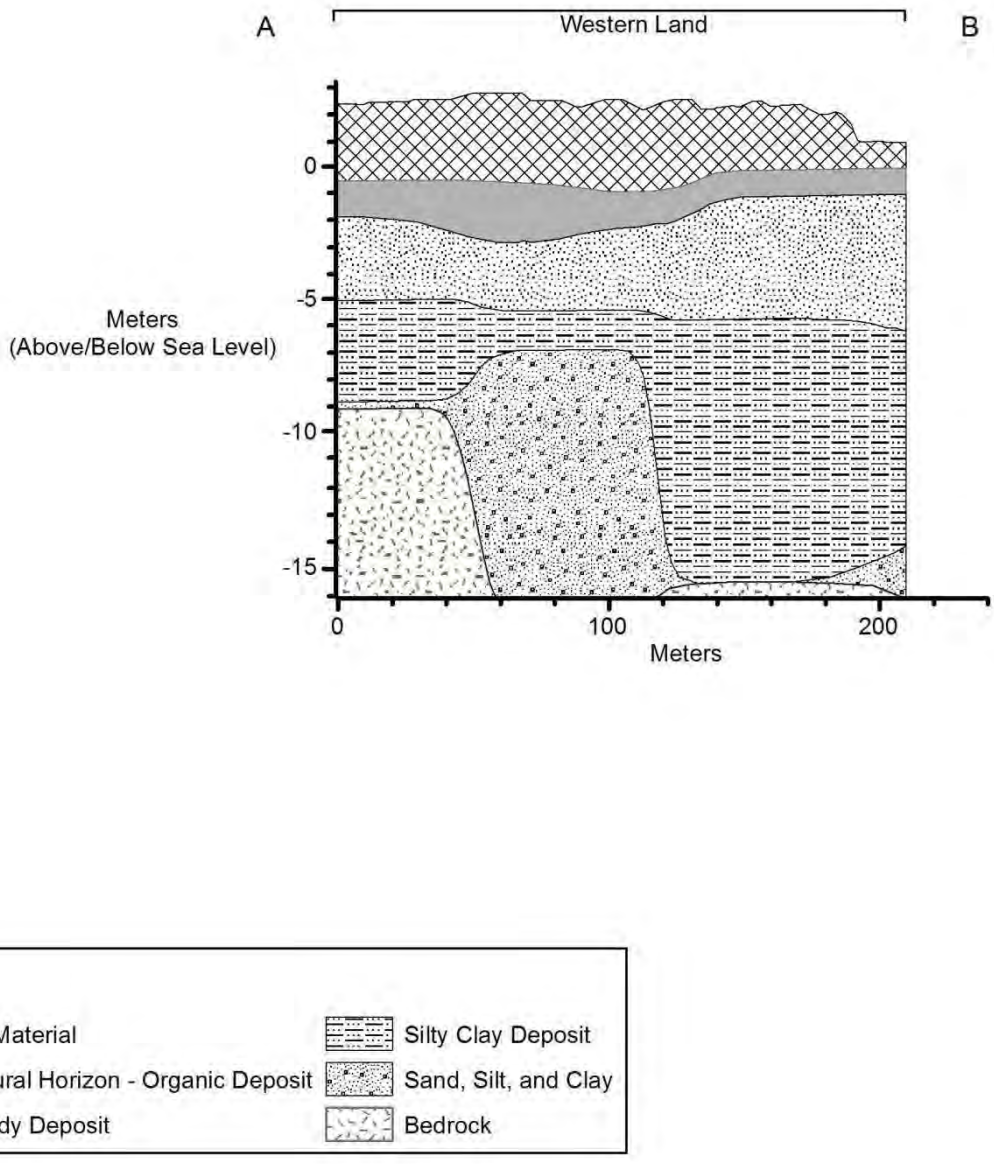
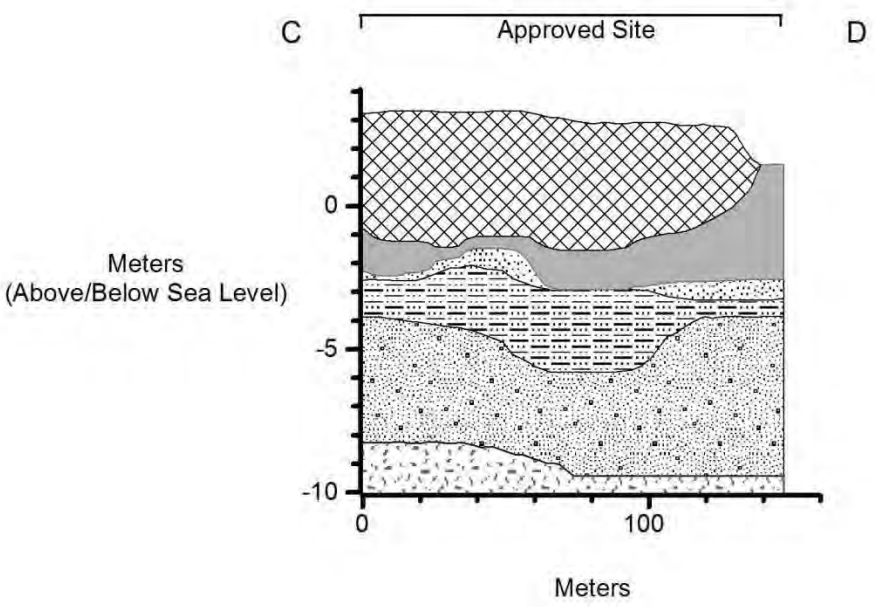


Figure 4.3 Section profile A-B (north-south).



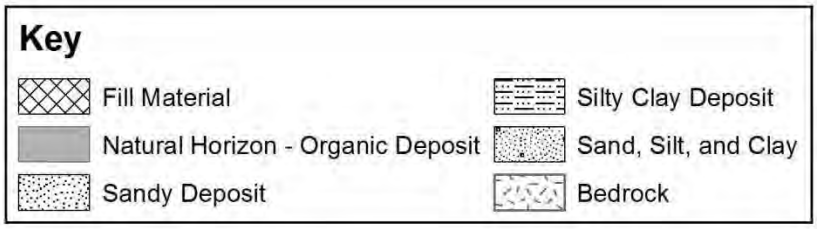


Figure 4.4 Section Profile C-D (North-South). (GML 2013)

