REPORT

316 Hudson Parade, Clareville Upgraded Boatshed Works Coastal and Marine Damages Assessment

Client: Mr Tony Walls

Reference: PA1959MARP1901310938

Status: P02.01/Final

Date: 31 January 2019

HASKONING AUSTRALIA PTY LTD.

Level 14
56 Berry Street
NSW 2060 North Sydney
Maritime & Aviation
Trade register number: ACN153656252

+61 2 8854 5000 **T**
+61 2 9929 0960 **F**
project.admin.australia@rhdhv.com **E**
royalhaskoningdhv.com **W**

Document title:	316 Hudson Parade, Clareville Upgraded Boatshed Works Coastal and Marine Damages Assessment
Document short title:	C&M Damages Assessment
Reference:	PA1959MARP1901310938
Status:	P02.01/Final
Date:	31 January 2019
Project name:	316 Hudson Parade, Clareville
Project number:	PA1959
Author(s):	Gary Blumberg

Drafted by:	Gary Blumberg
Checked by:	Greg Britton
Date / initials:	12/12/18 GWB
Approved by:	Gary Blumberg
Date / initials:	31/1/19 GPB

Classification
Project related

MANAGEMENT SYSTEM CERTIFICATION DNV·GL ISO 9001 = ISO 14001 OHSAS 18001

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Executive Summary

Northern Beaches Council has formed the opinion that unauthorised development work has been undertaken at 316 Hudson Parade, Clareville, in particular the removal of the existing boatshed and the construction of a foundation wall to protect an upgraded boatshed. A Stop Work Order issued by Council cites a number of reasons for issuing the Order including the following (reason number 5) for which Royal HaskoningDHV has been retained to provide an opinion:

It is unknown if the building works within the coastal environment has caused any environmental damage to the coastal and marine environment.

Consideration has been given to the physical coastal and marine processes operating at the site, in particular morphologic, hydrodynamic and sedimentary processes. A site inspection was carried out on 26/10/18. Points of fact and observations have been provided by the owner. An assessment has been made by RHDHV of any environmental damage to the physical coastal and marine environment that the current building works have caused.

A permanent drying pocket beach occurs immediately south of the boatshed site. The beach width is variable, with its widest midpoint ranging from about 5 to 15m at mean tide established from 10 years of Nearmap air photos between October 2009 and November 2018. Estuarine hydraulics at the site have been examined comprising tides, waves, currents and closure depth.

Damage to the physical shoreline, and impact on physical shoreline processes have been considered.

Following demolition of the former marine structures at the site, sand and rock would have been cleared to permit construction of a Dincel foundation wall. It is expected that the rock clearing would have been minor involving surface scabbling to form a level surface upon which to found the Dincel walls.

We are advised that a minimum 250mm thick sandstone block seawall is to be constructed around the Dincel foundation wall. Once this is completed, it is our opinion that the wave reflection behaviour at this wall is unlikely to be significantly different from that which occurred with the former boatshed and its perimeter seawall. If slightly more reflection did occur, this would have no material influence on beach or shoreline stability to the north or south of the new seawalls.

The boatshed and the protruding natural rock platform upon which it is situated potentially act as a groyne assisting to stabilise the beach immediately to the south, and potentially denying supply of littoral sand downdrift. It is instructive therefore to consider the design of a hypothetical groyne located at the same position along the shoreline as the boatshed, and compare this design to the groyne action attributed to the natural and man-made structures at this location. Functional considerations are given to the design of groynes.

Records show that the boatshed was in existence at the point of subdivision in 1981. It is our opinion that any early air photos of the site which may exist without any boatshed in place would most likely show a pocket beach in the same location as the existing pocket beach, but possibly with a reduced long-term average volume of beach fill. It is expected that similar behaviour would occur elsewhere in the Pittwater where boatshed foundations occupy the intertidal zone.

Importantly, the seawalls are effectively located inside the so-called Horizontal Shore Section of a notional groyne. While they may have a slightly higher elevation than the former boatshed floor level of 1.2-1.3m AHD, their influence as a groyne on longshore sediment transport would exhibit no material difference to

that compared to the former boatshed and ramp structures. Accordingly no impact or “damage” on longshore sediment transport would occur.

1 Introduction

1.1 Background

In November 2016 a Complying Development Certificate (CDC) was issued by Anthony Protas Consulting Pty Ltd for *"Repairs and restoration of existing marine structures"* at 316 Hudson Parade, Clareville. The works relate to the reconstruction of a boatshed, concrete jetty, ramp, slipway, timber jetty, piles and timber steps. DPI Crown Lands had previously provided Land Owners Consent to make the CDC. A modified CDC was subsequently issued to cover a varied roof form at the boatshed. Works have recently commenced on the site including demolition of former marine structures, and construction of foundation walls surrounding the former boatshed. A survey by LTS Lockley Registered Surveyors dated 29/7/15 showing the former marine structures is presented in **Figure 1**, the approved CDC dated 24/5/17 is shown in **Figure 2**.

