REPORT

Manly Golf Course Maintenance Facility Renewal Flood Impact Assessment

Client: Manly Golf Club

Reference: PA1966-RHD-00-FL-RP-D-0001

Status: S0/P01.01

Date: 21 April 2020

Royal HaskoningDHV

Enhancing Society Together

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:	Manly Golf Course Maintenance Facility Renewal Flood Impact Assessment
Document short title:	
Reference:	PA1966-RHD-00-FL-RP-D-0001
Status:	P01.01/S0
Date:	21 April 2020
Project name:	Manly GC Maintenance Facility Renewal
Project number:	PA1966
Author(s):	Tim Michel

Drafted by:	Tim Michel
Checked by:	Rohan Hudson
Date / initials:	RH – 19.03.2020
Approved by:	Greg Britton
Date / initials:	GWB – 20.04.2020

Classification
Project related

Royal HaskoningDHV

Table of Contents

Table of Tables

Table of Figures

Appendices

1 Introduction

1.1 Background

This report summarises the findings of a Flood Impact Assessment (FIA) undertaken to support the Development Application (DA) for the construction of a maintenance shed for Manly Golf Course (the Site).

A Pre-lodgement Meeting (PLM) occurred on 7 March 2019 for this Development Application in response to preliminary plans prepared by Leffler Simes Architects dated 18 October 2018. The primary purpose of this FIA is to address the recommendations made by Council's Flood Engineer and aim to demonstrate the Applicant's ability to satisfy relevant controls outlined in Manly Council's Development Control Plan (DCP).

1.2 Objectives of this Report

The overall objectives of this FIA are to:

- Describe the current flood affectation at the site.
- Identify whether the proposed works are likely to have a significant impact on flood behaviour within the site.
- Identify whether the proposed works have the potential to increase the flood affectation of neighbouring properties.
- Recommend measures to mitigate the potential impacts on flood behaviour within the site and at neighbouring properties.

2 Site Description

2.1 Location

The maintenance facility at Manly Golf Course is located in the south-eastern portion of Lot 30 of DP649787, near the intersection of Kenneth Road and Balgowlah Road, Manly (refer to **Figure 2-1**). The site is currently zoned RE2 – Private Recreation under the *Manly Local Environmental Plan 2013*. Vehicle access to the maintenance facility is via Kenneth Road.

Figure 2-1: Site Locality Plan

2.2 Existing Site Conditions

The site generally grades from south to north and is considered to be very flat, with a grading generally towards the fairway of the 2nd hole on the golf course. Aerial imagery showing the existing site condition is presented below as **Figure 2-2**. A Site Survey plan prepared by LTS Lockley is included in **Appendix A**.

The existing maintenance facility consists of:

- A single-storey maintenance shed, approximately 24m by 18m. This shed is constructed as a slab on ground, with a floor level of 2.49 mAHD.
- A demountable building, approximately 15m by 13m, that includes a staff / meeting room, kitchen, amenities and timber veranda. This building is elevated above ground and has a floor level of approximately 3.23 mAHD.
- A corrugated steel shed, approximately 10m by 9m, adjacent to the staff room. The shed has a floor level of approximately 2.80 mAHD.
- Two awnings, each approximately 8.5m by 8.5m.

- Material stockpile enclosures, for select materials used in the upkeep of the golf course (e.g. sand, mulch).

There is no formal parking for staff or visitors to the facility, although around 10-12 vehicles typically park on the site on weekdays during business hours (mostly staff parking and some occasional visitors).

Figure 2-2: Site Aerial Plan (source: nearmap, image date 22/10/2019)

Ground levels within and adjacent to the maintenance facility vary from approximately 2.2 - 2.3 mAHD near the amenities building to approximately 1.9 - 2.0 mAHD in the north-eastern portion of the site. The level on the driveway entry off Kenneth Road is approximately 2.3 mAHD (at the property boundary).

2.3 Existing Flooding Conditions

Consistent with advice received from Northern Beaches Council as outlined in the PLM notes (8 March 2019), the following predicted flood levels derived from the Manly Lagoon Flood Study (BMT WBM, 2013) apply to the site:

- 1% AEP Flood Level – RL 3.16 mAHD (NB: this is the level of the 1% AEP catchment event with a 5% AEP ocean water level)
- Flood Planning Level (FPL) – RL 3.66 mAHD (equivalent to the 1% AEP Flood Level plus 500mm freeboard, which is consistent with the *Manly Development Control Plan 2013* guideline for FPL).
- Probable Maximum Flood (PMF) level – RL 5.65 mAHD.
- Flood Risk Precinct – medium to high.

3 Proposed Development

3.1 Description of Works

The proposed upgrades to the maintenance facility consist of:

- Demolition of the existing maintenance shed and surrounding concrete pavement.
- A 58 metre long by 16 metre wide single-storey building to replace the existing maintenance shed. The majority of the floorspace will be used for golf cart storage and workshop space. The shed will be constructed as an elevated concrete slab, supported by piled foundations.
- A concrete hardstand adjacent to the new maintenance building, including manoeuvring area for maintenance vehicles, and provision of parking for up to 12 cars (for employees and visitors to the maintenance facility).
- New material storage enclosures on the eastern side of the hardstand area, each approximately 6 metres by 4 metres.

A Site Plan showing the proposed maintenance facility upgrades is included in **Appendix B**.

3.2 Proposed Building Floor Level

A key issue for the proposed development is managing the flood risk associated with potential inundation of the site due to flooding. As discussed further in subsequent sections, the site is prone to flooding due to events as frequent as the 20% AEP event (almost equivalent to 5 year ARI).

The selection of the proposed building floor level and level of the adjacent hardstand area poses two conflicting issues relating to flood risk management:

1 Setting the proposed building floor level as high as possible – noting the low-lying and flood prone nature of the existing maintenance facility.

2 Minimising the volume of fill associated with raising the building and adjacent hardstand as far as possible (due to implications for flood storage) – noting the higher the building floor level, the higher the surrounding hardstand (having regard to access requirements between the two) and therefore the greater the volume of fill required to raise finished ground levels above existing.

Constraints that applied to determining an appropriate building floor level included:

- Existing flood levels and flood hazard (velocity and depth) within the site (refer to **Section 4.3** and **Section 4.4**)
- Existing ground levels within the maintenance facility and along the property boundary adjacent to Kenneth Road.
- The volume of earthworks required to raise the proposed building and its adjacent hardstand, as well as any compensatory earthworks (cut) required to offset any fill and therefore satisfy Council's development control relating to no loss of flood storage.

In order to arrive at a suitable building floor level, considering the conflicting constraints listed above, the proposed maintenance building has been designed with a suspended floor rather than slab on ground. While a suspended slab poses significant additional cost and more complex constructability, it is considered the most appropriate solution to achieve a floor level higher than existing, whilst minimising the volume of fill required across the site. The final design of the proposed works will generate a net cut volume of approximately 100 m^3, hence a minor increase in flood storage.

Various site grading and cut / fill scenarios have been tested during design development to determine an appropriate building floor level and the likely volumes of cut and fill associated with the building and its adjacent hardstand. Ultimately, the proposed works involve setting the building floor level at RL 3.16 mAHD, which is equivalent to the 1% AEP Flood Level at the site.

It is acknowledged that the Flood Planning Level (FPL) at the site is defined as the 1% AEP Flood Level plus 500mm freeboard (i.e. 3.66 mAHD). However, considering the ground levels along the property boundary at Kenneth Road, the proposed position of the building on the site and the maximum allowable gradient on the concrete hardstand areas (1:20 or 5%), a building floor level any higher than 3.16 mAHD would not be feasible. As noted above, the building would be used only for storage of vehicles and as a workshop, it would of course not be habitable.

It is also acknowledged that the floor level of the existing maintenance facility is at 2.49 mAHD, which is 0.67 metres below the proposed building floor level and 1.17 metres below the FPL. Therefore, the proposed building upgrade would provide a solution that would reduce the likelihood of building inundation (flood damages) due to flooding in the Manly Lagoon catchment. The solution also improves the existing available flood storage at the site.

3.3 Earthworks and Grading Strategy

In order to provide a design solution that results in no net loss of flood storage, it is proposed that there be an average of 1.2 metre depth (clearance) between final ground level and the underside of the suspended slab to offset the approximate 500m^3 of fill across the hardstand and driveway. The elevation of the building floor and the opening to the undercroft area under the building will be sufficient to prevent the collection of flood debris and will not impede upon the flow paths.

4 Relevant Documents

4.1 Manly Local Environmental Plan 2013

The *Manly Local Environmental Plan 2013* makes local planning provisions in relation to the development of land within the former Manly LGA, which is now part of the amalgamated Northern Beaches LGA. Clause 6.3 of the Manly LEP relates to flood planning, and its sub-clauses are relevant to the proposed maintenance facility upgrade works. These are reproduced below for ease of reference:

Clause 6.3 – Flood planning

(1) The objectives of this clause are as follows—

(a) to minimise the flood risk to life and property associated with the use of land,

(b) to allow development on land that is compatible with the land's flood hazard, taking into account projected changes as a result of climate change,

(c) to avoid significant adverse impacts on flood behaviour and the environment.

(2) This clause applies to land at or below the flood planning level.

(3) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development—

(a) is compatible with the flood hazard of the land, and

(b) is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and

(c) incorporates appropriate measures to manage risk to life from flood, and

(d) is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and

(e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding.

(4) A word or expression used in this clause has the same meaning as it has in the Floodplain Development Manual (ISBN 0 7347 5476 0) published by the NSW Government in April 2005, unless it is otherwise defined in this clause.

(5) In this clause—

flood planning level means the level of a 1:100 ARI (average recurrent interval) flood event plus 0.5 metre freeboard.

4.2 Manly Development Control Plan 2013

The following principles and consequent objectives outlined in the *Manly Development Control Plan 2013* (Amendment 11) pertain to flooding:

- **Section 3.7 – Stormwater Management**

  Objective 1 – To manage urban stormwater within its natural catchments and within the development site without degrading water quality of the catchments or cause erosion and sedimentation.

  Objective 2 – To manage construction sites to prevent environmental impacts from stormwater and protect downstream properties from flooding and stormwater inundation.

  Objective 3 – To promote ground infiltration of stormwater where there will be no negative (environmental) impacts and to encourage on-site stormwater detention, collection and recycling.

  Objective 4 – To make adequate arrangements for the ongoing maintenance of stormwater facilities.

- **Section 5.4.3 – Flood Prone Land**

  A full list of the relevant development controls for Flood Prone Land (Section 5.4.3) is reproduced in **Table 6-1**.

4.3 Manly Lagoon Flood Study (2013)

BMT WBM prepared the *Manly Lagoon Flood Study* in 2013 to define historical, existing and likely future flood behaviour within the Manly Lagoon catchment. Relevant extracts from the 2013 Flood Study are included in **Appendix C**.

The main findings of the study showed that:

- Longer duration events typically result in the worst-case flooding conditions in Manly Lagoon. As the Lagoon provides the majority of flood storage, the lower reaches of the tributary catchments are dominated by lagoon water levels.
- Catchment derived flooding is more severe than ocean-derived flooding for equivalent design events.
- Generally the worst affected areas from flooding of Manly Lagoon include the lower parts of the catchment, including the Site. The 1% AEP flood extent as documented in the Flood Study shows the majority of the site is inundated due to elevated water levels from Manly Lagoon (refer to **Figure 4-1**).
- Peak flood water levels are likely to progressively increase due to climate change, resulting in an increase in mean sea level over time. This could cause more regular tidal inundation of low-lying flood-prone land.

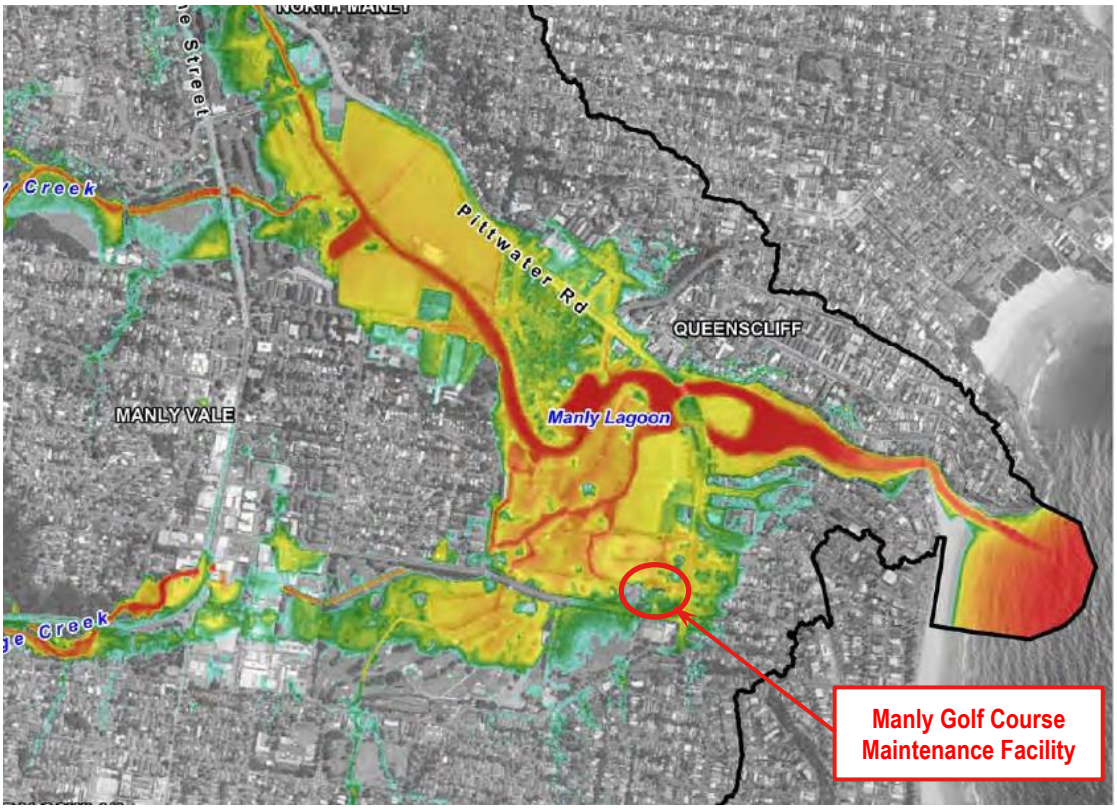


***Figure 4-1: 1% AEP Flood Depth Map Extract from* Manly Lagoon Flood Study (2013)**

A summary of the modelled peak flood levels reported in the 2013 Flood Study for catchment derived flooding only (not including effects of ocean water levels) are reproduced below in **Table 4-1**.

Table 4-1: Modelled peak flood levels near the Manly Golf Course Maintenance Facility (BMT WBM, 2013)

Location	Modelled peak flood level for catchment derived event (mAHD)			
	20% AEP	5% AEP	1% AEP	PMF
Upstream of Pittwater Road Bridge (approx. 550 metres north of the Site)	2.4	2.7	3.0	5.6
Upstream of Manly Golf Course Floodway (approx. 350 metres west of the Site)	2.8	3.0	3.2	5.7

In addition to the flood levels derived for catchment flooding only, various scenarios were modelled for joint probability of catchment flooding and elevated ocean water levels. These results are summarised in **Table 4-2**.

Table 4-2: Modelled peak flood levels near the Manly Golf Course Maintenance Facility (BMT WBM, 2013)

Location	Modelled peak flood level for joint probability (catchment and ocean) (mAHD)			
	1% AEP (9 hour) catchment event	1% AEP ocean event	1% AEP catchment + 5% AEP ocean	5% AEP catchment + 1% AEP ocean
Upstream of Pittwater Road Bridge (approx. 550 metres north of the Site)	3.0	2.5	3.1	2.9
Upstream of Manly Golf Course Floodway (approx. 350 metres west of the Site)	3.1	2.5	3.2	2.9

4.4 Manly Lagoon Floodplain Risk Management Study & Plan (2018)

The *Manly Lagoon Floodplain Risk Management Study & Plan* (FRMS&P), prepared by WMAwater in October 2018, assessed the full existing flood risk within the catchment and provided a range of mitigating measures for managing flood risks for the area.

The contents of the report include:

- A description of data collection, methodologies, community consultation, floodplain management policy;
- A study of the existing and future flood environment;
- A discussion of the extent and damage of flooding;
- Proposed floodplain risk management measures; and
- A cohesive Floodplain Risk Management Plan.

Peak flood levels for catchment derived flooding (i.e. excluding ocean influence) were presented in the 2018 FRMS&P, which were slightly different to those presented in the 2013 Flood Study. A summary of these levels is presented below in **Table 4-3**.

