DOLTONE HOUSE PTY LTD

Planning Proposal for
30-31 Webster Street, Milperra

Supplementary Report on Flood Risk Management

Rev A

March 2025

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Project No. 311015-00738

Planning Proposal for 30-31 Webster Street, Milperra

Supplementary Report on Flood Risk Management

Rev	Description	Author(s)	Reviewer	Approver	Revision Date
A	Final Report	LT L To	CRT C Thomas	Chris Thomas	13-03-2025

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1. Introduction

Doltone House Group Pty Ltd (Doltone House) has approval for redevelopment of the site known as 30-31 Webster Street, Milperra. The site is currently zoned *RE2 Private Recreation* under the Canterbury-Bankstown Local Environmental Plan 2023 (CB LEP 2023). Doltone House has submitted a planning proposal to list "function centres" as an additional permitted use (APU) type for the site, which Council has incorporated into a broader Planning Proposal for several sites in the LGA for a range of APUs.

The site is located within the Canterbury Bankstown Local Government Area (LGA). It covers an area of about 4.1 hectares and comprises part Lot A in Deposited Plan (DP) 405225 and Lot D in DP 391154. It is located on the eastern bank of the Georges River and is situated approximately 500 metres downstream from the M5 Motorway crossing of the river (refer Figure 1-1). The Deepwater Motor Boat Club is currently located on the site.

Figure 1-1 Location of Doltone House site at 30-31 Webster Street, Milperra

Flooding at the site has previously been assessed and the findings documented in a report titled, *'Redevelopment of Deepwater Motorboat Club Site, Milperra; Flood Impact Assessment & Flood Emergency Response Plan'* (WorleyParsons, March 2014). The findings of the WorleyParsons Report are based on flood modelling outcomes from the *'Georges River Floodplain Risk Management Study & Plan'* (Bewsher Consulting, 2004). The 2004 study was based on the results of flood modelling undertaken using a MIKE-11 hydraulic model of a 46-kilometre section of the Georges River extending from Macquarie Fields to Botany Bay.

An array of flood-related guideline and policy documents have been released since the completion of the WorleyParsons report in 2014. This includes publication of a report documenting conclusions and recommendations from the 2022 NSW Flood Inquiry and the publication of the NSW *Flood Risk Management Manual* in 2023 which replaced the NSW *Floodplain Development Manual* (*2005*).

The 2022 NSW Flood Inquiry was published in response to the NSW Government's concerns about the disastrous floods which occurred at a range of locations. Several of the major flood events involved record-breaking rainfalls and resulted in river peaks that were significantly higher than previous records (NSW Government, 2022). The most significant events were:

- the south-east Queensland and northern NSW floods of February and March 2022;
- the Hunter and greater Sydney floods of July 2022; and,
- the central west NSW floods of November and December 2022.

The inquiry found several areas where failures occurred in the flood response and made 28 recommendations for change, which it said were "intended to provide practical, proactive and sustained mechanisms to ensure readiness for and resilience" ahead of future floods. Notwithstanding, only a small number of these recommendations relates to planning and those that do are largely covered by existing procedures and industry best practice.

The NSW Flood Risk Management Manual (FRMM) was published on 30 June 2023 and replaces the NSW Floodplain Development Manual (April 2005) (FDM). The FDM had been the longstanding guideline for the management of flood liable land gazetted for the purposes of section 733 of the Local Government Act 1993 (LG Act). Section 733(1) of the LG Act exempts councils from liability in respect of advice furnished, or anything done or omitted to be done in good faith, relating to the likelihood of any land being flooded or the nature or extent of any such flooding.

The FRMM is a strategic management document which provides councils with a framework for implementing the NSW Government's *Flood Prone Land Policy* (the Policy). The primary objective of the Policy *'is to reduce the impacts of flooding and flood liability on communities and individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible."*

Consistent with the FDM, the FRMM is primarily concerned with the implementation of this policy and provides guidance to councils on the selection of the flood planning level. Both manuals recognise that it is the role of each council to select appropriate flood planning levels and both manuals provide for a merit-based approach for achieving this. Consistent with the FDM, the FRMM also outlines the process for formulation and implementation of flood risk management plans.

Therefore, the FRMM, like the FDM before it, does not outline a set of controls against which individual development applications are to be assessed. Instead, the development controls that should be applied are those contained within the Canterbury-Bankstown DCP 2024 (CB DCP 2024).

The 2023 *Flood Risk Management Manual* (FRMM) provides a more comprehensive flood risk management framework than its predecessor, which integrates both flood risk management plans and processes, emphasising a strategic approach to managing flood risk, including consideration of climate change, and requiring councils to actively consider flood behaviour and potential risk variations across different flood events, rather than solely focusing on a single flood planning level.

Based on a review of relevant sections of the CB DCP 2024, the flood related controls that apply to the site at 30-31 Webster Street, Milperra, are materially the same as those that applied at the time the flood impact assessment for the original DA for the site was lodged with the former Bankstown City Council (refer

Schedule 3 of the CB DCP 2024). Accordingly, it follows that the existing flood impact assessment for the proposed development at 30-31 Webster Street, Milperra, addresses the requirements of the current planning instrument, namely the CB DCP 2024, and therefore is not in need of updating.

However, it is recognised that the existing CB LEP is silent on the suitability of “function centres” as a permitted use of the land at 30-31 Webster Street, Milperra. Therefore, Doltone House has engaged Worley Consulting (previously WorleyParsons) to prepare a report which addresses the suitability and how the outcomes / requirements of the 2022 NSW Flood Inquiry and the 2023 NSW Flood Risk Management Manual would be incorporated for future development applications at the subject site.

This report is prepared as a supplementary report to be read in conjunction with the 2014 WorleyParsons Flood Impact Assessment (FIA) and Flood Emergency Response Plan (FERP).

2. Planning Proposal

The site at 30-31 Webster Street Milperra is currently zoned *RE2 Private Recreation* under the Canterbury Bankstown Local Environmental Plan 2023 (CB LEP 2023). The land uses which are permitted with consent on land zoned as RE2 within the CB LEP 2023 currently include the following:

- Aquaculture
- Building identification signs
- Business identification signs
- Car parks
- Community facilities
- Early education and care facilities
- Environmental facilities
- Environmental protection works
- Flood mitigation works
- Kiosks
- Recreation areas
- Recreation facilities (indoor)
- Recreation facilities (major)
- Recreation facilities (outdoor)
- Registered clubs
- Respite day centres
- Restaurants or cafes
- Roads

This a planning proposal which would list ‘function centres’ as an additional permitted land use for the RE2 zoning only for 30-31 Webster Street, Milperra (the Site).

The land zoning in the vicinity of the Site is shown in Figure 2-1.

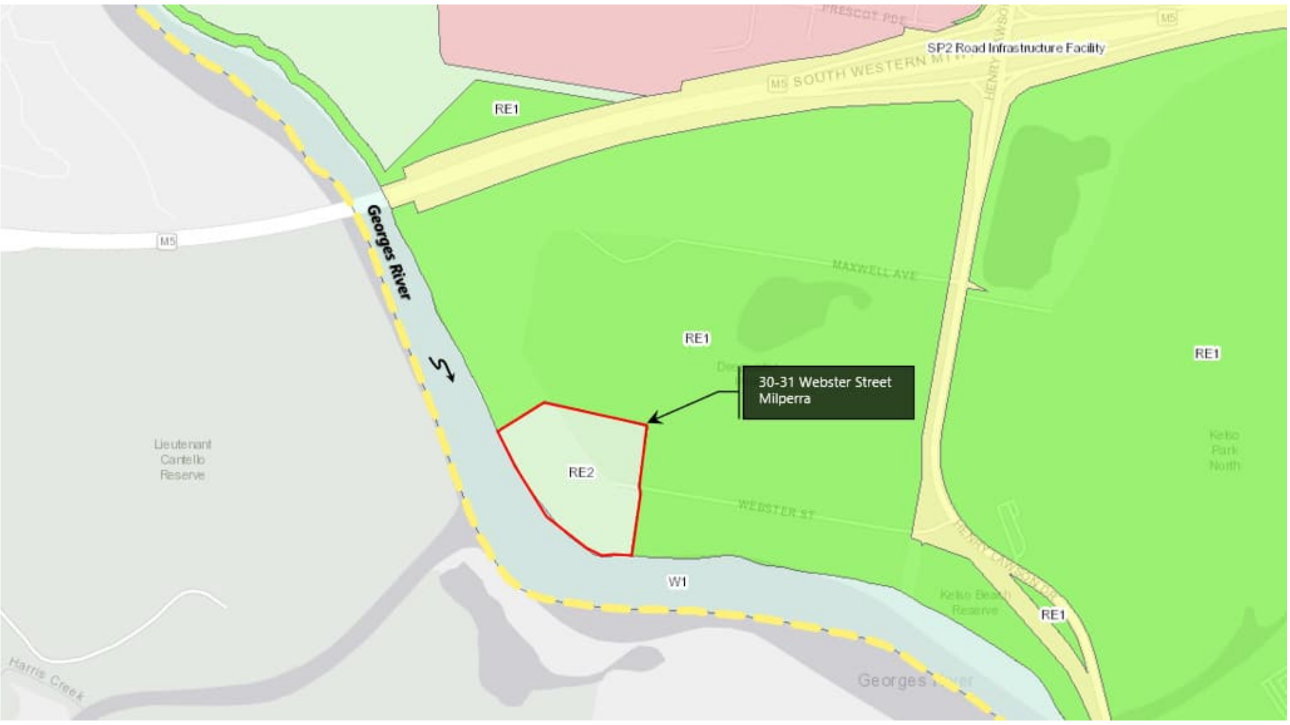

Figure 2-1 CB LEP 2023 Zoning for land adjoining 30-31 Webster Street, Milperra

3. Flood Characteristics at the Site

3.1 Previous Valley Wide Flood Studies

3.1.1 Georges River Flood Study (1991)

Flood characteristics and flow behaviour along the Georges River have been defined and documented as part of the '*Georges River Flood Study*', which was published by the NSW Department of Public Works in 1991. The Flood Study was prepared in response to the major flooding of the Georges River that occurred in August 1986 and April 1988. It was based on the results of physical modelling that had been undertaken in the 1980s and documents design flood levels for that section of the Georges River between Liverpool and East Hills.

Peak flood levels for the 5%, 2% and 1% Annual Exceedance Probability (AEP) events and the Probable Maximum Flood (PMF) have been extracted from the 1991 Flood Study for the section of the Georges River that adjoins 30-31 Webster Street. These levels are documented in a report prepared by FloodMit Pty Ltd (FloodMit), who were engaged by Bankstown City Council in 2012 to investigate the potential impact of climate change on flood levels within the Georges River. The design peak flood levels and some additional levels documented in the FloodMit report are listed in Table 3-1.

Table 3-1 Design Flood Levels in the vicinity of 30-31 Webster Street

Design Event (AEP)	Peak Flood Level (mAHD)
Highest Annual Tide	1.1*
20%	2.4*
5%	4.2 (PWD, 1991)
2%	4.7 (PWD, 1991)
1%	5.1 (PWD, 1991)
PMF	10.3 (PWD, 1991)

* *Flood data contained in FloodMit Report dated March 2012*

3.1.2 Georges River Floodplain Risk Management Study and Plan (2004)

In 2004, Bankstown City Council published the '*Georges River Floodplain Risk Management Study & Plan'*, which was prepared by Bewsher Consulting. A MIKE-11 hydraulic model was developed as part of the study and covers a 46-kilometre section of the Georges River extending from Macquarie Fields to Botany Bay. The model was used to verify results derived from the previous flood study and to test the impact of development and other works that had occurred on the floodplain over the period from the mid-1980s to the early 2000s. The flood model also provided additional information on flood characteristics, including flow rates and flow velocity data.

The 1991 Flood Study and the 2004 Floodplain Risk Management Study & Plan were completed in accordance with rainfall data and methods outlined in *Australian Rainfall and Runoff 1987* (ARR 1987).

3.1.3 Georges River Flood Study (2020)

In 2020, Canterbury-Bankstown Council and Liverpool City Council published an updated flood study for the Georges River. This update was triggered by moderate flooding in the upper valley in June 2016 and updated design rainfall data and flood estimation procedures outlined in an updated edition of *Australian Rainfall and Runoff* that was published in 2019 (ARR 2019). The updated flood study involved development and application of a new TUFLOW hydrodynamic model of the river and its floodplain which was based on improved topographic definition of the floodplain.

The 2020 Flood Study documented the results of a comparison of design flows in the Georges River derived from the 1991 Flood Study, application of design rainfall data and procedures detailed in ARR 1987 and ARR 2019, and a flood frequency analysis of water level records at Liverpool Weir. The 2020 Flood Study found that the adoption of ARR 2019 techniques generated design flow estimates which are about 30% lower than those derived by the application of other methods.

In order to ensure a conservative approach to flood estimation for the valley, the Councils adopted the peak flows determined as part of the 1991 Flood Study and recommended that the ARR 2019 rainfall data and flood estimation techniques be incorporated as part of future floodplain risk management studies for the Georges River.

The results presented in the 2020 Flood Study indicate that the adoption of peak flow estimates from the 1991 Flood Study typically resulted in peak flood level differences of +/- 0.2 metres for the 5% and 1% AEP events, which was considered to be reasonable given the use of a new flood modelling software (TUFLOW) which incorporated updated and more detailed topographic data.

However, modelled peak flood levels for the PMF in the 2020 Flood Study were found to be up to 1.4 metres higher than the corresponding flood levels from the 1991 Flood Study. These significant differences were attributed to major hydraulic losses occurring through tight meanders in the Georges River which had been captured by the 2D TUFLOW model in the 2020 Flood Study but not by the 1D MIKE-11 model which had been used for the 1991 Flood Study.

It is understood that the 2020 Flood Study has not been adopted by Council as of February 2025.

3.2 Flood Characteristics

3.2.1 Flood Hazard

Flood hazard provides a measure of the potential risk to life, well-being and property posed by a flood.

Figure 3-1 presents a set of curves which classify hazard based on the vulnerability of people, vehicles and buildings to various flood depth and velocity thresholds. The hazard curves were developed based on laboratory testing in 2014 (Smith et al.) and were subsequently published in Australian Disaster Resilience Guideline 7-3 Flood Hazard (AIDR 2017b) and in ARR 2019. As a result, these hazard classifications are known by various names. For the purposes of this report, they will be referred to as 'AIDR Flood Hazard'

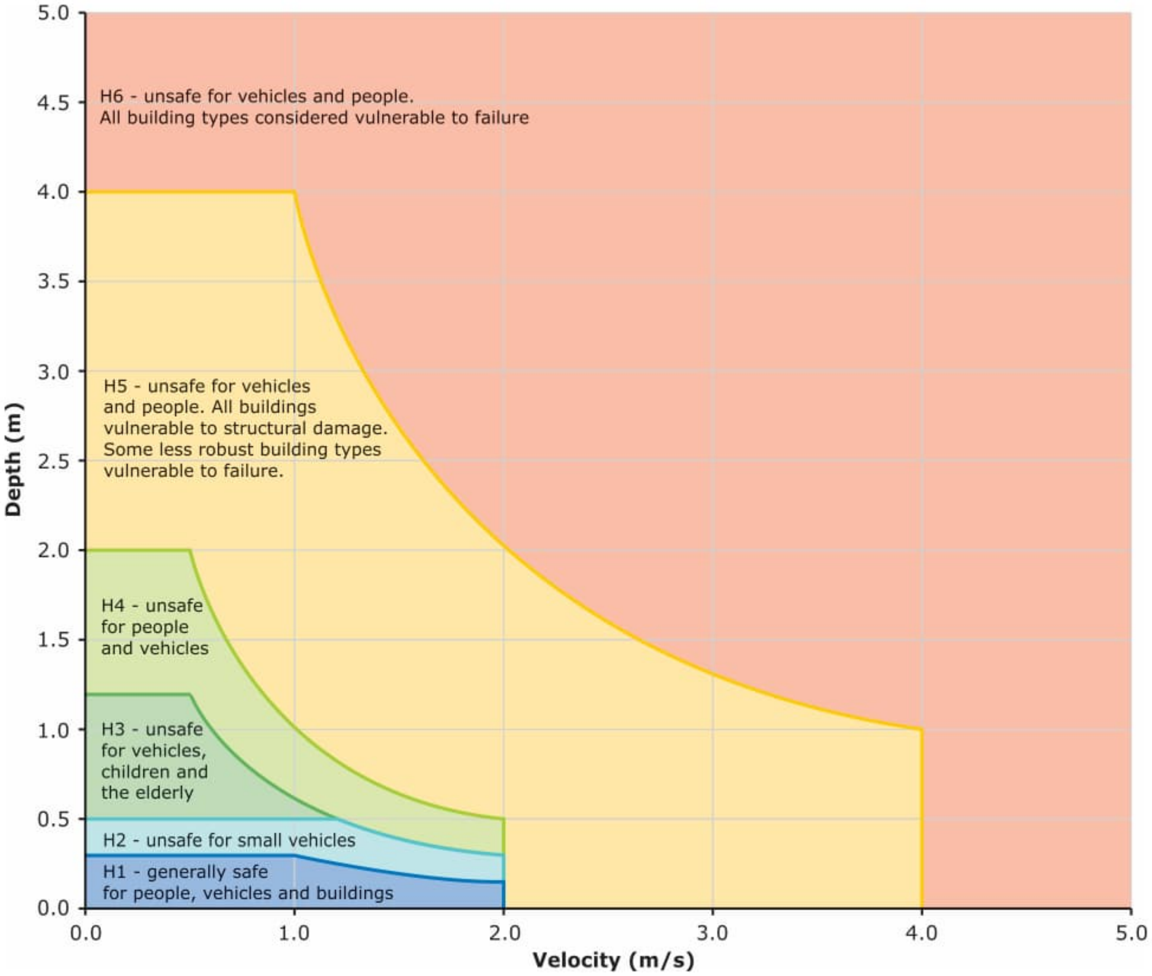

Figure 3-1 AIDR Flood Hazard Categories

AIDR flood hazard categories are not available from the 1991 Flood Study as this study pre-dates the release of the AIDR hazard curves. Notwithstanding, the AIDR flood hazard at the site can be estimated through an analysis of the peak flood depths and flow velocities.

The latest topographic data for the site was sourced from the online ELVIS project, which comprised a one metre resolution LiDAR grid which was captured in 2019. The 2019 LiDAR data indicates that ground levels vary across the site from about 3.3 mAHD at the northern property boundary to 1.5 mAHD at the top of the bank of the Georges River to the south. The majority of the site is located below 3.0 mAHD.

According to the 1991 Flood Study, the peak 1% AEP flood level at the site is expected to be 5.1 mAHD (refer Table 3-1). Given that the majority of the site is located below 3.0 mAHD, the depth of flooding at the site would typically be greater than 2.0 metres during the 1% AEP event.

In accordance with Figure 3-1 above, peak flood depths greater than 2.0 metres would correspond to an AIDR flood hazard category of at least H5, with the potential to rise to H6 if flow velocities exceed about 1.5 m/s.

As noted previously, the 2020 Flood Study 1% AEP peak flood level estimates are typically within +/- 0.2 metres of the 1991 Flood Study 1% AEP peak flood level estimates. Therefore, it is likely that the 1% AEP peak flood depths predicted by the 2020 Flood Study at 30-31 Webster Street would be 2.0 metres and greater. Accordingly, the flood hazard category at the subject site would be H5 to H6.

3.3 Climate Change Considerations

3.3.1 Sea Level Rise

In 2012, Bankstown City Council engaged FloodMit Pty Ltd (FloodMit) to investigate the potential impact of climate change on flood levels within the Georges River. The FloodMit assessment analysed planning benchmarks of an increase above 1990 mean sea levels of 0.4 metres by 2050 and 0.9 metres by 2100. These sea level rise planning benchmarks align with '*NSW Coastal Planning Guideline: Adapting to Sea Level Rise*' (NSW Department of Planning, 2010).