The Council has formed the opinion that unauthorised development work has been undertaken at the site for which a planning approval is required but has not been obtained. According to Council, the works carried out are not in accordance with the CDC, and the building works are not considered exempt from development consent under the provisions set out within the SEPP *(Exempt and Complying Development Codes) 2008.*

Pursuant to the Environmental Planning and Assessment Act 1979, Council has issued a Notice of Intention to give a Development Control Order to the property owner, Mr Tony Walls, relating to repair or removal of works in a public place.

Legal matters between Mr Walls and the Council have subsequently progressed to statements of contention. The current case is an appeal against a Stop Work Order issued by Council. Six reasons for the Stop Work Order have been provided:

1. *Council received a complaint alleging that unauthorised building works have been undertaken at the Crown land fronting Lot 2 DP 827733 known as 316 Hudson Pde, Clareville.*

2. *An inspection undertaken by Council Officers on 12 September 2018 revealed the following observations: Existing boat shed has been demolished and new concrete footings and foundations constructed.*

3. *The works carried out are not in accordance with the Complying Development Certificate issued by certifier Anthony Protas for "Repairs and restoration of existing marine structures" on 15 November 2016 (as modified on 24 May 2017) which is a breach of Section 4.2(1)(b) of the Environmental Planning and Assessment Act 1979.*

4. *The building works are not considered exempt from development consent under the provisions set out within the State Environmental Planning Policy (Exempt and Complying Development Codes) 2008.*

5. *It is unknown if the building works within the coastal environment have caused any environmental damage to the coastal and marine environment.*

6. *It is in the public interest that this unsatisfactory state of affairs be remedied as soon as possible.*

Royal HaskoningDHV (RHDHV) have been retained by Mr Walls to provide an opinion regarding reason number 5.

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Figure 1 Survey showing former marine structures at 316 Hudson Parade, Clareville