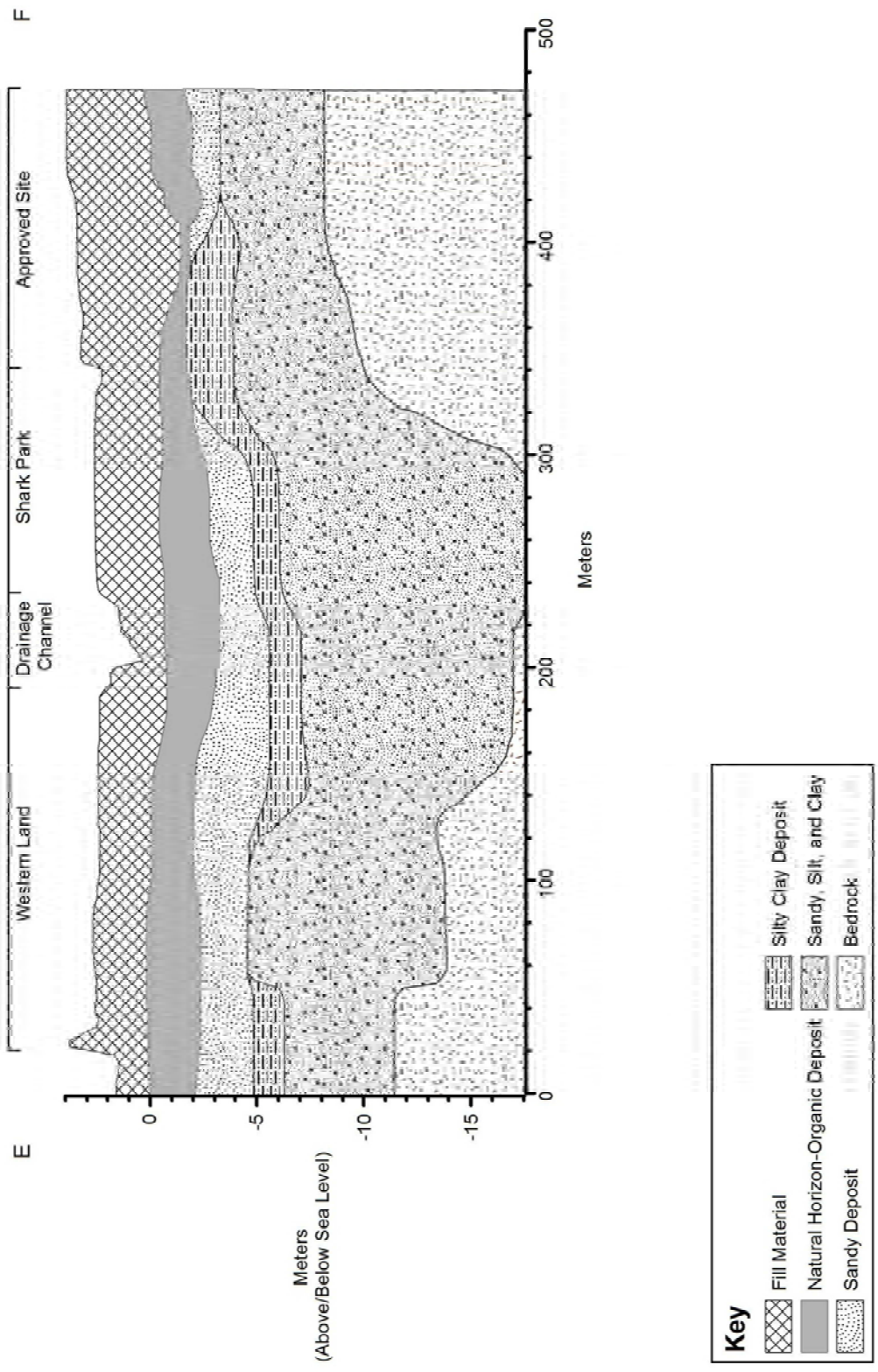


Figure 4.5 Centre section profile E-F (east-west). (GML 2013).

Of key importance is that through all soil profiles (and shown in all section drawings) is sea level. Across the entire study area, 'natural' (non-fill) layers are all located at sea level or below. There are no soil profiles within non-fill layers above sea level.

The level of organic silts and silty clays found to be present across the study area immediately below the layer of fill was generally consistent with an estuarine/mangrove swamp zone. This layer was commonly recorded through the geotechnical borehole soil logging to contain shell fragments. The consistency of shell fragments reported from this soil profile from multiple boreholes, as well as its location within organic silt/silty clay, suggests that these shell fragments are representative of the vast quantities of natural shell that are present within a mangrove environment and therefore exist within the study area below the levels of fill.

Boreholes with a typical soil profile within the study area, for which data to bedrock (or inferred bedrock) was present in the geotechnical report, are summarised in Tables 4.1 to 4.4. Borehole core logging sheets for the examples provided below are included at Appendix C. See Figure 4.1 for locations of the summarised boreholes.

Table 4.1 Borehole Example: Borehole 1

Depth (m)	Soil Profile
0–2.5	Fill
2.5–5.6	Organic silt and clay, dark grey, shell fragments
5.6–7.3	Sand/Sandy clay, light grey to brown
7.3–8.5	Silty clay
8.5–10	Clayey sand, grey, some shell fragments
10–20.5	Clay/Sandy clay, brown-grey (sandstone bedrock reached at 20.5)

Table 4.2 Borehole Example: Borehole 101

Depth (m)	Soil Profile
0–2.5	Fill
2.5–5	Organic silty clay, dark green-brown, shells fragments and decayed roots.
5.0–6.0	Sandy clay, brown
6–7.2	Sand, grey
7.2–16.5	Sandy clay, light grey (sandstone bedrock reached at 16.5m)

Table 4.3 Borehole Example: Borehole 601

Depth (m)	Soil Profile
0–3.5	Fill
3.5–5.7	Organic silty clay, dark brown-grey, shell fragments and fine roots
5.7–7	Silty sand to sand, grey to orange-brown
7–8.1	Clayey sand, pale brown and red (sandstone bedrock reached at 8.1m)

Table 4.4 Borehole Example: Borehole 808

Depth (m)	Soil Profile
0–3.0	Fill
3.0–5.2	Organic silty clay
5.2–7.5	Sand and silty sand
7.5–18.9	Silty clay (inferred bedrock reached at 18.93m)

Based on the geotechnical data, when mapped as section profiles across the site, the soil deposits across the study area can be reduced to four main definable deposits:

1. Fill Layer;
2. Natural Horizon/Organic Deposit (Dark Brown-Grey, shell fragments and root inclusions);
3. Sandy Deposit (Generally grey-light grey); and
4. Silty Clay (Light to dark grey).

4.2 Comparison with Soil Landscapes

As summarised in Section 2.2.1, the soil landscapes described for the Mangrove Zone (Hazelton and Tille 1990) can be described as follows:

- mc1: Organic silty loam (Dark brown)
- mc2: Organic sandy loam (Black)
- mc3: Sand (Greyish yellow)
- mc4: Sandy clay (Grey/gleyed)

The typical colour of each soil profile is listed in brackets after the soil type. Shell fragments are listed as present through mc1, mc2 and mc3, but absent in mc4.

In an attempt to investigate the study area soil profiles, as sampled by geotechnical work, in comparison with the Mangrove soil landscapes soil descriptions, mc1 and mc2 will be combined here to represent the 'organic' deposit witnessed across the study area.

Four borehole logs entries taken from different locations across the study area (Table 4.1 to 4.4) were compared to the soil descriptions for soil landscapes; either Mangrove Creek or Kurnell aeolian. The layer of fill present across the study area was disregarded for this comparison. Where consistent with a soil description from either the Mangrove Creek or Kurnell soil landscape description, this was recorded. The results of this comparison are presented in Table 4.5.

Table 4.5 Comparison between study area borehole profiles, and soil landscapes.