The draft findings from that investigation are taken from a report prepared by FloodMit and are summarised in Table 3-2. This data shows that the impact of the projected sea level rise (SLR) planning benchmarks is not that significant when applied to large floods.

Table 3-2 Impacts of Climate Change at 30-31 Webster Street (*source: FloodMit, 2012)*

Assessment Condition	1% AEP Flood Level (mAHD)	Highest Astronomic Tide (mAHD)
Existing Conditions	5.10	1.1
2050 SLR benchmark (+0.40)	5.15	1.5
2100 SLR benchmark (+0.90)	5.24	2.0
2100 SLR benchmark plus 10% increase in design rainfall intensity	5.63	N/A

Since the completion of the FloodMit assessment in 2012, new sea level rise projections were released in the Intergovernmental Panel on Climate Change's *Sixth Assessment Report* (IPCC, 2023). New sea level rise projections were available for five Shared Socioeconomic Pathway (SSP) scenarios which adopted conditions during the period from 1995 to 2014 as baseline conditions.

The latest sea level rise projections for Sydney Harbour are summarised in Table 3-3 and also shown graphically in Figure 3-2 and Figure 3-3. These estimates were extracted from the NASA sea level projection tool which is based on the findings of IPCC 2023.

A comparison of the IPCC 2023 and the NSW Department of Planning 2010 estimates indicates that the projected sea level rises in Sydney Harbour are similar. For example, the NSW Department of Planning estimates (2010) predict an increase in sea levels of about 0.9 metres by the year 2100, whereas the IPCC 2023 data predicts an increase of 0.78 metres over the same timeframe under a high emissions scenario.

Therefore, the predicted sea level rise impacts at 30-31 Webster Street specified in the 2012 FloodMit report are still considered valid. Accordingly, peak 1% AEP flood levels at 30-31 Webster Street are expected to increase in accordance with the predictions outlined in the 2012 FloodMit Report (sea level increases of 0.05 metres and 0.14 metres by 2070 and 2100, respectively).

Table 3-3 Summary of latest SLR projections in Sydney Harbour (*source: IPCC, 2023*)

SSP	Description	2070 Projection	2100 Projection
SSP2-4.5	"Middle of the road" scenario. CO_2 emissions hover around current levels before starting to fall around 2050, but do not reach net-zero by 2100. Socioeconomic factors follow their historic trends with no notable shifts. Progress toward sustainability is slow, with development and income growing unevenly. Temperatures rise by 2.7°C by 2100.	+0.32 m	+0.53 m
SSP5-8.5	"High emissions" scenario. Current CO_2 emissions approximately double by 2050. The global economy grows quickly, but this growth is fueled by exploiting fossil fuels and energy-intensive lifestyles. Average global temperatures increase by 4.4°C by 2100	+0.41 m	+0.78 m

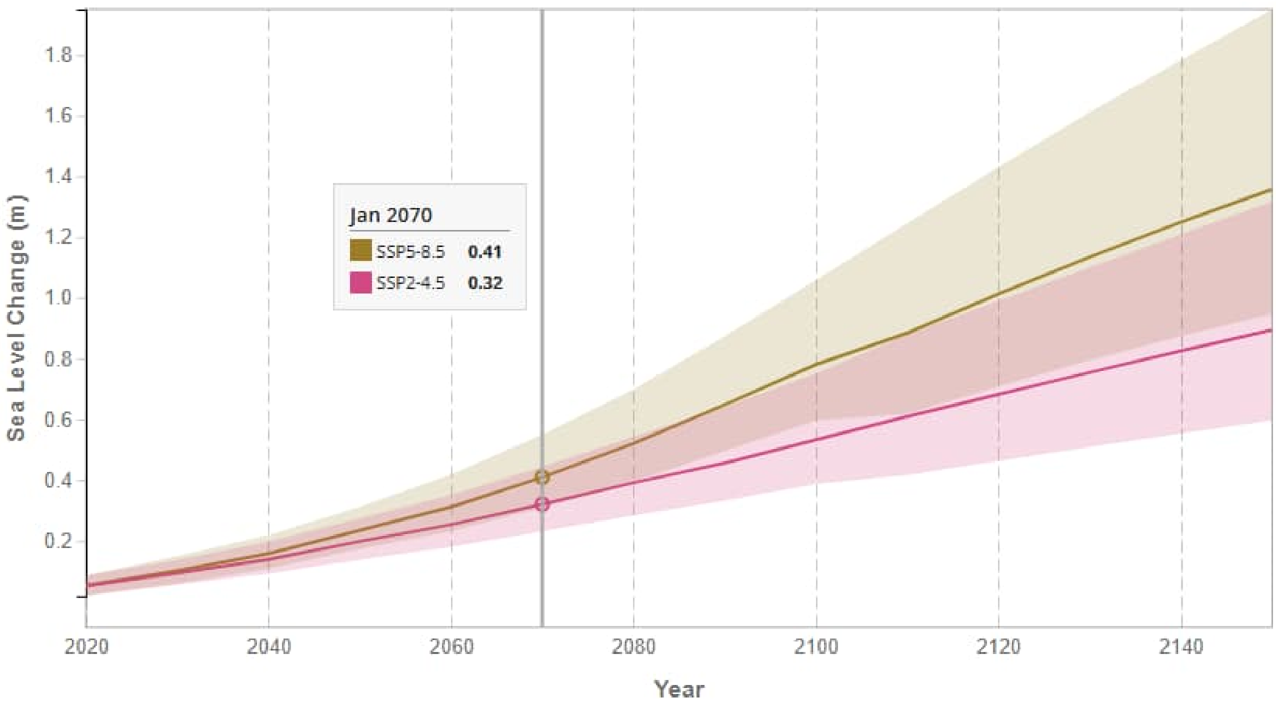

Figure 3-2 Sea Level Rise Projection for Sydney Harbour to 2070
(*source: NASA Sea Level Projection Tool*)

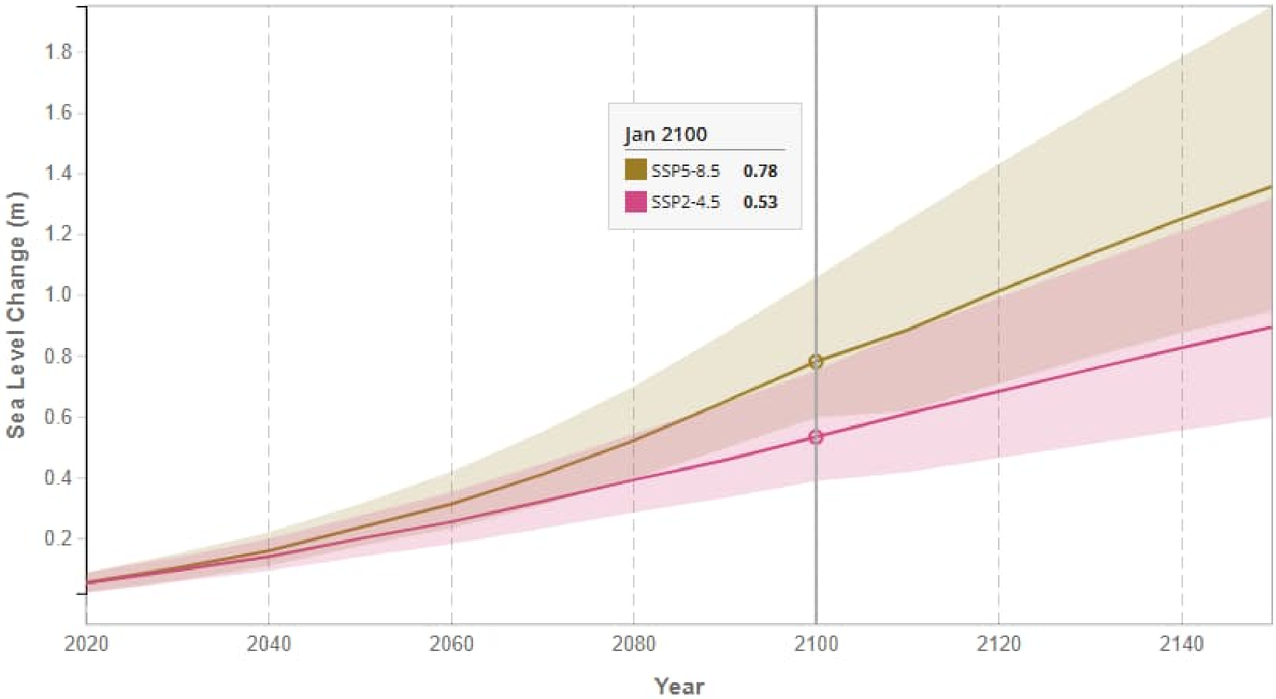

Figure 3-3 Sea Level Rise Projection for Sydney Harbour to 2100
(*source: NASA Sea Level Projection Tool*)

3.3.2 Rainfall Intensity Increase

Current guidance on the impact that climate change is projected to have on rainfall intensities is detailed in the Climate Change Considerations chapter of *Australian Rainfall and Runoff 2019* (Book 1 Chapter 6) which was published by Geoscience Australia. This chapter of ARR 2019 was updated on 27 August 2024 to include additional guidance prepared by Wasko et al (2024) and which is aligned with the latest relevant science (IPCC 2023). The guidance includes new estimates of increased rainfall intensity under a range of climate change scenarios which are typically higher than those presented in the original chapter.

Under this new guidance, rainfall intensity for the Georges River catchment is projected to increase by the following:

- SSP2-4.5: rainfall intensity to increase by about 20%
- SSP5-8.5: rainfall intensity to increase by about 37%.

The 2012 FloodMit report only assessed a 10% increase in rainfall intensity.

Accordingly, any future flood investigations of the site should investigate the impacts of greater increases in rainfall intensity as part of a climate change analysis to align with the recent ARR 2019 climate change updates.

4. Requirements for Future Development

4.1 Introduction

Future developments at 30-31 Webster Street, Milperra, including proposals involving function centres, would need to comply with the requirements of the Canterbury-Bankstown Local Environmental Plan 2023 (CB LEP 2023) and the Canterbury-Bankstown Development Control Plan (CB DCP 2023).

Additionally, potential developments at the site would also be required to align with guidelines that accompany the NSW *Flood Risk Management Manual* (DPE, 2023) and incorporate relevant recommendations from the 2022 NSW Flood Inquiry.

Flood-related requirements from the aforementioned documents are summarised in the following sections.

4.2 Flood Related Controls for Development

4.2.1 Canterbury-Bankstown Local Environmental Plan 2023

The CB LEP 2023 is the statutory planning instrument that establishes the permissible and/or prohibited forms of development and land use within the Canterbury-Bankstown LGA.

Flood planning is addressed in Clause 5.21, as reproduced below.

Clause 5.21 applies to "*land the consent authority considers to be within the flood planning area (FPA)*", where "*flood planning area has the same meaning as it has in the Flood Risk Management Manual*".

The Manual (2023) defines the flood planning area as "*the area of land below the flood planning level (FPL), generally developed based on the FPL for typical residential development. Different types of development may have different FPLs applied within the FPA. In addition, development controls will vary across the FPA due to varying flood constraints.*"

The specifics of Clause 5.21 are listed overleaf.

It is noted that the dictionary within the CB LEP 2023 does not define the Flood Planning Level (FPL). However, the FPL is typically nominated as the peak 1% AEP flood level plus a freeboard of 500 mm. Given that the entire site at 30-31 Webster Street is inundated during the 1% AEP event, the provisions of Clause 5.21 would be applicable to any potential developments at the site.

The NSW Government's revised flood-prone land package released on 14 July 2021 included the option for councils to adopt the "5.22 Special flood considerations" clause in their LEP. The clause would allow development controls to apply on land "*between the flood planning area and the probable maximum flood*" where the development is "*sensitive or hazardous*" and in areas where there is a particular risk to life or where evacuation is required.

Canterbury-Bankstown Council has not adopted Clause 5.22.

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 flood function and behaviour on the land, taking into account projected changes as a result of climate change,*
   c. *to avoid adverse or cumulative impacts on flood behaviour and the environment,*
   d. *to enable the safe occupation and efficient evacuation of people in the event of a flood.*
2) *Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development—*
   a. *is compatible with the flood function and behaviour on the land, and*
   b. *will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and*
   c. *will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and*
   d. *incorporates appropriate measures to manage risk to life in the event of a flood, and*
   e. *will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.*
3) *In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters—*
   a. *the impact of the development on projected changes to flood behaviour as a result of climate change,*
   b. *the intended design and scale of buildings resulting from the development,*
   c. *whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood,*
   d. *the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.*
4) *A word or expression used in this clause has the same meaning as it has in the Considering Flooding in Land Use Planning Guideline unless it is otherwise defined in this clause.*
5) *In this clause—*
   a. *Considering Flooding in Land Use Planning Guideline means the Considering Flooding in Land Use Planning Guideline published on the Department's website on 14 July 2021.*
   b. *flood planning area has the same meaning as it has in the Flood Risk Management Manual.*
   c. *Flood Risk Management Manual means the Flood Risk Management Manual, (ISBN 978-1-923076-17-4), published by the NSW Government in June 2023.*

4.2.2 Canterbury-Bankstown Development Control Plan 2023

The CB DCP 2023 sets the standards, controls and regulations that apply when carrying out development within the Canterbury-Bankstown LGA. These specific controls in the DCP support the broader conditions of the CB LEP 2023 and state-wide policies.

'Chapter 2.2: Flood Risk Management' provides Council's requirements for development upon flood prone land and land below the flood planning level, and has the following objectives:

1. To reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods
2. To control development and other activity within each of the individual floodplains in Canterbury-Bankstown having regard to the characteristic and level of information available for each of the floodplains
3. To assess applications for development on land that could be flood affected in accordance with the principles included in the Flood Risk Management Manual, issued by the NSW Government
4. To apply a 'merit-based approach' to all development decisions which takes account of social, economic and environmental as well as flooding considerations in accordance with the principles contained in the Flood Risk Management Manual

Section 2 of 'Chapter 2.2: Flood Risk Management' provides prescriptive criteria for determining applications for proposal which could potentially be affected by flooding. The criteria varies in recognition that different controls are applicable to different land uses and levels of potential flood inundation and hazard.

Council has adopted eight major land use categories which are identified as:

- Critical uses and facilities
- Sensitive uses and facilities
- Subdivision
- Residential
- Commercial / Industrial
- Tourist related development
- Recreation or non-urban uses
- Concessional development

The CB DCP 2023 also adopts three flood risk precincts as follows:

- High Flood Risk Precinct: areas of land below the 100-year (1% AEP) flood that is either subject to a high hydraulic hazard or where there are significant evacuation difficulties. Most development should be restricted in this precinct as development in high flood risk precincts is associated with higher risk to life and evacuation difficulties during the event of flood. In this precinct, there would be significant risk of flood damages without compliance with flood related building and planning controls.

- Medium Flood Risk Precinct: areas of land below the 100-year (1% AEP) flood that is not subject to a high hydraulic hazard and where there are no significant evacuation difficulties. There would still be a significant risk of flood damage in this precinct. However, these damages can be minimised by the application of appropriate development controls.

- Low Flood Risk Precinct: all other land within the floodplain (within the extent of the Probable Maximum Flood) but not identified within either the High Flood Risk or Medium Flood Risk Precinct. The risk of damages due to flood event in low flood risk precincts is low for most of the land uses.

As noted in Section 3.2, the AIDR flood hazard category at 30-31 Webster Street is expected to be H5 or H6, which is considered high hydraulic hazards. Therefore, the site at 30-31 Webster Street would be considered a High Flood Risk Precinct.

Schedule 3 of the Chapter 2.2 of the CB DCP 2023 specifies that six of the eight land use types adopted by Council would be considered as ‘Potentially Unsuitable Land Uses’ in a High Flood Risk Precinct in the Georges River floodplain (refer Figure 4-1). The land use types of ‘Recreation & Non-Urban’ and ‘Concessional Development’ could be permitted in High Flood Risk Precincts but would be subject to controls relating to floor level, building components, building method, structural soundness, flood effects, car parking, driveway access, evacuation, management and design.

	Flood Risk Precincts															
	Medium Flood Risk								High Flood Risk							
	Critical Uses & Facilities	Sensitive Uses & Facilities	Subdivision	Residential	Commercial & Industrial	Tourist Related Development	Recreation & Non-Urban	Concessional Development	Critical Uses & Facilities	Sensitive Uses & Facilities	Subdivision	Residential	Commercial & Industrial	Tourist Related Development	Recreation & Non-Urban	Concessional Development
				2,6,7	5,6,7	2,6,7	1,6	4,7							1,6	4,7
				1	1	1	1	1							1	1
				1	1	1	1	1							1	1
			1	2	2	2	2	2							1	1
				1,3,5,6,7	1,3,5,6,7	1,3,5,6,7	2,4,6,7	6,7,8							2,4,6,7	6,7,8
			6	2,3	1,3	2,3	4,3	2,3							4,3	2,3
			1		2,3,5	2,3,5	2,3,5	2,3,5							2,3,5	2,3,5

COLOUR LEGEND: Not Relevant Potentially Unsuitable Land Use

Figure 4-1 Extract from Schedule 3 of Chapter 2.2 in CB DCP 2023

4.2.3 NSW Flood Risk Management Manual 2023

Background

The Flood Risk Management Manual (DPE, 2023) updates the Floodplain Development Manual (2005) and several of the existing technical guides. Similar to the 2005 Manual, the 2023 Flood Risk Management Manual guides the implementation of the NSW Flood Prone Land Policy in the floodplain risk management process. It aims to reduce the impacts of flooding and flood liability on individual owners and occupiers of flood prone property and to reduce private and public losses resulting from floods.

The Manual outlines a merit-based framework to assist with floodplain risk management. It confirms that responsibility for management of flood risk remains with local government and provides guidance for councils in the development and implementation of local floodplain risk management plans.

Importantly, the 2023 Manual considers lessons learnt from floods and the application of the flood risk management process since 2005.

Criteria for Assessing Future Development Proposals

In accordance with the 2023 Manual, proposed developments within the floodplain would require consideration of the floodplain risk management guides which accompany the Manual. These guides provide additional technical information to councils and consultants to support floodplain risk management processes, including:

- AG01 Administration Arrangements;
- FG01 Delivery under the flood risk management framework
- FB01 Understanding and Managing Flood Risk;
- FB02 Flood Function;
- FB03 Flood Hazard;
- MM01 Flood Risk Management Measures;
- EM01 Support for Emergency Management Planning;
- LU01 Flood Impact and Risk Assessment.

In particular, the LU01 guideline (Flood Impact and Risk Assessment) identifies typical modelling and assessment considerations and processes to identify, assess and management potential flood risks due to a development proposal.

A consent authority (such as Council) may require a FIRA to support an application under Part 4 Development Assessment and Consent of the *Environmental Planning and Assessment Act 1979* (EP&A Act). A FIRA may also be undertaken to support an activity under Part 5 of the EP&A Act where the activity is affected by flooding. A FIRA is also likely to be required where it is anticipated a proposed development could change flood behaviour, affect flood risk to the existing community or expose its users to flood risks that require management.

Given that the site at 30-31 Webster Street is flood affected, a FIRA would be required in support of any potential future developments at the site. The typical scope of work for a FIRA is detailed in Appendix A of the LU01 guidelines. In summary, a FIRA should comprise the following:

a. Introduction – background, project context, FIRA requirements.

b. Background – study area, known flood behaviour, flood history, emergency management.

c. Available information – previous studies, relevant legislation, historic data, hydrometric data, site observations, survey data and GIS data.

d. Flood-related requirements – requirements of the consent authority, relevant legislation, scale of assessment, identify compatibility or deviation from existing FRM plans.

e. Pre-developed modelling and analysis – description of existing flood behaviour and modelling methodology.

f. Post-developed modelling and analysis – description of post-development flood behaviour and modelling methodology, flood impacts of proposed development.

g. Key risks to be managed – proposed management measures, effectiveness and limitations, residual risks.

h. Conclusions and recommendations.

i. References and appendices.