Table 4-3: Modelled peak flood levels near the Manly Golf Course Maintenance Facility (WMAwater, 2018)

Location	Modelled peak flood level for catchment derived event (mAHD)			
	10% AEP	5% AEP	1% AEP	PMF
Upstream of Pittwater Road Bridge (approx. 550 metres north of the Site)	2.55	2.69	2.96	5.75
Downstream of Manly Golf Course Floodway (approx. 350 metres west of the Site)	2.56	2.70	2.97	5.75

It is noted the flood levels reported in the 2018 FRMS&P are at the downstream side of the Manly Golf Course floodway (northern side of Kenneth Road), whereas the 2013 Flood Study reported flood levels on the upstream (southern) side of the floodway.

Flood categorisation undertaken by WMAwater shows the extent of the site is either Flood Storage or Flood Fringe, which are associated with low to medium hazard flooding (i.e. relatively low flood depths and/or velocities).

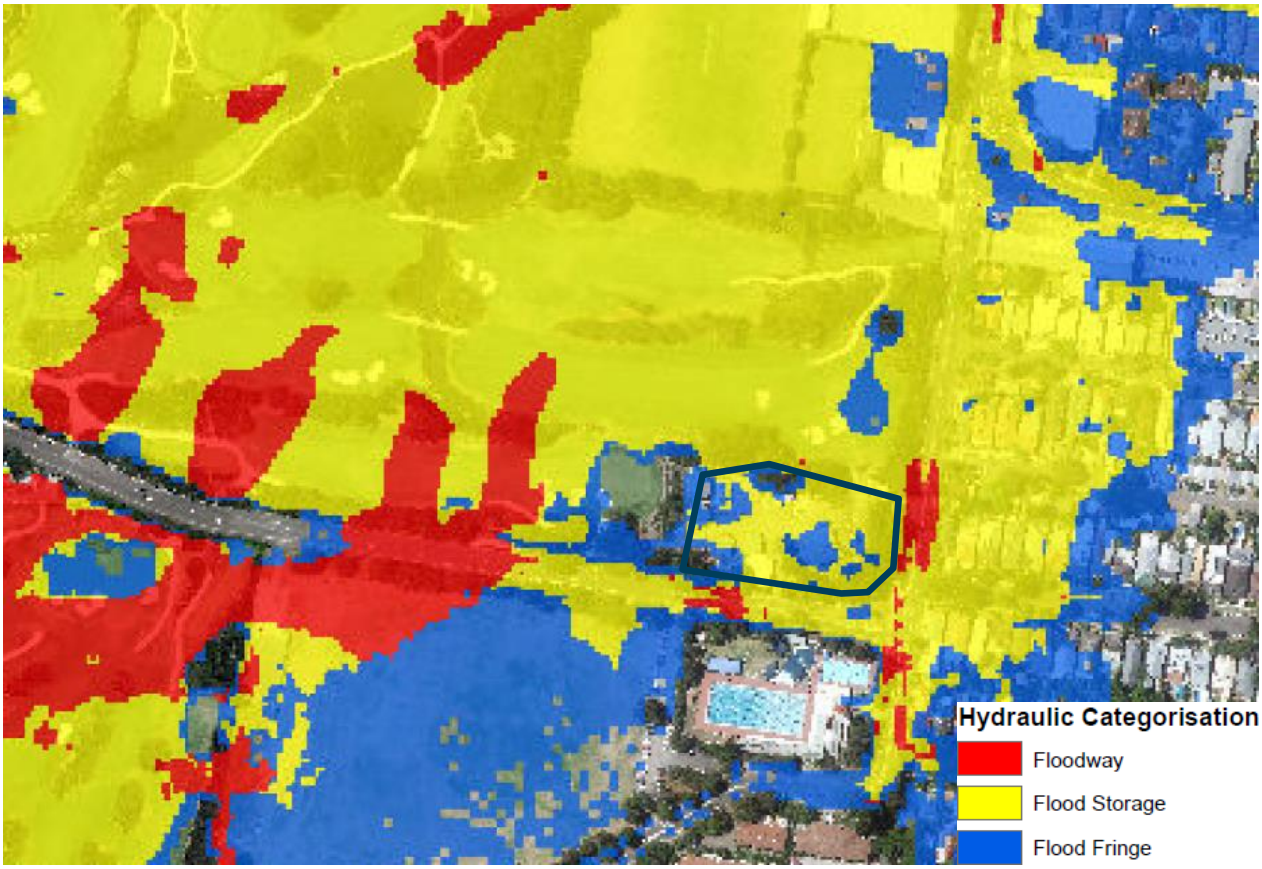


Figure 4-2: Hydraulic categories – 1% AEP event (WMAwater, 2018)

Flood hazard mapping included in the 2018 FRMS&P shows the hydraulic hazard categories within the Site are generally H3-H4 due to the 1% AEP event (refer to **Figure 4-3**) and H5 due to the PMF (refer to **Figure 4-4**).

Figure 4-3: Extract of True Hydraulic Hazard map for the 1% AEP event (WMAwater, 2018)

Figure 4-4: Extract of True Hydraulic Hazard map for the PMF event (WMAwater, 2018)

5 Flood Model Summary

5.1 Model Setup

The model developed within the *Manly Lagoon FRMS&P* (WMAwater, 2018) has been used as the basis for the flood modelling for the purpose of this FIA. The model developed by WMAwater was purchased from Council by Manly Golf Club and provided to RHDHV to further develop a proposed scenario model for the purpose of preparing this FIA.

Hydrologic modelling was undertaken using XP-RAFTS and two-dimensional hydraulic modelling was undertaken using TUFLOW.

5.2 Existing Scenario

The existing scenario was modelled utilising the base TUFLOW model prepared by WMAwater for the *Manly Lagoon FRMS&P*. No amendments were made to the existing scenario model for the purpose of determining differences between the proposed scenario and existing scenario models. The existing scenario model did not include the existing maintenance building, which is situated at a level below the extent of the 1% AEP flood.

5.3 Proposed Scenario

The proposed scenario flood model was developed by amending the Digital Elevation Model (DEM) in the base model to include the extent of the proposed maintenance building and hardstand area as shown in **Figure 5-1**. It should be noted that the final design of the proposed works will generate a net cut volume of approximately 100 m^3. No other changes were made to the model.

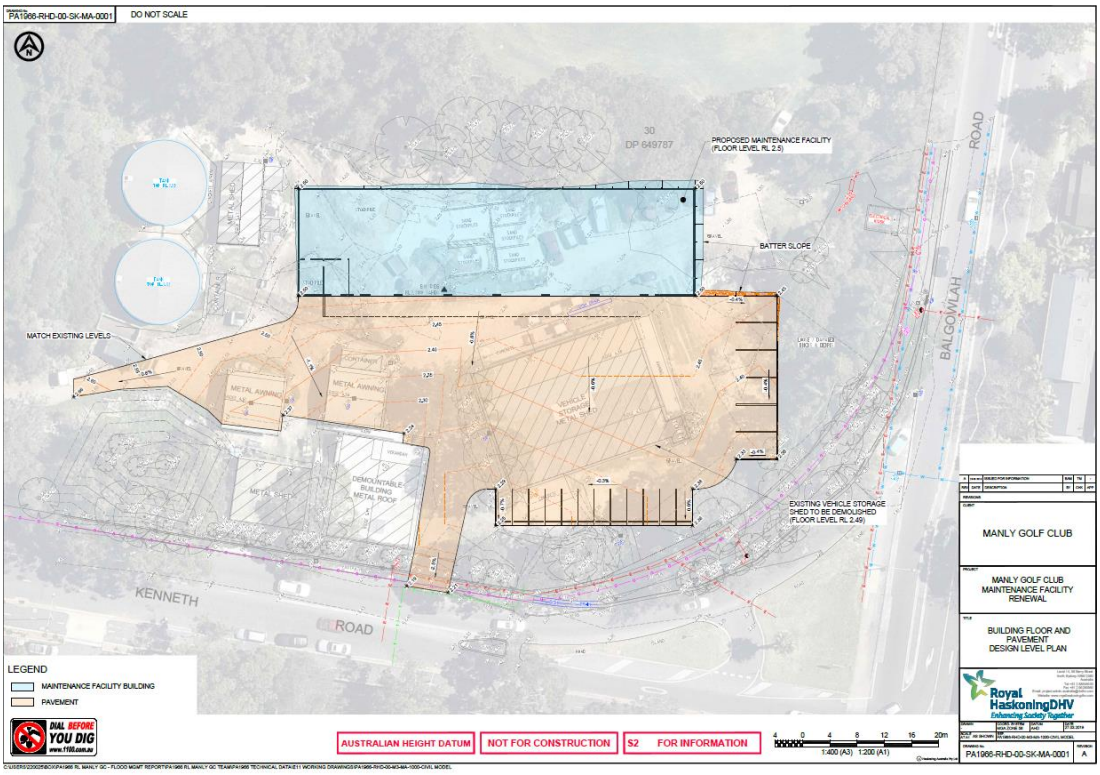


Figure 5-1: Building Floor and Hardstand Design Plan

As previously noted, the proposed building FFL has been adopted at 3.16 mAHD, which is equivalent to the adopted 1% AEP Flood Level for the site.

5.4 Model Results

The model was run for the 20% AEP, 5% AEP and 1% AEP design storm events. A summary of the differences between the proposed scenario and existing scenario for these three design events is summarised below.

5.4.1 20% AEP

The flood model results for the 20% AEP event indicate minor changes in flood depth and extent within the Site. The results also indicate a potential increase in flood levels at properties of 1mm, however it is noted that this is within the level of accuracy of the model itself. Difference mapping for the 20% AEP event is presented in **Figure 5-2**.

Figure 5-2: 20% AEP flood difference mapping

5.4.2 5% AEP

The flood model results for the 5% AEP event indicate no changes in flood depth and extent within the Site, other than within the extent of the proposed maintenance building. The results indicate a potential increase in flood level of 1mm at one property on the corner of Balgowlah Road and Alexander Street, however it is noted that this level difference is within the level of accuracy of the model itself. Difference mapping for the 5% AEP event is presented in **Figure 5-3**.

Figure 5-3: 5% AEP flood difference mapping

5.4.3 1% AEP

The flood model results for the 1% AEP event indicate no changes in flood depth and extent within the Site, other than within the extent of the proposed maintenance building. The results indicate a potential decrease in flood level of up to 2mm at properties on the eastern side of Balgowlah Road, however it is noted that this level difference is within the level of accuracy of the model itself. Difference mapping for the 1% AEP event is presented in **Figure 5-4**.

Figure 5-4: 1% AEP flood difference mapping

5.5 Summary of Model Results

The results of the proposed scenario flood modelling confirm that the proposed development will have no measurable flood impact on adjacent properties. Any changes in flood behaviour, depths and levels would be confined to the Site and would be a direct result of changes in ground and building floor levels due to the proposed maintenance facility renewal works.

6 Compliance with Manly DCP

Section 5.4.3 of *Manly Development Control Plan 2013* outlines the relevant controls that apply to all flood prone land within the former Manly LGA. For the purposes of this analysis, the construction of the maintenance shed at the site is classified as Business & Industrial development, located within a High Flood Risk Precinct. **Table 6-1** identifies the relevant prescriptive controls included in Council's DCP and includes the appropriate measures taken to address them. For ease of reference, the development matrix of flood prone risk precincts included in the Manly DCP is reproduced below as **Figure 6-1**.

	MATRIX : Flood Risk Precincts																			
	High Flood Risk							**Medium Flood Risk**							**Low Flood Risk**					
	Critical Uses	Vulnerable Uses	Subdivision	Residential	Business & Industrial	Recreational & Environmental	Concessional	Critical Uses	Vulnerable Uses	Subdivision	Residential	Business & Industrial	Recreational & Environmental	Concessional	Critical Uses	Vulnerable Uses	Subdivision	Residential	Business & Industrial	Recreational & Environmental	Concessional
A. Flood effects caused by Development	A1 A3 A4	A1 A3 A4	A1 A3	A1 A3	A1 A3	A2 A3	A2 A3	A1 A3 A4	A1 A3 A4	A1 A3	A1 A3	A1 A3	A2 A3	A2 A3	A2 A3 A4	A2 A3 A4	A2 A3				
B. Drainage Infrastructure & Creek Works	B1 B2	B1 B2	B1 B2	B1 B2	B1 B2	B1 B2		B1 B2	B1 B2	B1 B2	B1 B2	B1 B2	B1 B2		B1 B2	B1 B2	B1 B2				
C. Building Components & Structural	C1 C2 C3	C1 C2 C3		C1 C2 C3	C1 C2 C3	C1 C2 C3	C1 C2 C3	C1 C2 C3	C1 C2 C3		C1 C2 C3	C1 C2 C3	C1 C2 C3	C1 C2 C3	C1 C2 C3	C1 C2 C3					
D. Storage of Goods	D1 D2	D1 D2		D1 D2	D1 D2	D1 D2	D1 D2	D1 D2	D1 D2		D1 D2	D1 D2	D1 D2	D1 D2	D1 D2	D1 D2					
E. Flood Emergency Response	E1 E2 E3	E1 E2 E3	E1 E4	E1 E2	E1 E2 E3	E1	E1	E1 E2 E3	E1 E2 E3	E1 E4	E1 E2	E1 E2 E3	E1	E1	E1 E2 E3	E1 E2 E3	E4				
F. Floor Levels	F2 F3 F7	F2 F3 F7	F5	F1 F2 F3 F6 F8	F1 F2 F3 F6 F8 F10	F2	F2 F3 F6	F2 F3 F7	F2 F3 F7	F5	F1 F2 F3 F4 F6 F8 F9	F1 F2 F3 F4 F6 F8 F9 F10 F11	F2	F1 F2 F3 F4 F6 F11	F2 F3 F7	F2 F3 F7	F5		F1 F2 F3 F8		
G. Car Parking	G1 G4 G6 G7 G9 G10	G1 G4 G6 G7 G9 G10	G1	G1 G2 G3 G4 G5 G6 G7	G1 G2 G3 G4 G5 G6 G7	G1 G2 G3 G4 G5 G6 G7	G1 G2 G3 G4 G5 G6 G7	G1 G4 G6 G7 G9 G10	G1 G4 G6 G7 G9 G10	G1	G1 G2 G3 G5 G6 G7 G8	G1 G2 G3 G4 G5 G6 G7	G1 G2 G3 G4 G5 G6 G7	G1 G2 G3 G4 G5 G6 G7	G2 G6 G7 G9 G10	G2 G6 G7 G9 G10					
H. Fencing	H1	H1	H1	H1	H1	H1	H1	H1	H1	H1	H1	H1	H1	H1	H1	H1					
I. Pools	I1	I1	I1	I1	I1	I1	I1	I1	I1	I1	I1	I1	I1	I1	I1	I1					

Figure 6-1: Manly DCP Development Matrix for flood risk precincts

NB: cells shaded in yellow represent controls that were specifically raised by Council in the PLM notes dated 8 March 2019.

Table 6-1: Performance Criteria for Flood Prone Land

Control ID	Prescriptive Controls for Flood Prone Land in *Manly Development Control Plan* (Section 5.4.3)	RHDHV response to Development Control Criteria
A1	Development (including earthworks and subdivision) shall not be approved unless it can be demonstrated in a Flood Management Report that it complies with the Flood Prone Land Design Standard, including: (a) There is no net loss of flood storage/ floodway; (b) There are no adverse changes in flood levels and velocities caused by alterations to the flood conveyance; (c) There are no adverse effects on surrounding properties; and (d) It is sited to minimise exposure to flood hazard.	As shown on drawing PA1966-RHD-00-C-1010 (RevA), included in **Appendix D**, the proposed works will generate a net cut volume of approximately 100 m^3. This will be achieved by: • Constructing the new maintenance building as a suspended slab (rather than a slab on ground), with compensatory cut under the suspended slab. The average depth of cut under the building would be in the order of 350mm.