Borehole	Soil Profile	Soil Landscape Description
1	Organic silt/clay	mc1/mc2: Organic silty loam/sandy loam
	Sand/Sandy clay, light grey to brown	mc3: Sand, greyish yellow
	Silty clay	N/A

	Clayey sand	Transition between mc3/mc4
	Clay/Sandy clay	mc4: Sandy clay
101	Organic silty clay	mc1/mc2
	Sandy clay	N/A
	Sand, grey	mc3
	Sandy clay	mc4
601	Organic silty clay	mc1/mc2
	Silty sand/sand, grey	mc3
	Clayey sand	N/A
808	Organic silty clay	mc1/mc2
	Sand and silty sand	mc3
	Clay/silty clay (Inferred bedrock reached at 18.93m)	N/A

Differentiation between the soil profiles and the soil landscapes was witnessed (ie some soil profiles logged through the geotechnical work was not consistent with any soil landscape description). However, regardless of the exact reconciliation of the soil profiles from the study area with the soil landscapes, it was clear that sand dunes consistent with the Kurnell soil landscape are not present within the study area.

4.3 Synthesis of Geotechnical Investigations

The analysis of the geotechnical investigations undertaken for the study area can be summarised as follows:

- fill across the study area is between 2.5 to 4.5m in depth below current surface level;
- the 'natural' soil profile across the study area immediately below the fill layer is an organic deposit consistent with a mangrove environment;
- natural soil profiles only commence at 0m (sea level);
- sandy deposits are present below the organic deposit. Where present, sand deposits are sporadic and not uniform across the study area;
- soil profiles from the boreholes across the study area are generally consistent with those from the Mangrove Creek soil landscape, (particularly mc1 to mc3); and
- soil profiles consistent with the Kurnell Aeolian soil landscape are not present within the study area.

5.0 Conclusions and Recommendations

This section presents the interpretations and conclusions drawn from the analysis of the study area. Recommendations regarding Aboriginal cultural heritage within the study area are provided. Reference locations within this addendum for these conclusions and inferences are noted in parentheses following each point.

5.1 Conclusions

Based on the investigations undertaken through the preparation of this addendum, the following conclusions have been reached regarding the additional information required by OEH for the study area:

1. AHIMS patterning shows many midden and burial sites on the Kurnell Peninsula. The landscape location of these sites is generally 200m or more from the current water's edge. There is little association between midden/burial sites and mangrove habitats (noting that Quibray Bay has three sites on the edge of the mangrove habitat where sand dunes commence) (Section 2.1).
2. Geomorphological processes within the study area are different to those on the Kurnell Peninsula (Section 2.2.4).
3. Woolooware Bay in 2013 has an average depth of mangroves of 500m in width (Section 2.2.3).
4. Fill across the study area is between 2.5 to 4.5m in depth below current surface level (Section 4.1).
5. The 'natural' soil profile across the study area (ie below the layer of fill) has an organic deposit immediately below the fill layer (Section 4.1). This layer commences at sea level.
6. If present below the organic deposit, a sand sheet is sporadic and not uniform (Section 4.1, Figures 4.5 to 4.5).
7. All pre-fill soil profiles would have been inundated by high tides, with average modern tides in the study area up to 2m above sea level (Section 2.2.4).
8. All boreholes at distance from the Mangrove zone exhibit characteristics of mangrove habitat soil landscape (Section 4.1).

5.2 Interpretation

The following points have been interpreted from the conclusions reached through the investigations undertaken for this addendum:

1. The mangrove zone within the study area has little to no archaeological potential.
2. Any organic deposit or sand below 1.5m above sea level would have been regularly flooded.
3. The drainage channel in 1943 appears to have been 'cut' (it is artificially straight) for land reclamation and mangrove drainage purposes.

4. The mangrove zone within the study area has been cut/reclaimed by approximately 200–300m based on the average width of the mangrove zone in Woolooware Bay remaining in 2013. Therefore, historically, mangrove growth would have covered most of the study area.
5. The landforms of the study area do not appear to contain dune formations (Attenbrow 2002; Hazelton and Tille 1990).
6. The study area did not contain sand dunes suitable to support Aboriginal habitation activities associated with burials and/or midden site formation.

It is concluded that prior to all land reclamation, the entire study area would have been covered by mangrove swamps and was located within the inter-tidal zone. No sand dunes or sand sheets were present within the study area.

The LPLALC will receive a copy of this draft addendum report for their review, and invited to comment on the Aboriginal cultural heritage values of the study area. Any comments received will be incorporated into the final addendum report (Section 3.0).

5.3 Recommendations

The following recommendations are made regarding the further management of Aboriginal cultural heritage within the study area:

- The study area does not have the potential to possess Aboriginal burials.
- The potential for the study area to possess intact Aboriginal archaeological deposits is considered to be low to nil.
- No further archaeological monitoring, recording or investigation is recommended within the study area prior to, or in conjunction with the development.
- A copy of this draft report should be provided to the LPLALC for comment, and any comments received should be incorporated into/addressed in the final report.

6.0 References

Attenbrow, V. 2002. *Sydney's Aboriginal Past*. University of NSW Press: Sydney.

Benson, D. and Howell, J. 1990. *Taken for Granted: The Bushland of Sydney and its Suburbs*. Kangaroo Press: Kenshurst.

Bureau of Meteorology. 2013 Tide predictions for New South Wales: Botany Bay- Times and Heights of High and Low Waters January 2013. Available at: http://www.bom.gov.au/cgi-bin/oceanography/tides/tide_predications.cgi. <Accessed 17 January 2013>

Godden Mackay Logan 2011. *461 Captain Cook Drive, Woolooware, Archaeological Assessment*. Report to Parkview.

Hazelton P.A. and Tille P.J., 1990. *Soil Landscapes of the Wollongong-Port Hacking 1:100,000 Sheet* map and report, Soil Conservation Service of NSW, Sydney

Jeffery & Katauskas Pty Ltd, 2002. *Geotechnical Investigation for Proposed Cronulla Leagues Club Rezoning at Captain Cook Drive, Woolooware*. Report to Cronulla Sutherland Leagues Club Limited.

7.0 Appendices

Appendix A

LPLALC Consultation Log and Letter Communication

Appendix B

Letter from OEH regarding Aboriginal Cultural Heritage

Appendix C

Borehole Soil Logging Examples (Boreholes 1, 102, 601 and 808)

Appendix A

LPLALC Consultation Log and Letter Communication

La Perouse Local Aboriginal Land Council Consultation Log

Group	Contact Name	Date Contacted. Method	Contact Details	Comments
La Perouse Local Aboriginal Land Council (LPLALC)	Christie Re: Shane Ingrey	21/1/13	9311-4282	SC called LPLALC reception in attempt to contact Shane Ingrey. Informed by receptionist that Shane does not work from the office, and to send an email to LPLALC (admin@laperouse.org.au) to be forwarded to Shane explaining project and requesting details. If we have not heard from Shane by end of week, to contact LPLALC office again to try again.
LPLALC	Shane Ingrey via LPLALC	21/1/13	admin@laperouse.org.au	Email sent to LPLALC admin for Shane Ingrey explaining project, forwarding previous report, requesting comment, and requesting contact to discuss project
LPLALC	Reception	24/1/13	9311-4282	JM rang LPLALC. Left voice mail message.
LPLALC		24/1/13	9311-4282	TO rang LPLALC. Left voice mail message asking for a return call requesting comment, verbal or written.
LPLALC	Reception	25/1/13	9311-4282	JM rang LPLALC. Left voice mail message.
LPLALC	Admin	29/1/13	admin@laperouse.org.au	JM sent email to admin requesting response.
LPLALC	Admin	1/2/13, 12.35pm	9311-4282	Engaged 12.35pm.
LPLALC	Rhonda	4/2/13, 2.35pm, Phone	9311-4282	SC spoke with Rhonda at LPLALC. Informed that person that looks after the admin account had stepped out for lunch. Left a message with Rhonda for Christie to return the call when she returned from lunch. Awaiting return call/call back later this afternoon.
LPLALC	Shane Ingrey/LPLALC	4/2/13	Registered Post PO Box 365 Matraville NSW 2036	SC sent current draft report and previous assessment report along with covering letter via registered post to LPLALC
LPLALC	Christie	4/2/13, 4pm	9311-4282	SC spoke with Christie. She had forwarded on the report to both Shane and Chris Ingrey. She will forward again and let them know to expect the registered post reports and letter over the next few days.
LPLALC	Reception	11/2/13, 3.30pm	9311-4282	SC spoke with Christie who confirmed that registered post reports were received and passed onto Chris Ingrey. Requested again phone conversation with Shane or Chris Ingrey to discuss project ASAP, needed early this week as a priority. Christie to pass on message to Chris/Shane. Left phone number for contact.