4.2.4 2022 NSW Flood Inquiry Report

Background

In recent years, NSW has experienced several major flood events in March 2021, February-March 2022 and July 2022. Disaster was declared across 98 Local Government Areas from the Northern Rivers region down to the Illawarra. Almost 15,000 homes were damaged with over 5,000 rendered uninhabitable. In particular, the February-March 2022 floods were the costliest in Australian history with claims totalling $5.1 billion in insured damages.

In response, the NSW Premier established the NSW Flood Inquiry to understand the events of the 2022 flooding and the effective and ineffective response measures which were employed during this event. The Inquiry provided 28 recommendations in light of key findings and themes which emerged from an analysis of the recent flood events.

Some of the recommendations which are applicable to developments in the floodplain are summarised in the following.

Principles for Future Development

Recommendation 18 from the NSW Flood Inquiry Report centres on the adoption of a risk-based approach in setting Flood Planning Levels (FPL). It recommends that councils and planning authorities consider design flood events rarer than the 1% AEP flood when setting a risk-based FPL, which should also consider the PMF, the 1 in 5000 AEP event, existing development, approved but not yet constructed developments, existing evacuation routes and approved but not yet constructed evacuation routes.

Recommendation 19 discusses potential actions to implement disaster adaptation plans for all towns. This includes a recommendation for the inclusion of evacuation routes which are available and of sufficient capacity for developments which are in "disaster-likely" areas, educating the community on the risk and providing instructions on how and when to evacuate.

Based on application of the classification system outlined in the CB DCP 2023, the site at 30-31 Webster Street, Milperra, is located in a High Flood Risk Precinct. Therefore, in order to align with the outcomes from the 2022 Flood Inquiry, potential future developments at 30-31 Webster Street should include analysis of the following items as part of any FIRA that is prepared for future development of the site.

- Feasibility of adopting a higher FPL.
- Available warning times for personnel to respond to a flood emergency.
- Potential evacuation routes to land above the peak PMF level.
- Time to inundation for potential evacuation routes, with particular attention to any low points along the route which may be cut off.
- Documentation of the above analysis in a Flood Emergency Response Plan.

5. Conclusions

This planning proposal aims to list "function centres" as an additional permitted use type for the site at 30-31 Webster Street, Milperra. The site is currently zoned *RE2 Private Recreation* under the Canterbury-Bankstown Local Environmental Plan 2023 (CB LEP 2023).

The site is located on the eastern bank of the Georges River. Flood behaviour along the Georges River has previously been assessed in the following studies:

- Georges River Flood Study (NSW Department of Public Works, 1991)
- Georges River Floodplain Risk Management Study and Plan (Bewsher Consulting, 2004)
- Georges River Flood Study (BMT, 2020)

These previous studies have identified that the site at 30-31 Webster Street is affected by high flood depths typically in excess of 2 metres during the 1% Annual Exceedance Probability (AEP) event. This corresponds to AIDR flood hazard categories of H5 and H6, meaning that the site is affected by high flood hazard and is considered to be a High Flood Risk Precinct as defined in the Canterbury-Bankstown Development Control Plan 2023 (CB DCP 2023).

A number of recent guidelines have been released which provide updated advice and provisions to be considered in floodplain risk management practice in NSW. These guidelines account for updated hydrologic data, advances in modelling techniques as well as lessons learnt from significant flood events which have occurred in the past 20 years. These guidelines include:

- Australian Rainfall and Runoff 2019, including the 2024 update to the Climate Change Considerations Chapter (Book 1 Chapter 6).
- NSW Flood Risk Management Manual and associated guideline documents (Department of Planning and Environment, 2023);
- NSW Flood Inquiry (State of NSW, 2022);
- Sixth Assessment Report on Climate Change 2023 (IPCC, 2023).

Any future developments at 30-31 Webster Street, including any proposed function centres, should address the following flood-related issues in accordance with Canterbury-Bankstown Council's planning instruments and the guidance outlined in the documents listed above.

a. Completion of a flood impact and risk assessment (FIRA) in accordance with guideline document LU01 which was released as part of the NSW Flood Risk Management Manual (DPE, 2023) and incorporating a flood emergency response plan (FERP).

b. Assessment of flood behaviour for the 1 in 5000 AEP event, or a suitable alternative such as the 1 in 2000 AEP event, in addition to other standard design events such as the 1% AEP event and the Probable Maximum Flood (PMF) in accordance with Recommendation 18 of the 2022 NSW Flood Inquiry Report.

c. Assessment of sea level rise and rainfall intensity increases in accordance with the projections in IPCC 2023 and the 2024 update to ARR 2019, which could comprise rainfall intensity increases of up to 37% for the Georges River catchment for a high emissions scenario.

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Redevelopment of Deepwater Motorboat Club Site, Milperra

Flood Impact Assessment & Flood Emergency Response Plan

Issue No. 2

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Water & Environment

Level 12, 141 Walker Street
North Sydney 2060 Australia
Tel: +61 2 8923 6866
Fax: +61 2 8923 6877
www.worleyparsons.com
WorleyParsons Services Pty Ltd
ABN 61 001 279 812

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DOLTONE HOUSE GROUP

DOLTONE HOUSE DEEPWATER, MILPERRA
FLOOD IMPACT ASSESSMENT AND FLOOD EMERGENCY RESPONSE PLAN

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Project 301015-02379 - REDEVELOPMENT OF DEEPWATER MOTORBOAT CLUB SITE, MILPERRA

REV	DESCRIPTION	AUTHOR	REVIEWER	WORLEY-PARSONS APPROVAL	DATE
1	Draft Report for Internal Review	CRT / ARM	W Honour		10-03-2014
2	Issued for inclusion with Development Application	ARM / WJH	C Thomas	C Thomas	13-03-2014

CONTENTS

1. INTRODUCTION

Doltone House plans to redevelop the existing Deepwater Motor Boat Club site at Milperra (the Site). The proposed redevelopment will involve alterations and additions to the existing two storey clubhouse to include a 900 person function centre and conversion of the existing pool and associated pool building to a 112 seat restaurant/café with organic garden.

It is also proposed that a boat shed with small craft launching pontoon be incorporated into the development, along with several gazebos and landscaped gardens. The Deepwater Motor Boat Club will continue to operate out of an expanded and upgraded area at the ground level of the main building.

The development site is situated within the Bankstown City Council Local Government Area (LGA) and is known as 30 Webster Street, Milperra. The site covers an area of 4.08 ha and comprises part Lot A in Deposited Plan (DP) 405225 and Lot D in DP 391154. It is located on the eastern bank of the Georges River and is situated approximately 500 metres downstream from the South Western Motorway (M5) Bridge crossing of the Georges River (refer **Figure 1**).

The development site is susceptible to flooding due to the low lying elevation of the land and its proximity to the Georges River. Accordingly, any proposal to redevelop the site or expand existing facilities associated with the Deepwater Motor Boat Club, will need to consider the potential for the proposed redevelopment to impact on existing flood characteristics. Consideration will also need to be given to ensuring that any increase in flood risk that patrons of the proposed development may be exposed to can be mitigated or managed.

In recognition of these issues, Doltone House engaged WorleyParsons to undertake a range of flood related investigations aimed at establishing the potential impact that the proposed redevelopment may have on existing flood characteristics. The engagement also involves a flood risk assessment for the proposed usage of the site and the associated development of a flood emergency response management plan.

This report incorporates a Flood Impact Assessment for the proposed redevelopment. It also addresses the flood risk management issues associated with conversion of the existing development to a function centre and new restaurant, and includes a Flood Emergency Response Strategy that can be implemented to mitigate any risk to patrons during the onset of major Georges River floods.

2. FLOOD CHARACTERISTICS AT THE SITE

2.1 Historical Floods

Major flooding of the Georges River has occurred on numerous occasions since European settlement. In particular, records gathered at Liverpool Weir indicate that 7 major floods occurred between 1873 and 1900 (*Public Works, 1991*). The largest of these occurred in 1873 and reached an elevation of 10.5 mAHD at the Liverpool Weir Gauge, which is located near the Newbridge Road crossing of the Georges River and about 15 kilometres upstream of the Deepwater Motor Boat Club Site.

The largest flood in the last century occurred in February 1956. This flood reached an elevation of 8.3 mAHD at the Liverpool Weir Gauge. Since then, the two largest floods occurred in August 1986 and April 1988. These floods led to significant flooding of the Georges River as well as major flooding of nearby catchment drainage systems including South Creek (*WorleyParsons, 2014*).

In more recent times, flooding of the Georges River occurred in March 2012. This flood is considered to be relatively minor. However, the banks of the Georges River were overtopped and inundation of part of the Deepwater Motor Boat Club Site occurred. Data compiled by FloodMit Pty Ltd indicates that the March 2012 flood reached a peak level of 1.94 mAHD and inundated the entire length of Webster Street which serves as the primary access to the Site from Henry Lawson Drive.

2.2 Design Flood Characteristics

Flood characteristics and flow behaviour along the Georges River have been defined and documented as part of the *'Georges River Flood Study'*, which was published by the NSW Department of Public Works in 1991. The Flood Study was prepared in response to the major flooding of the Georges River that occurred in August 1986 and April 1988. It was based on the results of physical modelling that was undertaken in the 1980s and documents design flood levels for that section of the Georges River between Liverpool and East Hills.

Peak flood levels for the 5%, 2% and 1% annual exceedance probability (AEP) events and the Probable Maximum Flood (PMF) have been extracted from the 1991 Flood Study for the section the Georges River that adjoins the Deepwater Motor Boat Club Site. These peak flood levels and some additional levels documented in a report prepared by FloodMit Pty Ltd, are listed in **Table 2-1**.

In 2004, Bankstown City Council published the *'Georges River Floodplain Risk Management Study & Plan'*, which was prepared by Bewsher Consulting. A computer model of the Georges River, from Botany Bay to upstream of Liverpool, was established as part of the study. The model was used to verify results derived from the previous flood study and to test the impact of development and other works that have occurred on the floodplain since the mid 1980s. The computer model also provided additional information on flood behaviour, including flow rates, velocities and flood hazard information.

Table 2-1 Design Flood Levels in the vicinity of the Deepwater Motor Boat Club Site

DESIGN EVENT (AEP)	PEAK FLOOD LEVEL (mAHD)
Highest Annual Tide	1.1*
20%	2.4*
5%	4.2 (PWD, 1991)
2%	4.7 (PWD, 1991)
1%	5.1 (PWD, 1991)
PMF	10.3 (PWD, 1991)

* Flood data contained in FloodMit Report dated March 2012

Modelling undertaken as part of the Floodplain Risk Management Study was used to characterise the flood risk for areas of the Georges River floodplain. The flood risk categorisation documented in the Floodplain Risk Management Study Report has been used in *Bankstown Development Control Plan 2005* (*DCP 2005*). DCP 2005 characterises the Deepwater Motor Boat Club Site as a 'High flood risk precinct'.

Further flood related information is contained in a letter from FloodMit Pty Ltd to Bankstown City Council dated 29th March 2012. This letter is titled *'Proposed Development the Deepwater Motor Boat Club Site by Doltone House, Review of Floodplain Management Issues'*, and was prepared following a peer review of the Flood Impact Assessment Report that was lodged with a Development Application for an earlier development proposal for the Deepwater Site.

3. STATUTORY AND DEVELOPMENT CONTROL REQUIREMENTS

The Deepwater Motor Boat Club site is zoned **6(b) Private Recreation** under *Bankstown Local Environmental Plan 2001* (BLEP 2001). It is located adjacent to Deepwater Reserve which is zoned **6(a) Open Space** and extends along the frontage to the Georges River downstream from the M5 Motorway Crossing.

The hierarchy of relevant environmental planning instruments and guidelines that inform the development proposal on matters relating to flooding include the following:

- *Greater Metropolitan Regional Environmental Plan No 2-Georges River Catchment 1999* (the Deemed SEPP)
- *Bankstown Local Environmental Plan 2001*
- *NSW Government Flood Prone Land Policy*
- *Bankstown Development Control Plan 2005*

The *Greater Metropolitan Regional Environmental Plan No 2 - Georges River Catchment* (*1999*) indicates that the following matters related to flooding need to be recognised:

(a) the benefits of periodic flooding to wetland and other riverine ecosystems;

(b) the pollution hazard posed by development on flood liable land in the event of a flood; and,

(c) the cumulative environmental effect of development on the behaviour of flood water and the importance of not filling flood prone land.

Only Item (c) is considered to be of relevance to the proposed redevelopment of the Deepwater Motor Boat Club Site.

Bankstown LEP 2001 specifies development standards for the regulation of development across the LGA. Clause 26 of the BLEP 2001 addresses flood liable land and states the following:

> *"Before determining an application for consent to carry out development on flood liable land, the consent authority must consider the provisions of any relevant development control plan and the requirements of any floodplain development manual published by a public authority that the Council considers relevant to the assessment of the development."*

In effect, Clause 26 directs matters which involve development on flood liable land to any development control plans that address flooding and to a certain extent, places emphasis on the need for development on flood liable land to conform to the requirements of the NSW Government's *'Floodplain Development Manual'* (*2005*).

Flood related development controls for the Georges River floodplain are outlined in *'Bankstown Development Control Plan 2005 – Part E3 Flood Risk Management'* (*DCP 2005*). The DCP identifies recommended planning provisions for the Georges River floodplain based on "flood risk precinct" mapping documented in the *'Georges River Floodplain Management Study & Plan'* (*2004*) and the proposed land use category of the development under consideration.

The DCP defines three separate types of flood risk precincts for land located within the Probable Maximum Flood (PMF) extent. The three flood risk precincts are defined as "High", "Medium" and "Low", and are shown on Map 1 of the DCP. Map 1 of the DCP indicates that the entire Deepwater Motor Boat Club site is categorised as a "High" flood risk precinct.

The proposed redevelopment of the site will involve alterations and additions to the existing two storey clubhouse so that it can continue to operate as a motor boat club as well as a function centre. A 'function centre' is not a defined use in the BLEP 2001 but could be considered to fall within the definition of a 'recreation facility.' In accordance with definitions outlined in DCP 2005, the redeveloped function centre is considered to be a commercial land use.

The proposed development will also involve conversion of the existing pool and associated pool building to a restaurant/café with organic garden. DCP 2005 indicates that this land use could be classified as either commercial or recreation.

Strict application of Schedule 3 of Part E of DCP 2005 indicates that the siting of a commercial land use within a high flood risk precinct, as defined by Map 1 of the DCP, is a "potentially unsuitable land use". However, Item 3 under the General Notes and Controls within Schedule 3 indicates that:

> *"Council can consider a DA for a "potentially unsuitable use" that clearly complies with the objectives of this DCP and with the performance criteria. In this case, prescriptive controls will be applied on a DA specific basis"*

The objectives of Part E3 of DCP 2005 are:

(i) to reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods;

(ii) to apply a "merit-based approach" to all development decisions which takes account of social, economic and environmental as well as flooding considerations in accordance with the principles contained in the NSW Floodplain Development Manual;

(iii) to control development and any other activity within each of the individual floodplains within the LGA having regard to the characteristics and level of information available for each of the floodplains; and,

(iv) to assess applications for development on land that could be flood affected in accordance with the principles included in the Floodplain Development Manual, issued by the State Government.

Accordingly, it follows that a proposal to site a commercial land use in a high flood risk precinct can be considered on a merits basis provided:

- any risk to human life caused by flooding can be managed;
- any risk of increased property damage due to flooding can be minimised; and,
- the proposed development has been designed to accommodate the typical flood characteristics in the vicinity of the site including the depth and velocity of flow, and the proximity to high ground.

4. FLOOD IMPACT ASSESSMENT

4.1 Description of the Site

The Deepwater Motor Boat Club Site (the Site) is located about 750 metres downstream of the M5 crossing of the Georges River at Milperra. The Site is situated at the northern end of Webster Street, which is accessed from Henry Lawson Drive near Kelso Park.

The site adjoins Deepwater Reserve and fronts the Georges River. It is currently used by the Deepwater Motor Boat Club which operates out of the two-level brick building located on the site. A swimming pool with outbuilding and a paved car parking area are also located on the site. The two-level building comprises a non-habitable storage on the ground level and offices and function facility on the first level. The existing paved car park area is located immediately north of the building.

The site is generally flat and falls with a gentle grade in a southerly direction toward the Georges River. Ground levels vary across the site from an elevation of 3.5 mAHD at the northern end of the site, to an elevation of 1.5 mAHD at the top of the bank of the Georges River. Ground levels in the vicinity of the motorboat club building range from 2.5 to 2.8 mAHD.

4.2 Description of Proposed Development

The proposed development is described as follows:

- Alterations and additions to the existing two storey clubhouse building (main building) for use as a function centre with an 800 seat capacity and 900 person cocktail function capacity (part ground level and all of the first floor) and expansion of the existing motorboat club area at ground level.
- Conversion of the existing swimming pool and associated pool building into a new 112 seat restaurant with proposed internal service road.
- Construction of a small craft launching facility and a new boat shed with capacity to store 30 small craft in the area between the southern and western boat ramps as well as eight car parking spaces and four coach/bus parking spaces.
- Upgrade to the existing car parking area to provide permanent formalised parking for up to 272 vehicles, and provision of spill over parking for 60 vehicles.
- Upgrade to the existing access road inside the site boundary, provision of a flood emergency access route from the site and construction of ancillary infrastructure and services.
- Landscaping of the site.

The proposed development is to be constructed in two stages. Stage 1 will involve works to upgrade the existing buildings for use of the site as a function centre, restaurant and continued use of the site as a motor boat club.

These works will include retrofitting of the existing buildings, upgrading of the car parking, internal service roads, construction of a flood emergency evacuation route and upgrades to existing services and associated landscaping.

The proposed main building will consist of two storeys including the undercroft area which will be retained at ground level. The proposed restaurant will be a separate building located to the north of the function centre and will be constructed from the existing derelict swimming pool outbuilding.

The proposed floor levels for the main building are:

- Pedestrian entry level via a new Porte Cochere to be located on the eastern side of the function centre and with an elevation of 2.7 mAHD. This is close to the existing ground level in this area which is typically at 2.6 mAHD.
- A first floor with a floor level elevation of 5.8 mAHD.

The restaurant will have a floor level of 3.5 mAHD.

The main building will be constructed around the existing building footprint which covers an area of 1811 m^2 (*comprising existing ground floor 870 m^2 and existing first floor 941 m^2*). The ground floor of the existing building is fully enclosed. The proposed redevelopment will involve extensions at the northern and southern ends of the existing building at first floor level, with the area beneath these extensions screened but left open as undercroft areas that will house four 20,000 litre rainwater tanks. The area of each extension at first floor level is 279 m^2 (*excluding the external terrace*). However, as the undercroft below these areas will remain open, the net change in the footprint of the existing building will be relatively small.

Similarly, the proposed gross floor area of the restaurant will mirror the footprint of the existing swimming pool outbuilding. Hence, any associated loss of flood storage due to the buildings that are proposed as part of the development will be small.

The existing car parking area will however be modified to accommodate a greater number of vehicles and to more closely align with minimum car parking area surface levels specified in DCP 2005. This will result in the importation of some fill across the carparking area in order for it to be suitably graded for drainage purposes. The proposal to connect the carparking area to Maxwell Avenue and to use Maxwell Avenue as a flood emergency evacuation route will also require some filling. The potential impact of the filling proposed for the car parking area and the flood emergency evacuation route is discussed in **Section 4.3**.