Control ID	Prescriptive Controls for Flood Prone Land in *Manly Development Control Plan* (Section 5.4.3)	RHDHV response to Development Control Criteria
A3	The applicant shall include in their submission, calculations to illustrate that any fill or other structures that reduce the total flood storage are replaced by Compensatory Works.	• Grading the hardstand from the southern face of the proposed building to the car parking area at a maximum gradient of 1:20 (5%). This will generate some cut toward the southern end of the carpark (up to 400mm deep). As presented in **Section 5.4**, the proposed development will cause no adverse changes in flood levels. Also, considering the site is situated within land categorised as either flood fringe or flood storage (refer to **Figure 4-2**), the proposed changes would also not result in significant changes to flood conveyance or velocities.
B1	Flood mitigation works or stormwater devices that modify a major drainage system, stormwater system, natural water course, floodway or flood behaviour within or outside the development site may be permitted subject to demonstration through a Flood Management Report that they comply with the Flood Prone Land Design Standard found on Council's webpage.	The proposed development will not impact existing drainage infrastructure, watercourses or floodways.
B2	A Section 88B notation under the *Conveyancing Act 1919* may be required to be placed on the title describing the location and type of flood mitigation works with a requirement for their retention and maintenance.	Whilst not preferred, the potential need to note the proposed compensatory earthworks on a Section 88B instrument is acknowledged. We envisage this would be discussed between Council and Manly Golf Club prior to finalising conditions of consent for construction and occupancy of the proposed works.
C1	All buildings shall be designed and constructed as flood compatible buildings in accordance with *Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas* (Hawkesbury-Nepean Floodplain Management Steering Committee, 2006).	The design of the maintenance shed and all associated components has been done so in accordance with this guideline – albeit this document largely applies to residential dwellings.
C2	All structures must be designed and constructed to ensure structural integrity up to the Flood Planning Level, taking into account the forces of floodwater, wave action, flowing water with debris, buoyancy and immersion. Structural certification shall be provided confirming the above. Where shelter-in-place refuge is to be provided the structural integrity is to be to the Probable Maximum Flood level.	The structural integrity of the proposed maintenance building will be maintained up to the FPL, which is 500mm above the proposed FFL of the building (3.16 mAHD). Certification of the structural integrity of the building will be provided by the Structural Engineer. No shelter-in-place refuge is to be provided, therefore this provision would not apply.
C3	All new electrical equipment, powerpoints, wiring, fuel lines, sewerage systems or any other service pipes and connections must be waterproofed and/or located above the Flood Planning Level. All existing electrical equipment and power points located below the Flood Planning Level must have residual current devices installed that turn off all electricity supply to the property when flood waters are detected.	Proposed electrical services (including power outlets) will be installed at or above the FPL (i.e. 500mm above the proposed floor level of the building). No other services (e.g. fuel, sewerage) will be required for the maintenance facility. All existing electrical services will be removed as part of the demolition of the existing maintenance building.
D1	Hazardous or potentially polluting materials shall not be stored below the Flood Planning Level unless adequately protected from floodwaters in accordance with industry standards.	Hazardous or potentially polluting materials will not be stored below the FPL during construction or use of the proposed maintenance facility. This requirement will be incorporated into a Plan that covers the operation and maintenance of the golf course.

Control ID	Prescriptive Controls for Flood Prone Land in *Manly Development Control Plan* (Section 5.4.3)	RHDHV response to Development Control Criteria
D2	Goods, materials or other products which may be highly susceptible to water damage are to be located/stored above the Flood Planning Level.	This requirement will be incorporated into a Plan that covers the operation and maintenance of the golf course.
E1	Development shall comply with Council's *Flood Emergency Response Planning for Development in Pittwater Policy* and the outcomes of any Flood Risk Emergency Assessment Report where it applies to the land.	The document titled *Flood Emergency Response Planning for Development in Pittwater Policy* appears to have been rescinded (it is not included in the current version of Council's DCP). The flood emergency response requirement would apply to employees and visitors of the maintenance facility. Evacuation of the site would be available either via Kenneth Road and Balgowlah Road to the golf course club house, or via the underpass under Kenneth Road and through golf course land to the club house. Considering the location of the site at the downstream extent of the Manly Lagoon catchment, and the critical storm duration being the 9 hour event, there would be ample warning time available in the event of a flood event likely to exceed the 1% AEP event to evacuate employees and visitors to the site. Ground levels above the PMF are also available on Pine Street, which is approximately 100m from the proposed development.
E2	New development must provide an appropriately sized area to safely shelter in place above the Probable Maximum Flood level and appropriate access to this area should be available from all areas within the development.	As described above, evacuation of the Site would be available to the golf course club house located on Balgowlah Road at the southern end of the golf course. Based on the existing ground levels, the proposed building floor level, the use of the site as a maintenance facility and the depth of flooding in the PMF, shelter-in-place is not considered an appropriate strategy to mitigate risks associated with extreme flood events (greater than the 1% AEP event).
F1	New floor levels within the development shall be at or above, the Flood Planning Level. A reduced Flood Planning Level may be considered only where it is permitted in this Development Control Plan. The structure must be flood proofed (wet or dry) to the Flood Planning Level. This control cannot be applied to critical or vulnerable uses.	As discussed in **Section 3.2**, the floor level has been set at 3.16 mAHD, which is the nominated 1% AEP Flood Level for the Site and 670mm above the floor level of the existing maintenance building. Flood proofing of the building will be undertaken up to the FPL, and will consist of: • Elevated electrical services and power outlets. • Facilities for storage of hazardous or potentially polluting materials (fuel). • Goods or materials that are susceptible to water damage.

Control ID	Prescriptive Controls for Flood Prone Land in *Manly Development Control Plan* (Section 5.4.3)	RHDHV response to Development Control Criteria
F2	All development structures must be designed and constructed so as not to impede the floodway or flood conveyance on the site, as well as ensuring no loss of flood storage in a 1% AEP Event. Where the dwelling is located over a flow path it must be elevated on suspended pier/pile footings such that the level of the underside of all floors including balconies and decks within the flood affected area are at or above, or raised to the Flood Planning Level to allow clear passage of the floodwaters under the building. The development must comply with the Flood Prone Land Design Standard.	The maintenance building is proposed to have a suspended slab floor at 3.16 mAHD. There is to be an average of 1.2 metre depth (clearance) between ground level and the underside of the suspended slab to offset the approximate 500m^3 of fill across the hardstand and driveway. This compensatory action will ensure there is no net loss in flood storage volume as a result of the proposed works. The elevation of the building floor and the opening to the undercroft area under the building will be sufficient to prevent the collection of flood debris and will not impede upon the flow paths.
F3	Where the lowest floor has been elevated to allow the passage of flood waters, a restriction shall be imposed on the title of the land, pursuant to S88B of the Conveyancing Act confirming that the undercroft area is not to be enclosed.	The undercroft area of the building will not be partially enclosed with either intermittent segmental blocks, breezeblocks or louvres to prevent the ingress of debris into the undercroft area. The materials adopted will suitably allow the passage of floodwaters under the building to enact flood storage.
F6	Any existing floor level may be retained below the Flood Planning Level when undertaking a first floor addition provided that: (a) it is not located within a floodway; (b) there is no increase to the building footprint below the Flood Planning Level;	The works proposed for this project do not include anywhere that an additional floor is added to an existing floor level, hence this control is not applicable.
F8	The minimum floor level of any first floor additions shall be at or above the Probable Maximum Flood Level.	The scope of this project does not include any works where an additional floor is added to an existing floor level, hence this control is not applicable.
F10	Consideration may be given to a minimum floor level for the first 5m from the street front of new development in business zonings below the Flood Planning Level provided it can be demonstrated that it complies with the Flood Prone Land Design Standard.	This control would not apply, as the proposed maintenance building is set back at least 40 metres from Kenneth Road.
G1	Open carpark areas and carports shall not be located within a floodway.	As demonstrated in **Figure 4-2**, the Site (including the proposed open car park and maintenance building) will not be located in a floodway.
G2	The lowest floor level of open carparks and carports (unroofed or with open sides) shall be constructed no lower than the natural ground levels.	The lowest level of the proposed car park along the southern edge of the hardstand area will be constructed slightly lower than existing ground levels (approximately 250mm), in order to provide a suitable gradient on the hardstand and to satisfy the requirement for no net loss of flood storage.
G3	All enclosed car parks must be protected from inundation up to the relevant flood planning level. For example, basement carparks must be provided with a crest at the entrance, the crest of which is at the relevant Flood Planning Level. All access, ventilation and any other potential water entry points to any enclosed car parking shall be above the relevant Flood Planning Level. Council will not accept any options that rely on electrical, mechanical or manual exclusion of the floodwaters from entering the enclosed carpark.	There will be no enclosed car parking for employees and visitors to the maintenance facility.

Control ID	Prescriptive Controls for Flood Prone Land in *Manly Development Control Plan* (Section 5.4.3)	RHDHV response to Development Control Criteria
G4	Vehicle barriers or restraints are to be provided to prevent floating vehicles leaving the site where there is more than 300mm depth of flooding in a 1 percent AEP flood event. The minimum height of the vehicle barriers or restraints must be at or above the Flood planning Level. Vehicle barriers or restraints must comply with the Flood Prone Land Design Standard.	The maintenance facility is surrounded by cyclone fencing to a height of approximately 1.8 metres (i.e. top of fence level approximately 3.8 mAHD, which is at least 600mm above the 1% AEP Flood Level at the Site).
G5	Enclosed Garages must be located at or above the 1% AEP level	We note the definition of ***garage*** in the Manly DCP is '*a partially or fully enclosed roofed structure for the parking of vehicles and includes a carport type structure attached to another structure or building*'. The proposed maintenance facility satisfies the definition of a garage, as the structure will be solely used for the parking and maintenance of golf course maintenance vehicles and golf carts. The proposed building floor level has been set at RL 3.16 mAHD, equivalent to the 1% AEP Flood Level, and therefore complies with this control.
G6	Carports must comply with the Flood Prone Land Design Standard.	The planned works do not include the construction of a carports, hence this control is not applicable.
G7	Where a driveway is required to be raised it must be demonstrated that there is no loss to flood stage (storage) in the 1 percent AEP flood event and no impact on flood conveyance through the site.	The driveway access off Kenneth Road will be raised to suit the proposed grading of the adjacent hardstand area. As demonstrated on drawing PA1966-RHD-00-C-1010 (RevA), included in **Appendix D**, the proposed building works and site grading will result in no net loss of flood storage.
H1	Fencing, including pool fencing, shall be designed so as not to impede the flow of flood waters and not to increase flood affectation on surrounding land. Appropriate fencing must comply with the Flood Prone Land Design Standard in addition to other regulatory requirements of pool fencing.	No additional permanent fencing is included within the scope of this development, hence this control is not applicable.
I1	Pools located within the 1 percent AEP flood extent are to be in-ground, with coping flush with natural ground level. Where it is not possible to have pool coping flush with natural ground level, it must be demonstrated that the development will result in no net loss of flood storage and no impact on flood conveyance on or from the site. All electrical equipment associated with the pool (including pool pumps) is to be waterproofed and/or located at or above the Flood Planning Level. All chemicals associated with the pool are to be stored at or above the flood planning level.	There are no pools included within the scope of this development, hence this control is not applicable.

7 Summary and Recommendations

This Flood Impact Assessment report summarises the existing flood affectation of the site of proposed maintenance facility upgrade works at Manly Golf Course.

Flood modelling of the proposed upgrade scenario confirms that the proposed works will not significantly impact on flood behaviour within or adjacent to the site. This is based on the proposed built form and earthworks strategy, which incorporates compensatory cut under the proposed building to offset fill required for the hardstand adjacent to the new building.

Measures that are recommended to mitigate potential impacts on flood behaviour have been incorporated into the architectural and structural design of the proposed building, as well as the civil design of the proposed hardstand and parking area adjacent to the building. Additional measures in response to Council's specific flood planning controls are outlined in **Table 6-1**.

8 References

BMT WBM, *Manly Lagoon Flood Study*, Revision 3 (Final), August 2013

Hawkesbury-Nepean Floodplain Management Steering Committee, *Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas*, Parramatta, June 2006

Northern Beaches Council, *Manly Development Control Plan 2013*

Northern Beaches Council, *Pittwater 21 Development Control Plan*, in force 28 August 2017

WMAwater, *Manly Lagoon Floodplain Risk Management Study and Plan*, Revision 7 (Final), October 2018

Appendix A

Site Survey Plan

LTS Lockley, 23/01/2018

Royal HaskoningDHV

NOTES

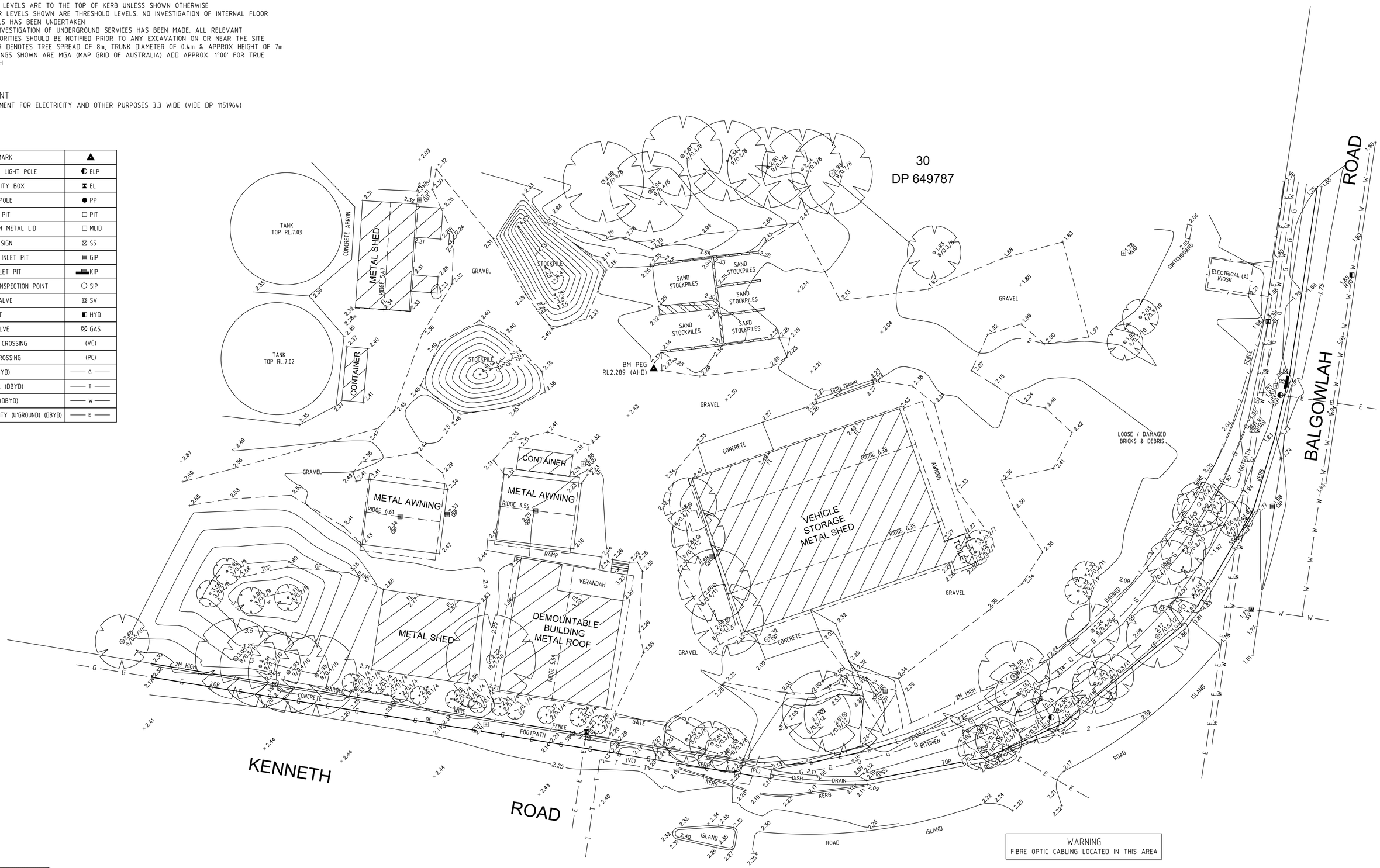
1. THE BOUNDARIES HAVE NOT BEEN MARKED
2. ALL AREAS AND DIMENSIONS HAVE BEEN COMPILED FROM PLANS MADE AVAILABLE BY NSW LAND REGISTRY SERVICES AND ARE SUBJECT TO FINAL SURVEY
3. ORIGIN OF LEVELS ON A.H.D. IS TAKEN FROM PM 715 R.L. 1.851 (A.H.D.) IN BALGOWLAH ROAD
4. CONTOUR INTERVAL 0.25 m
5. CONTOURS ARE INDICATIVE ONLY. ONLY SPOT LEVELS SHOULD BE USED FOR CALCULATIONS OF QUANTITIES WITH CAUTION
6. KERB LEVELS ARE TO THE TOP OF KERB UNLESS SHOWN OTHERWISE
7. FLOOR LEVELS SHOWN ARE THRESHOLD LEVELS. NO INVESTIGATION OF INTERNAL FLOOR LEVELS HAS BEEN UNDERTAKEN
8. NO INVESTIGATION OF UNDERGROUND SERVICES HAS BEEN MADE. ALL RELEVANT AUTHORITIES SHOULD BE NOTIFIED PRIOR TO ANY EXCAVATION ON OR NEAR THE SITE
9. 8/.4/7 DENOTES TREE SPREAD OF 8m, TRUNK DIAMETER OF 0.4m & APPROX HEIGHT OF 7m
10. BEARINGS SHOWN ARE MGA (MAP GRID OF AUSTRALIA) ADD APPROX. 1°00' FOR TRUE NORTH