LPLALC	Chris Ingrey	13/2/13, 9am	Phone	Chris Ingrey phoned GML and spoke with SC. Provided initial verbal response regarding the general significance of the area. Noted that should more detailed information be required, the local Aboriginal communities and families should be consulted, rather than just the Land Council. Suggested that interpretation of the general cultural significance of the area be undertaken at the site if possible. Will send official letter for inclusion in report by the end of Friday 15 February 2013.

4 February 2013

La Perouse Local Aboriginal Land Council
PO Box 365
MATRAVILLE NSW 2036

Attention: Shane Ingrey

Our Ref: 11-9631sil1

Re: Cronulla Sharks Development, 461 Captain Cook Drive—Archaeological Assessment Addendum Report

Dear Mr Ingrey

I contacted the La Perouse Local Aboriginal Land Council (LPLALC) office via phone on Monday 21 January 2013, hoping to discuss with you the Cronulla Sharks Development project, 461 Captain Cook Drive, Archaeological Assessment, for which you participated in a site inspection in August 2011.

Following my phone conversation with the LPLALC administration, I sent through an email to admin@laperouse.org.au, that I requested be forwarded on to you requesting contact in order to hopefully discuss the Aboriginal cultural heritage significance of the site.

Following the completion and submission of the original assessment report in 2011, a reply was received from the OEH detailing further requirements for Aboriginal cultural heritage in reference to the site. It recently has come to my attention that you were possibly not forwarded a final copy of the report for comment or your records in 2011. I attached a copy of the original report to the email sent on 21 January 2013, and have also attached a hard copy of the original report to this letter.

GML are now preparing an addendum report to the original archaeological assessment report to include investigation into the nature and extent of the original ground surface (underlying a layer of fill across the entire site, which is up to 4.5m in depth in some locations), and its likelihood to possess subsurface deposits. The findings of this investigation are presented in the draft report, and conclude that the potential for the study area to possess intact Aboriginal archaeological deposits is considered to be low to nil. This is based on analysis of geotechnical data for the area, profiling of the original land surface, and GIS generated maps presenting sub-surface soil profiles across the site.

A copy of this draft addendum report accompanies this letter.

We would very much appreciate comment regarding the Aboriginal cultural heritage values for the site and/or comment on the draft addendum report.

GML

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TAS Australia 7001
T +61 3 6223 2810
F +61 3 6223 2820

Godden Mackay Logan Pty Ltd
ABN 60 001 179 362

www.gml.com.au
heritage@gml.com.au

If you are not the correct person to contact regarding this project, please forward this letter to the appropriate person at the LPLALC.

Could either yourself or the relevant person at LPLALC please contact me on (02) 9319-4811, or via email to samc@gml.com.au ASAP to discuss this project.

Yours sincerely
Godden Mackay Logan Pty Ltd

Sam Cooling
Consultant

Attachments:

- Godden Mackay Logan 2013, *461 Captain Cook Drive, Woolooware—Archaeological Assessment Addendum, Draft Report*
- Godden Mackay Logan 2011, *461 Captain Cook Drive, Woolooware—Archaeological Assessment Report*

LA PEROUSE
Local Aboriginal Land Council

Ms Sam Cooling
Consultant
Godden Mackay Logan Heritage Consultants
78 George Street
REDFERN NSW 2016

Dear Ms Cooling,

RE: CRONULLA SHARKS DEVELOPMENT, 461 CAPTAIN COOK DRIVE

I write in reply to your letter dated the 4 February 2013 in which you provided the La Perouse Local Aboriginal Land Council's (**La Perouse LALC**) with the August 2011 report regarding an Archaeological Assessment of the above mentioned development and an addition report dated January 2013.

As you may be aware, the La Perouse LALC was established and operates within the provisions of the NSW *Aboriginal Land Rights Act 1983* (**ALRA**) and currently represents a membership of 380 Aboriginal persons who reside within or have an association with the La Perouse LALC area. In accordance with Section 52 of the ALRA the La Perouse LALC has a statutory function to "*take action to protect the culture and heritage of Aboriginal persons in the Council's area*".

The La Perouse LALC and members of the La Perouse Aboriginal Community recognise that the Botany Bay area is of great significance to the Aboriginal Community due to the past occupation of the area both pre and post European contact. In particular the Woolooware Bay, Weeney Bay and surrounding areas where used for resource gathering by the Aboriginal community possibly as late as the 1980's. The Aboriginal community continued to utilised the natural resources in Woolooware Bay for food gathering and traditional artifact making – such as Boomerangs and fishing spears.

In addition to the above mentioned significance it is well documented that traditional Aboriginal people of the area participated in the local oyster and grazing industry throughout the 1800's which ensured their continual occupation and connection to their traditional lands. If you require further information regarding the cultural significance of the area the La Perouse LALC would be more than pleased to assist in providing the relevant contact details of Aboriginal persons who may hold such knowledge of the area.

I have reviewed the reports and provide the following recommendations:

Recommendation 1:

The La Perouse LALC supports the recommendations provided in the draft report dated January 2013

1 Elaroo Ave, La Perouse NSW 2036 I PO Box 365, Matraville NSW 2036 I Phone: (02) 9311 4282
Email: admin@laperouse.org.au I ABN: 89 136 607 167

Recommendation 2:

Due to the high Aboriginal occupation and significance of the area, the La Perouse LALC strongly recommends the proponent consider researching and documenting the Aboriginal cultural heritage values of Woolooware Bay.

Recommendation 3:

The proponent considers implementing interpretive signs that promote the Aboriginal cultural heritage values of the area – in particular the heritage values of Woolooware Bay.

Recommendation 4:

The La Perouse LALC advises that if any Aboriginal objects (such as human or animal bone, shell material or stone artifacts) are unearthed during the works, all works must cease and the NSW Office of Environment and Heritage and La Perouse LALC be contacted immediately.

If you would like to discuss this issue further please don't hesitate to contact the La Perouse LALC office on 9311 4282 during business hours.