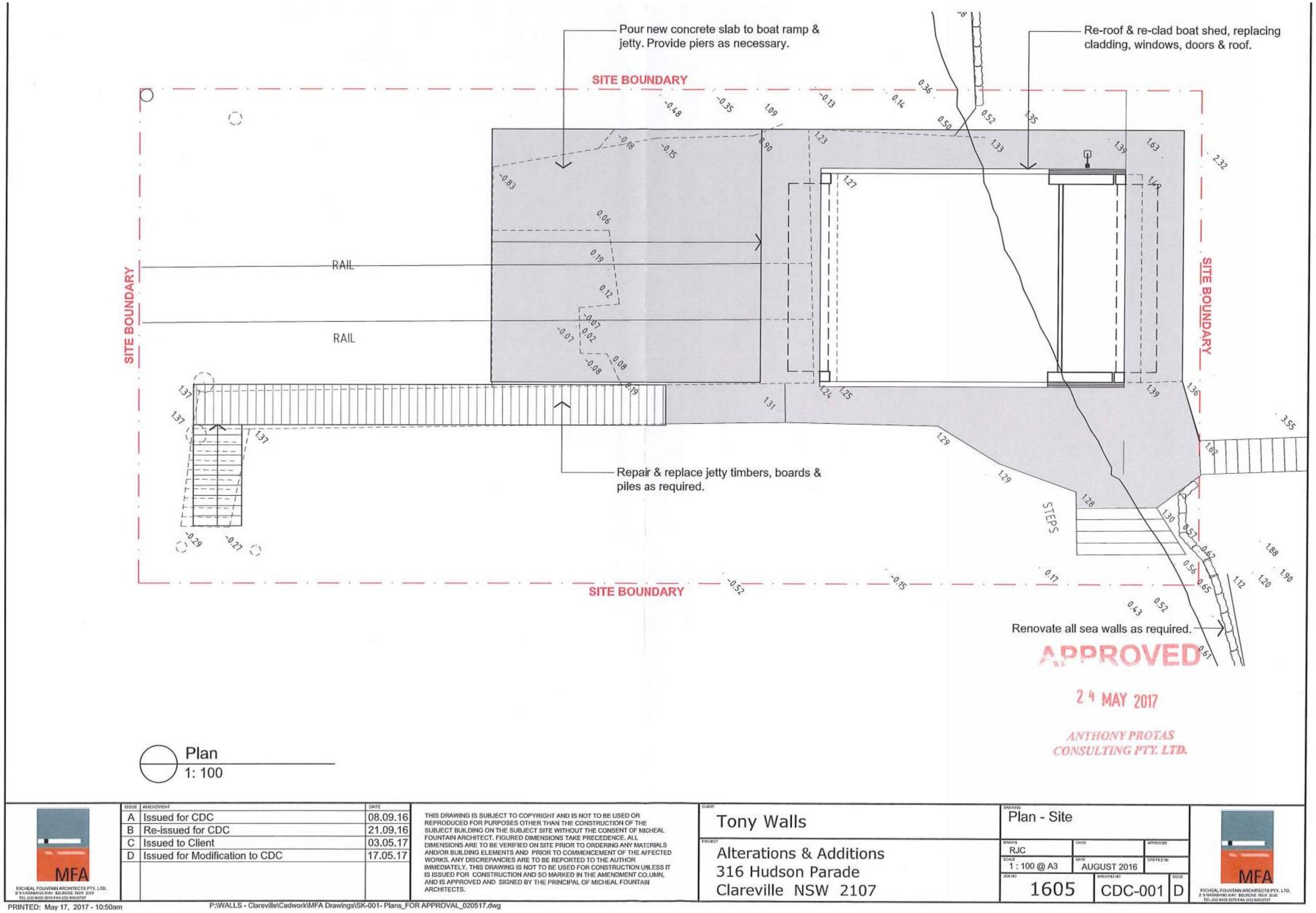

Figure 2 Approved CDC drawing

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1.2 Scope of work

To assist addressing Stop Work Order reason number 5, RHDHV proposed to provide an opinion on the physical coastal and marine processes operating at the site, in particular morphologic, hydrodynamic and sedimentary processes. A site inspection would be carried out.

This has permitted an assessment of any environmental damage to the physical coastal and marine environment that the current building works have caused.

1.3 Study area

The study area includes the site of the subject boatshed, adjacent seawalls and associated marine structures. The study area includes the sandy beach immediately to the south of the boatshed site and, in the main, would extend approximately 80m along the shoreline to the north and south. The study area is shown in **Figure 3**.

Figure 3 Study area

2 Background Information Provided by Property Owner

In the briefing correspondence received by RHDHV, the following points of fact and observation have been made by Mr Walls (quoted below in italics)

(i) *A boatshed, slipway and ancillary structures have been in existence at the site for at least half a century.*

(ii) *The boatshed foundation structure is paramount to the creation and preservation of the beach immediately south of the boatshed site which is in the public interest.*

(iii) *The former boatshed hardstand is completely inundated at King Tides.*

(iv) *The existing boatshed hardstand slab had serious deterioration with large concrete portions falling into the water over a long period of decay.*

(v) *The pre-existing hardstand foundation was soil only with no piering support and is incapable of supporting the approved new hardstand slab or ramp structure. New piling was required and was also approved.*

(vi) *The Dincel foundation installation (proprietary plastic formed concreting system used to support the repaired seawall at the restored boatshed) is very environmentally friendly. The need for footings was minimised at the site, as was pollution given its two day controlled installation vs months of installation with alternative 'dirty' methods. The Dincel foundation is high strength in an environment badly affected by wave action, which should promote the further formation and protection of the beach and protection of the embankment.*

(vii) *Existing seawalls at the site are in a very fragile state of disrepair. Tides are well over existing seawalls leading to serious undercutting erosion.*

RHDHV is further advised that Mr Walls proposes the following actions going forward:

(i) *Install random sized 'rockfaced' sandstone block seawall of at least 250mm thickness around the Dincel foundation* (refer **Figure 4**).

(ii) *Repair and replace badly eroded seawalls (north and south of the boatshed site) with sandstone block seawall of at least 250mm thickness to protect badly undercut embankment.*

Figure 4 Example of random sized 'rockfaced' sandstone block seawall proposed to cover the Dincel foundation

3 Site Inspection

A site inspection was conducted between 2.00pm and 3.00pm on 26 October 2018 by Gary Blumberg, Technical Director Coastal with RHDHV. Weather during the inspection was fine, winds at the site were light and the predicted tide was -0.3m AHD and falling. Photos taken during the inspection are shown below.

Photo 1 Dincel foundation wall enclosing demolished former boatshed. Toe of former ramp just visible below the waterline beyond the pile of demolished materials

Photo 2 Southern Dincel foundation wall showing edge of rock shelf and sand overlay spread naturally from adjacent pocket beach


Photo 3 Southern Dincel foundation wall with outer poles of former jetty behind


Photo 4 SW corner of Dincel foundation wall


Photo 5 SW corner of Dincel foundation wall looking south showing fringing rock reef with pocket beach beyond


Photo 6 Pocket beach immediately south of boatshed site

Photo 7 Pocket beach backed against dilapidated former seawall with southern Dincel foundation wall in background

Photo 8 Northern Dincel foundation wall

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Photo 9 Minor sand fillet washed into corner against dilapidated rock seawall and northern flank of Dincel foundation wall

Photo 10 Rocky foreshore immediately north of boatshed site

The demolished rubble seawall which supported and protected the former boatshed was mostly contained within the perimeter (three sides) of the foundation wall, but also extended further seaward (**Photo** 1). All demolition materials were located over the former ramp and bedrock reef. No demolition materials appeared to be located beyond the perimeter of the reef and submerged remnant of the former boat ramp.