EASEMENT

(A) EASEMENT FOR ELECTRICITY AND OTHER PURPOSES 3.3 WIDE (VIDE DP 1151964)

LEGEND

BENCH MARK	▲
ELECTRIC LIGHT POLE	ELP
ELECTRICITY BOX	EL
POWER POLE	PP
SERVICE PIT	PIT
PIT WITH METAL LID	MLID
STREET SIGN	SS
GRATED INLET PIT	GIP
KERB INLET PIT	KIP
SEWER INSPECTION POINT	SIP
STOP VALVE	SV
HYDRANT	HYD
GAS VALVE	GAS
VEHICLE CROSSING	(VC)
PRAM CROSSING	(PC)
GAS (DBYD)	G
TELSTRA (DBYD)	T
WATER (DBYD)	W
ELECTRICITY (U'GROUND) (DBYD)	E



WARNING
FIBRE OPTIC CABLING LOCATED IN THIS AREA

DIAL BEFORE YOU DIG
www.1100.com.au

REFER TO NOTES AND LEGEND

0 4 6 8 12 16 20
SCALE 1:200 @ A1

Revision	Date	Description	Reference
D	00/00/00	-	00
C	00/00/00	-	00
B	00/00/00	-	00
A	00/00/00	-	00

THIS IS THE PLAN REFERRED TO IN MY LETTER DATED:

.....
Registered Surveyor NSW

LTS LOCKLEY
Registered Surveyors NSW
www.ltsl.com.au
Suite 1, Level 1
810 Pacific Highway
Gordon NSW 2072
Locked Bag 5
Gordon NSW 2072
P 1300 587 000
F 02 9499 7760

Client MANLY GOLF CLUB LTD

Drawing title
PLAN OF DETAIL AND LEVELS OVER PART LOT 30 IN DP 649787, MANLY GOLF CLUB MAINTENANCE FACILITIES, 38-40 BALGOWLAH ROAD, MANLY

datum	AHD	reference number	50232 001DT
site Area	N/A	scale	1:200 @A1
LGA	NORTHERN BEACHES	date of survey	23/01/2018
		SHEET OF	1 1

Appendix B

Proposed Maintenance Facility Upgrades

Leffler Simes Architects, March 2020

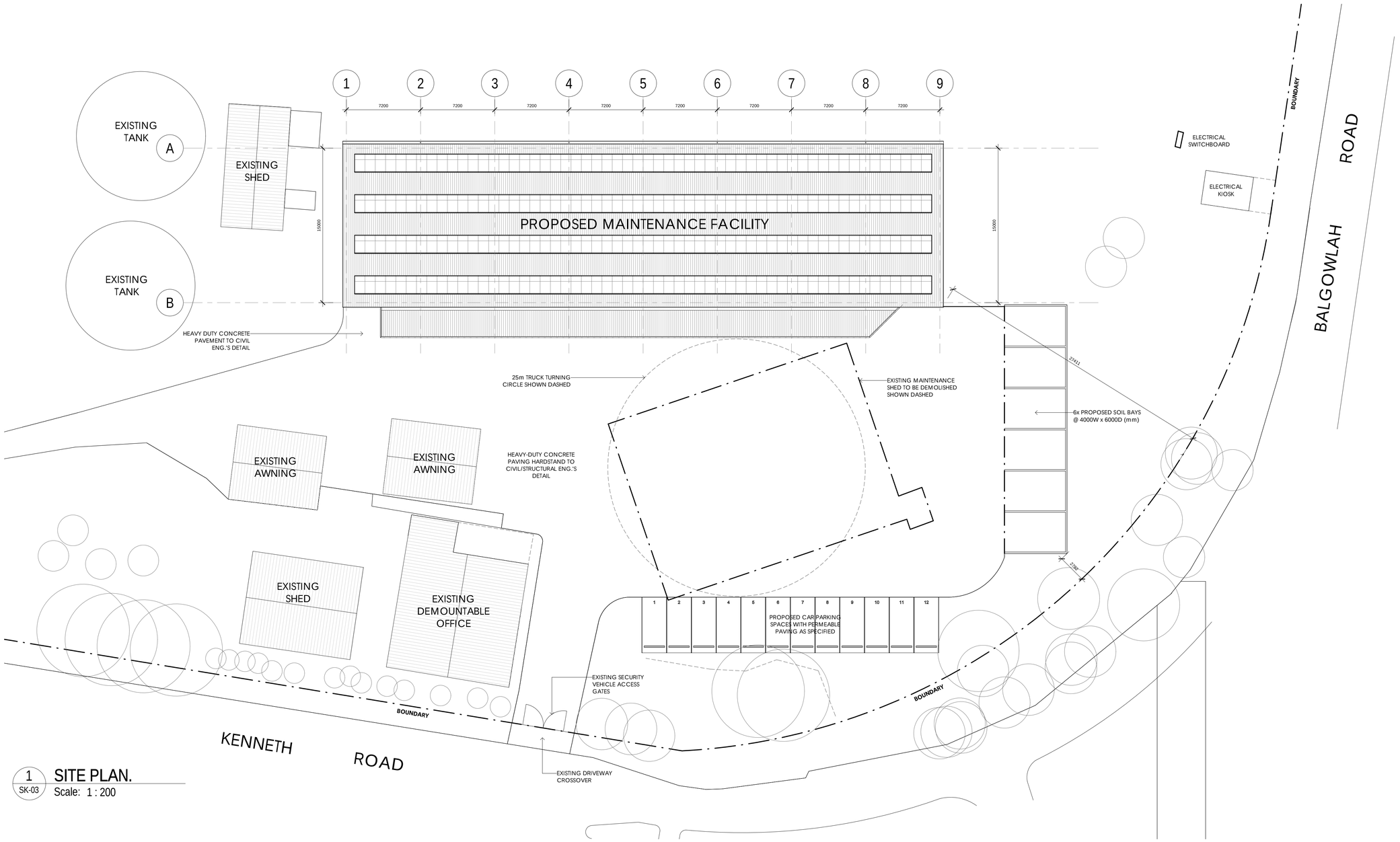
Royal HaskoningDHV

green building council australia MEMBER

Member Australian Institute of Architects

ISSUE	AMENDMENT	DATE	CHK'D
P 1	ISSUE FOR INFORMATION	22.02.19	SN

PRELIMINARY



1 SK-03 **SITE PLAN.**
Scale: 1 : 200

SITE PLAN

LEFFLER SIMES PTY LTD SYDNEY 7 YOUNG ST, NEUTRAL BAY, NSW 2089 T:+61 2 99093344
ABN 39 001 043 992 MELBOURNE LEVEL 2 - 370 LT BOURKE ST, VIC 3000 T:+61 3 96546344
WEB: www.lefflersimes.com.au BRISBANE 2 - 290 BOUNDARY ST, SPRING HILL, QLD 4004 T:+61 7 31235544

SCALE 1:200
0 4 8 12 16 20

MAINTENANCE FACILITY - MAINLY GOLF CLUB
38-40 BALGOWLAH RD, MANLY, NSW 2094

JOB NO: 4482
DATE: 18/10/18
DRAWN: MSL
DWG NO. SK-01
REV. P1

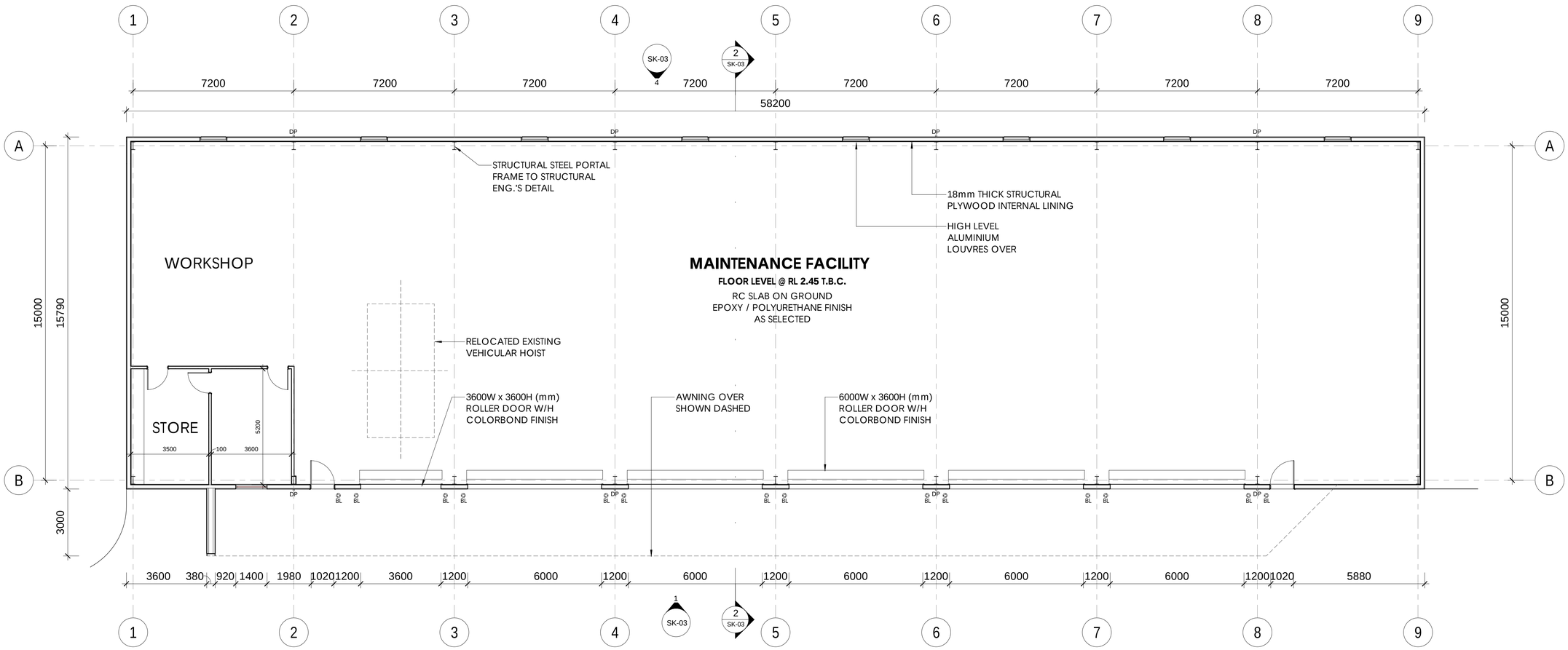
LEFFLER SIMES ARCHITECTS

green building council australia MEMBER

Member Australian Institute of Architects

ISSUE	AMENDMENT	DATE	CHK'D
P 1	ISSUE FOR INFORMATION	22.02.19	SN

PRELIMINARY



1 SK-03 GROUND FLOOR PLAN
Scale: 1 : 100

GROUND FLOOR PLAN

LEFFLER SIMES PTY LTD
ABN 39 001 043 992
WEB: www.lefflersimes.com.au
SYDNEY 7 YOUNG ST, NEUTRAL BAY, NSW 2089 T:+61 2 99093344
MELBOURNE LEVEL 2 - 370 LT BOURKE ST, VIC 3000 T:+61 3 96546344
BRISBANE 2 - 290 BOUNDARY ST, SPRING HILL, QLD 4004 T:+61 7 31235544

SCALE 1:100

MAINTENANCE FACILITY - MAINLY GOLF CLUB
38-40 BALGOWLAH RD, MANLY, NSW 2094

JOB NO: 4482
DATE: 02/22/19
DRAWN: EC
DWG NO. SK-02
REV. P1

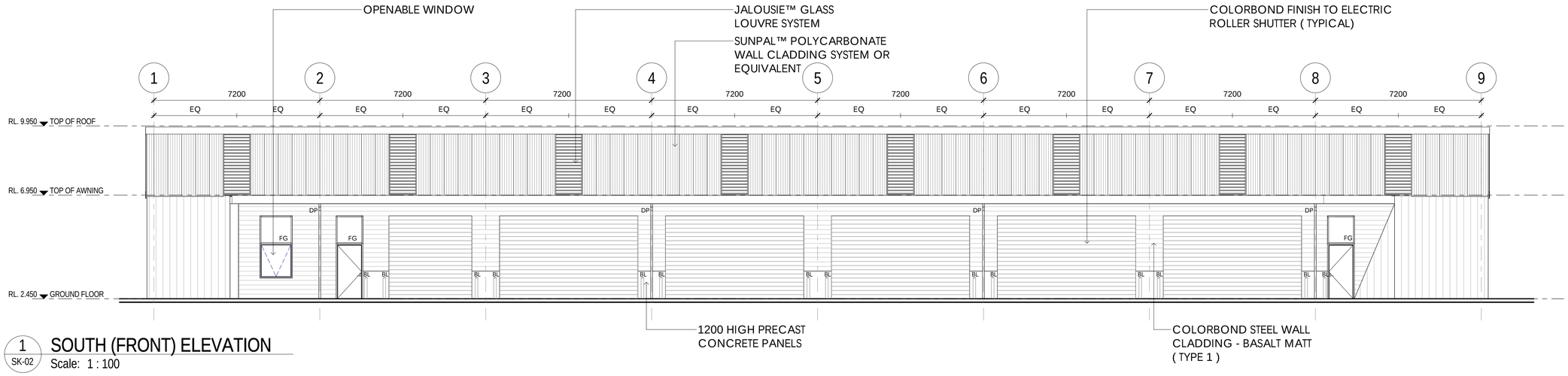
LEFFLER SIMES ARCHITECTS

green building council australia MEMBER

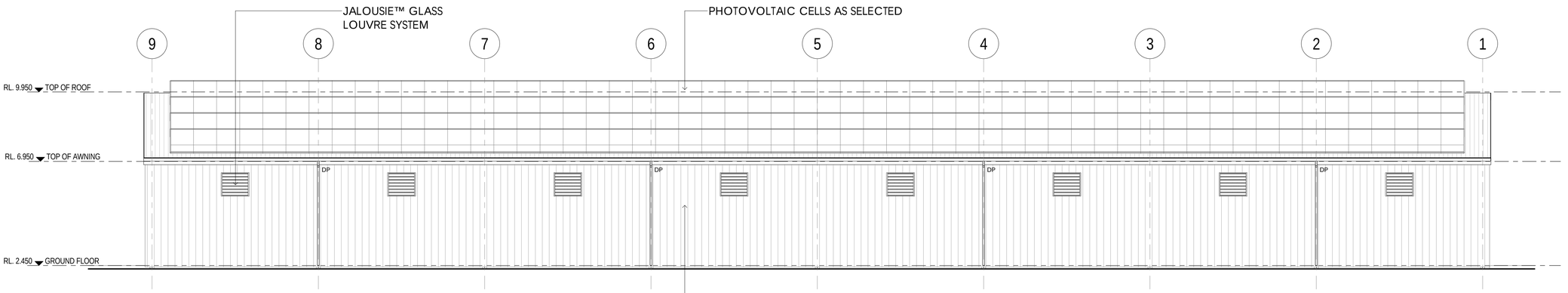
Member Australian Institute of Architects