Approval to construct the new boat shed and small craft launching facility will form Stage 2 and will be the subject of a separate Development Application (Stage 2).

4.3 Assessment of Potential Flood Impacts

As outlined above, Stage 1 of the proposed redevelopment of the site will involve retrofitting and extension of the existing club house building, retrofitting of the swimming pool outbuilding, regrading and expansion of the existing car parking area, landscaping and upgrading of Maxwell Avenue to enable it to function as a flood emergency evacuation route.

Some of the works associated with these components of the proposal have the potential to impact on flood characteristics along the Georges River. These include:

- the potential for a reduction in flow conveyance due to the increased footprint of the proposed main building;
- a reduction in flood storage associated with filling of the floodplain due to the proposed carpark; and,
- changes to flow conveyance due to the raising of Maxwell Avenue so that it can function as a flood evacuation route.

A concept cut and fill plan has been prepared for areas of the site where filling is proposed (*refer* **Figure 3**). This plan indicates that the proposed regrading of the car parking area will increase the general elevation of the car parking area and that a net volume of 1,070 m^3 of fill will need to be imported to the site to achieve the design surface.

Works associated with the proposal to upgrade Maxwell Avenue to serve as a flood evacuation route will require the existing road pavement to be raised. The associated filling will involve the importation of an additional 1,500 m^3 of fill.

4.3.1 Impact of Proposed Main Building Upgrade

Plate 1 shows the existing Deepwater Motor Boat Club building viewed looking to the south-east along the alignment of the eastern bank of the Georges River. As shown, the existing building is fully enclosed at ground level. Therefore, the existing building would effectively "block out" an area of flood storage equivalent to the plan area or footprint of the building.

The proposed modifications to the building will involve extension of the first floor, which is above the predicted peak level of the 1% AEP flood. The extensions include increasing the floor area of the first floor by approximately 550 m^2. However, the extensions will be supported on columns and the ground floor, whilst screened, will be an unenclosed undercroft. The undercroft area will house four rainwater tanks. The rainwater tanks will result in a minor reduction in flood storage but their proposed position adjacent to the existing structure will mean they will not have any impact on floodwater conveyance capacity.

In that regard, it needs to be recognised that the Site would be classified as a flood storage area. The Site and Deepwater Reserve are located downstream and therefore in the "shadow" of the M5 Motorway embankment (refer **Figure 1**).

Plate 1 View looking south towards the existing Deepwater Motor Boat Club Building

Floodwaters would typically enter the site by overtopping the banks of the Georges River, "backing-up" into the site along the river frontage. There are no known floodways or flood runners that run through the site.

Therefore, the proposed retrofitting and expansion of the building will not result in a material change to conveyance of floodwaters through the site. Nor will it materially reduce the flood storage afforded by the site.

4.3.2 Impact of Filling on Flood Characteristics

Filling of both the car parking area and sections of Maxwell Avenue is proposed as part of the redevelopment. The combined volume of fill is estimated to be in the order of 2,500 m^3.

The introduction of this fill to the site will reduce the available flood storage and therefore has the potential to affect flood characteristics elsewhere in the floodplain.

A volumetric assessment was carried out to determine the impact that the proposed filling would have on flood storage at the site. The volumetric assessment considered the peak 1% AEP flood level at the site, detailed topographic data for the site and fill profiles for the proposed upgrade to the car parking area and the proposed raising of Maxwell Avenue. The objective was to estimate the change in available flood storage volume at the peak of the 1% AEP flood.

The volumetric assessment established that the site itself provides approximately 124,000 m^3 of storage at the peak of the 1% AEP flood. This is based on a site area of approximately 4 hectares and an average surface level across the site of 2 mAHD. The total fill volume associated with upgrading the carparking area is estimated to be only 1,070 m^3. Therefore, works associated with upgrading the car parking area represent a 0.9% reduction in the flood storage available at the site at the peak of 1% AEP flood.

This loss of flood storage is not significant relative to the flood storage afforded by the site and the overall flood storage available along this section of the Georges River floodplain. Any impacts will be minor and primarily contained within the boundary of the development. Therefore, the minor loss of flood storage associated with the proposed upgrade to the car parking area will have no measurable impact on flood characteristics along the Georges River.

Notably, the Georges River Floodplain Risk Management Study & Plan (2004) highlights that filling to form the existing car parking area at the Deepwater Motor Boat Club Site occurred in 1998. The Study indicates that a flood impact assessment was undertaken prior to placement of the fill and that this assessment determined that the filling would result in no greater than a 10 mm increase in peak 1% AEP flood levels.

An increase of this magnitude is considered to be well within tolerance levels for flood impact assessment and is commonly interpreted as a zero net impact on flood characteristics. Due to the similar scale of the works currently proposed for the upgraded car parking area, it is reasonable to conclude that any impacts associated with the filling proposed to form the upgraded car park, will be minor and will be contained within the development site.

The proposed raising of the unpaved section of Maxwell Avenue to allow it to function as a flood evacuation route will involve filling along the existing road alignment over a length of about 650 metres. This will involve raising the road by up to 1.3 metres in localised low points and generally by about 1 metre (*refer* **Figure 5**).

The first 350 metres of this road raising is aligned parallel to the direction of flow of floodwaters carried by the Georges River (*refer* **Figure 5**). In addition, the location of this section of the road within Deepwater Reserve is such that it sits in the shadow of the M5 Motorway embankment. As a result, no significant overland flows travel downstream through the reserve during major floods and flooding typically occurs as backwater flooding from overtopping of the banks of the Georges River along the frontage to Deepwater Reserve.

Therefore, due to the alignment of the roadway and its location in the shadow of the M5 Motorway, the proposed raising of Maxwell Avenue will only serve to reduce the available flood storage afforded by this section of Deepwater Reserve. As discussed above, the loss of flood storage is estimated to be less than 1,500 m^3, which is a very small proportion of the flood storage afforded by Deepwater Reserve.

Furthermore, the proposed Maxwell Avenue evacuation route becomes overtopped during events in excess of the 20% AEP flood. Hence, the road will become "drowned out" and the filling associated with the road raising will be inconsequential during floods exceeding the 5% AEP event.

Therefore, the proposed raising of Maxwell Avenue will not have a significant impact on flooding through the area.

4.3.3 Summary

The proposed development involves minor filling of relatively small areas of the site. Filling associated with the proposed upgrade to the carparking area will result in a net loss of flood storage of no more than 1,100 m^3. Filling to raise Maxwell Avenue will result in a net loss of flood storage of no more than 1,500 m^3.

The net loss of floodplain storage due to the proposed redevelopment of the Deepwater Site is estimated to be less than 1% of the total flood storage currently afforded by the site. This is a relatively minor reduction in flood storage and will have no impact on floodwater conveyance. As a consequence, the proposed redevelopment of the site will have no measureable impact on upstream flood levels.

4.4 Consideration of Climate Change Impacts

Council does not currently have a specific active policy or control regarding the potential for future sea level rise as a result of climate change. Council appears to have relied on guidelines specified by the NSW Government.

In that regard, the NSW Coastal Planning Guideline: Adapting to Sea Level Rise was released by the Department of Planning (DoP) in August 2010 and highlights the need to consider the effects of sea level rise due to climate change. The guideline refers to the NSW Sea Level Rise Policy Statement published in 2009 by the then NSW Department of Environment, Climate Change and Water (DECCW) (now the Office of Environment & Heritage), which lists the sea level rise planning benchmarks as an increase above 1990 mean sea levels of 400 mm by 2050 and 900 mm by 2100.

However, since that time the NSW Government has moved away from enforcing a formal climate change policy that requires implementation as part of development proposals. Instead, the onus is placed on Local Government to determine an appropriate response to climate change consistent with projections from the available science.

In 2012, Bankstown City Council engaged FloodMit Pty Ltd to investigate the potential impact of climate change on flood levels within the Georges River. The draft findings from that investigation are taken from a report prepared by FloodMit and are summarised in **Table 4-1**.

Table 4-1 Impacts of Climate Change at Deepwater Motor Boat Club Site

ASSESSMENT CONDITION	1% AEP FLOOD LEVEL (mAHD)	HIGHEST ASTRONOMIC TIDE (mAHD)
Existing Condition	5.10	1.1
2050 SLR benchmark (+0.40)	5.15	1.5
2100 SLR benchmark (+0.90)	5.24	2.0
2100 SLR benchmark plus increased design rainfall	5.63	N/A

* Flood data contained in FloodMit Report dated March 2012

This data shows that the impact of the projected sea level risk (SLR) planning benchmarks is not that significant when applied to large floods. The proposed main floor level of the function centre will be at an elevation of 5.8 mAHD, which is above all predictions for the 1% AEP flood level over the planning horizon to 2100.

A nominal 50 year design life is proposed for the function centre, meaning a nominal end of services in 2065 (approximately). Interpolating between the current flood level estimate for the site and the 2100 SLR plus increased design rainfall estimate, indicates that the Year 2065 1%AEP flood level at the site would be about 5.4 mAHD. This level is 400 mm below the proposed floor level for the function centre. Hence, the potential increase in design flood levels that may manifest due to climate change over the design life of the development is such that the increase will only take up 20% of the available freeboard to the design floor level for the function centre.

The proposed restaurant is to be sited at a level of 3.5 mAHD, which is below the predicted peak level of the 5% AEP flood. It is recognised that inundation of the restaurant will occur during floods in the order of about a 10% AEP event. That is, flooding of the restaurant to above floor level is expected to occur once in every 10 years, on average.

Accordingly, the risk for damage to equipment housed within the restaurant is recognised by the proponent. In that regard, any additional risk posed by climate change impacts would serve to slightly increase the frequency of inundation that could be expected.

Perhaps more relevant is the fact that climate change impacts could result in an increase in the frequency of inundation of the site. However, measures are proposed to provide evacuation from the site via Maxwell Avenue which will be raised to a minimum elevation of 2.7 mAHD.

5. FLOOD EMERGENCY RESPONSE STRATEGY

Part E3 of DCP 2005 outlines a range of flood evacuation requirements. These evacuation requirements also influence the design of the carpark. The DCP requires that "*any change in use does not increase flood risk having regard to property damage and personal safety*".

As outlined, the proposed development falls entirely with the "high" flood risk precinct, as defined by the DCP. Therefore, an appropriate evacuation route needs to be identified, consistent with the requirements of the DCP in relation to level, warning time and signage and consistent with the principals of the NSW Floodplain Development Manual (*2005*).

The following outlines the proposed flood evacuation strategy for the site. It is based on two fundamental principles:

(i) That events proposed at the function centre would be cancelled in advance should a Flood Watch be issued by the Bureau of Meteorology that indicates the high likelihood of major flooding of the Georges River; and,

(ii) Should a flood event occur when patrons are on-site at either the restaurant or the function centre, then the entire site would be evacuated in advance of the onset of the flood.

The philosophy for the Flood Emergency Response Strategy is that patrons should not be on-site once floodwaters exceed an elevation of 2.7 mAHD. This Strategy therefore requires a failsafe Flood Evacuation Plan which includes the adoption of an appropriate trigger to facilitate evacuation and a mechanism for safe evacuation to occur. The following outlines the basis for the proposed Flood Evacuation Plan for the site. A Draft Flood Evacuation Plan for the development is provided in **Section 7**.

5.1 Assessment of Flood Evacuation Potential

5.1.1 Rate of Rise of Floodwaters

The *Georges River Flood Study* includes hydrographs for the 5% and 1% AEP flood events at a number of locations along the river. Hydrographs plot the change in flood level with time and hence are important when considering the time available to effect evacuation during a flood.

There is no specific flood hydrograph available for the Deepwater Motor Boat Club Site. However, the site is located approximately midway between the hydrographs reported for Milperra (*upstream*) and East Hills (*downstream*). Accordingly, a representative hydrograph based on an interpolation between these two records can be developed to assess warning times for the site.

The time available from the start of the design storm to selected thresholds has been identified for the 5% and 1% AEP flood events is reported in Error! Reference source not found..

Table 5-1 Time from Commencement of Design Storm to Inundation of Development Site

DESIGN EVENT (AEP)	RL 1.5 mAHD (inundation of low lying areas)	RL 2 mAHD (inundation across significant areas of the site)	RL 2.7 mAHD (approximate ground floor level)	Peak Design Flood Level
5%	17 hrs	19 hrs	21 hrs	~28 hrs
1%	15 hrs	17 hrs	19 hrs	~28 hrs

Source: Figure 18, Georges River Flood Study

The information presented in Error! Reference source not found. indicates that there is approximately 4 hours between the time when overtopping of the banks of the Georges River commences at 1.5 mAHD and when flooding reaches the ground floor level of the function centre which is at an elevation of 2.7 mAHD. There is approximately 2 hours from when there is widespread inundation across site at 2.0 mAHD and when floodwaters reach an elevation of 2.7 mAHD.

5.1.2 Selection of Proposed Evacuation Route

The site is currently accessed via Webster Street. Access via Maxwell Avenue is currently closed. A previous development application for the site adopted Webster Street as the preferred route for flood evacuation. Following this, an assessment was undertaken of the suitability of maintaining normal access to the site via Webster Street in a condition essentially unchanged from present, and providing separate flood evacuation via Maxwell Avenue.

This has been adopted as the preferred option due to a range of factors. To facilitate flood evacuation, Maxwell Avenue will be modified to accommodate the following features (*refer* **Figure 5**):

- Consistent with the requirements of the NSW Floodplain Development Manual, Maxwell Avenue will be raised to provide an upwardly grading egress from the site, beginning at an elevation of 2.7 mAHD at the northern end of function centre carpark near the site of the proposed restaurant (*refer* **Figure 3**).
- Raising of the unpaved section of Maxwell Avenue between Chainage 00 and Chainage 625 as shown in **Figure 5**. This will provide an upwardly grading roadway that will extend from an elevation of 2.7 mAHD at the carpark to 2.9 mAHD at Chainage 625.

- Raising of the paved section of Maxwell Avenue between Chainage 650 and Chainage 1180 (*corresponding to the intersection with Henry Lawson Drive*). This paved section of the road will be raised nominally to an elevation of 2;9 mAHD in conjunction with roadworks that have been earmarked for this section of Maxwell Avenue by Council. The works will involve filling of up to 1.3 metres to remove the existing sag point in Maxwell Avenue that exists near the intersection with Henry Lawson Drive (*refer Chainage 1050 in* **Figure 5**).

5.1.3 Warning Time Required for Evacuation and Adoption of Trigger Level

The natural surface of the land surrounding the existing main building is typically at an elevation of 1.5 mAHD. Therefore, flooding to this elevation would serve as an on-site “trigger” that flooding of the area and potentially the site, is likely to occur.

As outlined above, there is approximately 2 hours from the time the flood level reaches 1.5 mAHD until it exceeds 2 mAHD, and 4 hours to the level exceeding 2.7 mAHD.

However, adopting such a trigger level may result in frequent unnecessary cancellations of functions at the site. A trigger level of 2 mAHD, which would be physically observed as widespread inundation of the site, would provide approximately 2 hours from reaching this threshold to inundation of the evacuation route and ground floor level of the function centre (*both at 2.7 mAHD*).

Similar flood evacuation investigations undertaken by SES for the Hawkesbury-Nepean Valley are based on the assumption that a single lane of road can be used to evacuate 600 vehicles per hour under flood onset conditions. Therefore, a warning time of 2 hours would be sufficient for evacuation of the maximum 340 cars that could be accommodated in the proposed formal car parking areas across the site including the spill over car parking area of 60 cars.

According to historic event hydrographs, similar warning time would have been provided in the event that occurred in August 1986. In the case of the event in August 1986, the warning time would have been about 2 hours.

As shown in the records for that event, there is potential for the peak level at the site to be reached prior to the peak level being reached upstream at Milperra. This is due to the backwater effects associated with constrictions in the floodplain downstream from the site.

Notwithstanding this, it is considered appropriate to assume that the rate of rise of floodwaters relative to an onsite trigger level of 2 mAHD would be similar at the upstream and downstream gauges.

5.1.4 Issues Associated with Onsite Carparking

Full compliance with the technical requirements of Council’s DCP is difficult to achieve and may in fact be undesirable. It is not practical to consider increasing the elevation of the carparking area (*and access road*) to the 20 year ARI flood level of 4.2 mAHD, as this would result in it being "raised" relative to the existing natural surface around the existing main building and the adjoining lands.

Furthermore, a car park level of 4.2 mAHD would result in an evacuation route that grades downwards in the direction of the M5 Motorway, because sections of Henry Lawson Drive which connect the site to the M5 Motorway and higher ground are at an elevation of only 2.9 mAHD (*in the vicinity of Maxwell Avenue*).

Notwithstanding, the risk of flood damage to vehicles will be minimised if an improved flood evacuation route is provided, even if it the car parking area does not strictly conform to the requirements of DCP 2005. A suitable balance also needs to be achieved against the environmental impact of raising Maxwell Avenue.

It also needs to be recognised that cars would not be left in the car parking area during a major flood. That is, it would be built into the flood evacuation plan for the site that all vehicles would be relocated from the site during the onset of any significant flooding.

Therefore, the carpark should be graded in such a manner that adheres with the principals required for flood evacuation, namely that this should occur along an upwardly grading route. The proposed grading plan, which is shown in **Figure 3**, has been developed to provide a finished surface level that grades upwards towards the start of the evacuation route at 2.7 mAHD.

5.2 Adopted Flood Evacuation Triggers

It is noted that the southern end of the car park has been designed to a surface elevation of 2.0 mAHD. This has been adopted to facilitate drainage of the car park. Therefore, the adoption of a trigger level of 2.0 mAHD for evacuation of the car park would mean that the southern end of the car park would have commenced being flooded at the time of evacuation notification.

Hence, it is recommended that a warning trigger level of 1.5 mAHD be adopted to allow monitoring of flood levels in the Georges River and that an evacuation trigger level of 1.8 mAHD be adopted as the basis for mobilising evacuation of the car parking area. As the levels will be lower at the southern end of the carpark, evacuation of vehicles in this area should occur as a priority shortly after the evacuation trigger level of 1.8 mAHD is reached.

It is noted that based on the rate of rise data outlined above, an evacuation of trigger level of 1.8 mAHD will still leave more than 2 hours for evacuation of all vehicles from the site. This is considered to be sufficient time to evacuate the maximum of 340 vehicles that could be housed by the proposed car parking area, based on vehicle evacuation rates of 600 vehicles per hour per lane, as determined by SES in investigations of flood evacuation potential in the Hawkesbury-Nepean Valley.

Details of the proposed mechanism for evacuating the site are outlined in **Section 7** which details the Draft Flood Emergency Response Plan for the Site.

6. ASSESSMENT OF COMPLIANCE WITH PLANNING CONTROLS

6.1 Deemed SEPP

Clause 9(3) of the *Greater Metropolitan Regional Environmental Plan No 2 - Georges River Catchment 1999* (*the Deemed SEPP*) requires that the following be recognised:

(a) the benefits of periodic flooding to wetland and other riverine ecosystems,

(b) the pollution hazard posed by development on flood liable land in the event of a flood,

(c) the cumulative environmental effect of development on the behaviour of flood water and the importance of not filling flood prone land.

The proposed development is consistent with the aims and objectives set out in Clause 9(3). It will involve only minor filling of relatively small areas of the site. Hence, the benefits of periodic flooding of the wetland areas within Deepwater Reserve will be retained.

The proposed development will also formalise sewer services to the site and will result in the removal of building debris. Therefore, the potential pollution hazard posed by the development will be reduced in the event of a flood that leads to inundation of the site.

The only aspects of the proposed development that could influence flood behaviour at the site are the filling associated with the proposed upgrade to the carparking area and the raising of Maxwell Avenue so that it can function as an evacuation route is.