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4 Shoreface Morphology

The site is located on the eastern shore of the Pittwater waterway between Salt Pan Cove to the south and Refuge Cove to the north and due east of Scotland Island, approximately 7km from the entrance to Pittwater at Broken Bay. A broader perspective of the site within the Pittwater is shown in **Figure 4**.

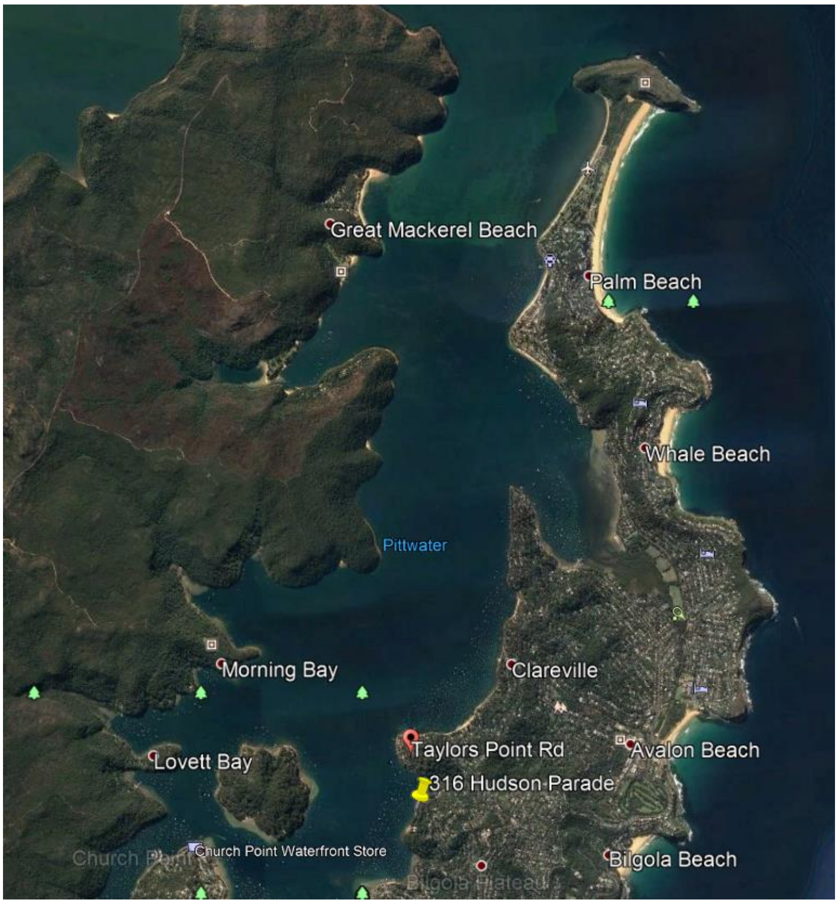

Figure 4 Pittwater showing site south of Taylors Point

Like Sydney Harbour, the Pittwater is a partially infilled drowned river valley with generally steep sloping foreshores. On the south side of Taylors Point the shoreline at Clareville is steep and the sand margin narrow. North of Taylors Point the beach widens considerably. Sandstone bedrock platforms scattered with rock boulders occur frequently at the shoreface, remnants of natural slumps and rock block failures.

In the immediate vicinity of the site the sandy seabed drops with moderate steepness into the waterway. Mean tide depths of about 2m are encountered at the end of the former timber jetty, increasing to 10m some 130m from the shoreline.

A permanent drying pocket beach occurs immediately south of the boatshed. The beach width is variable, with its widest midpoint ranging from about 5 to 15m at mean tide established from 10 years of Nearmap air photos between October 2009 and November 2018.

5 Estuarine Hydraulics

The following estuarine hydraulic parameters are relevant to the matter:

- Tides
- Waves
- Currents
- Closure depth

5.1 Tides

The Pittwater is fully tidal with tidal planes recently derived by Manly Hydraulics Laboratory as follows:

Tidal Plane	Level (m AHD)
High High Water Summer Solstice (HHWSS)	1.02
Mean High Water Springs (MHWS)	0.68
Mean Sea Level (MSL)	0.05
Mean Low Water Springs (MLWS)	-0.59
Indian Spring Low Water (ISLW)	-0.83

Source: Manly Hydraulics Laboratory

5.2 Waves

The site is exposed to wind and boat generated waves, but not ocean swell. Dominant wind fetches are to the NW and SW measured at 2.5km and 1.7km respectively. Hindcast wind waves at the site for these fetches are calculated for average recurrence intervals (ARIs) as follows:

ARI	NW		SW	
	Hs (m)	Tp (s)	Hs (m)	Tp (s)
1 week	0.2	1.5	0.2	1.6
1 year	0.6	2.4	0.6	2.2
50 years	1.0	2.9	0.9	2.6