ISSUE	AMENDMENT	DATE	CHK'D
P 1	ISSUE FOR INFORMATION	22.02.19	SN

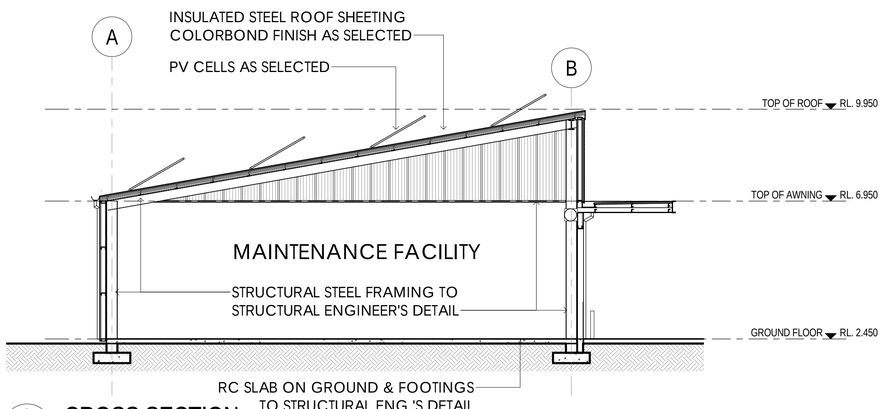
PRELIMINARY



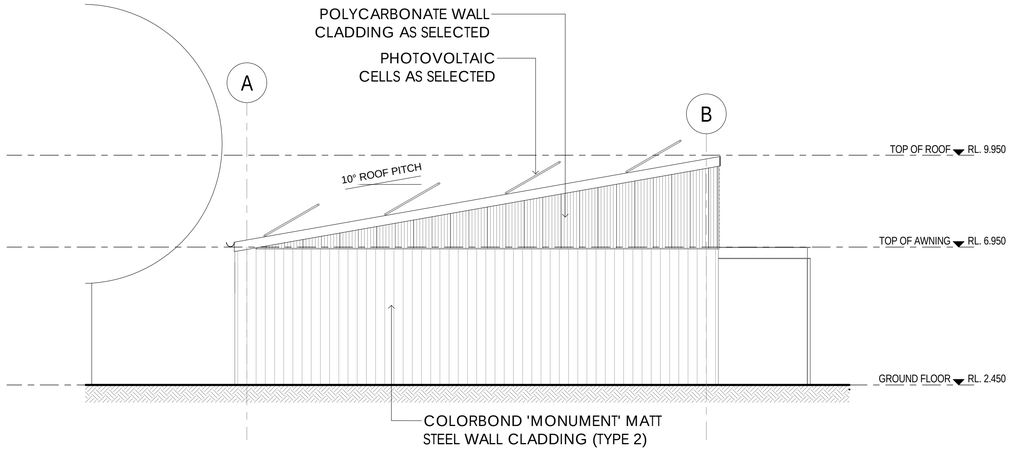
1 SK-02 **SOUTH (FRONT) ELEVATION**
Scale: 1 : 100



4 SK-02 **NORTH (REAR) ELEVATION**
Scale: 1 : 100



2 SK-02 **CROSS SECTION**
Scale: 1 : 100



3 **WEST (SIDE) ELEVATION**
Scale: 1 : 100

EXTERNAL ELEVATIONS & CROSS SECTION

LEFFLER SIMES PTY LTD
ABN 39 001 043 992
WEB: www.lefflersimes.com.au
SYDNEY 7 YOUNG ST, NEUTRAL BAY, NSW 2089 T:+61 2 99093344
MELBOURNE LEVEL 2 - 370 LT BOURKE ST, VIC 3000 T:+61 3 96546344
BRISBANE 2 - 290 BOUNDARY ST, SPRING HILL, QLD 4004 T:+61 7 31235544

SCALE 1:100

MAINTENANCE FACILITY - MAINLY GOLF CLUB
38-40 BALGOWLAH RD, MANLY, NSW 2094

JOB NO: 4482 DWG NO. SK-03 REV. P1
DATE: 10/18/18
DRAWN: MSL

LEFFLER SIMES ARCHITECTS

Appendix C

Extracts from Manly Lagoon Flood Study

BMT WBM, 2013

Royal HaskoningDHV

7 DESIGN FLOOD RESULTS

A range of design flood conditions were modelled, the results of which are presented and discussed below. The simulated design events included the 50% AEP, 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP, 0.1% AEP and PMF events for catchment derived flooding and the 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP and 0.5% events for ocean derived flooding. A series of design flood maps for selected events are provided in Appendix A.

7.1 Peak Flood Conditions

7.1.1 Catchment Derived Flood Events

The design flood results are presented in a flood mapping series in Appendix A. For the simulated design events including the 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP, 0.1% AEP and PMF events, a map of peak flood level, depth and velocity is presented covering the modelled area.

Predicted flood levels at selected locations are shown in Table 7-1 for the full range of design event magnitudes considered. The locations of reported flood levels are shown in Figure 7-1.

Similar peak flood levels are reached over the general area of the Lagoon water body, extending from Queenscliff Bridge to the upper reaches on each tributary channel. This indicates the relative control of the entrance condition on peak flood levels across the Lagoon body. Flood levels along the tributary channels naturally increase moving up higher within the catchments.

7.1.2 Ocean Derived Flood Events

The design flood results are presented in a flood mapping series in Appendix A. For the simulated design events including the 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP and 0.5% AEP events, a map of peak flood level, depth and velocity is presented covering the modelled area.

Predicted flood levels at selected locations are shown in Table 7-2 for the full range of design event magnitudes considered. The locations of reported flood levels are shown in Figure 7-1.

All events are modelled with an open entrance condition (refer Section 6.3). For lower order events that occur during a closed entrance condition the berm may offer some form of flood protection. However, for large ocean derived events the entrance berm would be overtopped or in some cases destroyed. The same peak flood level is reached across the Lagoon area, corresponding to the peak ocean surge level. Accordingly there is no attenuation of the tide surge through the Lagoon body given the relatively small storage volume.

7.1.3 Joint Catchment and Ocean Derived Flood Events

Predicted peak flood levels at selected locations for the coincident catchment and ocean flooding scenarios are shown in Table 7-3. The coincident flooding scenarios presented include:

- 1% AEP catchment rainfall with 5% AEP design ocean condition; and
- 5% AEP catchment rainfall with 1% AEP design ocean condition.

Table 7-1 Modelled Peak Flood Levels for Catchment Derived Design Events

Location	Modelled Peak Flood Level (m AHD)									
	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	0.2% AEP	0.1% AEP	PMF
US Queenscliff Bridge (Manly Lagoon)	2.2	2.3	2.5	2.6	2.7	2.8	2.9	3.2	3.3	5.4
US Pittwater Rd Bridge (Manly Lagoon)	2.3	2.4	2.5	2.7	2.8	3.0	3.1	3.3	3.4	5.6
Riverview Parade (Manly Lagoon)	2.3	2.4	2.6	2.7	2.8	3.0	3.1	3.3	3.4	5.7
US Kentwell Rd Culvert (Manly Lagoon)	2.9	3.0	3.1	3.2	3.3	3.3	3.4	3.5	3.5	5.7
US Manly Golf Course Floodway (under Kenneth Rd)	2.6	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	5.7
US Condamine St Culvert (Manly Creek)	3.9	4.1	4.2	4.5	4.7	4.9	5.0	5.2	5.3	6.3
DS Condamine St Culvert (Brookvale Creek)	5.8	5.9	6.0	6.1	6.2	6.2	6.3	6.4	6.5	7.0
US Condamine St Culvert (Burnt Bridge Creek)	7.9	9.4	10.0	10.7	11.0	11.2	11.3	12.0	12.1	12.3
US Clearview Place Culvert (Brookvale Creek)	19.8	20.5	20.6	20.9	21.2	21.4	21.6	22.1	22.3	24.3
US Burnt Bridge Creek Deviation Culvert (Burnt Bridge Creek)	32.2	32.7	33.1	33.4	33.8	34.2	34.6	34.9	35.0	36.1
US Bangaroo St Culvert (Burnt Bridge Creek)	39.3	40.4	40.7	40.9	41.0	41.1	41.2	41.5	41.6	42.3

Title:

Design Event Peak Flood Level Reporting Locations

Figure: 7-1

Rev: A

N

0 0.5 1km

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath : K:\N2069_Manly_Lagoon_Flood_Study\MI\Workspaces\DWG_022_Design_Level_Locations.WOR

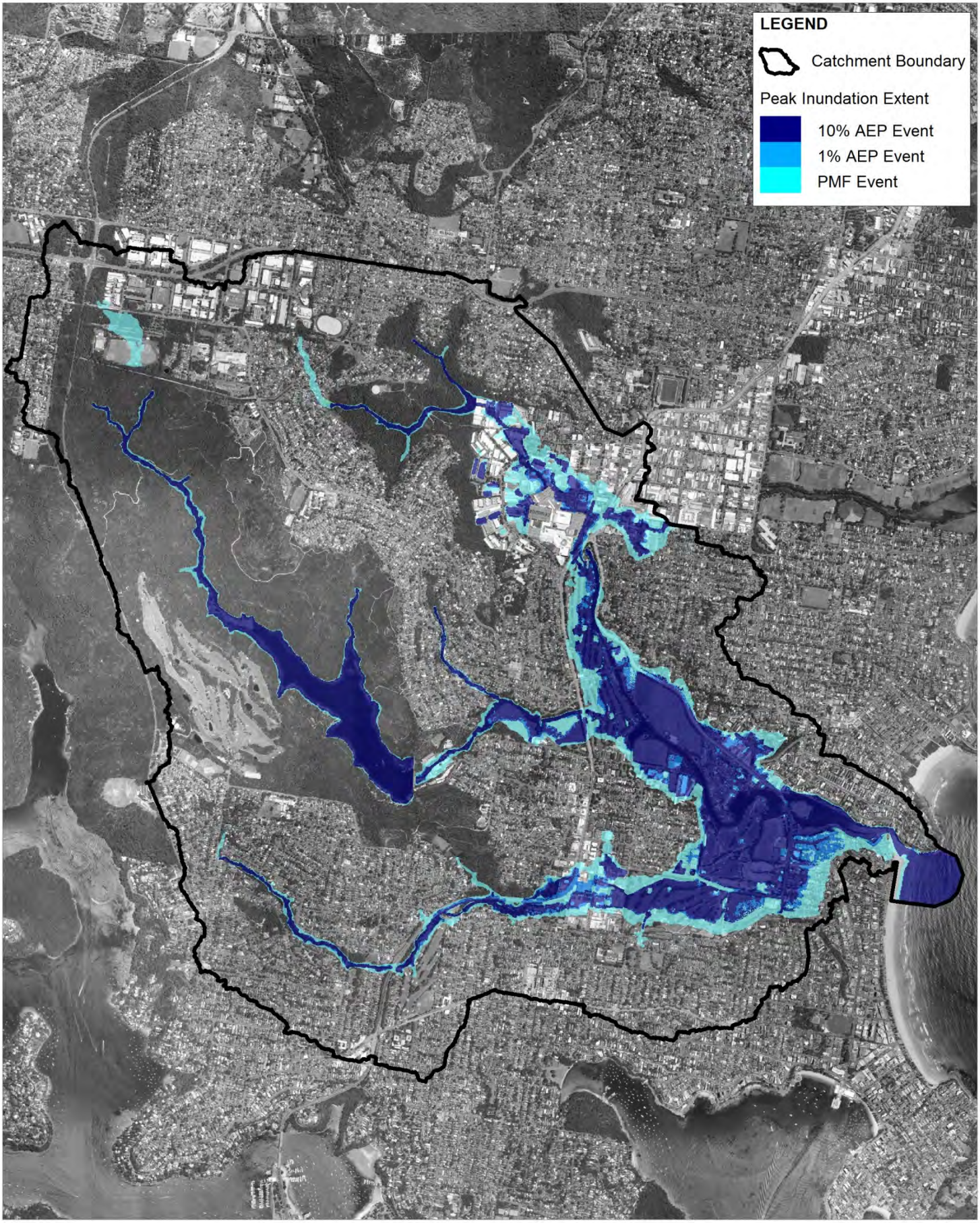
Table 7-2 Modelled Peak Flood Levels for Ocean Derived Design Events

Location	Modelled Peak Flood Level (m AHD)					
	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP
US Queenscliff Bridge (Manly Lagoon)	1.9	2.1	2.2	2.4	2.5	2.7
US Pittwater Rd Bridge (Manly Lagoon)	1.9	2.1	2.2	2.4	2.5	2.7
Riverview Parade (Manly Lagoon)	1.9	2.1	2.2	2.4	2.5	2.7
US Kentwell Rd Culvert (Manly Lagoon)	1.8	2.1	2.2	2.4	2.5	2.7
US Manly Golf Course Floodway (under Kenneth Rd)	1.9	2.1	2.2	2.4	2.5	2.7
US Condamine St Culvert (Manly Creek)	1.9	2.1	2.2	2.4	2.5	2.7

Table 7-3 Modelled Peak Flood Levels for Joint Design Events

Location	Modelled Peak Flood Level (m AHD)			
	1% AEP 9-hour Catchment Event	1% AEP Ocean Event	1% AEP Catchment + 5% AEP Ocean	5% AEP Catchment + 1% AEP Ocean
US Queenscliff Bridge (Manly Lagoon)	2.8	2.5	3.1	2.8
US Pittwater Rd Bridge (Manly Lagoon)	3.0	2.5	3.1	2.9
Riverview Parade (Manly Lagoon)	3.0	2.5	3.2	2.9
US Kentwell Rd Culvert (Manly Lagoon)	3.2	2.5	3.3	3.1
US Manly Golf Course Floodway (under Kenneth Rd)	3.1	2.5	3.2	2.9
US Condamine St Culvert (Manly Creek)	4.9	2.6	4.9	4.5
DS Condamine St Culvert (Brookvale Creek)	6.1	-	6.1	6.0
US Condamine St Culvert (Burnt Bridge Creek)	10.0	-	10.0	8.8
US Clearview Place Culvert (Brookvale Creek)	20.5	-	20.5	20.2
US Burnt Bridge Creek Deviation Culvert (Burnt Bridge Creek)	32.6	-	32.6	32.3
US Bangaroo St Culvert (Burnt Bridge Creek)	40.1	-	40.1	39.5

Figure 7-2 shows the peak flood inundation extents of the 10% AEP, 1% AEP and PMF flood events. The overall extent of inundation particularly in the lower catchment around the Lagoon doesn't change significantly with increasing flood event magnitude, however, the depth of flooding increases with event severity.



Title:

Manly Lagoon Flood Study
Peak Flood Inundation Extents

Figure: 7-2

Rev: A

N

0 0.5 1km

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath : K:\N2069_Manly_Lagoon_Flood_Study\MI\Workspaces\DWG_023_Design_InundationI_Extents.WOR

7.2 Design Flood Hydrographs

A range of storm durations were modelled in order to identify the critical storm duration for design event flooding in the Manly Lagoon catchment. Design durations considered included the 0.5-hour, 1-hour, 1.5-hour, 2-hour, 3-hour, 4.5-hour, 6-hour, 9-hour, 12-hour, 18-hour and 24-hour durations.

Outputs from the model simulations indicate that the maximum peak inflows to Manly Lagoon are generally derived when using a design storm duration of 6 to 9 hours. In the upper reaches of some of the tributary catchments, the 1 to 2-hour duration provided for the highest peak flows.

A plot of the water level response at the location of the Kentwell Road culvert on Manly Lagoon provides a good representation of general flood response in the catchment. Figure 7-3 shows the simulated water level time series at Kentwell Road for the 1% AEP 2-hour and 9-hour storm durations. This location is approximately at the limit of where the influence of Manly Lagoon flooding ends and the local catchment flood condition becomes the dominant flooding condition. This is further illustrated in Figure 7-4 showing a plot of the critical duration for the 1% AEP event across the lower part of the catchment. Within the broader Lagoon and the lower reaches of the tributary channels, the longer 9 hour duration events provide for the peak flood water levels in the system. Kentwell Road on the Brookvale Creek tributary represents the approximate limit where the shorter duration 2-hour event for local flooding becomes the critical duration.

Figure 7-3 shows the flood peak for the 2-hour and 9-hour durations to be almost the same level at Kentwell Road. The 2-hour duration water level profile is largely driven by the local flooding generated in the Brookvale Creek catchment. The relatively small catchment provides for a rapid water level response to rainfall, within peak flood conditions being reached within 1-2 hours.