Yours sincerely,

Chris Ingrey
Chief Executive Officer

Date: 15 February 2013

Appendix B

Letter from OEH regarding Aboriginal Cultural Heritage

NSW GOVERNMENT | Office of Environment & Heritage

Your reference MP10_0229
Our reference: DOC11/45470 & DOC11/45827-01
Contact Richard Bonner: 9995 6833

Michael Woodland
Director – Metropolitan & Regional Projects South
Department of Planning & Infrastructure
GPO Box 39
Sydney NSW 2001

Attn: Mark Brown

Dear Mr Woodland,

I refer to your letter forwarded to the Office of Environment and Heritage (OEH) Wollongong office and received on 4 October 2011 inviting comments on the environmental assessment (EA) of the concept plan for the Cronulla Sharks Development at 461 Captain Cook Drive, Woolooware (MP10_0229) by 21 November 2011. A separate invitation forwarded to OEH's Hurstville Office inviting comments on same by 5 December 2011 was also received on 30 September 2011.

OEH has previously provided input in March and August 2011 to the Director General Environmental Assessment Requirements (DGRs) and the Test of Adequacy Assessment of the EA. These responses are attached for your information. In its submission of 22 August 2011, OEH raised issues with regard to biodiversity, Aboriginal cultural heritage, flooding and acid sulphate soils.

OEH has reviewed the publicly exhibited EA, the issues raised its August submission and provides the following comments.

Biodiversity

OEH considers the EA does not adequately address the DGRs. As a consequence any approval that may be granted will be based on insufficient ecological information about the importance of the adjoining mangroves and mudflats as habitat for threatened species or ecological communities. In addition, the likely impacts of the proposed redevelopment on these habitats and other significant habitat surrounding Woolooware Bay (Towra Point Nature and Aquatic Reserves, the Taren Point Shorebird Endangered Ecological Community and the Towra Point Ramsar site) have not been adequately considered.

OEH notes the Ecological Assessment is primarily based on a desktop analysis which acknowledges the need for further assessment to accurately determine the potential impacts on adjacent habitats resulting from light spill, increased access (e.g. rubbish dumping, trampling, weeds), noise, and stormwater runoff (altered hydrology and water quality). It is proposed additional assessment be deferred to the detailed design phases of the project when identified impacts will be mitigated via a series of management plans, yet to be developed.

PO Box 668 Parramatta NSW 2124
Level 7, 79 George St Parramatta NSW 2150
Tel: (02) 9995 5000 Fax: (02) 9995 6900
ABN 30 841 387 271
www.environment.nsw.gov.au

In the absence of adequate information about the ecological values impacted, OEH recommends the following conditions be considered for incorporation in any approval that may be granted. These recommended conditions are in addition to those proposed in the EA draft Statement of Commitments:

1. Baseline surveys of the adjacent estuarine areas along the northern boundary of the site and Woolooware Bay be undertaken over a period of 12 months using OEH's recommended survey methodologies to determine whether they serve as roosting, breeding or foraging habitat for threatened birds and microbats and to ascertain if they have a role as a movement corridor for these or other threatened fauna. The surveys should be completed prior to the submission of further development applications for the Cronulla Sharks redevelopment.
2. If baseline surveys indicate there is habitat for threatened fauna in the adjacent estuarine areas, targeted surveys for these threatened fauna be undertaken to determine how they use the habitat and the likely impacts of the development on these areas. This information will inform any adaptive management plans recommended below or in the draft Statement of Commitments, as well as the final design of each stage of the development.
3. Material (e.g. seed or cuttings) for future revegetation works should be collected on-site and propagated well before the clearing of any vegetation.
4. Revegetation should not rely on the collection of propagation material from off-site endangered ecological communities (e.g. Coastal Saltmarsh and Swamp Oak Floodplain Forest). The collection of any off-site propagation material would require approval from OEH which may not be provided.
5. Barriers must be constructed to prevent the access of humans and domestic animals during and post construction into mangroves and adjacent estuarine areas. Barriers should not impede the movement of any threatened fauna that use these areas as habitat.
6. Board walks and cycle paths must be designed and constructed to avoid impacts on mangroves and adjoining estuarine areas.
7. A stormwater management plan (SMP) must be prepared detailing how all stormwater runoff will be collected and treated. The SMP should include:
   - a program to measure and monitor pre and post development changes to the quantity and quality of stormwater runoff into adjacent estuarine vegetation;
   - baseline data and fine scale mapping showing the current extent and condition of the adjoining estuarine vegetation communities; and
   - contingency actions to be funded by the proponent should impacts on adjoining estuarine vegetation communities be detected.
8. A noise management plan (NMP) must be prepared to investigate the likely impacts of construction and ongoing operational noise on fauna using the adjacent estuarine areas as habitat. The NMP should:
   - outline management actions that will be undertaken to minimise noise impacts; and
   - include a monitoring program to ascertain the efficacy of actions and any modifications that may be required.
9. A lighting management plan (LMP) must be prepared to investigate and minimise the impacts of light spill on threatened fauna using the adjacent estuarine areas as roosting and foraging habitat. The LMP should include:
   - lighting design criteria that must be met during the construction and operation of the proposed development to avoid impacts on threatened fauna;
   - a program to monitor the impacts of light spill on threatened fauna; and
   - additional measures to reduce light spill impacts on threatened fauna.

10. A bird management plan (BMP) must be prepared to investigate the potential for bird strike from reflective surfaces associated with the development. The BMP should describe the construction materials and design methods that will be used to avoid or minimise the likelihood of bird strike.

Adjacent Towra Point Nature Reserve – Ramsar Wetland Site

The nearby OEH managed Towra Point Nature Reserve (TPNR) includes extensive areas of wetlands listed under the Ramsar convention on Wetlands of International Importance. OEH's general guidelines for development adjoining OEH managed land and water should be reviewed to ensure all relevant issues have been adequately addressed. A copy of these guidelines are available at the following link: http://www.environment.nsw.gov.au/resources/protectedareas/10509devadjdeccw.pdf

In particular, stormwater run-off from the site during and post development has the potential to increase litter, sediment, nutrients, pesticides, heavy metals and other pollutants into the TPNR wetlands.

OEH notes a stormwater management plan (SMP) has not been prepared for the development. It is therefore recommended the following conditions be considered for incorporation in any approval that may be granted. These conditions specifically relate to the protection of wetlands in TPNR. They are additional to condition 7 recommended above and are largely based on issues included in the SMEC Stormwater Drainage and Water Quality Strategy (Appendix K):

11. Stormwater from the site cannot be discharged directly into Woolooware Bay. The stormwater drainage system must intercept all surface run off and convey it away from Woolooware Bay.
12. A detailed flood study must be prepared prior to development that details potential impacts on Towra Point Nature Reserve (TPNR) in the event of a flood and includes strategies for preventing impacts.
13. A leachate management plan must be prepared and implemented to ensure that no leachate from the landfill on the site is exported to the TPNR wetlands.
14. An Acid Sulphate Soil Management Plan (ASSMP) must be prepared and implemented (see comments below).

Acid Sulphate Soils

The site is classified as being of "high probability" of Acid Sulphate Soil (ASS) occurrence at or near the ground surface in the area immediately north of the site exists but no ASS tests have been carried out elsewhere on the site which has been mapped as "disturbed terrain", to determine acid sulphate soil conditions.