Based on long term Sydney wind statistics and hindcast methods after CERC (1984)
ARI average recurrence interval
Hs significant wave height (average height of highest of 1/3 of waves in a wave train). Hmax approximately equals 1.8Hs
Tp peak wave period

Boat generated wave heights at the site would exceed wind wave heights on a daily basis but are unlikely to control the wave energy environment at the shoreline in relation to shoreline stability and sediment transport. Although there is an 8 knot speed limit inside of a line joining Taylors Point and Salt Pan Point, design incident boat wave conditions which could occur daily are estimated as follows:

H max = 0.4m
Tp = 2.5s

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5.3 Currents

Currents in the waterway could be generated by winds, tides and propeller wash. Wind induced currents would not exceed 2% of the wind speed up to about 7m/s after which the wind stress is transferred to wave generation rather than formation of currents. Hence wind induced currents would not exceed about 0.15m/s. Near shore tidal currents off Clareville would also be low, due to large waterway flow cross-section, and of a comparable magnitude to wind induced currents. Propeller wash however can be very high locally, up to 8m/s or more, but this would be of little consequence to movement of sand on Clareville Beach which is well removed from propeller driven vessels.

5.4 Closure depth

Wave action would dominate the transport of beach sand at the site. Waves stir the sand at the bed and longshore currents then direct the transport of the sand as suspended load or bedload.

The seaward limit of effective profile fluctuation over seasonal or multi-year time scales is a useful engineering concept and is referred to as the "closure depth," denoted by hc. This is relevant to a consideration of whether the former (now demolished) and proposed marine facilities, and the rock reef upon which they are founded, act as a groyne (**Section 7.2.2**).

Hallermeier (1981) defined the closure depth based on a condition for sediment motion resulting from wave conditions that are relatively rare. Effective significant wave height He and effective wave period Te were based on conditions exceeded only 12 hr per year; i.e., 0.14 percent of the time. The resulting approximate equation for the depth of closure was determined to be

$$h_c = 2.28 H_e - 68.5 \left(\frac{H_e^2}{g T_e^2} \right)$$

It is estimated that the bed level associated with hc inshore of which disturbance of the seabed could lead to sand transport due to waves is -1.7m AHD.

6 Beach Sediments and Stability

Beach sediments in the Pittwater would be mainly medium to fine sands, with medium sands mostly occupying the intertidal beaches and finer materials occurring at depth. Shoreline areas at the mouths of creeks and drains along the Pittwater could exhibit a higher proportion of coarser materials. Seaward of the tidal delta near the entrance to the Pittwater at Palm Beach, finer sands would be less common. The beaches in the vicinity of the site would comprise medium sands.

The distribution of inshore sediments along the Clareville shoreline is evident from historical aerial photography. Nearmap imagery freely available on the web includes 50 aerial photos of the Pittwater spanning the period October 2009 to November 2018. A close inspection of these photos indicates a generally stable shoreline with little movement of shoreline sediments. Focussing in on the site the photos show the stable pocket beach immediately to the south of the boatshed, and the rocky foreshore margin immediately to the north which is essentially devoid of sand. Larger intertidal beaches occur further along and around the shoreline to the south opposite 170 Prince Alfred Parade, and to the north apposite 266 Hudson Parade.