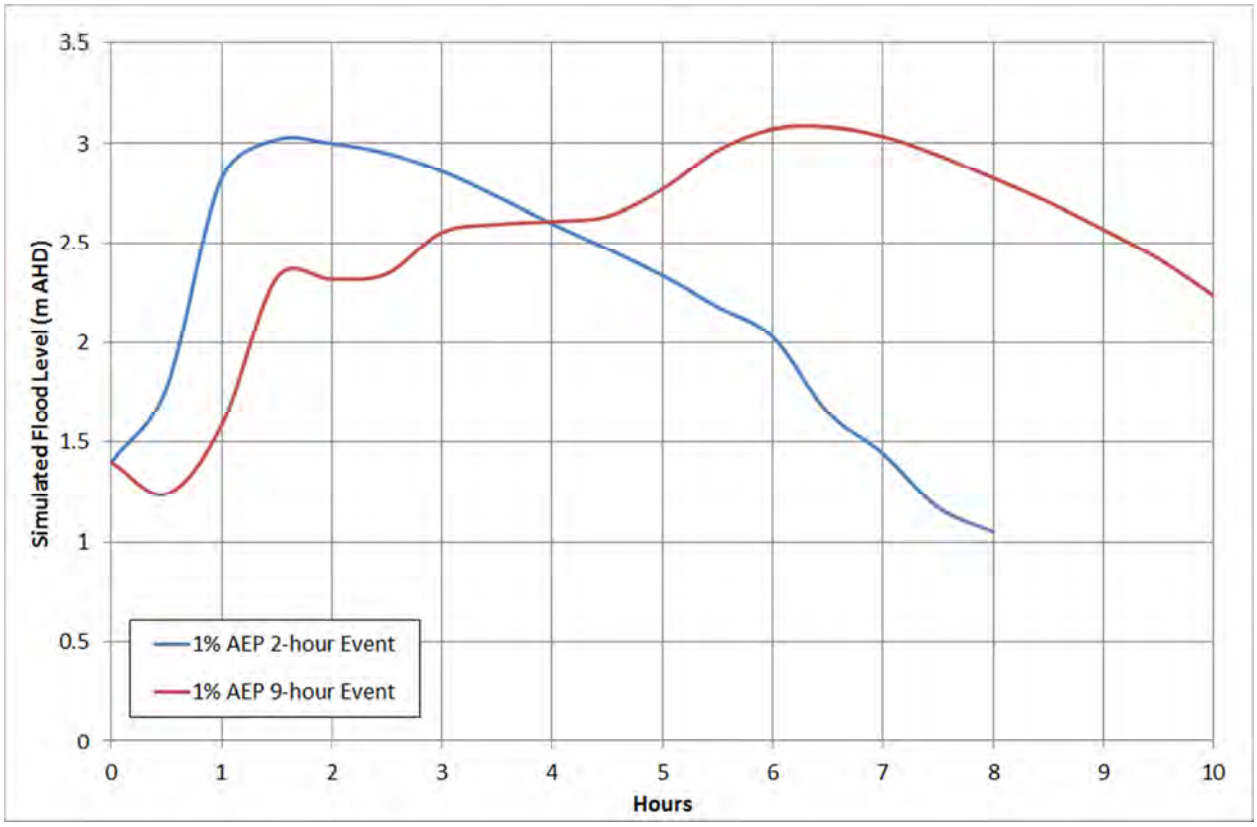
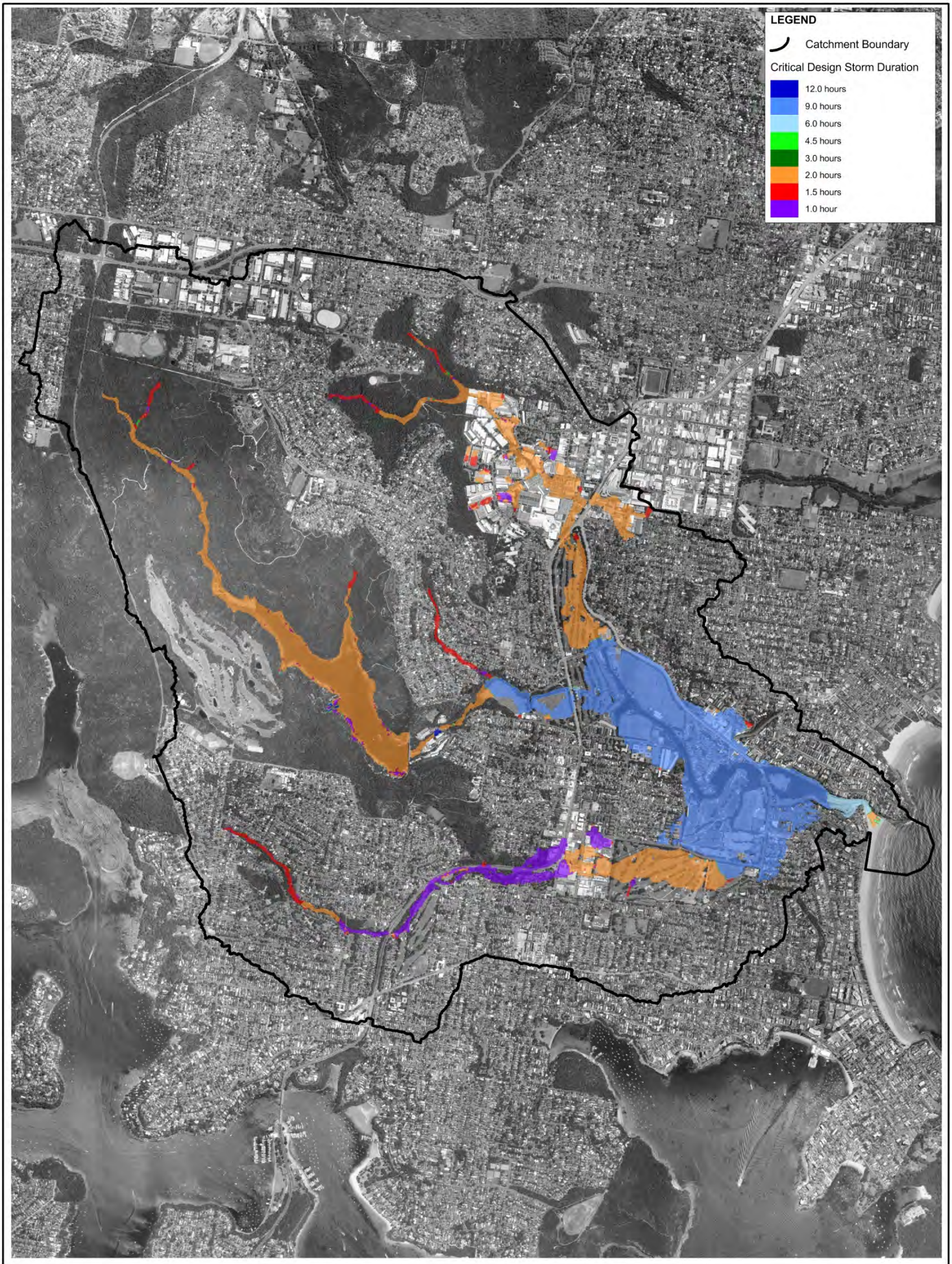


Figure 7-3 Simulated Water Level Response at Kentwell Road, Brookvale Creek



Title:

Crtitical Design Storm Duration - 1% AEP Catchment Event

Figure: **7-4**

Rev: **A**

N

0 0.5 1km

Approx. Scale

BMT WBM
www.bmtwbm.com.au

Filepath : K:\N2069_Manly_Lagoon_Flood_Study\MI\Workspaces\DWG_025_CriticalDuration_1%AEP.wor

The 1% AEP 9-hour water level time series shown in Figure 7-3 represents significantly longer storm duration with a greater overall runoff volume. The plot shows a dual peak with the local catchment contribution peaking at around 4-hours before the higher peak at around 6-hours. This later peak represents the peak flood condition being reached in the broader Manly Lagoon. Further upstream within Brookvale Creek, there is less influence from the Lagoon flood level in which short duration local catchment flooding becomes the clear dominant flooding mechanism. This type of flood behaviour is similar on the other small tributaries where the critical durations in the upper reaches are relatively short as shown in Figure 7-4.

The rapid water level rise as seen in Figure 7-3 has implications for flood planning and emergency response given the potential for limited available warning time before the onset of peak flood conditions. Critical durations are similar for most of the other design event return periods. For the PMF event, the critical duration for the broader Lagoon area is the 5-hour duration with the 0.5 and 1-hour events typically the critical duration for the local flooding in the upper tributaries.

The simulated 1% AEP 9-hour duration hydrographs for each of the main tributaries at the confluence with Manly Lagoon and the Lagoon hydrograph at Queenscliff Bridge are shown in Figure 7-5. Also shown for reference is the combined inflows to the Lagoon from the tributary catchments. The effect of the storage on attenuating flows through the Lagoon is evident in comparing the combined inflow hydrograph to the Queenscliff Bridge hydrograph.

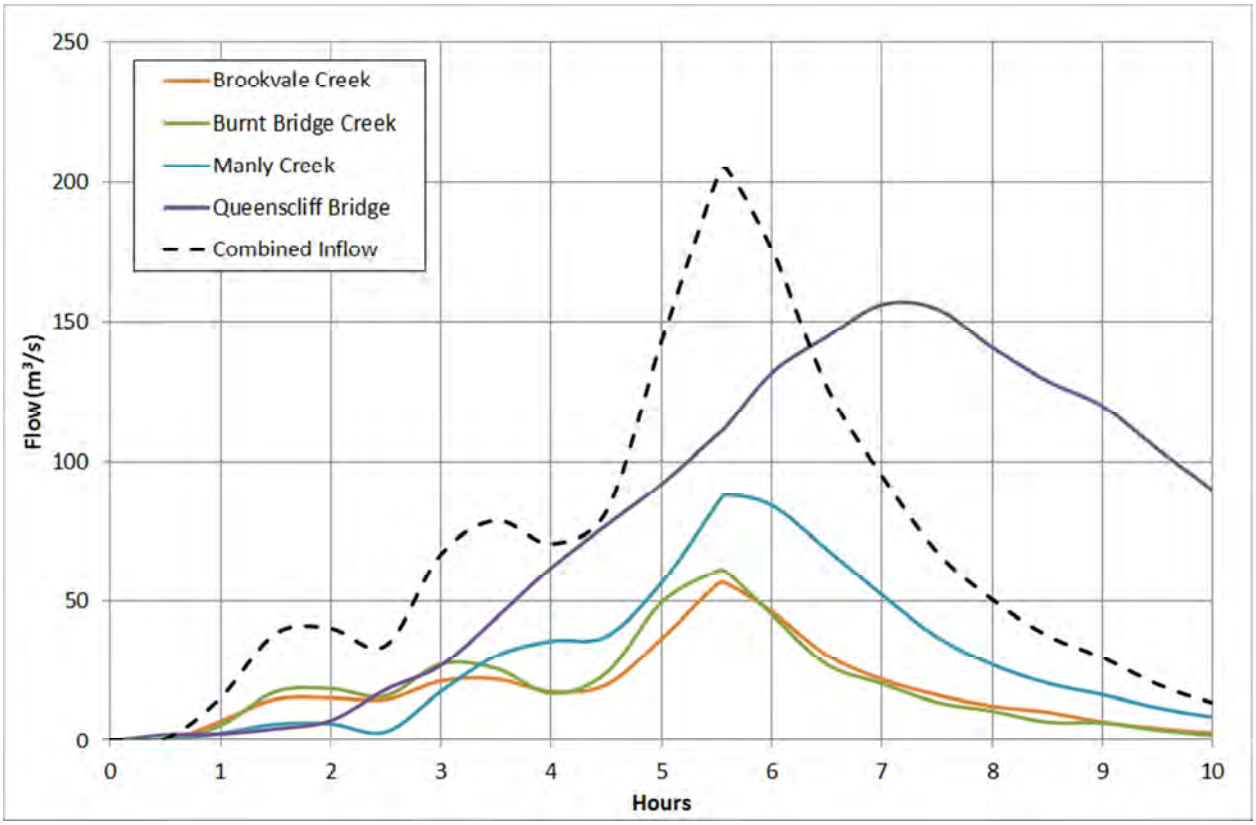


Figure 7-5 Sub-catchment Contributions to Manly Lagoon (1% AEP Event)

The rates of rise of the hydrographs are to some to degree dependent on the adopted temporal patterns across the range of design storm event durations. However, the response shown in

Figure 7-5 with a rapid rise in flow over 1 to 2 hours is generally typical of the catchment response. Even shorter response times may be apparent in the upper reaches of the catchments.

For the simulated 1% AEP design event the combined peak inflow into Manly Lagoon is some 220 m^3/s. The relative inflows for other selected design event magnitudes are shown in Figure 7-6 for comparison.

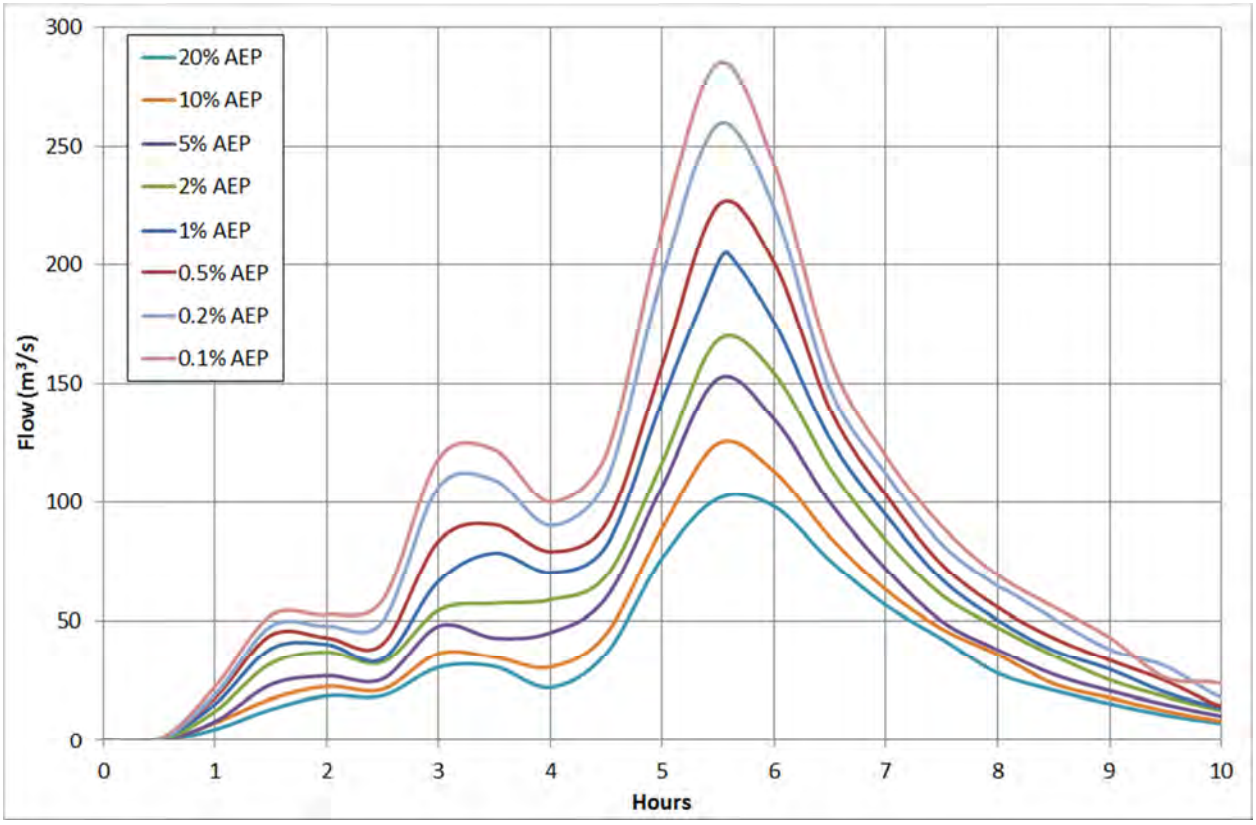


Figure 7-6 Combined Inflows to Manly Lagoon for Sample Design Events

7.3 Comparison with Previous Studies

A comparison of the peak flood levels from the current study with those of the 1992 Manly Lagoon Flood Study (MHL, 1992) (refer Section 2.2.1.1) for Riverview Parade (representative of a general Lagoon water body level) is shown in Table 7-4.

Generally the water levels simulated between the current study and 1992 Manly Lagoon Flood Study (MHL, 1992) are of a similar order with typical variations less than 0.2m when comparing like for like model conditions (typical of order of accuracies expected through a model calibration process).

The variation in the peak flood levels between the current study and 1992 Manly Lagoon Flood Study (MHL, 1992) may be attributed to the following factors:

- Differences in modelling approach and software;
- Differences in topographical data sets;
- Assumptions in regard to design entrance conditions;

- Improved model calibration and use of historical data;
- Changes to flow structures;
- Catchment land use changes.

Table 7-4 Comparison of Peak Flood Levels to 1992 Manly Lagoon Flood Study (Riverview Parade)

Event Scenario	Peak Flood Level (m AHD)	
	Current Study	1992 Manly Lagoon Flood Study (MHL, 1992)
1% AEP Catchment Event (entrance closed)	3.0	2.7
5% AEP Catchment Event (entrance closed)	2.7	2.5
20% AEP Catchment Event (entrance closed)	2.4	2.2
PMF Event	5.7	5.1
1% AEP Catchment Event / 5% AEP Ocean Event	3.2	2.7
5% AEP Catchment Event / 1% AEP Ocean Event	2.9	2.8

The main contributions to flows in Manly Lagoon come from the largest tributary sub-catchments being Brookvale Creek, Manly Creek and Burnt Bridge Creek. A summary of the design peak flows from each tributary for the 1% AEP event are summarised in Table 7-5. Shown for comparison in the table are the peak discharges from the 1992 Manly Lagoon Flood Study (MHL, 1992).