In its response to the Test of Adequacy of the EA prior to public exhibition, OEH recommended the preparation of an ASSMP – this was also included as a DGRs. It is noted an ASSMP has not been prepared with the EA indicating ASSMPs will be prepared in accordance with the *Acid Sulphate Soils Assessment Guidelines (ASSMAC 1998)* and submitted with future applications for development. OEH considers deferment of an ASSMP to the development application stage inappropriate. As there is a significant environmental risk associated with the "high probability" classification if ASS materials are disturbed by activities such as shallow drainage, excavation or clearing, OEH again recommends an ASSMP be prepared. This is to ensure that potential impact on building materials and infrastructure as well as potential run-off of acid into sensitive environments is managed and avoided at the planning stage.

Flooding

In its response of 22 August 2011 to the EA Test of Adequacy, OEH raised concerns that the proposal as presented may be impacted by flooding and may adversely impact on flooding in adjacent properties. These concerns were detailed in the environmental assessment requirements provided by OEH in its response of 25 March 2011. OEH requirements were not fully presented in the final DGRs.

The DGRs require the EA to provide an assessment of any flood risk on site in consideration of any relevant provisions of the NSW Floodplain Development Manual (2005) including the potential effect of climate change, sea level rise and expected increases in rainfall intensity and address measures to be taken to render the site suitable for high density residential development free from flooding.

Suitable arrangements for floodwater and overland flow need to be considered from the earliest stages of the design process, particularly when the site is identified as being on a floodplain. Without this adverse effects on flood behaviour might prove difficult to rectify. While the EA's Draft Statement of Commitments identifies the need for a detailed flood assessment in future applications for the development, the flood assessments should be undertaken at the initial conceptual stage. On this basis, it is not possible for OEH to adequately review the impact of flooding on the development or the mitigation options presented.

OEH's flood concerns raised in its letter of 25 March 2011 are therefore still valid and will form the basis of its review of the future detailed flood modelling. OEH recommends the following condition be considered for incorporation in any approval that may be granted:

15. A detailed flood study must be completed prior to the development stage which includes:
    - A description of flood behaviour and flood hazards at the site.
    - An assessment of cumulative impact of all proposed development on flood behaviour both upstream and downstream of the site.
    - An assessment of the impact of flooding on the proposed development for a range of Annual Exceedance Probability (AEPs) to the Probable Maximum Flood (PMF).
    - An assessment of the impact on flood levels due to climate change from increased sea levels and rainfall.
    - Recommended flood risk strategies for the development which may include a flood warning system, safe flood evacuation, on site refuge and provisions to minimise any impacts on the effectiveness of flood evacuation of existing communities, noting that access along Captain Cook Drive during a flood may not be available.
    - Underground car parking should not be considered unless appropriate flood risk management measures can be implemented to ensure safe operation for a full range of flooding.

Aboriginal Cultural Heritage

As part of the EA, an assessment of the Aboriginal heritage was prepared by Godden MacKay Logan in August 2011. This report notes that no Aboriginal sites have been registered with OEH, within a 1km radius of the development site. However, the wider Kurnell Peninsular area is known for its extensive middens, burials and other evidence of Aboriginal occupation. It should be noted that there are no surveys recorded for the Cronulla area.

The evidence of the development history is augmented by photographs and cadastral maps from as early as the 1860's. These show that the edge of the shoreline has not changed substantially since early settlement and much of the development land is likely to be located on/over original dunes. This landform is a highly sensitive part of the landscape and is highly likely to be associated with evidence of Aboriginal occupation.

The report notes that the area of the development has been covered with between 1.1 and 8.6m of fill deposits and playing fields have been established on the surface of the fill. It is also stated that "natural ground levels are likely to have remained intact under and sealed beneath the introduced material" (p.29). The geotechnical testing referred to in the report provides the information on the depths of the introduced fill but no reference is made to what lies beneath, which could be dunes or mangroves or both. The drawing of the land for the first land grants shows that this land is beyond the mangrove area. If the original surface is dunes, then the potential for Aboriginal objects to be associated with those deposits is high, if the

underlying levels are swamp lands then the potential for associated Aboriginal objects is negligible. This requires further clarification.

A site inspection of the development site confirmed that there is no possibility for any Aboriginal objects to be detected because of the extensive cover of the fill. The assessment reports that there are high levels of disturbance, but this appears to be disturbance of the fill layer where no Aboriginal objects would be expected to occur. The report concludes that the land surface below the fill is likely to be intact. Therefore, if the original land surface is in fact dunes, and would be affected by the proposed development, then there is a high probability that harm to objects could occur.

No assessment of the cultural values is included in the report, though there is a note (section 5.2.3) to the effect that the *"area may hold cultural significance to the Aboriginal people*" (p.32).

OEH recommends incorporation of the conditions be considered for incorporation in any approval that may be granted to confirm no Aboriginal objects, especially burials, are located on the site:

16. An evaluation of the geotechnical testing results to confirm the nature of the deposits below the introduced fill[1].
17. Mapping of the distribution of any original land surface area below the fill to determine whether there are likely to be any areas where Aboriginal objects could occur.
18. Profiling of the old land surface below the fill to show whether the landform adjacent to the swamp lands was suitable for occupation in the past.
19. A cultural assessment of the area by the Aboriginal community.

If you have any queries regarding any of the above matters, please contact Richard Bonner on 9995 6833.

Yours sincerely

G Howard 22/11/2011

GISELLE HOWARD
Director Metropolitan
Environment Protection and Regulation
Office of Environment and Heritage
Department of Premier and Cabinet

1. If the geotechnical testing does not provide detailed information establishing the nature of the underlying deposits, then additional geotechnical testing and/or archaeological testing may be warranted to confirm that the natural land surface below the fill is swamp land and therefore no Aboriginal objects are likely to occur.

Appendix C

Borehole Soil Logging Examples (Boreholes 1, 102, 601 and 808)

JEFFERY AND KATAUSKAS

FIELD LOG

Location No. BH1

1/2

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE.

Job No: 15009-JTP
Date: 24&25.7.78

Method: AUGER & WASHBORE

R.L. Surface: NT
Datum: N.T

Water Level	Samples and Field Tests	Depth (m.)	Graphic Log	Unified Classif.	Soil Description	Moisture Condition	Consistency / Rel. Density	Hand penetrometer x100KPa 1 2 3 4	Structure & Geology
		1			FILL silt, sand with metal, construction rubble, wood, sandstone dark grey		loose		
▼	N=11 (3,9,7)	2							
		3		OL	SILT AND CLAY, organic some shell pieces, pungent odour dark grey	MC>PL	V.Soft		
	N<1	4							
		5							
		6		CL	SANDY CLAY brown	MC>PL	V.Soft		
	NC=20	7		SM	SAND light grey fine to medium grained		M.Dense		
	NC=14	8		CL	SILTY CLAY, some sand layers grey.		Stiff		
	N=13 (10,9,4)	9		SC	CLAYEY SAND some clay layers & shell pieces grey		loose		
		10							
NX CASING To 10.5m	N=8 (2,4,4)	11		CH	CLAY high plasticity greenish grey then mottled grey and brown then mottled red and grey	MC>PL	Stiff		
		12							
		13							
	N=25 (5,9,16)	14							
		15							

JEFFERY AND KATAUSKAS

FIELD LOG

Location No. BH1

2/2

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE.

Job No: 15009JTP Method: AUGER & WASHBORE R.L. Surface: NT
Date: 24-25.7.78 Datum: N.T

Water Level	Samples and Field Tests	Depth (m.)	Graphic Log	Unified Classif.	Soil Description	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer 1 2 3 4	Structure & Geology
		15		CH	as above				
		16							
		17							
		18		CL	SANDY CLAY mottled brown and grey, some dark grey with depth				
		19							
		20							
		21			SANDSTONE				
					END BOREHOLE 21.0m.				