The concept design for the proposed car parking area recognises the importance of not filling flood prone land. The design is based on minimal change to the existing landform across the car parking area. The proposed reshaping of this area of the floodplain is required for drainage of the car parking area surface. It will result in a net loss of flood storage of no more than 1,100 m^3.

Filling to raise Maxwell Avenue will result in a net loss of flood storage of no more than 1,500 m^3.

The net loss of floodplain storage due to the proposed redevelopment of the Deepwater Site is estimated to be less than 1% of the total flood storage currently afforded by the site. This is minor loss in flood storage will have no measurable impact on flood behaviour and will result in no change in upstream flood levels.

Due to the small scale of the proposed filling and the negligible impact that this will have on on-site flood characteristics, it follows that the contribution of the proposed development to the cumulative impact of all existing and potential future development in this reach of the Georges River floodplain will be negligible.

6.2 Bankstown LEP 2001

Bankstown LEP 2001 requires that where development is proposed on flood liable land, the consent authority must:

(i) consider the provisions of any relevant development control plan; and,

(ii) the requirements of any floodplain development manual

Accordingly, in undertaking its assessment, Council needs to consider the requirements of Bankstown DCP 2001. It also needs to consider the tenets of the NSW Floodplain Development Manual (2005) and guidelines for development contained therein. A commentary on the alignment of the proposed development with guidelines provided in Bankstown DCP 2001 is provided in **Section 6.3**.

6.3 Bankstown DCP 2005

The following addresses the relevant controls and policies for developments and works within flood risk areas as per Schedule 3 of Bankstown DCP Part E3 Flood Risk Management. The DCP identifies recommended planning provisions for the Georges River floodplain based on "flood risk precinct" mapping and the proposed land use category of the development under consideration.

The Georges River Floodplain Management Study and Plan (2004) indicates that the flood risk category of the Deepwater Site is identified as "High". Application of Schedule 3 of DCP 2005 suggests that the land use category for the proposed function centre would be "commercial and industrial", is a "potentially unsuitable land use".

However, Item 3 under the General Notes and Controls within Schedule 3 indicates that:

> *"Council can consider a DA for a "potentially unsuitable use" that clearly complies with the objectives of this DCP and with the performance criteria. In this case, prescriptive controls will be applied on a DA specific basis"*

Hence, it follows that development may be permissible if it can be shown that the development complies with specific prescriptive controls and the objectives of DCP 2005.

The following is an assessment of specific prescriptive flood management controls that apply to proposed development under Bankstown CDP 2005.

6.3.1 Minimum Habitable Floor Levels

DCP 2005 specifies minimum habitable floor levels for different land uses according to the level of flood risk. Typically, minimum habitable floor levels are required to be 500 mm above the design 1% AEP flood level.

As outlined in **Table 2-1**, the design 1% AEP flood level in the vicinity of the Site is 5.1 mAHD. Hence, strict application of the floor level criteria would require the minimum habitable floor level to be 5.6 mAHD; i.e., 5.1 mAHD corresponding to the 1% AEP flood level + 0.5 metres freeboard.

As described above, the existing building comprises a ground floor level at an elevation of 2.7 mAHD and a first floor level at an elevation of 5.8 mAHD.

The proposed ground floor area of the main building includes enclosed areas that comprise existing and expanded boat storage areas, various amenities rooms, the motor boat club room, pre-function rooms and an office. These areas are below the 1% AEP flood level but typically serve as the existing clubhouse area, storage areas or pre-function areas, to facilitate entry and accessibility to the first floor of the function centre from street level. None of the enclosed area will be used as a habitable area; that is, as an area where people would live or sleep overnight.

Therefore, the habitable floor level of the proposed main building will be at an elevation of 5.8 mAHD, which is above the minimum floor level criteria specified in DCP 2005. Hence, the proposed main building will comply with the minimum floor level requirement of the DCP.

The proposed restaurant is to be sited on the existing concrete slab of the existing outbuilding that adjoins the existing swimming pool. This concrete slab is at an elevation of 3.5 mAHD, which is 1.6 metres below the predicted peak level of the 1% AEP flood. It is recognised that inundation of the restaurant will occur during floods in the order of about a 10% AEP event. That is, flooding of the restaurant to above floor level is expected to occur once in every 10 years, on average. Therefore, the restaurant as proposed does not conform to the minimum floor level criteria specified in DCP 2005.

6.3.2 Building Components and Methods

The proposed minimum habitable floor level for the function centre will have an elevation of 5.8 mAHD as discussed in **Section 4.3.1**. This is approximately 3.2 metres above the existing ground level and 700 mm above the design 1% AEP flood level. DCP 2005 makes no requirement for building component materials for development in areas above the 1% AEP flood level.

The ground floor will be partly enclosed as per the existing building structure and partly open undercroft with a floor level of 2.7 mAHD. The area will be 300 mm above the predicted peak level of the design 20% AEP flood (*5 year ARI flood*) and 1.4 metres below the predicted peak level of the 5% AEP flood (*20 year ARI flood*). DCP 2005 requires that all structures below the 1% AEP flood level are to be constructed from flood compatible building components.

Accordingly, all facilities below the 1% AEP flood level will be “flood proofed” using flood compatible materials as described in the architectural plans.

The proposed restaurant will be constructed on the slab of the existing swimming pool outbuilding which has an elevation of 3.5 mAHD. This is 800 mm above the design level of the undercroft area of the function centre, but will be 700 mm below the predicted peak level of 5% AEP flood and 1.6 metres below the predicted peak level of the 1% AEP flood.

Accordingly, in order to align with the requirements of DCP 2005, the restaurant will be constructed with flood compatible building components as shown on the architectural drawings.

6.3.3 Structural Soundness

The main building and the restaurant will be designed and certified by a qualified structural engineer to cater for both hydrostatic loads associated with floodwater inundation and impact loading associated with debris carried by floodwaters. As shown on the architectural drawings, the extension to the main building will be supported on columns which will be designed to cater for live and dead loads associated with the proposed usage of the first floor. These design criteria are expected to be more onerous than any impact or hydrostatic loading associated with flooding. Notwithstanding, a brief report addressing these hydraulic loads will be prepared and supplied to address this issue at the detail design stage.

The restaurant building will be constructed from flood compatible materials as shown in the architectural drawings. It will also be designed to cater for impact loading associated with floating debris carried by floodwaters using 1% AEP overbank flow velocities extracted from the flood modelling that was undertaken for the Georges River Floodplain Management Study & Plan (*2004*).

Accordingly, both the main building and the restaurant will meet the structural soundness requirements specified in DCP 2005.

6.3.4 Carparking and Access

As outlined above and shown in **Figure 2**, the proposed car parking area will extend to the east of the proposed function centre and will cover a greater area than the existing car park. DCP 2005 indicates that non-enclosed car parking areas should be no lower than the design ground floor level of the building that the car park will service (*refer Schedule 3, Clause 8 of Section titled "Car Parking and Driveway Access"*). However, this clause goes on to state that:

> *"where this is not practical, a lower level may be considered. In these circumstances the level is to be as high as practical, and, when undertaking alterations and additions, no lower than the existing level"*

A concept grading plan has been prepared for the proposed carpark and is shown in **Figure 3**. This indicates that the carparking area grades from 2.0 mAHD near the entry from Webster Street to 2.7 mAHD near the proposed evacuation route connection to Maxwell

Avenue (*refer* **Figure 3**). It is noted that these levels are at or below the proposed ground floor level for the function centre. This is necessary to meet the following constraints:

- To ensure functionality in terms of access from the entry access road into the Porte Coucherie
- To facilitate drainage of the car parking area (refer to Stormwater Management Strategy)
- To ensure that the elevation of the evacuation route is at a minimum level of 2.7 mAHD at its point of connection to the car park, thereby meeting minimum criteria for flood evacuation, while at the same time ensuring that the associated raising of Maxwell Avenue does not result in a substantial volume of additional filling of the floodplain along the Maxwell Avenue corridor.

In terms of the criteria for car parking specified in DCP 2005, it should be noted that the proposed redevelopment is an alteration and addition to an existing development and use of the site. Hence, compliance with DCP 2005 can be achieved if the car parking area is no lower than the level of the existing car parking area. As shown in the preliminary grading plan presented in **Figure 3** and the profiles provided in **Figure 4**, the proposed grading of the upgraded and extended car park will not result in any material lowering of the existing car parking area.

DCP 2005 also specifies that *"restraints or vehicle barriers are to be provided around car parking areas to prevent floating vehicles leaving a site during a 1% AEP flood"*. Bollards or barriers are proposed to be installed around the perimeter of the car parking area as a means of delineating the car parking area from adjoining landscaped areas of the site. These have the capacity to limit the floatation of any vehicles that might be in the carpark during flooding of the site. However, flooding to the level of the 1% AEP flood will mean that the car parking area will be flooded to depths of up to 3 metres. It is not intended to install bollards to this height.

In that regard, it is not considered good flood management practice to try to contain all vehicles within the site during floods that will result in inundation of the car park. Best practice flood management should aim to evacuate all vehicles from the site prior to and during the onset of major flooding of the Georges River. Adherence to Clause 8 of the Section of Schedule 3 titled "Car Parking and Driveway Access" in this instance is at odds with this best practice approach.

Accordingly, although standard size bollards will be installed, it is proposed that implementation of a flood emergency response strategy as outlined in Section 5 of this report occur as a mechanism for minimising the potential for vehicles to be in flooded areas in the first instance.

6.4 Compliance with Objectives of DCP 2005

Strict application of Schedule 3 of Part E of DCP 2005 indicates that the siting of a commercial land use within a high flood risk precinct, as defined by Map 1 of the DCP, is a "potentially unsuitable land use".

However, Item 3 under the General Notes and Controls within Schedule 3 indicates that siting of a commercial land use within a high flood risk precinct is possible provided the objectives of Part E3 of DCP 2005 are achieved. The objectives require evidence that the development proposal will:

(i) reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods;

(ii) can be considered on a merits basis that takes account of social, economic and environmental as well as flooding considerations in accordance with the principles contained in the NSW Floodplain Development Manual; and,

(iii) is consistent with the principles included in the Floodplain Development Manual, issued by the State Government.

Each of these is addressed in the following.

6.4.1 Potential for Reduced Risk to Human Life and Property

Existing uses of the site currently involve activities associated with the Deepwater Motor Boat Club which is the second oldest continuously racing powerboat club in NSW. The Club has 60 active members and stores approximately five boats on the ground floor of the existing building. Race days are held every two months and can be attended by up to 1,000 people. Currently there are no known protocols for managing flood emergencies.

The proposal to redevelop the site has the potential to bring up to 900 people to the function centre to attend organised functions such as weddings. It also has the potential to bring up to 112 people to the site as patrons to the proposed restaurant. At face value, this will not result in an increase in the maximum number of people that could be on site during the onset of major flooding of the Georges River. However, the number of times that this maximum number of people could be on site in any given year will increase. Hence, the increased frequency of patronage of the site due to the proposed development will increase the risk to human life during floods, if measures to mitigate that risk are not implemented.

As outlined in Section 5, a detailed analysis has been undertaken to assess the potential for the site to be evacuated during the onset of flooding of the Georges River. This analysis shows that safe evacuation can occur within available timeframes provided a suitable evacuation route is provided. The development proposal includes provisions for Maxwell Avenue to be raised to a minimum elevation of 2.7 mAHD (*above the 5 year ARI flood level*) along its full length to the intersection of Henry Lawson Drive.

This will allow patrons to be evacuated in advance of any flooding of the site via a roadway which at the time of evacuation will not be flooded. Hence, the proposed strategy for managing flood risk is to mitigate any risk by ensuring that patrons are not located on site when inundation occurs.

This philosophy and the protocols outlined above and in the Flood Evacuation Plan documented in **Section 7**, indicate that although the frequency of patronage of the site will increase over a given year, the risk that flooding may present to those attending the site will actually be reduced. Therefore, it is considered that this objective of Part E3 of DCP 2005 can be achieved by successful implementation of the Draft Flood Evacuation Plan.

Objective (i) also indicates that there must be evidence of a reduced risk of damage to property. In this regard, it is noted that the proposed development will involve the retrofitting of existing facilities on the site. As shown in the architectural drawings, those facilities that are below the level of the 1% AEP design flood will be constructed using flood compatible materials. In effect, the ground floor area of the function centre building will be "flood proofed" which will be an improvement on the existing ground floor facilities. Therefore, proposed retrofitting of the function centre building will result in a facility that if flooded would incur less flood damage than an upgraded version of the existing facility.

It is noted that although the proposed restaurant is to be constructed using flood compatible materials, its elevation at 3.5 mAHD, will mean that it will be inundated once in every 10 years on average. Hence, there is potential for an increase in flood damage to be incurred within this facility relative to existing conditions or previous land uses.

Notwithstanding, when combined with the main building upgrade, it is considered that the net change in flood damages that could be incurred relative to those that would occur under existing or previous land use conditions is minor.

6.4.2 Compliance with Principles of the Floodplain Development Manual

The primary objective of the NSW Flood Prone Land Policy is to reduce to impact of flooding and flood liability on individual owners of flood prone property, and to reduce public and private losses due to floods. This objective must be considered with due recognition that flood prone land is a valuable resource that should not be sterilized by precluding its development.

At first glance, these objectives appear to be at odds. However, their intent is to emphasise the importance of a merits based assessment of any proposal for development in the floodplain such that development is not precluded by the application of prescriptive assessment criteria.

In this regard, Stage 1 of the Doltone House Deepwater development proposal does not involve any significant expansion to the building footprints that currently exist on site. The proposal to retrofit the existing buildings (function centre and swimming pool outbuilding) will not result in any increase in habitable or semi-habitable floor areas.

Similarly, the proposal to upgrade the existing car parking area will not materially change the existing land use opportunity afforded by the car park and which would currently be used on days when the Deepwater Motor Boat Club holds its regattas.

Accordingly, although intensification of use may be interpreted to occur as a consequence of the development, it needs to be recognised that there are existing use rights. These use rights need to be considered in any assessment of compliance with the Flood Prone Land Policy in order to avoid sterilisation of the land.

In that regard, the proposal incorporates measures that are designed to mitigate the potential impact of flooding on both the new infrastructure that is proposed and patrons who will attend the venue. These measures include:

- No provision for overnight habitation of the development, thereby ensuring that no one will be on-site outside designated function periods or operating hours for the proposed restaurant.
- A Flood Evacuation Plan that when implemented will ensure that patrons are evacuated from the site along a route that will not be flooded at the time evacuation is triggered. This is considered to be best practice for flood emergency response management.
- The use of flood compatible materials in all areas of the retrofitted buildings up to the level of the 1% AEP flood.

Therefore, the measures that are proposed to mitigate the flood risk that may occur at the site from time to time are considered to sufficiently demonstrate that the risk to life and property can be minimised, while at the same time allowing site usage to occur consistent with the existing on-site infrastructure.

7. DRAFT FLOOD EVACUATION PLAN

7.1 Draft Flood Emergency Response Measures

There are a range of other considerations, separate to the adoption of appropriate warning times and design of an evacuation route that are required in order to facilitate appropriate emergency response. These are considered in the following.

7.1.1 Functions and Event Cancellation Procedure

The fundamental requirement of the Emergency Response Plan would be that in the event of a flood related emergency, as defined by floodwaters reaching the trigger level, all functions at the site would be cancelled and staff and patrons evacuated. This is the primary operational requirement for the mitigation of flood related risk to the function centre.

At least 6 hours prior to every function, the Bureau of Meteorology (*BOM*) would be consulted to determine if there are any flood warnings or expectations of heavy rainfall either in the vicinity of the site or in the upstream catchment.

The Bureau of Meteorology also provides up to 12 hours warning for flooding on the Georges River at Milperra Bridge, which is approximately 3 km upstream of the site. This warning is sent to the SES, who are responsible for broadcasting flood warnings to the public. The BOM website also displays graphs of river heights at Milperra Bridge and also provides direct access to flood warning predictions. These should be monitored daily by the function centre staff.

If flood predictions indicate that a peak level of 1.5 mAHD or greater will be reached, then the planned event will need to be cancelled.

In such an event the site would be "packed up" and closed (*including implementation of the onsite response plan which will include removal of any stored goods from all ground floor areas to safe storage*). All staff and the primary contact for the function would be contacted by phone, SMS and email to communicate the notice of cancellation of the particular function.

Furthermore, the main site entry gate would be closed and locked upon the departure of all staff, and an appropriately lit warning sign would be raised at the gate and at the entry to Webster Street and Maxwell Avenue.

7.1.2 State Emergency Service Flood Warnings

The SES typically makes a decision to evacuate the area of the Georges River based on a combination of weather warnings, predicted rainfall, fallen rainfall and river gauge measurements.

Discussions have been held previously with the SES Bankstown Branch. The SES has verbally indicated that it has responsibility for evacuation for the area of the Georges River and the site. The SES confirmed that it would provide warnings and communicate these to the function centre operators. Accordingly, the SES would be provided with a list of all relevant phone numbers to provide redundancy for communications to site management.

At the onset of a flood emergency following the commencement of a function:

- SES would issue a warning if flooding in the Georges River is anticipated.
- General public warnings shall come in the form of TV news broadcasts, radio bulletins, fax and email to targeted audiences, automatic telephone dialling, mobile public address and door to door personal notification. Specifically for the site, SES would contact Deepwater (*operators of the function centre*) by phone and in person.
- The warning would come approximately 12 to 15 hours in advance of anticipated inundation of the site and the surrounding areas.
- Following warnings, the SES would make a decision to commence evacuation, and this would be communicated to the club by phone and in person

As a failsafe, at the onset of a potential flooding the SES will send a representative to inspect the site and advise any occupants of the need to evacuate. During the function, the SES representative would assist the site with communication and advise the timing for the evacuation. The SES has advised that should a decision to evacuate be made following commencement of a site function, there would be ample time to arrange and organise an evacuation without the need to rush.

In these discussions the SES have shown that they, in principle, have no fundamental objections to the development and its proposed usage.

7.1.3 Secondary Warning System

The SES warnings and associated evacuation procedures represent the primary response measures for the function centre, following the primary procedure of cancelling a function and closing the site as discussed above.

A secondary warning system will also be installed at the cost of the function centre operators. This would consist of a flood gauge sensor that would communicate a warning directly to the function centre management in case of rising floodwaters. This would act as an additional warning system in case the SES managed system failed.

It is proposed to set the warning sensor to measure water at a level of RL 1.5 mAHD. This will alert the nominated representative that the flood warning trigger level has been breached. Once triggered, the water level will be monitored and evacuation commenced should the flood level at the site rise above RL 2.0 mAHD. This will allow sufficient time for an evacuation to be enacted prior to the inundation of the site (*see* **Section** Error! Reference source not found.). In the first instance the warning would consist of flashing lights strategically placed within the function centre and offices which would occur for ten minutes.

In this period flood wardens or other trained staff would be able to investigate the river conditions and ascertain the nature of the alarm and "reset" if it is a false positive. If the alarm is not reset within the 10 minutes it will escalate to an audible fire alarm type to provide an alert to all staff and patrons.

The alarm will be implemented and managed by the centre. It is expected that "false positive" alarms will occur from time to time and the site management will be trained to review and respond appropriately.

7.1.4 Flood Wardens

Site management would ensure that designated flood wardens are suitably trained and ready for duty at all times during functions.

- Training of the flood wardens would be undertaken by a service provider approved by Bankstown Council and training of wardens and staff would be subject to audit.
- All staff would be trained by flood wardens.
- There should be at least two nominated flood wardens on duty at any time the function centre is in use.
- All staff and flood wardens will have access to torches.
- SES shall notify flood wardens by phone or in person of need for evacuation. Once wardens have been notified they shall commence the evacuation procedure.