Table 7-5 Design Peak Tributary Flows (1% AEP Event)

Sub-catchment	Peak 1% AEP Flow (m^3/s)	
	Current Study	1992 Manly Lagoon Flood Study (MHL, 1992)
Brookvale Creek	79	83
Manly Creek	90	84
Burnt Bridge Creek	89	77

7.4 Design Flood Behaviour

The design flood mapping in Appendix A presents the peak design flood condition throughout the catchment, giving the peak flood extents, depth and velocity distributions.

There are a number of areas within the Manly Lagoon catchment which represent the most significant flood risk exposure to existing property. The worst affected areas are typically in the lower parts of the catchment and most severely impacted on by major flooding in Manly Lagoon.

Extensive areas of the lower Manly Lagoon area are subject to significant inundation even for relatively frequent flood events such as of the order of 20% AEP. Largely however, the inundation is limited to existing open space area, such as the Golf Courses, Nolan Reserve, Passmore Reserve etc. Significantly, even at these low order events the Balgowlah and Pittwater Roads adjacent to Keirle Park and Manly Golf Course are inundated.

With increasing flood magnitude, these low-lying areas around the Manly Lagoon foreshore are subject to significant inundation. For events of the order of the 5% AEP more extensive areas of existing residential area can be impacted upon, particularly in the Golf Parade/Rolfe Street/Alexander Street areas adjacent to Balgowlah Road and the Riverview Parade area. The eastern end of Campbell Parade which services a commercial/industrial sector is also relatively low-lying. Extensive lengths of Balgowlah Road and Pittwater Road are subject to significant inundation which would impact on trafficability.

On Burnt Bridge Creek the most significant areas of flood risk are around the Balgowlah Industrial Estate. This area is serviced by a significant trunk drainage system, however, in major events such as the 1% AEP may be subject to increasing overland flows as the trunk drainage system capacity is exceeded.

In the upper reaches of Burnt Bridge Creek, flooding inundation is typically confined to the creek corridors. However, many properties extend to the creek lines such that significant inundation can occur within residential lot boundaries even for relatively small flood events. Being relatively steep catchments, the dwellings on the lots adjacent to the creek channel are typically at higher levels, with the major inundation limited to yard areas closer to the creek.

There appears to be no major concerns in regard to existing development adjacent to Manly Creek. Outside of the creek channel the major inundation is limited to the open space areas of David Thomas Reserve ad Miller Reserve.

The Brookvale Industrial area and Warringah Mall represent the most significant existing development at risk of flooding within Brookvale Creek catchment. Whilst significant trunk stormwater drainage systems exist for these areas, once the capacity is exceeded, overland flooding through the industrial/commercial areas can occur. Typically inundation is mainly in car park areas and along access roads.

Under PMF conditions, extensive areas of development are subject to inundation depths in excess of 2m. The main areas worst affected are similar to the areas discussed above including the lower foreshore areas, Riverview Parade residential area, Balgolwah Industrial Area, Brookvale Industrial and Warringah Mall. Within these areas there is potential for a high concentration of people to at significant risk. At these PMF levels, long sections of the major transport routes would not be trafficable including, Pittwater Road, Condamine Street, Burnt Bridge Deviation and Balgowlah Road. The loss of major flood evacuation routes will have impacts for flood emergency management.

7.5 Hydraulic Classifications

There are no prescriptive methods for determining what parts of the floodplain constitute floodways, flood storages and flood fringes. Descriptions of these terms within the Floodplain Development Manual (NSW Government, 2005) are essentially qualitative in nature. Of particular difficulty is the fact that a definition of flood behaviour and associated impacts is likely to vary from one floodplain to another depending on the circumstances and nature of flooding within the catchment.

The hydraulic categories as defined in the Floodplain Development Manual are:

Floodway - Areas that convey a significant portion of the flow. These are areas that, even if partially blocked, would cause a significant increase in flood levels or a significant redistribution of flood flows, which may adversely affect other areas.

Flood Storage - Areas that are important in the temporary storage of the floodwater during the passage of the flood. If the area is substantially removed by levees or fill it will result in elevated water levels and/or elevated discharges. Flood Storage areas, if completely blocked would cause peak flood levels to increase by 0.1m and/or would cause the peak discharge to increase by more than 10%.

Flood Fringe - Remaining area of flood prone land, after Floodway and Flood Storage areas have been defined. Blockage or filling of this area will not have any significant effect on the flood pattern or flood levels.

A number of approaches were considered when attempting to define flood impact categories across the Manly Lagoon catchment. Approaches to define hydraulic categories that were considered for this assessment included partitioning the floodplain based on:

- Peak flood velocity;
- Peak flood depth;
- Peak velocity * depth (sometimes referred to as unit discharge);
- Cumulative volume conveyed during the flood event; and
- Combinations of the above.

The definition of flood impact categories that was considered to best fit the application within the Manly lagoon catchment, was based on a combination of velocity*depth and depth parameters. The adopted hydraulic categorisation is defined in Table 7-6.

Preliminary hydraulic category mapping for the 20% AEP, 5% AEP, 1% AEP and PMF design events is included in Appendix A (Figures A-22, A-23, A-24 and A-25). It is also noted that mapping associated with the flood hydraulic categories may be amended in the future, at a local or property scale, subject to appropriate analysis that demonstrates no additional impacts (e.g. if it is to change from floodway to flood storage).

Table 7-6 Hydraulic Categories

Floodway	Velocity * Depth > 0.5 m^2/s	Areas and flowpaths where a significant proportion of floodwaters are conveyed during a flood (including all bank-to-bank creek sections).
Flood Storage	Velocity * Depth < 0.5 m^2/s and Depth > 0.5 m	Floodplain areas where floodwaters accumulate before being conveyed downstream. These areas are important for detention and attenuation of flood peaks.
Flood Fringe	Velocity * Depth < 0.5 m^2/s and Depth < 0.5 m	Areas that are low-velocity backwaters within the floodplain. Filling of these areas generally has little consequence to overall flood behaviour.

7.6 Provisional Hazard

The NSW Government's Floodplain Development Manual (2005) defines flood hazard categories as follows:

High hazard – possible danger to personal safety; evacuation by trucks is difficult; able-bodied adults would have difficulty in wading to safety; potential for significant structural damage to buildings; and

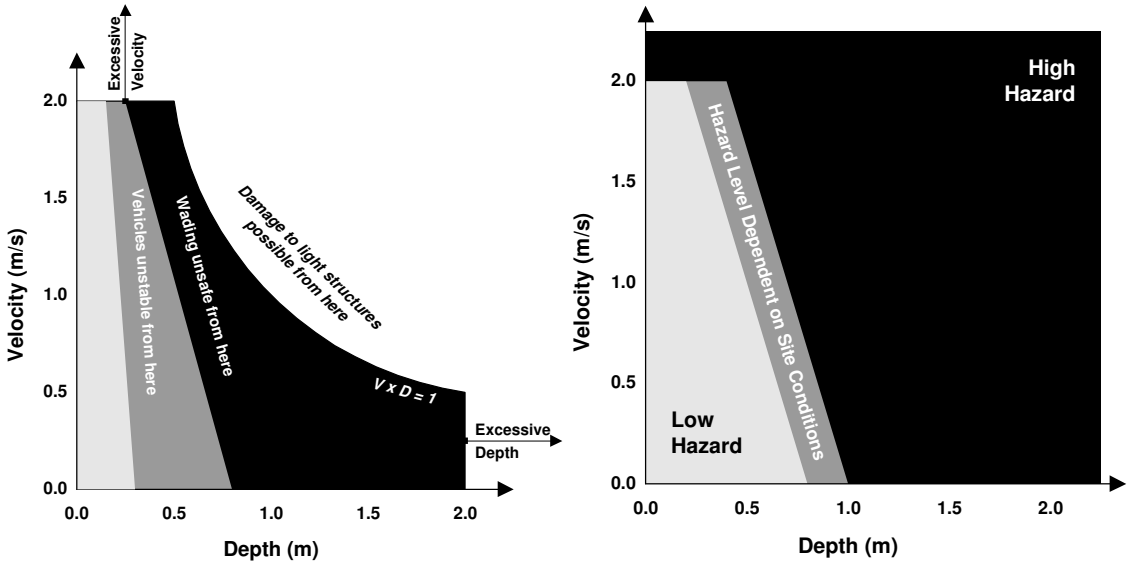
Low hazard – should it be necessary, trucks could evacuate people and their possessions; able-bodied adults would have little difficulty in wading to safety.

The key factors influencing flood hazard or risk are:

* Size of the Flood
* Rate of Rise - Effective Warning Time
* Community Awareness
* Flood Depth and Velocity
* Duration of Inundation
* Obstructions to Flow
* Access and Evacuation

The provisional flood hazard level is often determined on the basis of the predicted flood depth and velocity. This is conveniently done through the analysis of flood model results. A high flood depth will cause a hazardous situation while a low depth may only cause an inconvenience. High flood velocities are dangerous and may cause structural damage while low velocities have no major threat.

Figures L1 and L2 in the Floodplain Development Manual (NSW Government, 2005) are used to determine provisional hazard categorisations within flood liable land. These figures are reproduced in Figure 7-7.



Velocity Depth Relationships **Provisional Hazard Categories**

Figure 7-7 Provisional Flood Hazard Categorisation

The provisional hydraulic hazard is included in the mapping series provided in Appendix A for the 20% AEP, 5% AEP, 1% AEP and PMF events (Figures A-26, A-27, A-28 and A-29).

7.7 Sensitivity Tests

A number of sensitivity tests have been undertaken on the modelled flood behaviour in the Manly Lagoon catchment. In defining sensitivity tests, consideration is given to the most appropriate tests taking into account catchment properties and simulated design flood behaviour. The tests undertaken have included:

- Increased hydraulic roughness;
- Structure blockage;
- Lagoon entrance condition;
- Rainfall losses;
- Lagoon initial water level; and
- Manly Dam initial water level.

The rationalisation for each of these sensitivity tests along with adopted model configuration/parameters and results are summarised in the following sections. The impact of the sensitivity tests on the standard design 1% AEP flood condition is also presented in Appendix A as a series of peak water level afflux diagrams (Figure A-41 – Figure A-51).

7.7.1 Hydraulic Roughness

Sensitivity tests on the hydraulic roughness (Manning's 'n') were undertaken by applying a 25% decrease and a 25% increase in the adopted values for the baseline design conditions. Whilst a calibration process has been undertaken with respect to available data, and adopted design

Appendix D

Civil Drawings

RHDHV, March 2020

DRAWING No.
PA1966-RHD-00-WA-1000

DO NOT SCALE

MANLY GOLF CLUB
MAINTENANCE FACILITY RENEWAL

LOCALITY PLAN
1:10,000 (A1)

DRAWING SCHEDULE

DRG No.	TITLE
PA1966/C/1000	TITLE SHEET AND LOCALITY PLAN
PA1966/C/1010	BUILDING FLOOR AND PAVEMENT CUT AND FILL PLAN
PA1966/C/1020	SITEWORKS AND STORMWATER DRAINAGE PLAN
PA1966/C/1021	SITEWORKS AND STORMWATER SECTIONS
PA1966/C/1031	VEHICLE TRACKING MOVEMENT IN
PA1966/C/1032	VEHICLE TRACKING MOVEMENT OUT

NOTES

1. ALL LEVEL SHOWN IN METRES TO AUSTRALIAN HEIGHT DATUM REFER TO XMA-50232 001DT
2. DETAILED SURVEY PROVIDED BY LTS LOCKLEY.

200 0 200 400 600 800 1000m
1:10000 (A1) 1:20000 (A3)

AUSTRALIAN HEIGHT DATUM **NOT FOR CONSTRUCTION** **UNFINISHED DRAWING**

REV	DATE	DESCRIPTION	BY	CHK	APP
A	X.2.2020	ISSUED FOR INFORMATION	EOZ	TM	-

REVISIONS

CLIENT
MANLY GOLF CLUB

PROJECT
MANLY GOLF CLUB
MAINTENANCE FACILITY
RENEWAL

TITLE
TITLE SHEET, LOCALITY PLAN
AND DRAWING LIST

Level 14, 56 Berry Street
North Sydney NSW 2060
Australia
Tel +61 2 88545000
Fax +61 2 99200980
Email: project.admin.australia@rhdhv.com
Website: www.royalhaskoningdhv.com

Royal HaskoningDHV
Enhancing Society Together

DRAWN	COORD. SYSTEM	DATUM	DATE
EOZ	MGA ZONE 56	AHD	07.02.2020
SCALE AT A1	REF.	PA1966-RHD-00-WA-1000	

DRAWING No.
PA1966-RHD-00-WA-1000

REVISION
A

C:\USERS\220113\BOX\PA1966 RL MANLY GC - FLOOD MGMT REPORT\PA1966 RL MANLY GC TEAM\PA1966 TECHNICAL DATA\E11 WORKING DRAWINGS\PA1966-RHD-00-WA-1000

DRAWING No.
PA1966-RHD-00-C-1010

DO NOT SCALE

EXTENT OF PROPOSED MAINTENANCE BUILDING, FFL 3.16 mAHD

TANK TOP RL.7.03

TANK TOP RL.7.02

METAL SHED RIDGE 5.47

CONCRETE APRON

CONTAINER

STOCKPILE

SAND STOCKPILES

GRAVEL

DISH DRAIN

METAL AWNING RIDGE 6.61

METAL AWNING RIDGE 6.56

CONTAINER

RAMP

VERANDAH

METAL SHED

DEMOUNTABLE BUILDING METAL ROOF RIDGE 5.98

VEHICLE STORAGE METAL SHED RIDGE 6.35

TOILET

CONCRETE

AWNING

LOOSE / DAMAGED BRICKS & DEBRIS

SWITCHBOARD

ELECTRICAL KIOSK

FENCE

FOOTPATH

KERB

BITUMEN

ISLAND

BALGOWLAH ROAD

KENNETH ROAD

ROAD

ELEVATIONS TABLE						
No.	MIN. (m)	MAX. (m)	COLOUR	AREA (m2)	VOL (m3)	
1	-1.20	-0.50		273.9	23.9	TOTAL CUT: 598 m³
2	-0.50	-0.40		421.9	47.5	
3	-0.40	-0.30		403.1	90.2	
4	-0.30	-0.20		244.5	123.4	
5	-0.20	-0.10		215.6	145.0	
6	-0.10	0.00		262.3	168.0	
7	0.00	0.10		267.7	124.6	TOTAL FILL: 496.9 m³
8	0.10	0.20		196.4	104.0	
9	0.20	0.50		529.8	201.9	
10	0.50	1.00		412.1	66.4	

DIAL BEFORE YOU DIG www.1100.com.au

AUSTRALIAN HEIGHT DATUM

NOT FOR CONSTRUCTION

S2 FOR INFORMATION

4 0 4 8 12 16 20m

1:400 (A3) 1:200 (A1)

REV	DATE	DESCRIPTION	BY	CHK	APP
A	X.02.2020	ISSUED FOR INFORMATION	E.OZ.	TM	-

REVISIONS

CLIENT

MANLY GOLF CLUB

PROJECT

MANLY GOLF CLUB
MAINTENANCE FACILITY
RENEWAL

TITLE

BUILDING FLOOR AND PAVEMENT CUT AND FILL PLAN

Level 14, 56 Berry Street
North Sydney NSW 2060
Australia
Tel +61 2 88545000
Fax +61 2 99290960
Email: project.admin.australia@rhdhv.com
Website: www.royalhaskoningdhv.com

Royal HaskoningDHV
Enhancing Society Together

DRAWN	COORD. SYSTEM	DATUM	DATE
EOZ	MGA ZONE 56	AHD	05.03.2020
SCALE AT A1	REF	PA1966-RHD-00-M3-WA-CIVIL MODEL	

DRAWING No. PA1966-RHD-00-C-1010

REVISION A

C:\USERS\220113\BOX\PA1966 RL MANLY GC - FLOOD MGMT REPORT\PA1966 RL MANLY GC TEAM\PA1966 TECHNICAL DATA\E11 WORKING DRAWINGS\PA1966-RHD-00-M3-WA-CIVIL MODEL

DRAWING No.
PA1966-RHD-00-C-1020

DO NOT SCALE

SEDIMENT FENCE

PROPOSED MAINTENANCE FACILITY
(FLOOR LEVEL RL 3.16 (REFER TO
ARCHITECTS DRAWINGS FOR DETAILS)