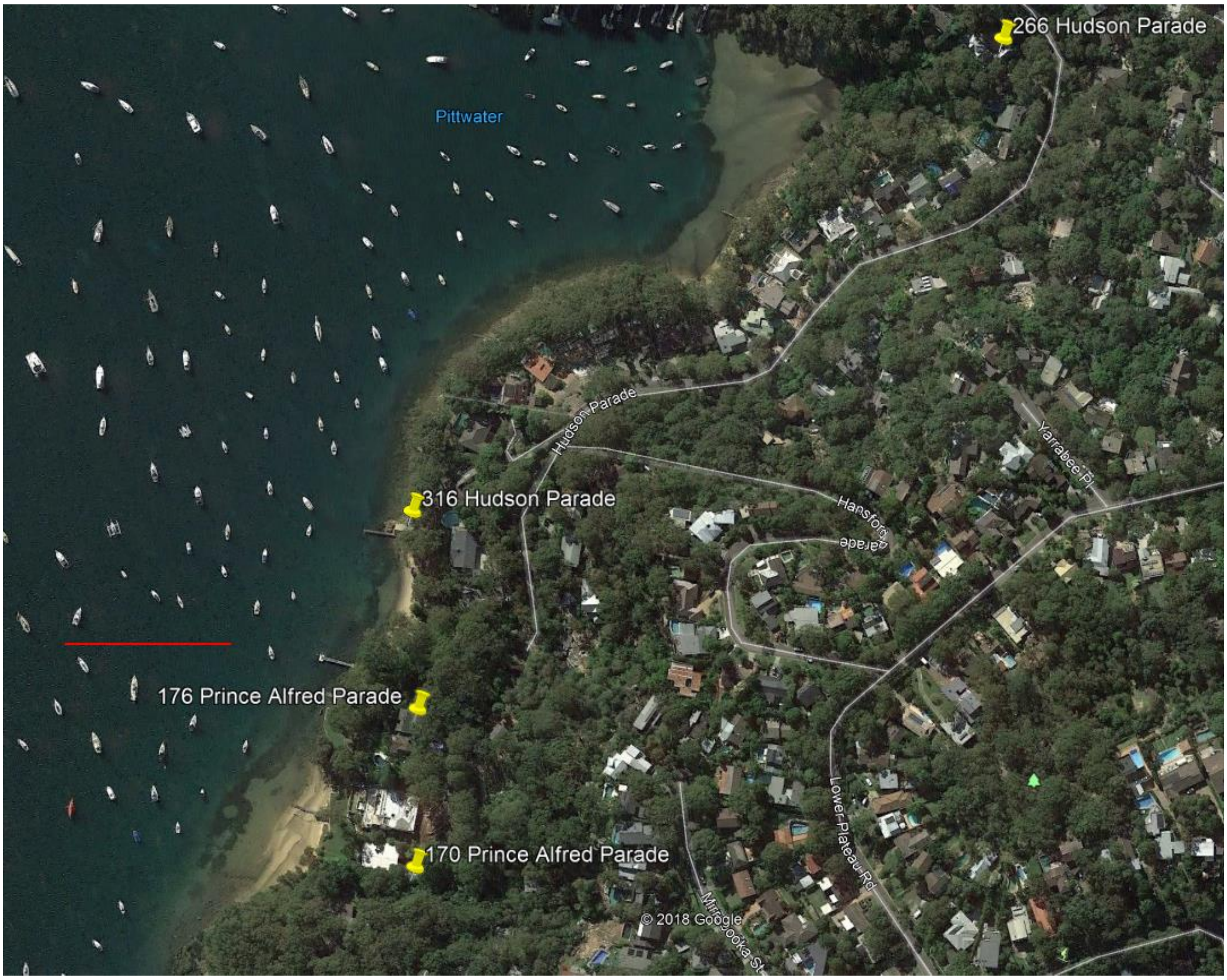

Figure 5 Distribution of nearby larger intertidal beaches opposite 170 Prince Alfred Parade, and 266 Hudson Parade. Red bar is 100m long

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The weighted incident wave energy direction at the site would be derived from the dominant NW and SW wind waves, and the incident boat wash (refer **Section 5.2**). Since the beach immediately south of the site faces WNW, it can be surmised that this weighted incident wave energy is directed from approximately WNW. The 10 years of Nearmap airphotos show no appreciable seasonal change in the alignment of the beach and no clear sediment transport direction along the shore. It appears that the sand within the pocket beach is largely “locked up” between the headland immediately to the south opposite 176 Prince Alfred Parade, and the subject boatshed foundation and exposed reef immediately to the north.

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7 Environmental Damage to Physical Coastal and Marine Environment

In response to reason number 5 (**Section 1.1**), the question of environmental damage to the physical coastal and marine environment that the current building works may have caused can be answered in relation to:

- Damage to the physical shoreline
- Impact on physical shoreline processes

7.1 Damage to physical shoreline

The physical shoreline at the site comprises natural materials and man-made structures. The natural materials comprise sand and bedrock. The former marine structures including boatshed, jetty and ramp have been demolished to make way for the upgraded marine facilities.

Following demolition of the man-made structures, sand and rock would have been cleared to permit construction of the Dincel foundation wall. It is expected that the rock clearing would have been minor involving surface scabbling to form a level surface upon which to found the Dincel walls.

7.2 Impact on physical shoreline processes

7.2.1 Estuarine hydraulic processes

The estuarine hydraulic processes operating at the site comprise water levels, waves and currents.

Water levels and currents would be unchanged as these are driven by tidal and wind processes which would not “see” minor modifications to the boatshed footprint or changes to its foundation arrangements.

Wave reflections would be higher from the smooth vertical Dincel wall compared to the former stone seawall. Once the minimum 250mm thick sandstone block seawall is constructed around the Dincel foundation (refer **Section 2**) the wave reflections would reduce to a similar condition that existed with the former boatshed and its perimeter seawall.

Whilst the pre-existing rubble sea walls will be replaced by sandstone block walls, this change in and of itself would not influence the wave reflection behaviour. If slightly more reflection did occur at the new ‘rockfaced’ sandstone block seawall compared to the former rubble seawall[1], given that the new seawall is typically 10m or more away from the southern beach separated by an intertidal rock reef (refer **Figure** 1), in our opinion the change in wave reflection behaviour would have no material influence on the beach. As there is no beach to the north, a consideration here is irrelevant.