7.1.5 Evacuation Procedure

In the event that flooding occurs during a function at the site, the following protocols will be enacted:

- Nominated staff monitor flood levels once a flood warning notification has been received from the SES, or alternatively once the the flood warning system has been activated when the level in the river rises above RL 1.5 mAHD.
- Once the river level exceeds the evacuation trigger level of 2.0 mAHD, evacuation announcement made over PA system as follows:
  "Attention patrons, the SES has issued a flood evacuation notice. Stay calm and slowly make your way to your vehicles following all instructions from flood wardens and emergency services personnel. Please have your radios tuned to the local station 89.9FM for updates".
  The announcement is to be repeated twice immediately and at regular (*e.g., five to ten minute*) intervals until all patrons have been evacuated.
- Security staff shall be informed and ready to act under wardens' instructions.

- Flood wardens are to coordinate on-ground evacuation of premises using two-way radios to communicate.
- Staff and patrons shall remain at designated areas until instructed by wardens to leave.
- Patrons with vehicles in the car park would be directed by wardens to exit along the Maxwell Avenue evacuation route.
- Patrons who walked or were dropped at the function centre would be transported from the site using bus services owned and operated by the function centre. A staging area for bus loading is proposed in the car park. The destination would be Bankstown City Sports Complex in Bankstown, as the designated SES flood refuge.
- As part of the site response plan, once all patrons have departed the function centre and there has been a thorough check by wardens, then staff would be required to evacuate. Wardens are to undertake a final inspection of all areas to ensure no patrons and staff are remaining on the premises and to relocate any valuable materials from the ground floor to storage areas on the first floor.
- Once all staff and patrons have exited the premises then security is instructed to lock the centre to prevent unauthorised access.

7.1.6 Evacuation Route

Upon evacuation commencement, all patrons would be asked to exit the site. The evacuation route from the function centre will be as follows:

- Exit the site via Maxwell Avenue;
- Turn left to head north along Henry Lawson Drive;
- Turn right to head east along the M5 Motorway;
- Turn left to head north along The River Road to the Bankstown City Sports Complex in Condell Park.

Further instructions would then be given by SES to evacuees once they have reached Bankstown City Sports Complex.

The gate to the proposed emergency evacuation route located on the site will be opened by site management for vehicular access in a flood emergency situation.

7.1.7 Evacuation Transport

The proposed formal car park areas have been designed to cater for 280 cars with capacity for spillover car parking for 60 cars. The majority of patrons and employees would be evacuating from the site via their own cars and will evacuate to the Bankstown City Sports Complex, as discussed above, while the remainder will be transported using buses.

Doltone House currently owns three buses which are used to chauffeur patrons to and from pick up points to their venues. A total of 45 seats are currently provided by the three buses and can be made available for use for functions at the site.

During an average function there is expected to be a total of up to 900 patrons and staff at the site (*including at the proposed restaurant*). About 80% of patrons are expected to arrive by private car, and therefore up to two bus trips would be required to evacuate the remainder. The return trip time to the Sports Centre is about 20 minutes.

Accordingly, Doltone House's buses could be made available to evacuate people from the site in the onset of major flooding of the Georges River.

The buses could pick up patrons at a designated marshalling area within the car park, which will be illustrated on Site Emergency Response signs located across the function centre. The bus will drop patrons off at the Bankstown City Sports Complex as discussed above.

For larger events at the site (*up to 900 persons*), Doltone House would make arrangements with a local bus company to ensure a bus is available to transport up to 100 patrons at a time, which would require up to two bus trips to evacuate the 20% of patrons who have arrived by means other than a private car. In reality, some of these patrons would be able to evacuate in private cars as there would be spare seating available in most cars.

The management and coordination of evacuation by bus would be coordinated by the flood wardens.

7.1.8 Signage

Signage is an important tool in flood risk management as it promotes awareness amongst the community. They provide graphical illustrations of instructions, which the community and users of the function centre should find easy to understand.

Signage for the Deepwater Function Centre would include:

- The flood evacuation procedure, including evacuation route maps
- Maps of roadways that are susceptible to flooding
- Flood planning level markers located around the site.

The flood evacuation procedure and maps would be located at prominent and well lit locations and shall include contact numbers for:

- Site management and flood wardens
- SES
- Police
- Electricity providers

- Telecommunications providers
- Local radio stations (phones and frequencies)

In the event of a function cancellation or evacuation, signage would be erected at the closed gate ensuring that any visitors or guests arriving are fully informed of the site closure.

Flood Evacuation Procedure Sign

The Flood Evacuation Procedure sign shows a map of the SES preferred evacuation route, evacuation procedures and relevant emergency telephone numbers. Signs shall be placed nearby all ingress/egress points in the function centre in a laminated wall mounted display. This sign would also raise awareness amongst patrons that the car park is subject to flooding and that it should not be used as a refuge from flooding. This plan would also include details of marshalling points for bus pickup.

Flood Planning Level Markers

A flood planning level marker shall be placed up to RL 5.1 mAHD (*100 year ARI flood level*) and beyond on one side of the building façade (*on the Webster Street frontage*). This marker would assist emergency services in judging the height of flood waters and raises flood awareness within the community. Additional markers and signage would be located throughout the site in order that the depths of inundation of the site can be gauged, in particular along the Maxwell Avenue evacuation route.

7.1.9 Staff Training and Education

It is the responsibility of centre management to maintain a register of trained flood wardens and to ensure all other employees are educated in the flood evacuation procedures.

Training of employees as to the evacuation plan shall be undertaken during employee induction. Annual drills would be undertaken to maintain familiarity with the procedures discussed herein.

An important component of the flooding management procedures and evacuation plans is to ensure appropriately trained staff and management teams. This will be achieved by the implementation of flood wardens (similar to the concept of fire wardens). Flood wardens will be appropriately trained by an external supplier who will be vetted and approved by Council. Flood wardens will be available at the site to ensure all provisions and procedures of the plan are followed and implemented at all times, and will be responsible for oversight, coordination and liaison in the event a flooding related evacuation is required.

Building management shall train flood wardens to comply with the following requirements. Flood wardens are to:

- Be intimately knowledgeable with the contents of this plan;
- Be able to train others and induct users of the function hall;

- Have experience using 2-way radios;
- Know the evacuation route and be able to direct others to use it;
- Ensure the SES is able to advise the function centre via phone, sms and email of flood evacuation;
- Undertake regular callout updates of key numbers and updating the emergency plan;
- Have regular contact with SES;
- Know how to control a crowd or be in a position to direct security or others to control;
- Responsible for coordinating the cancellation of any event and ensuring the site is appropriately closed as per the site response plan and all guests notified;
- Have undertaken an emergency response training course, or as a component of another course, and first aid;
- Monitor warning systems including flood gauges, BOM warnings, SES advice and review expected weather forecasts, prior to and during each function;
- Inspect and manage failsafe secondary alarm to review false alarms and response accordingly;
- To arrange maintenance of all systems as required and ensure compliance with the audit requirements.

Further to this all staff on the site will be inducted and will be made familiar with the procedures, roles and principles of this plan.

7.1.10 Audit Procedure

The building manager shall undertake an audit each year of all staff, facilities and operations to ensure the building procedures are effective. An audit record shall be maintained and be available for inspection at any time by Council or SES staff. The building manager shall also be responsible for the annual training drills and inducting new staff and tenants to the flood evacuation strategy procedures. The audit record shall document all persons who have been trained with date and signatures of the trainer and trainee.

This document, along with all appendices, shall be reviewed annually in consideration of the audit by building management and be updated with the release of the up to date SES Flood Emergency Sub Plan.

The audit shall confirm that the function centre is on the SES list for notification of warnings and evacuation decisions, and that all contact details are correct.

8. CONCLUSIONS

This report presents the findings of a Flood Impact Assessment that has been undertaken for the proposed redevelopment of the Deepwater Motor Boat Club Site at 30 Webster Street, Milperra. The proposal involves alterations and additions to the existing two storey clubhouse building (main building) for use as a function centre with an 800 seat capacity and 900 person cocktail function capacity (part ground level and all of the first floor) and expansion of the existing motorboat club area at ground level. Anew restaurant will be constructed on the site of the existing swimming pool and associated outbuilding. The proposal also involves upgrading the existing car parking area and raising nearby Maxwell Avenue so that it can serve as an evacuation route during times of flooding of the Georges River.

The proposed development involves minor filling of relatively small areas of the site. Filling associated with the proposed upgrade to the carparking area will result in a net loss of flood storage of no more than 1,100 m^3. Filling to raise Maxwell Avenue will result in a net loss of flood storage of no more than 1,500 m^3.

The net loss of floodplain storage due to the proposed redevelopment of the Deepwater Site is estimated to be less than 1% of the total flood storage currently afforded by the site. This is a relatively minor reduction in flood storage and will have no impact on floodwater conveyance. As a consequence, the proposed redevelopment of the site will have no measureable impact on upstream flood levels.

The proposed redevelopment of the site has also been considered in the context of the potential flood risk to future patrons. A Flood Evacuation Plan has been prepared which addresses and provides for the key principles of flood evacuation, namely:

- Suitable flood warning systems and procedures
- Sufficient time for evacuation
- Proposed evacuation route
- Appropriate site management responsibilities and procedures.

These findings from the investigations documented in this report demonstrate that in the event of a significant flood event in the Georges River, a full evacuation of the site can be completed in less than two hours, before inundation of critical sections of the car parking area and the proposed evacuation route. Safe evacuation will be facilitated by road raising works along Maxwell Avenue.

Doltone House has also demonstrated its commitment to adopt the proposed measures to minimise any risks by:

- The proposal to upgrade Maxwell Avenue so that it can function as a flood emergency evacuation route that will connect the site to Henry Lawson Drive and allow orderly evacuation during the onset of flooding of the Georges River

- Commitment to adopt and implement the Flood Evacuation Plan
- The implementation and installation of a secondary warning system
- Training of staff by Council approved experts
- Undertaking annual audit with Council and SES

Measures that are proposed to mitigate the flood risk that may occur at the site from time to time are considered to sufficiently demonstrate that the risk to life and property can be minimised, while at the same time allowing site usage to occur consistent with the existing on-site infrastructure. Hence, the proposed redevelopment of the site is considered to be consistent with the flood related requirements the Georges River SEPPP, BLEP 2001 and DCP 2005.

9. REFERENCES

- Bankstown City Council (*2006*), *'Development Engineering Standards'*
- Bankstown City Council (*May 2004*), *'Georges River Floodplain Risk Management Study & Plan'*; prepared by Bewsher Consulting.
- Bankstown City Council (*2005*), *'Development Control Plan 2005: Part E3 – Flood Risk Management''*
- FloodMit Pty Ltd (*March 2012*), *'Proposed Development of the Deepwater Motor Boat Club Site by Doltone House Group – Review of Floodplain Management Issues'*; prepared for Bankstown City Council.
- Institution of Engineers (*1987*), *'Australian Rainfall and Runoff – A Guide to Flood Estimation'*; edited by DH Pilgrim, ISBN 085825 434 4.
- NSW Government (*April 2005*), *'Floodplain Development Manual: the management of flood liable land'* ISBN 0 7347 5476 0.
- NSW Government – Department of Planning (2010) NSW Coastal Planning Guideline: Adapting to Sea Level Rise
- NSW Government – Department of Climate Change and Water (2009) NSW Sea Level Rise Policy Statement
- NSW Government – Department of Climate Change and Water (2007) *'Floodplain Risk Management Guideline: Practical Consideration of Climate Change'*
- Public Works (*1991*), *'Georges River Flood Study'* PWD Report No. 91066 ISBN 0730586537
- WorleyParsons (*2013a*), Letter report titled, *'Deepwater Motor Boat Club Function Centre Redevelopment, Milperra - Assessment of Flooding Issues and Response to Report prepared by FloodMit Pty Ltd'*; *Referenced as* "lr301015-02379crt130909-Deepwater Function Centre Flood Advice.doc" and dated 9th September 2013.
- WorleyParsons (*2013b*), Letter report titled, *'Deepwater Motor Boat Club Function Centre Redevelopment, Milperra - Assessment of Alternative Evacuation Route via Maxwell Avenue'*; Referenced as "lr301015-02379crt130909-Deepwater Function Centre Flood Advice.doc" and dated 9th September 2013.

301015-02379 – Deepwater Motorboat Club Site
fg301015-02379-140313-fig1 Location.doc

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ISSUE	DATE	ISSUE DESCRIPTION

NORTH

DEEPWATER MOTORBOAT CLUB
SITE LOCATION

FIGURE 01

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A	28.02.14	ISSUED TO CLIENT
ISSUE	DATE	ISSUE DESCRIPTION

NORTH

DOLTONE HOUSE DEEPWATER
LAYOUT AND EXTENT OF PROPOSED DEVELOPEMENT

FIGURE 02

LEGEND

- ● F1.77 FINISHED SURFACE
- EXISTING CONTOURS (INTERVAL 0.1m)
- 2.00 PROPOSED CONTOURS (INTERVAL 0.1m)
- PROPOSED BATTER
- CONCRETE CAUSEWAY

NOTE

1. ALL BATTERS ARE 1:3
2. ALL LEVELS IN METERS AHD

5 0 5 10 15 20 25m
1:250 (A1) 1:500 (A3)

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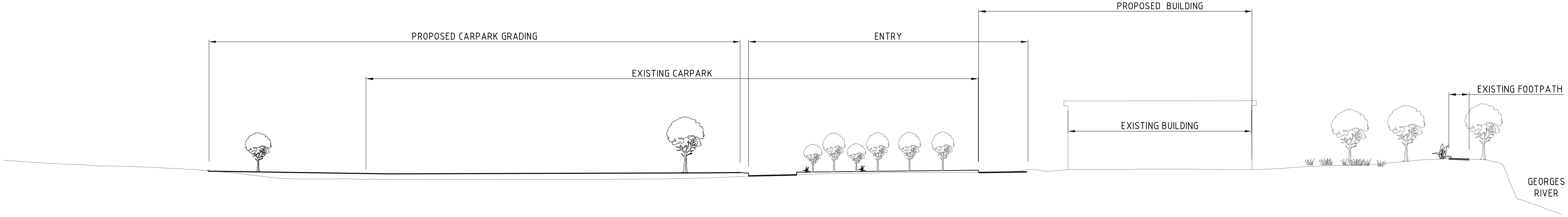
ISSUE	DATE	ISSUE DESCRIPTION

NORTH

DOLTONE HOUSE DEEPWATER
PROPOSED CAR PARK GRADING PLAN

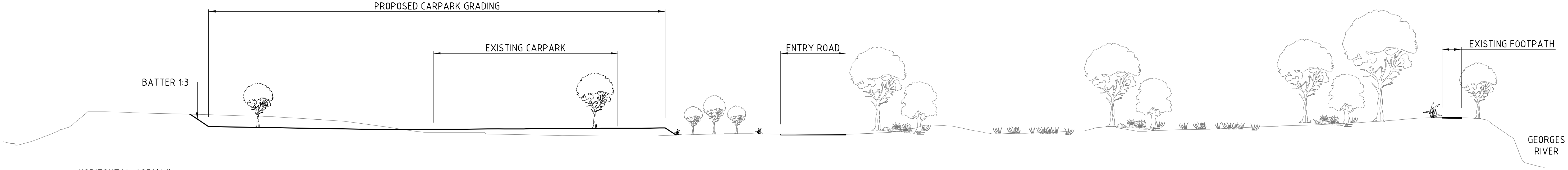
FIGURE 03

LOCATION: W:_INFRASTRUCTURE\PROJECTS\301015\02379 - DEEPWATER MOTOR BOAT CLUB REDEVELOPMENT\110 DRAWINGS\SKETCHES\301015-02379-FIGURE 03_A.DWG
USER NAME: phil.cornish CTB FILE: Worley-Full.ctb Plotter:None
PLOT DATE & TIME: 28/2/2014 3:14:05 PM SAVE DATE & TIME: 28/2/2014 3:10:42 PM



HORIZONTAL=1:250(A1)
VERTICAL=1:125(A1)

SECTION 1/02
AS SHOWN



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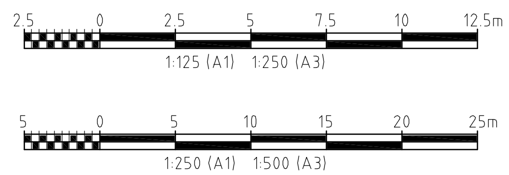
VERTICAL=1:125(A1)

SECTION 2/02
AS SHOWN



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A	28.02.14	ISSUED TO CLIENT

DOLTONE HOUSE DEEPWATER
PROPOSED SITE SECTIONS

FIGURE 04

LOCATION: W:_INFRASTRUCTURE\PROJECTS\301015\02379 - DEEPWATER MOTOR BOAT CLUB REDEVELOPMENT\11.0 DRAWINGS\SKETCHES\301015-02379-FIGURE 04_A.DWG
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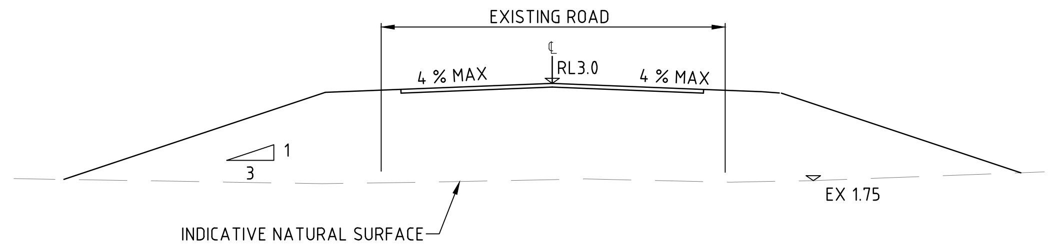
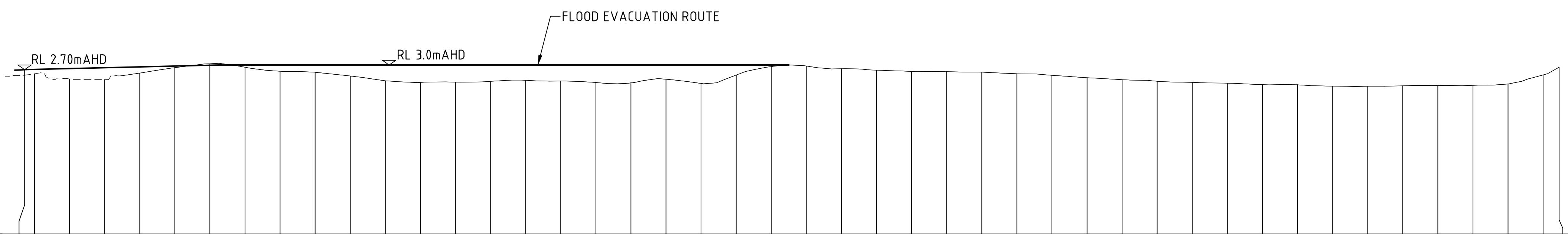
CTB FILE: Worley-Full.ctb Plotter:None
PLOT DATE & TIME: 28/2/2014 3:16:09 PM
SAVE DATE & TIME: 28/2/2014 3:10:41 PM

PLAN
SCALE 1:2000



SECTION 1/-
SCALE 1:50



Datum RL-9.0

EXISTING SURFACE LEVEL	2.276					2.840	3.119	2.870	2.585	2.511	2.245	1.908	1.793	1.811	1.865	1.938	1.887
CHAINAGE	92.994	100.000	125.000	150.000	175.000	200.000	225.000	250.000	275.000	300.000	325.000	350.000	375.000	400.000	425.000	450.000	475.000

EXISTING SURFACE LEVEL	1.782	1.754	2.014	1.719	2.315	2.920	2.955	2.763	2.663	2.568	2.557	2.518	2.410	2.297	2.127	1.984
CHAINAGE	500.000	525.000	550.000	575.000	600.000	625.000	650.000	675.000	700.000	725.000	750.000	775.000	800.000	825.000	850.000	875.000

EXISTING SURFACE LEVEL	1.871	1.790	1.733	1.630	1.621	1.529	1.521	1.548	1.569	1.579	1.677	2.321	2.872
CHAINAGE	900.000	925.000	950.000	975.000	1000.000	1025.000	1050.000	1075.000	1100.000	1125.000	1150.000	1175.000	1186.412

CL01 LONGITUDINAL SECTION
Horiz. Scale 1:2000
Vert. Scale 1:200

NOTE

NO TREES OR SUBSTANTIAL VEGETATION IS TO BE REMOVED AS PART OF THE REGRADING/RESURFACING WORKS.