PROPOSED
INFILTRATION BASIN

FILL BATTER,
MAX 1V:4H

REFER TO
LONGSECTION
DWG C-1021

EXISTING VEHICLE STORAGE
SHED TO BE DEMOLISHED
(FLOOR LEVEL RL 2.49)

CUT BATTER,
MAX 1V:4H

MATCH EXISTING
LEVELS

400mm HIGH
BLOCK WALL

SEDIMENT FENCE

STABILISED SITE
ENTRY/EXIT
WHEEL WASH SYSTEM

CONCRETE MEDIAN TO
TRANSITION LEVEL DIFFERENCE
BETWEEN ENTRY / EXIT DRIVEWAY
AND HARDSTAND / CAR PARK

300 WIDE ACO POWERDRAIN
SLOPED TO DRAIN TO PIPE OUTLET

TANK
TOP RL.7.03

TANK
TOP RL.7.02

METAL SHED

CONTAINER

METAL AWNING

DEMOLITABLE
BUILDING
METAL ROOF

VEHICLE
STORAGE
SHED

SAND
STOCKPILES

STOCKPILE

GRAVEL

CONCRETE

CONCRETE APRON

BARBED WIRE FENCE

FOOTPATH

KERB

ROAD

KENNETH

BALGOWLAH

ISLAND

ELECTRICAL KIOSK (A)

SWITCHBOARD

LOOSE / DAMAGED
BRICKS & DEBRIS

DISH DRAIN

DP 649787

DESIGN OBJECTIVES

1. MAX. GRADIENT ON HARDSTAND 1V:20H
2. NO NET FILL ACROSS EXTENT OF WORK
3. CUT & FILL BATTERS 1V:4H MAX.
4. PROVIDE SUSPENDED SLAB WITH AVE. 1150mm DEPTH BETWEEN FINISHED GROUND LEVEL AND UNDERSIDE OF SLAB TO OFFSET (APPROX.)
   500m^2 FILL ACROSS HARDSTAND AND DRIVEWAY

DIAL BEFORE YOU DIG www.1100.com.au

AUSTRALIAN HEIGHT DATUM | **NOT FOR CONSTRUCTION** | **S2 FOR INFORMATION**

4 0 4 8 12 16 20m
1:400 (A3) 1:200 (A1)

REV	DATE	DESCRIPTION	BY	CHK	APP
A	X.02.2020	ISSUED FOR INFORMATION	BAM	TM	-

REVISIONS

CLIENT
MANLY GOLF CLUB

PROJECT
MANLY GOLF CLUB
MAINTENANCE FACILITY
RENEWAL

TITLE
SITEWORKS AND
STORMWATER DRAINAGE PLAN

Royal HaskoningDHV
Enhancing Society Together
Level 14, 56 Berry Street
North Sydney NSW 2060
Australia
Tel +61 2 88545000
Fax +61 2 99209960
Email: project.admin.australia@rhdhv.com
Website: www.royalhaskoningdhv.com

DRAWN	COORD. SYSTEM	DATUM	DATE
EOZ	MGA ZONE 56	AHD	05.03.2020
SCALE AT A1 AS SHOWN	REF. PA1966-RHD-00-M3-WA-CIVIL MODEL		

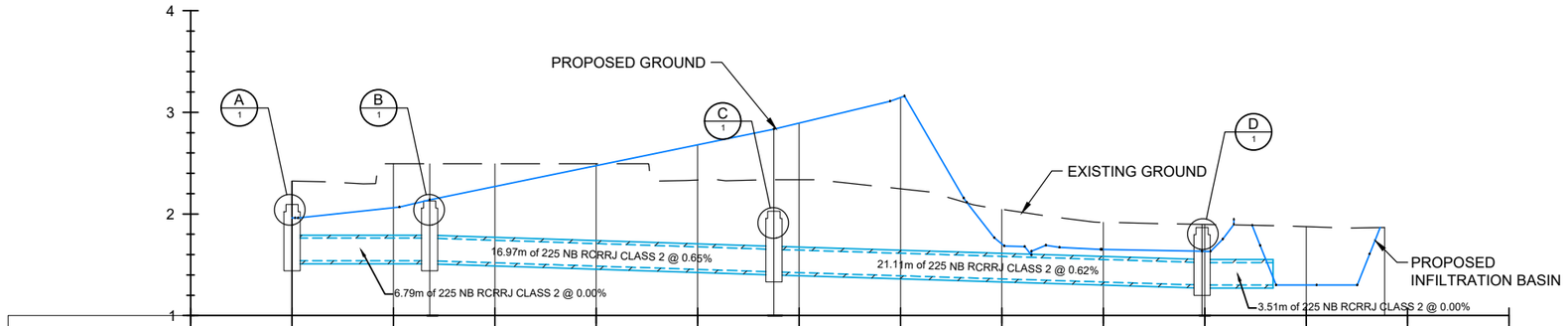
DRAWING No. PA1966-RHD-00-C-1020 | REVISION A

C:\USERS\220113\BOX\PA1966 RL MANLY GC - FLOOD MGMT REPORT\PA1966 RL MANLY GC TEAM\PA1966 TECHNICAL DATA\E11 WORKING DRAWINGS\PA1966-RHD-00-M3-WA-CIVIL MODEL

DRAWING No.
PA1966-RHD-00-C-1021

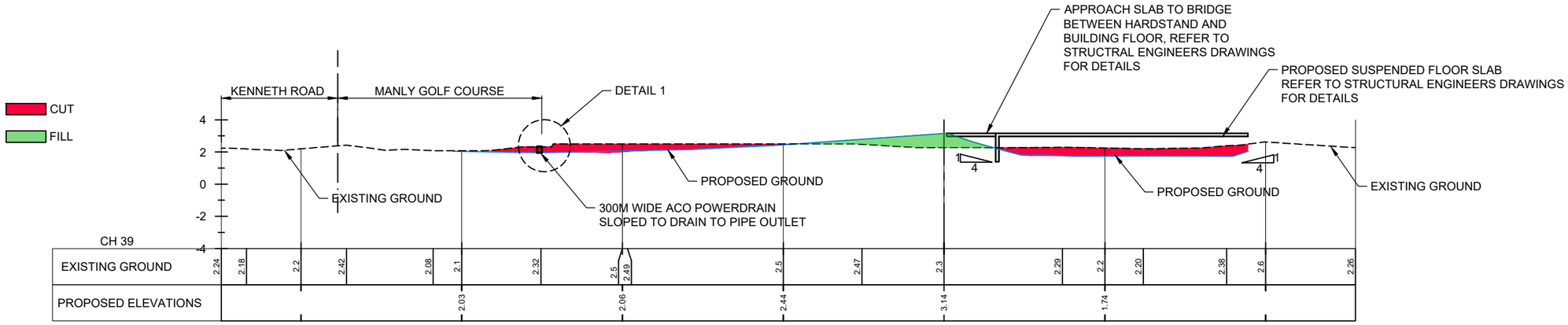
DO NOT SCALE

NOTES
1. STORMWATER LONG SECTION HAS BEEN DISTORTED 5 TIMES.



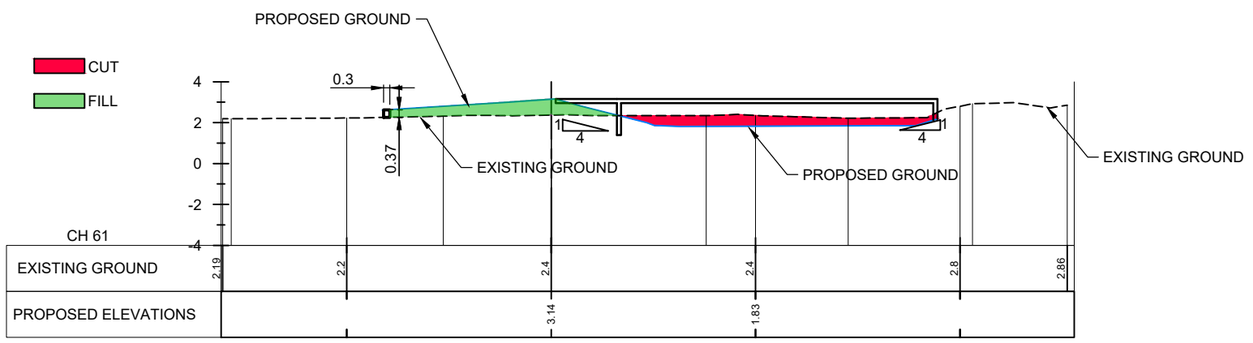
EXISTING GROUND	2.32	2.49	2.49	2.49	2.33	2.34	2.25	2.05	1.92	1.90	1.88	
PROPOSED GROUND		2.061	2.271	2.476	2.681	2.895	3.146	1.703	1.651	1.633	1.300	
PIPE INVERT		1.54	1.54	1.54		1.43	1.43			1.30	1.30	1.30
CHAINAGE	-5.000	5.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000	55.000	60.000

STORMWATER LONG SECTION-LINE 1
1:150



CH 39																								
EXISTING GROUND	2.24	2.18	2.2	2.42	2.08	2.1	2.32	2.5	2.49	2.5	2.47	2.3	2.29	2.2	2.20	2.38	2.6	2.26						
PROPOSED ELEVATIONS						2.03		2.06		2.44		3.14		1.74										

SECTION A
1:150 (A1)
1020



CH 61						
EXISTING GROUND	2.19	2.2	2.4	2.4	2.8	2.86
PROPOSED ELEVATIONS			3.14	1.83		

SECTION B
1:150 (A1)
1020

DETAIL 1
1:20

DIAL BEFORE YOU DIG www.1100.com.au

AUSTRALIAN HEIGHT DATUM | NOT FOR CONSTRUCTION | S2 FOR INFORMATION

400 0 400 800 1200 1600 2000mm
1:40 (A3) 1:20 (A1)

3 0 3 6 9 12 15m
1:300 (A3) 1:150 (A1)

© Haskoning Australia Pty Ltd

REV	DATE	DESCRIPTION	BY	CHK	APP
A	X.02.2020	ISSUED FOR INFORMATION	EOZ	TM	-

REVISIONS

CLIENT
MANLY GOLF CLUB

PROJECT
MANLY GOLF CLUB MAINTENANCE FACILITY RENEWAL

TITLE
SITEWORK AND STORMWATER SECTIONS

Level 14, 56 Berry Street
North Sydney NSW 2060
Australia
Tel +61 2 88545000
Fax +61 2 99200982
Email: project.admin.australia@rhdhv.com
Website: www.royalhaskoningdhv.com
Royal HaskoningDHV
Enhancing Society Together

DRAWN	COORD. SYSTEM	DATUM	DATE
EOZ	MGA ZONE 56	AHD	05.03.2020
SCALE AT A1	REF	PA1966-RHD-00-M3-WA-CIVIL MODEL	

DRAWING No. PA1966-RHD-00-C-1021 | REVISION A

C:\USERS\220113\BOX\PA1966 RL MANLY GC - FLOOD MGMT REPORT\PA1966 RL MANLY GC TEAM\PA1966 TECHNICAL DATA\E11 WORKING DRAWINGS\PA1966-RHD-00-M3-WA-CIVIL MODEL

DRAWING No.
PA1966-RHD-00-C-1031

DO NOT SCALE

EXTENT OF PROPOSED MAINTENANCE BUILDING, FFL 3.16 mAHD

TANK TOP RL.7.03

TANK TOP RL.7.02

CONCRETE APRON

METAL SHED RIDGE 5.47

CONTAINER

GRAVEL

STOCKPILE 4.43

SAND STOCKPILES

STOCKPILE 4.51

BM PEG RL2.289 (AHD)

DISH DRAIN

CONCRETE

CONTAINER

METAL AWNING RIDGE 6.61

METAL AWNING RIDGE 6.56

RAMP

VERANDAH

DEMOUNTABLE BUILDING METAL ROOF

METAL SHED

RIDGE 5.98

VEHICLE STORAGE METAL SHED

RIDGE 6.35

AWNING

RIDGE 6.58

GRAVEL

CONCRETE

2M HIGH

BARBED WIRE

CONCRETE

FENCE

FOOTPATH

KERB

KERB

KERB

DISH DRAIN

BITUMEN

TOP

ISLAND

ROAD

KENNETH ROAD

BALGOWLAH ROAD

SWITCHBOARD

ELECTRICAL KIOSK (A)

LOOSE / DAMAGED BRICKS & DEBRIS

FENCE

FOOTPATH

KERB

8 BARBED WIRE

2M HIGH

ISLAND

ROAD

DIAL BEFORE YOU DIG www.1100.com.au

AUSTRALIAN HEIGHT DATUM

NOT FOR CONSTRUCTION

S2 FOR INFORMATION

4 0 4 8 12 16 20m

1:400 (A3) 1:200 (A1)

© Haskoning Australia Pty Ltd

REV	DATE	DESCRIPTION	BY	CHK	APP
A	X.02.2020	ISSUED FOR INFORMATION	E.OZ.	TM	-

REVISIONS

CLIENT

MANLY GOLF CLUB

PROJECT

MANLY GOLF CLUB
MAINTENANCE FACILITY
RENEWAL

TITLE

VEHICLE TRACKING
MOVEMENT IN

Level 14, 56 Berry Street
North Sydney NSW 2060
Australia
Tel +61 2 8854 5000
Fax +61 2 9929 0960
Email: project.admin.australia@rhdhv.com
Website: www.royalhaskoningdhv.com

Royal HaskoningDHV
Enhancing Society Together

DRAWN	COORD. SYSTEM	DATUM	DATE
EOZ	MGA ZONE 56	AHD	05.03.2020
SCALE AT A1	REF	PA1966-RHD-00-M3-WA-CIVIL MODEL	

DRAWING No. PA1966-RHD-00-C-1031

REVISION A

C:\USERS\220113\BOX\PA1966 RL MANLY GC - FLOOD MGMT REPORT\PA1966 RL MANLY GC TEAM\PA1966 TECHNICAL DATA\E11 WORKING DRAWINGS\PA1966-RHD-00-M3-WA-CIVIL MODEL

DRAWING No.
PA1966-RHD-00-C-1032

DO NOT SCALE

EXTENT OF PROPOSED MAINTENANCE BUILDING, FFL 3.16 mAHD

TANK TOP RL.7.03

TANK TOP RL.7.02

CONCRETE APRON

METAL SHED RIDGE 5.47

CONTAINER

GRAVEL

STOCKPILE

SAND STOCKPILES

SAND STOCKPILE

BM PEG RL2.289 (AHD)

DISH DRAIN

CONTAINER

METAL AWNING RIDGE 6.61

METAL AWNING RIDGE 6.56

RAMP

VERANDAH

DEMOUNTABLE BUILDING METAL ROOF

METAL SHED

VEHICLE STORAGE METAL SHED RIDGE 5.35

AWNING

CONCRETE

GRAVEL

-1.5%

-5.0%

-1.0%

-4.0%

-1.65%

LOOSE / DAMAGED BRICKS & DEBRIS

ELECTRICAL KIOSK (A)

SWITCHBOARD

FENCE

FOOTPATH

KERB

BITUMEN

DISH DRAIN

ISLAND

ROAD

KENNETH ROAD

BALGOWLAH ROAD

2H HIGH CONCRETE BARBED WIRE FENCE

REV	DATE	DESCRIPTION	BY	CHK	APP
A	X.02.2020	ISSUED FOR INFORMATION	E.OZ.	TM	-

REVISIONS

CLIENT

MANLY GOLF CLUB

PROJECT

MANLY GOLF CLUB
MAINTENANCE FACILITY
RENEWAL

TITLE

VEHICLE TRACKING
MOVEMENT OUT

Level 14, 56 Berry Street
North Sydney NSW 2060
Australia
Tel +61 2 88545000
Fax +61 2 99290960
Email: project.admin.australia@rhdhv.com
Website: www.royalhaskoningdhv.com

Royal HaskoningDHV
Enhancing Society Together

DRAWN	COORD. SYSTEM	DATUM	DATE
EOZ	MGA ZONE 56	AHD	05.03.2020
SCALE	REF		
AT A1	PA1966-RHD-00-M3-WA-CIVIL MODEL		

DRAWING No. PA1966-RHD-00-C-1032 REVISION A

DIAL BEFORE YOU DIG www.1100.com.au

AUSTRALIAN HEIGHT DATUM

NOT FOR CONSTRUCTION

S2 FOR INFORMATION

4 0 4 8 12 16 20m

1:400 (A3) 1:200 (A1)

C:\USERS\220113\BOX\PA1966 RL MANLY GC - FLOOD MGMT REPORT\PA1966 RL MANLY GC TEAM\PA1966 TECHNICAL DATA\E11 WORKING DRAWINGS\PA1966-RHD-00-M3-WA-CIVIL MODEL