With regard to shoreline stability, the shorelines immediately adjacent to the boatshed within the subject property are protected by dilapidated seawalls. These are to be “renovated” as part of the project (refer

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[1] We estimate that changing from the former rubble seawall to the new ‘rockfaced’ sandstone block seawall (with its Dincel foundation) could potentially increase the reflection coefficient by up to 10%. This depends on the relative slope and roughness of the two seawalls, and the wave condition that is being considered. For the 10% estimate we have assumed that the former seawall had a slope of 60 degrees compared to 90 degrees for the new seawall, the incident wave height is 0.5m with 2.5s period, and the roughness coefficients for the new and former walls are 0.9 and 0.8 respectively.

Figure 2). The small increase in wave reflections considered here (~10%) would not materially alter the function or performance of these seawalls, be they the existing dilapidated structures or the renovated walls. Shorelines or seawalls further away at neighbouring properties would be unaffected.

7.2.2 Longshore sediment transport processes

Sediments could potentially move along the shoreline under the action of oblique waves and currents. Further consideration can be given to the differences in the interaction of the former demolished boatshed substructure and the new Dincel seawalls on longshore sediment transport processes.

The former boatshed and the protruding natural rock platform upon which it was situated may have potentially acted as a groyne assisting to stabilise the beach immediately to the south and potentially denying supply of littoral sand downdrift (to the north). If the boatshed and protruding rock platform had not been there, it could be argued that the sand which is presently located on this beach may not have been stable and that it could have been transported alongshore to the north, driven under SW wind wave conditions (refer **Section 5.2**). It is instructive therefore to consider the design of a hypothetical groyne located at the same position along the shoreline as the boatshed, and compare this design to the groyne action attributed to the natural and man-made structures at this location.

A groyne is a shore protection structure designed to trap longshore drift of sand. They are narrow structures of varying lengths and heights, usually constructed perpendicular to the shoreline. A typical groyne contains three sections along its length that contribute to its functionality (CEM, 2005) listed below and shown in **Figure 5**:

- Horizontal shore section HSS
- Intermediate sloped section ISS
- Outer section OS

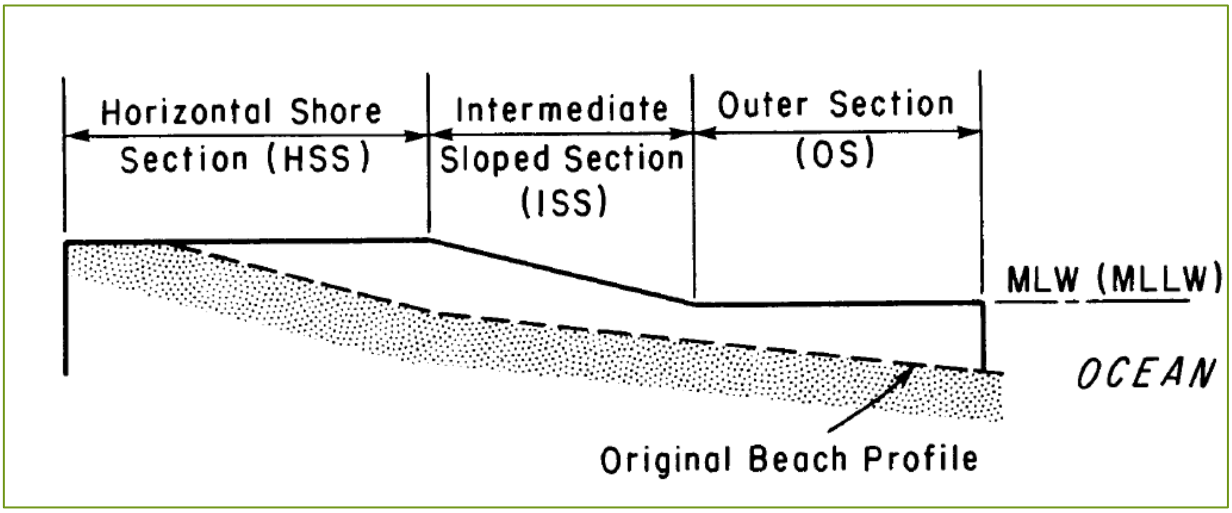

Figure 5 Theoretical sectional design for a groyne (CERC, 1984)

The HSS and ISS sections are relevant to the matter. The HSS of a groyne would typically by set at the normal beach berm height, equal to high tide level plus the height of normal wave uprush. Weekly wind waves at the site are estimated at 0.14m significant height (**Section 5.2**), hence a design HSS is unlikely to exceed about 0.8-0.9m AHD.