40 0 40 80 120 160 200m — 1:2000 (A1) 1:4000 (A3)

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

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ISSUE	DATE	ISSUE DESCRIPTION
A	14.03.14	ISSUED TO CLIENT

NORTH

DOLTONE HOUSE DEEPWATER

MAXWELL AVENUE EVACUATION ROUTE & LONG SECTION

FIGURE 05

DOLTONE HOUSE GROUP

Doltone House Deepwater, Milperra

Stormwater Management Plan

Issue No. 2

18th March 2014

rp301015-02379crt_tim140317-Doltone House Deepwater SWMP.doc

Water & Environment

Level 12, 141 Walker Street
North Sydney 2060 Australia
Tel: +61 2 89236866
Fax: +61 2 8923 6877
www.worleyparsons.com
WorleyParsons Services Pty Ltd
ABN 61 001 279 812

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DOLTONE HOUSE GROUP

DOLTONE HOUSE DEEPWATER, MILPERRA
STORMWATER MANAGEMENT PLAN

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Project 301015-02379 - DOLTONE HOUSE DEEPWATER, MILPERRA

REV	DESCRIPTION	AUTHOR	REVIEWER	WORLEY-PARSONS APPROVAL	DATE
1	Draft Issued for internal review	CRT / ARM			
2	Issued for inclusion with Development Application	ARM	TM / CRT	Chris Thomas	18/3/2014

CONTENTS

1. INTRODUCTION

Doltone House plans to redevelop the existing Deepwater Motor Boat Club site at Milperra (the Site). The proposed redevelopment will involve alterations and additions to the existing two storey clubhouse to include a 900 person function centre and conversion of the existing pool and associated pool building to a 112 seat restaurant/café with organic garden. It is also proposed that a boat shed with small craft launching pontoon be incorporated into the development, along with several gazebos and landscaped gardens. The Deepwater Motor Boat Club will continue to operate out of an expanded and upgraded area at the ground level of the main building.

The development site is located on the northern bank of the Georges River at Milperra (*refer* **Figure 1**). It is situated within the Bankstown City Council Local Government Area (LGA) and is known as 30 Webster Street, Milperra. The site covers an area of 4.08 ha and comprises part Lot A in Deposited Plan (DP) 405225 and Lot D in DP 391154.

In order to redevelop the site as proposed, it will be necessary to incorporate stormwater drainage infrastructure of sufficient capacity to drain the car parking area and landscaped areas adjacent to buildings. It will also be necessary for the proposed stormwater management system to be able to treat runoff to achieve acceptable levels for pollutants before discharge to the receiving waters.

In recognition of this, Doltone House engaged WorleyParsons to prepare a Stormwater Management Plan for the site. The Stormwater Management Plan (SWMP) conceptually outlines the stormwater infrastructure proposed to control and treat runoff from the developed site to acceptable levels. This report documents the SWMP for the site and details components of the stormwater system that will allow runoff during storm events to be managed to achieve acceptable off-site discharge criteria.

2. DESCRIPTION OF THE PROPOSED DEVELOPMENT

The proposed development is shown in plan in **Figure 1** and is described as follows:

- Alterations and additions to the existing two storey clubhouse building for use as a function centre with an 800 seat capacity and 900 person cocktail function capacity (part ground level and all of the first floor) and expansion of the existing motorboat club area at ground level.
- Conversion of the existing swimming pool and associated pool building into a new 112 seat restaurant with proposed internal service road.
- Construction of a small craft launching facility and a new boat shed with capacity to store 30 small craft in the area between the southern and western boat ramps as well as eight car parking spaces and four coach/bus parking spaces.
- Upgrade to the existing car parking area to provide permanent formalised parking for up to 272 vehicles, and provision of spill over parking for 60 vehicles.
- Upgrade to the existing access road inside the site boundary, provision of a flood emergency access route from the site and construction of ancillary infrastructure and services.
- Landscaping of the site.

The proposed development is to be constructed in two stages. Stage 1 will involve works to upgrade the existing buildings for use of the site as a function centre, restaurant and continued use of the site as a motor boat club. These works will include retrofitting of the existing buildings, upgrading of the car parking, construction of a flood emergency evacuation route and upgrades to existing services and associated landscaping. The Development Application seeks concept approval for all of the nominated site uses as well as sufficient detail to enable the Stage 1 development to be constructed.

Approval to construct the new boat shed and small craft launching facility will form Stage 2 and will be the subject of a separate Development Application (Stage 2).

3. WATER QUALITY TREATMENT TARGETS

3.1 Bankstown Council Stormwater Management Requirements

Bankstown Development Control Plan 2005 (DCP 2005) does not provide specific requirements for stormwater treatment for the type of development that is proposed by Doltone House for the site. Part D7 of DCP 2005 outlines requirements for water conservation for new development, but these requirements are limited to specifying the need for water conservation to be built into a development proposal. Requirement W2 of Section 2 of Part D7 of DCP 2005 indicates that a Site Water Management Plan must be prepared for all new development proposals which have a gross floor area of greater than 5,000 m^2. The Site Water Management Plan is not specific to stormwater except in so far as it is a requirement that proposals for reducing mains water supply use by treating and re-using stormwater from the site.

Notwithstanding, Section 9 of Bankstown City Council's *'Development Engineering Standards'* (*2006*) provides guidance on stormwater treatment measures that Council considers appropriate for new development. Section 9.3.8 of the Standards indicates that new developments need to incorporate permanent stormwater pollution controls. These permanent stormwater pollution controls should include silt arrestors and trash screens for most developments and oil arrestors for industrial and commercial developments where oil or grease may be carried by runoff to the receiving waters.

The Development Engineering Standards also indicate that stormwater runoff that discharges to natural waterways must have "greater controls on stormwater quality" than under existing conditions, and where required, "individual pollution controls".

Section 10 of Council's Development Engineering Standards (2006) provides further guidance for stormwater drainage. However, this guidance primarily relates to stormwater drainage structures and on-site detention systems and serves to inform the detail design of an adopted stormwater management strategy.

3.2 Stormwater Pollutant Reduction Targets

As outlined in Section 3.1, Bankstown City Council does not impose any specific requirements for pollutant reduction targets for urban, commercial and industrial development that is proposed within the LGA. As a comparison, current best practice pollution reduction targets outlined in the UrbanGrowth NSW (formerly Landcom) guideline *Water Sensitive Urban Design Book 1: Policy* recommend the following reduction targets for annual runoff pollutant loads from developments:

- 85% for total suspended solids (TSS)
- 65% for total phosphorous (TP)
- 45% for total nitrogen (TN)

The UrbanGrowth NSW pollutant reduction targets are typically applied to new development where significant changes to land uses are proposed, and where the percentage of impervious surfaces will increase. The Doltone House Deepwater development will primarily involve the refurbishment of an existing development and will not substantially increase the impervious area across the overall site. In this regard, it needs to be noted that the existing car parking area is sealed and that the proposal to increase the extent of the paved carparking area involves a net increase in surface area of only 2,000 m^2. This is relatively small compared to the total site area of just over 4 ha.

In addition, the proposed refurbishment works will not result in a significant change to the developed footprint across the site. This is because the new development will largely comprise the same footprint as the footprints of existing buildings / pool areas across the site.

Therefore, it can be concluded that the proposed development is not a new “greenfield” type development and on that basis, it follows that the UrbanGrowth NSW criteria for pollutant load reduction is not appropriate. In recognition of the nature of the development and the proportion of the site that is to be re-developed, it is considered appropriate that the stormwater management strategy focus on ensuring that post development pollutant loads discharged from the site are no greater than under existing conditions.

4. WATER QUALITY MANAGEMENT STRATEGY

4.1 Potential Treatment Devices

4.1.1 Bio-retention Systems

The purpose of bio-retention systems is to remove pollutants typically found in urban runoff (*i.e. TN, TP and TSS*) by sedimentation, filtering and biological action. Low flows are maintained as much as possible on the surface (*i.e. not piped*) to maximise the exposure to sunlight and to increase the potential for oxygen entrainment via turbulence.

The role of the bio-retention systems is not to promote infiltration into the surrounding subsoils but to maintain it below the surface in the drainage media incorporated at the base of the swale.

Bio-retention systems promote the detention and passage of stormwater through a prescribed subsurface filter medium. Runoff is forced to pond on the surface of the bio-retention system and then percolate through the filter media. Typical bio-retention systems include swales, rain gardens and tree pits.

The type of filter medium determines the effectiveness of the pollutant removal. Material of lower hydraulic conductivity provides the most efficient pollutant removal through higher retention time and a greater filtering effect.

Small rainfall events will pond and filter through the media, while during larger rainfall events water will initially infiltrate the trenches before also spilling into a collection pit or along a designated overland flowpath.

A typical bio-retention system consists of the following:

- Subsurface bio-filter material consisting of sandy-loam
- Extended detention depth of at least 0.3 metres
- An impermeable liner (*if required to prevent infiltration of groundwater or exfiltration to groundwater*)
- A subsoil drainage pipe system surrounded by a gravel medium
- A transition layer of medium – coarse sand. The sizing of the sand and gravel is critical to prevent the overlying material including the bio-retention filter media from moving into the subsoil drain.
- Plantings generally consisting of native sedge plants and grasses.
- A concrete pipe to accommodate trunk drainage requirements, where necessary.

4.1.2 Gross Pollutant Traps

A Gross Pollutant Trap (GPT) is a mechanical treatment device which captures litter, coarse sediment, some nutrients, oils and greases. While the pollutant capture efficiency of various traps may vary, the paper titled, *'Removal of Suspended Solids and Associated Pollutants by a Gross Pollutant Trap'* (*Cooperative Research Centre for Catchment Hydrology, 1999*) suggests the following efficiencies in terms of pollutant reduction for a GPT:

- gross pollutants up to 95%
- sediments up to 70%
- total phosphorous up to 30%
- total nitrogen up to 13%

4.1.3 Oil and Grease Separators

An oil and grease separator is designed to assist in the trapping and removal of hydrocarbons from a catchment area. Oil and grease separators can also assist in removing TN, TP and TSS, however not at the same efficiencies of a GPT.

It is noted that there are GPT's on the market that can capture hydrocarbons.

The oil and grease separators would be designed to capture and treat up to the 3 month ARI storm event of corresponding catchments.

4.2 Proposed Stormwater Management Strategy

The proposed stormwater management strategy for the redevelopment of the site is presented in **Figure 2**. It incorporates a water sensitive urban design (WSUD) approach with emphasis on a treatment train that extends throughout the development.

This strategy is based on achieving stormwater treatment close to the source and incorporates rainwater tanks that collect roof runoff, a bio-retention system, a gross pollutant trap and an oil and grease separator, all of which will serve to reduce potential pollutant loads discharging from the site.

4.2.1 Car Parking Area Drainage

The proposed stormwater quality treatment strategy for the Site has been developed with the primary objective of polishing runoff from the proposed car parking area. The proposed car park is the single largest area of the proposed development that has the greatest potential to increase pollutant loads in runoff from the site. It will cover an area of approximately 7500 m^2, which is an increase of approximately 2000 m^2 over the area covered by the existing car park.

The proposed car park will incorporate a pit and pipe drainage network as shown in **Figure 2**. The car parking area will be graded from north to south as shown in **Figures 3** and **4**, and will ultimately discharge to the Georges River via an existing swale located near the southern site boundary (*refer* **Figure 2**).

The drainage system will have sufficient capacity to convey peak flows generated in a 20 year average recurrence interval (ARI) design storm event. Flows in excess of the peak 20 year ARI storm event will be conveyed within an overland flow path.

A GPT and a single oil and grease separator will be located at the end of the car park pipe drainage network near its point of discharge to the proposed bio-retention basin (*refer* **Figure 2**). The oil and grease separator will remove oil and grease from captured stormwater runoff that is drained toward the bioretention basin. The location of the proposed oil and grease separator is shown in **Figure 2**.

A bio-retention system / swale will also be incorporated into the stormwater treatment train for additional runoff treatment. This will be achieved by sub-surface filtration via a filter medium of sandy loam and planted macrophytes. The filter medium will be one metre deep and cover a surface area of approximately 80 m^2. The total area of the swale, including the extended detention area within the bio-retention basin (*refer* **Figure 2**) will cover an area of approximately 300 m^2. The proposed location and extent of the bio-retention system is shown in **Figure 5**.

High flows from the catchment draining to the bio-retention system will pass through the basin and be conveyed through culverts underneath the access road that extends into the site from Webster Street, before being discharged into the Georges River via an existing swale (*refer* **Figure 5**).

Stormwater runoff from the car parking area will be directed to the bio-retention basin via the network of stormwater pits and reinforced concrete pipes shown in **Figure 2**. The bio-retention basin will be lined with an impermeable layer to prevent infiltration of groundwater.

The bio-retention basin will be constructed with a combined low and high flow outlet system as shown in **Figure 5**.

The low flow system will consist of slotted drainage pipes which will collect stormwater captured within the bio-retention basin filter media. Collected stormwater will be directed to a pre-cast concrete pit located adjacent to the site entry at the western end of Webster Street (*refer* **Figure 5**). A reinforced concrete pipe will be connected to the pit and will direct low flows across Webster Street (underground) to an outlet to be constructed in the bank of the Georges River near the eastern boat launching ramp. A baffle plate will be constructed inside the concrete pit to prevent tidal intrusion into the basin.

The high flow system will consist of a weir and graded open channel which will convey high flows overland across Webster Street and into an existing drainage channel (*refer* **Figure 5**), before discharge to the Georges River.

The invert of the bio-retention basin will have an elevation of 1.4 mAHD. This will ensure that there is sufficient grade to collect stormwater from the car parking area and to provide adequate extended detention, while allowing sufficient head for the captured stormwater to discharge from the site. It is noted that the basin is designed to cater for flows equivalent to those generated in events up to the 3 month ARI storm event, with drainage of the system occurring during low tides in the Georges River.

4.2.2 Stormwater Reuse

The proposed development will also incorporate rainwater tanks for internal and external non-potable water reuse. The undercroft space within the function centre building will be used to house four 20,000 litre water storage tanks. The rainwater collected from the roof of the function centre building will be collected in the tanks and will be used for non-potable uses external to the building, as well as other non-potable uses within the building, including the flushing of toilets and urinals and for fire fighting purposes. Dual reticulation systems including backflow prevention devices will be incorporated within the rainwater storage and distribution system.

Rainwater storage and reuse will further assist in reducing pollutant loads in runoff from the developed site.

4.2.3 Summary

The stormwater management system for the site will incorporate an oil and grease arrestor, a GPT and a bio-retention basin. Therefore, it incorporates greater controls on stormwater quality than currently exist and will incorporate specific individual pollution controls for key pollutants. Hence, it aligns with the requirements of Section 9.3.8 of Council's Development Engineering Standards.

The proposed system also incorporates four 20,000 litre rainwater tanks which will be devoted to re-use on the site either via toilet flushing systems or for irrigation. Therefore, the proposed strategy achieves the objectives of Requirement W2 of Section 2 of Part D7 of Bankstown City Council DCP 2005.

An assessment of the capacity for the proposed system to ensure that post-development runoff water quality will be at or better than the standard of water quality of existing site runoff was subsequently undertaken using a MUSIC water quality model of the site. The findings from the associated analysis are presented in **Section 5**.

5. WATER QUALITY MODELLING

The proposed Water Management Strategy for the site was analysed and sized with the assistance of a MUSIC water quality model. MUSIC is a conceptual water quality assessment software package developed by the Cooperative Research Centre for Catchment Hydrology (*CRCCH*). It can be used to estimate the long-term annual average stormwater volume generated by a catchment as well as the expected pollutant loads. MUSIC is able to conceptually simulate the performance of a group of stormwater treatment measures (*treatment train*) to assess whether a proposed water quality strategy is able to meet specified water quality objectives.

Accordingly, a long-term MUSIC model was established for the existing site to allow the water quality of runoff from the site to be assessed for existing conditions. The model was used to estimate the annual pollutant load generated under existing conditions using a 3 year period of historically averaged rainfall for the area. A separate post-development scenario model was developed and used to estimate the annual pollutant load generated under existing condition

MUSIC was chosen for this investigation because it has the following attributes:

- It can account for the temporal variation in storm rainfall throughout the year;
- Modelling steps can be as low as 6 minutes to allow accurate modelling of treatment devices;
- It can model a range of treatment devices;
- It can be used to estimate pollutant loads at any location within the catchment; and
- It is based on logical and accepted algorithms.

5.1 MUSIC Model Input Data

5.1.1 Rainfall

The annual rainfall recorded at Liverpool (*Station No. 67035*) for all years between 1963 and 2000 (*excluding 1994 where a complete year was not recorded*) was obtained from the Bureau of Meteorology. The long term average annual rainfall determined from this gauge record is 866 mm.

In order to develop a model that can comprehensively assess the performance of water quality treatment devices such as bio-retention systems, it is preferable to have access to 6 minute pluviograph data. Unfortunately no pluviograph data was available for the site or surrounding areas. Therefore, a pluviograph record for the period from 1st January 1972 through until 31st December 1975 with a total annual rainfall of 885 mm, was obtained from a nearby rainfall station and utilised in the MUSIC modelling.

5.1.2 Evaporation

Monthly areal potential evapotranspiration values were obtained for the Deepwater Site from a Bureau of Meteorology publication titled, *'Climate Atlas of Australia - Evapotranspiration'* (*2001*). This data is listed in **Table 5-1**.

Table 5-1 Monthly Areal Potential Evapotranspiration

Month	Areal Potential Evapotranspiration (mm)
January	175
February	135
March	125
April	85
May	58
June	44
July	45
August	59
September	89
October	125
November	151
December	165
TOTAL	1256

5.1.3 Soil Parameters and Model Calibration

Soil profile parameters affect the amount of stormwater runoff generated from pervious areas of a catchment. In the absence of any site specific data, the default soil parameter values provided in the MUSIC software were used to model the development site. Soil properties for the site were calibrated to achieve a runoff coefficient (C_v) of 0.23 for the pre-developed site, which is appropriate for an area predominately made of parklands.

5.1.4 Pollutant Concentrations

The event mean pollutant concentrations (EMCs) that were used in the modelling were derived from the Engineers Australia publication titled, *'Australian Runoff Quality – A guide to Water Sensitive Urban Design'* (*2006*). The adopted pollutant concentrations are listed in **Table 5-2**.

Table 5-2 Adopted Pollutant Concentrations

LAND USE	POLLUTANT CONCENTRATION (mg/L)					
	Wet Weather Concentration (mg/L)			Dry Weather Concentration (mg/L)		
	Suspended Solids	Total Phosphorous	Total Nitrogen	Suspended Solids	Total Phosphorous	Total Nitrogen
Commercial	140	0.25	2	16	0.14	1.3
Roof Area	20	0.13	2	-	-	1.3
Roads/Carpark	270	0.5	2.2	-	-	-

5.2 Existing Conditions

5.2.1 MUSIC Model Inputs

The primary objective is to achieve a no net increase in pollutant export relative to existing conditions. Therefore, the existing pollutant export from the site was estimated to establish the base case against which to measure the performance of the proposed development.