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Borehole No. 10.1 1/4

BOREHOLE LOG

Client: CRONULLA SHARKS

Project: SHARK PARK REDEVELOPMENT

Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP Method: SPIRAL AUGER

Date: 26-2-90 EDSON 3000

Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer kPa.	Remarks
			1			FILL: Silty sand, fine gravel, dark brown.		VL		APPEARS POORLY COMPACTED
	DS					FILL: Silt, sand, brick, concrete rubble, plastic & glass.				POOR SAMPLE RETURN ON AUGERS DUE TO VOIDS IN FILL
	DS	N=5 1, 1, 4	2							
	DS		3		OL	ORGANIC SILTY CLAY: low plasticity, dark green brown with many shells & decayed roots.	MC>PL	VS	30 45 50 50	STRONG ORGANIC ODOUR
	DS	SUNK UNDER HAMMER WEIGHT N<1	4							
	DS	N=18 3, 8, 10	5		CL	SANDY CLAY: low plasticity, mid brown, sand fine grained, occasional gravelly bands.	MC>PL	S to F		
			6		SP	SAND: fine grained, grey & dark grey with occasional thin clayey bands.	W	MD		

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Borehole No. 101 2/4

BOREHOLE LOG

Client: CRONULLA SHARKS

Project: SHARK PARK REDEVELOPMENT

Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009.JTP Method: SPIRAL AUGER

Date: 26-2-90 EDSON 3000

Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer kPa.	Remarks
			7			SAND: as above grading to				1½ m. CAVE-IN CASED TO 7.5 m.
FULL RETURN					CH	SANDY CLAY: high plasticity, light grey, occasional orange brown veins, with occasional bands of clayey sand.	MC>PL	V. St. - H	270 430 390	COMMENCED MUD DRILLING
	DS	N=17 3, 7, 10	8							
			9							
			10		CL-CH	SANDY CLAY: medium to high plasticity, light grey, occasional pockets of red brown very sandy clay.			250 200 350 410 280	
	DS	N=12 3, 5, 7	11							
			12							
¼ RETURN						as above, but with occasional ironstone bands.	MC>PL	St. - V. St.		FLUSH LOSS IN IRONSTONE BANDS
FULL RETURN	DS	N=14 4, 6, 8	13						170 120 140 260 240	

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Borehole No. 101 3/4

BOREHOLE LOG

Client: CRONULLA SHARKS

Project: SHARK PARK REDEVELOPMENT

Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP Method: SPIRAL AUGER

Date: 26-2-90 EDSON 3000

Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
			14			SANDY CLAY: as above	MC>PL	St.		
	DS	N=9 3, 5, 4	15						140 200 130 140	
			16							
						REFER TO CORED B.H. LOG				ATTEMPTED SPT 15 BLOWS/0mm.
			17							

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Borehole No. 101 4/4

CORED BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE.

Job No: 15009JTP
Date Drilled: 26&27-2-90
Drill Type: EDSON 3000

Core Size: N.M.L.C.
Inclination: –
Bearing: –

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components.)	Weathering	Strength	POINT LOAD INDEX STRENGTH $I_S(50)$ (EW VW W MS S VS ES)	DEFECT DETAILS: DEFECT SPACING (mm) (500 300 100 50 30 10)	DEFECT DETAILS: DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating.) Specific / General
		16		START CORING AT 16.49m.					
FULL RETURN		17		SANDSTONE: fine grained, light grey & red brown, occasional orange brown bands.	MW	W			— BEDDING PARTING, 0°, ORANGE BROWN STAINING
TOTAL LOSS		18				W-MS			— CLAY SEAM, 10mm. — JOINTS 30° PLANAR, SMOOTH
		19		— as above, but with occasional shale layers.	HW MW	EW MS			— CLAY SEAM 50mm. N.B. ALL DEFECTS NOT LABELLED ARE BEDDING PLANES, PLANAR, SMOOTH, & OCCASIONAL DRILLING BREAKS
		20		END OF BOREHOLE AT 19.58m.					

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Borehole No. 601 1/2

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 11-8-97
Method: SPIRAL AUGER BCD 350
Logged/Checked by: S.E./
R.L. Surface: N/A
Datum:

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
AFTER 4 HRS					N = 7 2,3,4	0			FILL: Silty clay, low plasticity, brown, with fine to medium igneous gravel, ironstone gravel, sand and a trace of glass.	MC>PL			APPEARS POORLY TO MODERATELY COMPACTED
						1			FILL: Sand, fine to medium grained, grey brown, with ash, timber pieces, plastic and silt fines.	M			
					N < 1 2,2/ 300mm	2			FILL: Silty clay, low plasticity, dark grey, with roots, timber pieces and sand.	MC>PL			APPEARS POORLY COMPACTED
						3							
						4		OL	ORGANIC CLAY: medium plasticity, dark grey brown, with fine roots and shell fragments.	MC>>PL	S	–	ALLUVIAL SOIL
					N = 1 1,-,1			CL	SILTY CLAY: medium plasticity, grey, with fine grained sand and a trace of shell fragments and fine roots.			40 50 50	SLIGHT ORGANIC ODOUR BELOW 4.5m.
						5							
					N = 19 4,7,12	6		SM	SILTY SAND: fine to medium grained, grey.	W	MD		
								SP	SAND: fine to medium grained, pale orange brown.				
						7							

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Borehole No. 601 2/2

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP **Method:** SPIRAL AUGER BCD 350 **R.L. Surface:** N/A
Date: 11-8-97 **Datum:**
Logged/Checked by: S.E./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					N > 20 2,20/ 150mm BOUNCING	7		SC	CLAYEY SAND: fine to medium grained, pale brown and red brown, with bands of coffee rock.	M	MD-D		
						8		–	SANDSTONE: fine to medium grained, mottled pale grey and red brown, with a trace of sandy clay bands.	DW	L	–	LOW 'TC' BIT RESISTANCE
					N > 20 20/ 150mm BOUNCING	9		CH	SILTY CLAY: high plasticity, pale grey, with a trace of clayey sand bands.	MC<PL	H	–	–
						10		–	SANDSTONE: fine to medium grained, pale grey, with a trace of red brown mottling and clay bands	DW	L	–	LOW RESISTANCE
						11					L-M		LOW TO MODERATE RESISTANCE
						12			SANDSTONE: fine to medium grained, pale grey.	SW	M		MODERATE RESISTANCE
						13			END OF BOREHOLE AT 13.0m				