The former boatshed occupied a cross shore profile that extended across a rock platform with a natural crest level of approximately 0.1-0.2m AHD. The boatshed itself was protected by a rubble seawall with its crest merging into a concrete path and jetty, and boatshed floor, with upper surface levels for these structures ranging between 1.2 and 1.3m AHD. The boat ramp out the front of the boatshed sloped down to -0.8m AHD[2], essentially occupying much of the width of the ISS. Hence the former boatshed, surrounding seawall and ramp structure presented as a partial groyne.

The Dincel foundation walls extend seaward out to a bed level of approximately -0.5m AHD close to the junction between the HSS and ISS. The former marine structures and current Dincel foundation walls have been mapped onto the theoretical sectional design for a groyne as shown in **Figure 6**.

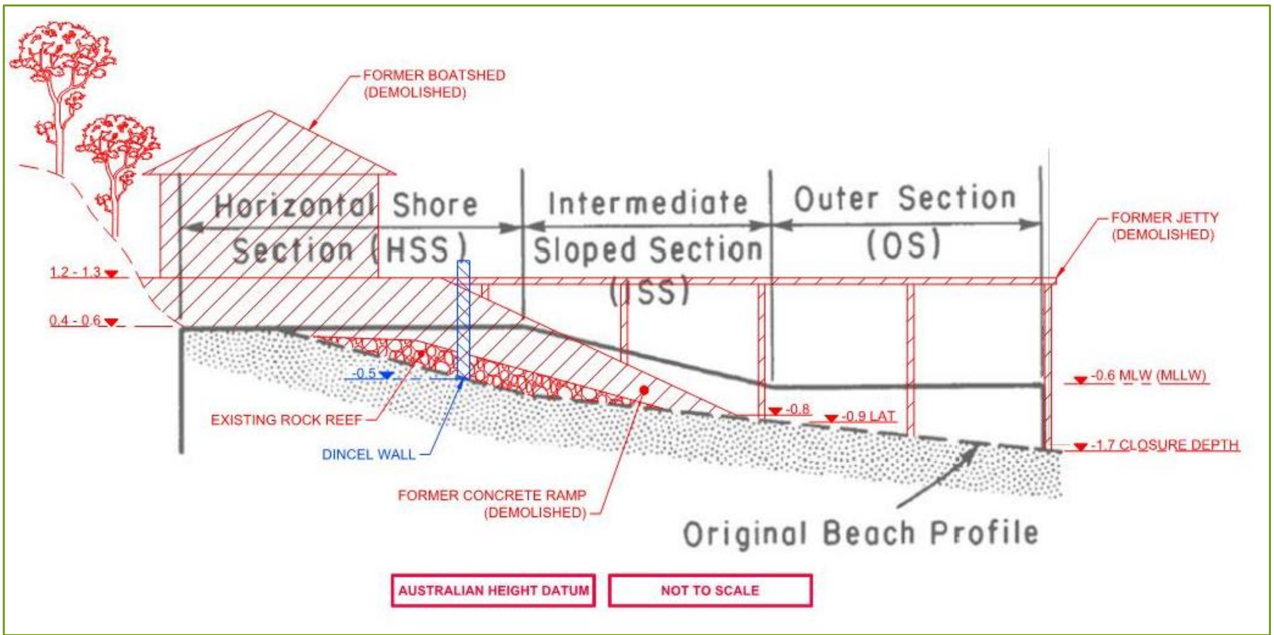

Figure 6 Theoretical sectional design of a groyne overlaid with marine structures at 316 Hudson Parade, Clareville (CERC, 1984)

In a cross shore sense the pocket beach at the site is denoted by the dashed black line extending from 0.4-0.6m AHD at the back of the beach, out to below low water. The beach is, for all intents and purposes, contained within the HSS and ISS sections. The bedrock reef protrudes above the profile of the pocket beach, and is also confined to the HSS and ISS sections.

It follows from the geometry of the cross-shore section that the bedrock reef and former boatshed present as a partial groyne. **Figure 6** shows that a theoretical groyne section, if it were to fully contain updrift sand from moving downdrift, would need to occupy the OS out to a “closure level” calculated as -1.7m AHD (**Section 5.4**). While the former timber jetty did extend out this far, it was a suspended structure hence permeable to sand movement so would have provided no groyne retention function.

It is our opinion that any early air photos of the site which may exist without any boatshed in place would most likely show a pocket beach in the same location as the existing pocket beach, but possibly with a reduced volume of beach fill. It is expected that similar behaviour would occur elsewhere in the Pittwater where boatshed foundations occupy the intertidal zone.

[2] It is understood that the former boat ramp was a solid structure rather than a suspended structure supported on piles.

Importantly for the reason 5 matter, the Dincel walls are effectively located inside the HSS. While they may have a slightly higher elevation than the former boatshed floor level of 1.2-1.3m AHD, their influence as a groyne on littoral draft (or longshore sediment transport) would exhibit no material difference to that compared to the former boatshed and ramp structures.

8 References

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Coastal Engineering Manual
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