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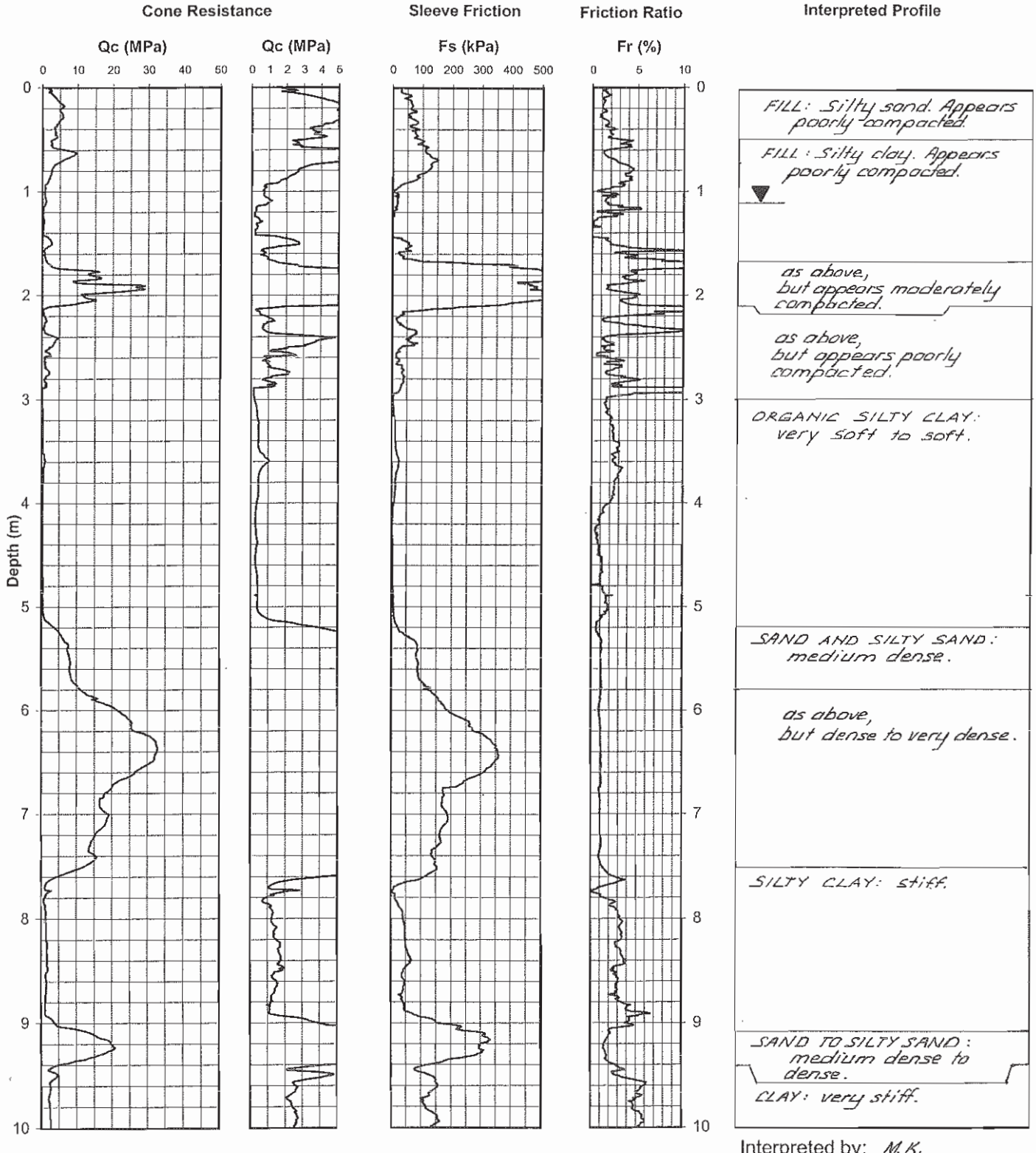
EFCP No. 808 1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt808	**RL Surface:**	NA	**Data File:**	AP061530.H1
Test Date:	6/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted by: M.K.

Checked by: PW

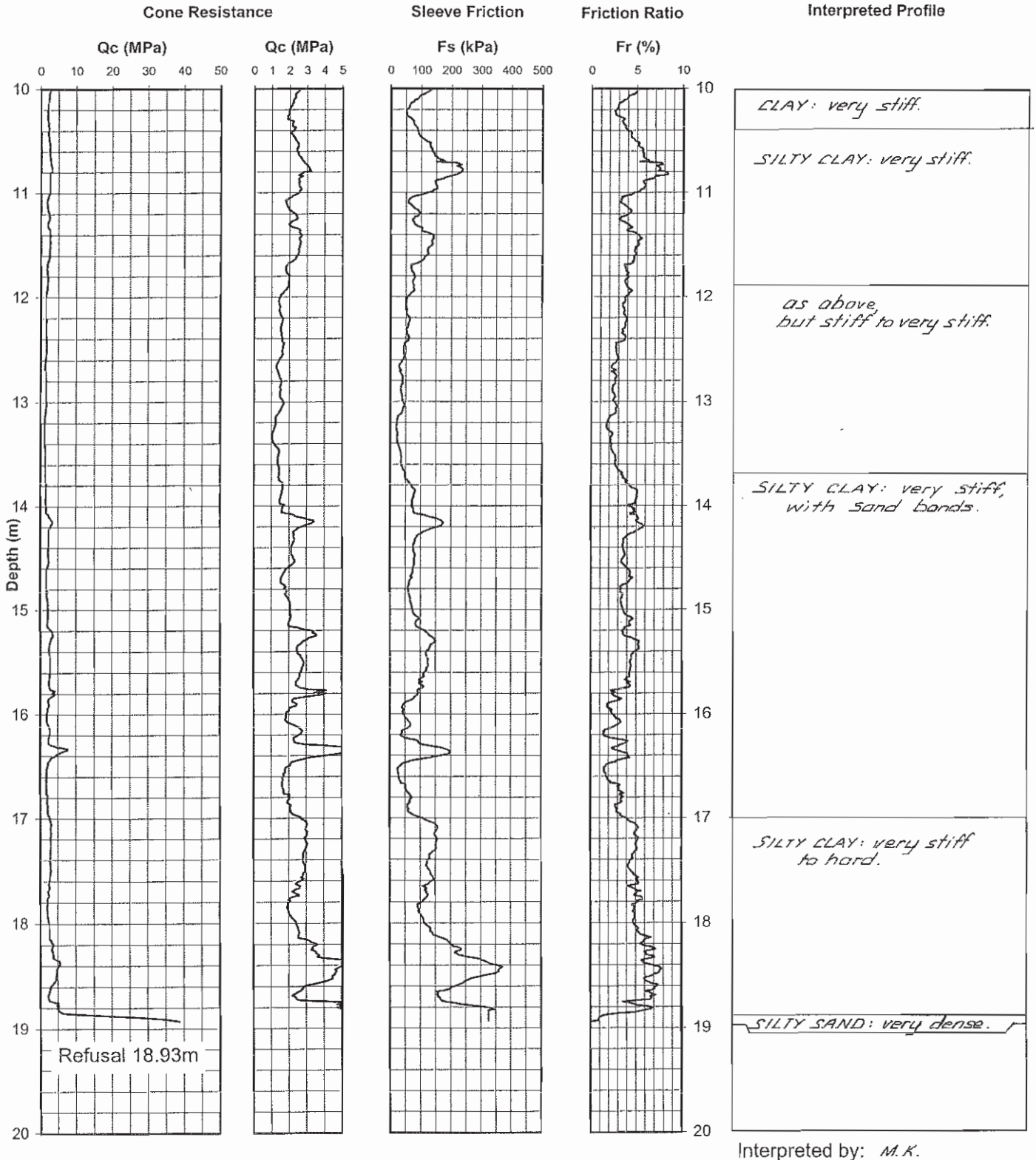
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. 808 2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt808	**RL Surface:**	NA	**Data File:**	AP061530.H1
Test Date:	6/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted by: M.K.

Checked by: PW