The data presented in **Table 5-3** was used to create a MUSIC model for the site.

Table 5-3 Existing Catchment Data

CATCHMENT AREA	LAND USE	AREA (*ha*)	IMPERVIOUS (%)
Roads/Carparking Area	Roads/Carpark	0.55	100
Roof Area of Function Centre	Roofs	0.10	100
Open space	Parkland	3.51	10
Total		4.16	24

5.2.2 MUSIC Modelling Results

The calibrated MUSIC model was used to simulate pollutant export generated during an average 3 year period using evaporation data listed in **Table 5-1** and typical pollutant concentrations contained in **Table 5-2**.

The annual export of pollutants generated from the existing site as determined from the MUSIC modelling, is summarised in **Table 5-4**. The results also indicate that the average volumetric flow from the existing site will be 14.4 ML/year, yielding a volumetric runoff coefficient (C_v) of 0.39. This is a relatively moderate C_v value and is consistent with the percentage of impervious area within the site.

Table 5-4 Total Annual Pollutant Export Loads from Site for Existing State

SCENARIO	POLLUTANT LOAD (*kg/yr*)			
	Suspended Solids	Total Phosphorous	Total Nitrogen	Gross Pollutants
Existing Site	2630	4.70	29.3	273

5.3 Post Development (No Treatment)

5.3.1 MUSIC Model Inputs

The existing state model was modified to reflect the post development conditions. No treatment techniques were implemented in the re-developed (*no treatment*) model. The model was modified to reflect the impervious proportions of the catchment as defined in **Table 5-5**.

Table 5-5 Redeveloped Site Catchment Data

CATCHMENT AREA	LAND USE	AREA (*ha*)	IMPERVIOUS (%)
Roads/Carparking Area	Roads/Carpark	0.88	100
Roof Area of Function Centre	Roofs	0.34	100
Open space	Parkland	2.94	10
Total		4.16	33

5.3.2 MUSIC Modelling Results

The estimated annual export of pollutants from the re-developed (*no treatment*) site are compared with existing conditions in **Table 5-6**.

Table 5-6 Annual Pollutant Export Loads for Re-developed State (No Treatment)

SCENARIO	POLLUTANT LOAD (*kg/yr*)			
	Suspended Solids	Total Phosphorous	Total Nitrogen	Gross Pollutants
Existing Site	2630	4.70	29.3	273
Proposed Site (no treatment)	3290	6.27	38.6	363

A comparison of pollutants discharged from the redeveloped site (*without treatment measures*) with those generated from the site under existing conditions, indicates that the proposed development has the potential to generate higher volumes of pollutants. This increase is primarily due to the increased impervious area associated with the proposed car parking area.

Results from the MUSIC modelling show an average volumetric runoff increase relative to the existing site conditions of 17.4 ML/year, yielding a C_v value of 0.47. Once again, the increase is a result of the increased impervious area across the car park and the roof area of the proposed function centre.

5.4 Post Development (With Treatment)

5.4.1 MUSIC Model Inputs

The MUSIC model of the re-developed site (*with treatment*) takes into consideration the nutrient uptake from the bio-retention system that is proposed to be incorporated into the car park drainage system. The bio-retention system is described in **Section 4.2** and is shown graphically in **Figures 2** and **5**.

5.4.2 MUSIC Modelling Results

Table 5-7 provides a comparison of the estimated annual export of pollutants from the re-developed site (*with treatment*) with those generated for existing and re-developed site (*no treatment*) conditions.

The comparison shows that the re-developed site *with the proposed treatment measures* will generate lower pollutant volumes than predicted under existing conditions.

The decrease in pollutant volumes is due to primarily to the proposal to construct a bio-retention system for stormwater treatment. The inclusion of a GPT will also serve to reduce potential pollutant loads.

Table 5-7 Annual Pollutant Export Loads for Re-developed State (With Treatment)

SCENARIO	POLLUTANT LOAD (*kg/yr*)			
	Suspended Solids	Total Phosphorous	Total Nitrogen	Gross Pollutants
Existing Site	2630	4.70	29.3	273
Redeveloped Site (no treatment)	3290	6.27	38.6	363
Redeveloped Site (with treatment)	1410	3.83	29.2	188

Results from the MUSIC modelling show an average volumetric runoff decrease from the re-developed site (without treatment) of 17.1 ML/year, yielding a C_v of 0.46. The decrease in volumetric runoff is likely to be a result of extended detention within the bio-retention system.

5.5 Summary

The MUSIC modelling results indicate that the proposed treatment train will improve the quality of runoff from the site and that runoff from the site will meet the water quality treatment targets listed in **Section 3**.

It is noted that four 20,000 litre rainwater tanks are also proposed to be installed within the undercroft of the function centre. These rainwater tanks will be fed from the function centre roof. The benefits that will be afforded by these rainwater tanks have not been considered in the water quality modelling. Hence, it is likely that runoff water quality will actually be better than predicted by the modelling.

6. CONSTRUCTION PHASE STORMWATER MANAGEMENT

It will be necessary to implement a range of erosion and sediment control measures during construction of the car parking area and during the works associated with raising Maxwell Avenue. These erosion and sediment control measures will be designed as part of the detail design phase of the project in accordance with guidelines outlined in the Landcom publication titled, *'Managing Urban Stormwater – Soils and Construction'* (*2004*) (*also known as 'The Blue Book'*).

Erosion and Sediment Control Plans would be prepared for each stage of the development prior to construction. These Plans will outline strategies to prevent the transfer of water borne pollutants to the receiving waters during and immediately following construction. It is recommended that the measures shown in **Figure 6** be implemented as part of the erosion and sediment control strategy for the site. The key elements of the strategy should include:

- Stabilised site access at all entry and exit points to the site in order to prevent the migration of soil and sediments to watercourses such as the Georges River. This should include a dedicated wash down bay at the entry from Webster Street, as shown in **Figure 6**.
- Silt fences are to be installed downslope from any disturbed areas and on the alignments specified in **Figure 6**.
- The area of soil disturbed at any one time is to be minimised where possible. Any stockpiled material should be covered, kept moist or planted with hydromulch.
- Sediment basins are to be constructed as required across the site, but as a minimum should include a dedicated sediment basin at the site of the proposed bioretention basin (refer **Figure 6**).
- Disturbed areas are to be rehabilitated as soon as practical.

These controls would serve to reduce the potential for pollutants carried by stormwater runoff to be distributed to the receiving waters during construction.

7. CONCLUSIONS

The proposed Stormwater Management Strategy for the Deepwater Site focusses on providing a stormwater treatment train for the car parking area that incorporates the use of an end of line bio-retention basin. The system also incorporates an on-line GPT and an on-line oil and grease separator connected to the end of the proposed stormwater drainage network (*refer to* **Figure 2**). The bio-retention system will be configured as a basin / rain garden and will cover a surface of approximately 300 m^2. It will incorporate a one metre deep infiltration system, which would cover an area of approximately 80 m^2.

Water quality modelling indicates that the proposed stormwater treatment train for the car parking area will ensure that post-development runoff from the Deepwater Site will result in no increase in nutrient loading to the Georges River.

Overland flows from the site will be conveyed via dish drains and grassed swales that will direct runoff into existing open channels that discharge to the Georges River.

The proposed Water Management Strategy for the Site addresses the relevant provisions of DCP 2005 and considers the requirements of Bankstown City Council's Development Engineering Standards (*2006*). In this regard, the proposed Stormwater Management System incorporates four 20,000 litres rainwater tanks which will be used for re-use on site. Accordingly, the proposed strategy is considered to achieve the requirements of Part D7 - Sustainable Development of DCP 2005.

8. REFERENCES

- Bankstown City Council (*2006*) *'Development Engineering Standards'*
- Bankstown City Council (*2005*), *'Development Control Plan 2005'*
- Bureau of Meteorology (*2001*), *'Climatic Atlas of Australia – Evapotranspiration'* ISBN 978-0-642-32048-3
- Co-operative Research Centre for Catchment Hydrology (*2005*), '*MUSIC User Guide*'
- Engineers Australia (*1987*), *'Australian Rainfall and Runoff – A Guide to Flood Estimation'* Volume 1, edited by DH Pilgrim.
- Engineers Australia (*2005*), *'Australian Runoff Quality – A Guide to Water sensitive Urban Design'*
- NSW EPA (*1997*), *'Managing Urban Stormwater: Council Handbook'*
- Landcom (*now UrbanGrowth NSW*), *'Managing Urban Stormwater, Soils and Construction'* (*The Blue Book*), Volume 1, 4th Edition, March 2004
- Landcom (now UrbanGrowth NSW), '*Water Sensitive Urban Design; Book 1 Policy*', May 2009

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DOLTONE HOUSE DEEPWATER
LAYOUT AND EXTENT OF PROPOSED DEVELOPEMENT

FIGURE 01

LOCATION: W:_INFRASTRUCTUREPROJECTS\301015\02379 - DEEPWATER MOTOR BOAT CLUB REDEVELOPMENT\110 DRAWINGS\SKETCHES\301015-02379-FIGURE 01_A.DWG
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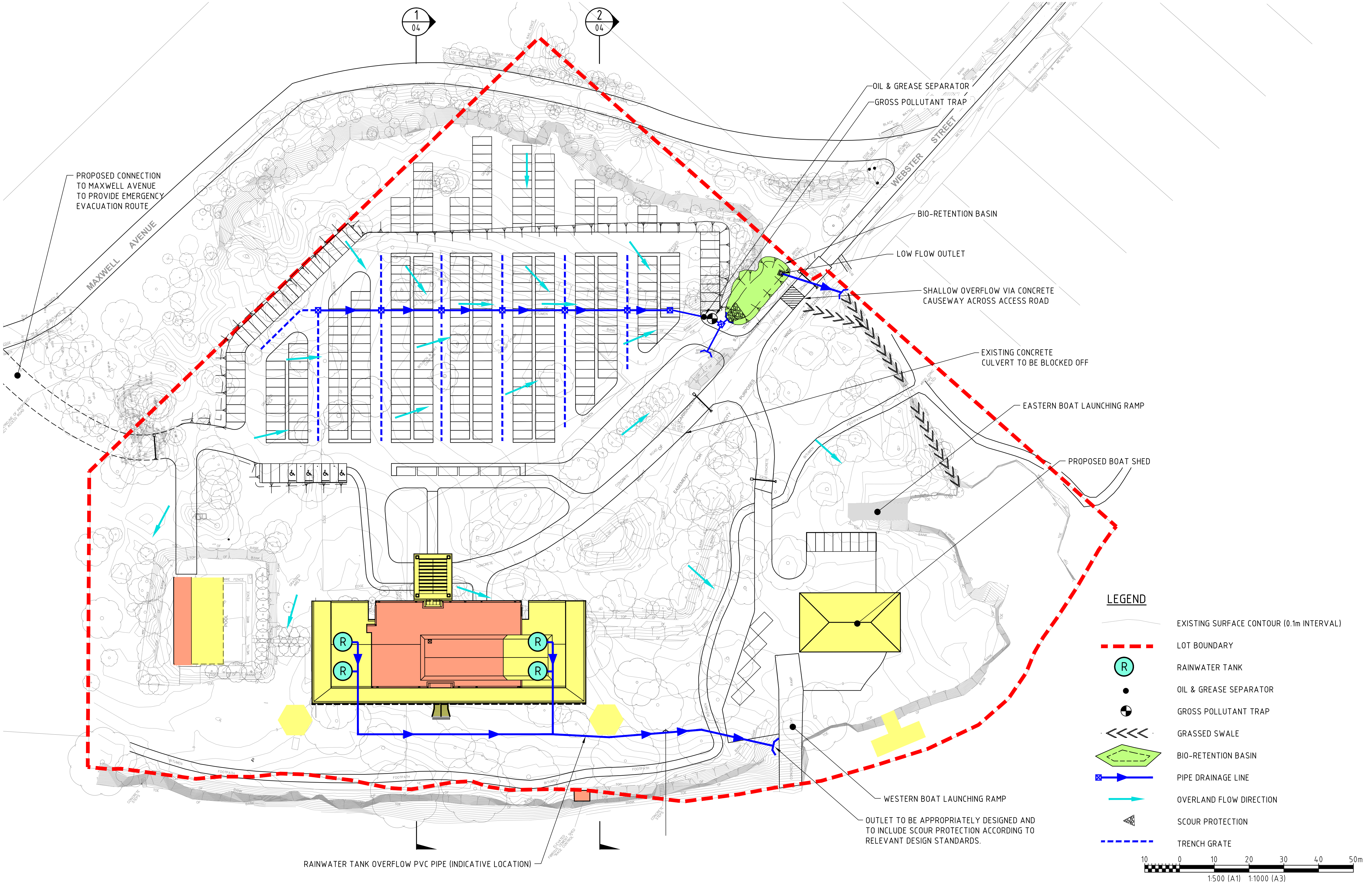

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NORTH

DOLTONE HOUSE DEEPWATER
LAYOUT OF PROPOSED
STORMWATER MANAGEMENT SYSTEM

FIGURE 02

LOCATION: W:_INFRASTRUCTURE\PROJECTS\301015\02379 - DEEPWATER MOTOR BOAT CLUB REDEVELOPMENT\110 DRAWINGS\SKETCHES\301015-02379-FIGURE 02_A.DWG
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DOLTONE HOUSE DEEPWATER
PROPOSED CAR PARK GRADING PLAN

FIGURE 03

LOCATION: W:_INFRASTRUCTURE\PROJECTS\301015\02379 - DEEPWATER MOTOR BOAT CLUB REDEVELOPMENT\110 DRAWINGS\SKETCHES\301015-02379-FIGURE 03_A.DWG

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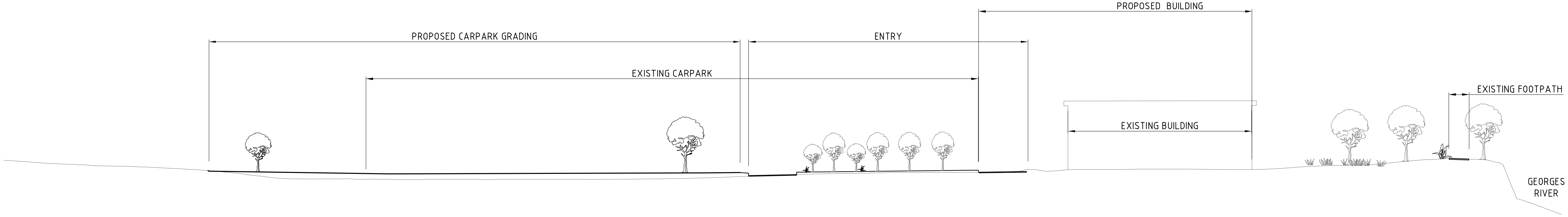

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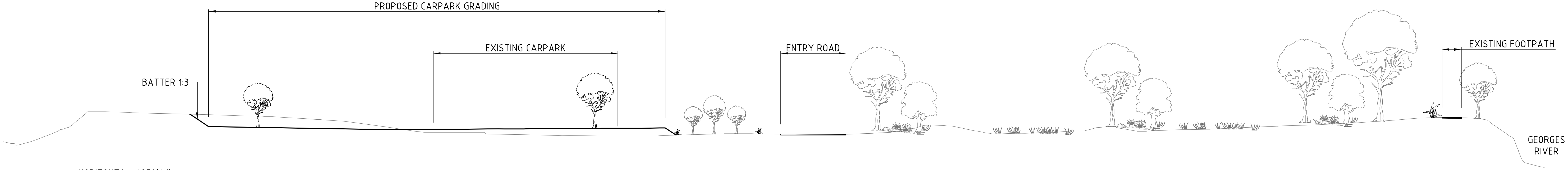

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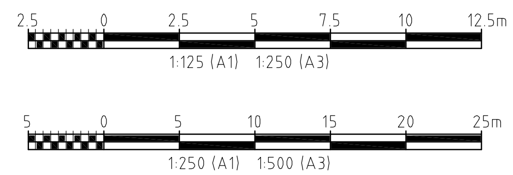

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DOLTONE HOUSE DEEPWATER
PROPOSED SITE SECTIONS

FIGURE 04

LOCATION: W:_INFRASTRUCTURE\PROJECTS\301015\02379 - DEEPWATER MOTOR BOAT CLUB REDEVELOPMENT\10 DRAWINGS\SKETCHES\301015-02379-FIGURE 04_A.DWG
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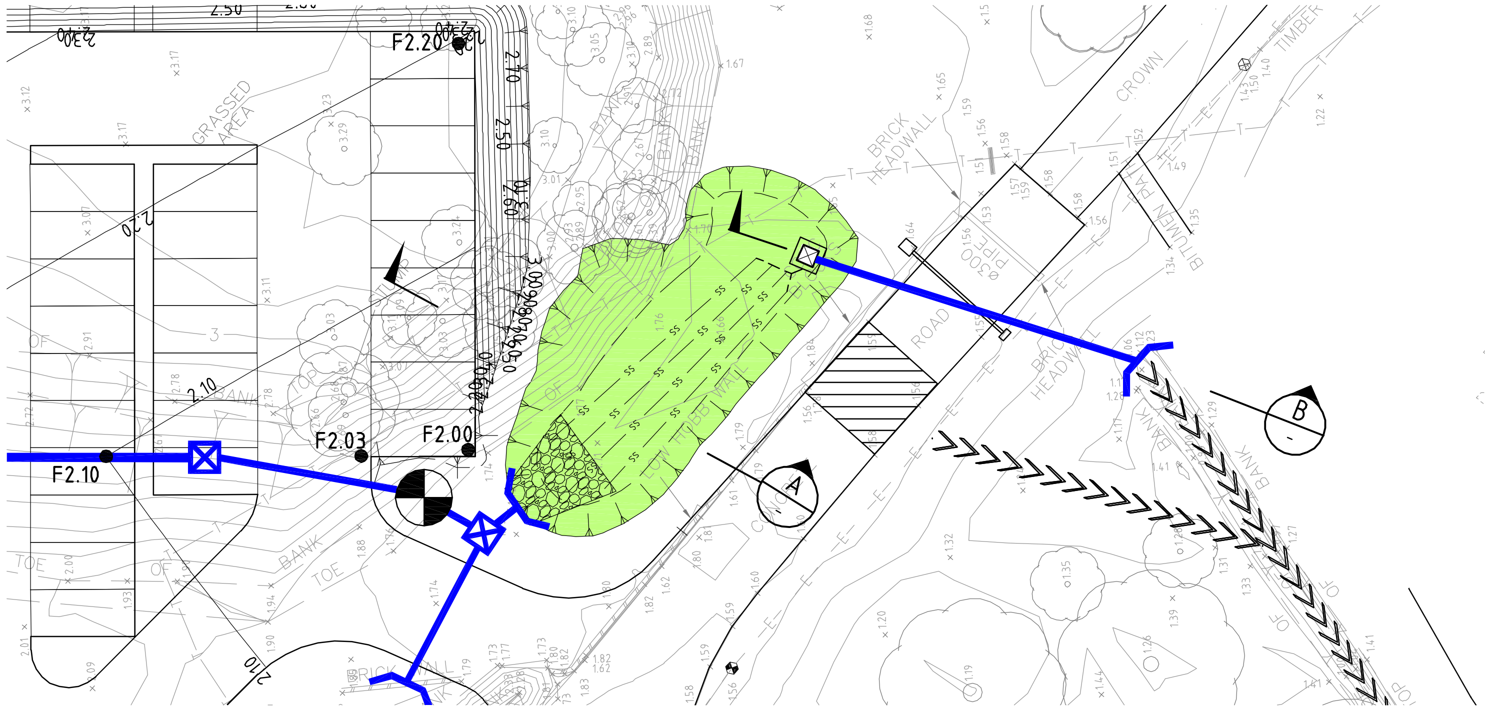

BIO RETENTION BASIN PLAN
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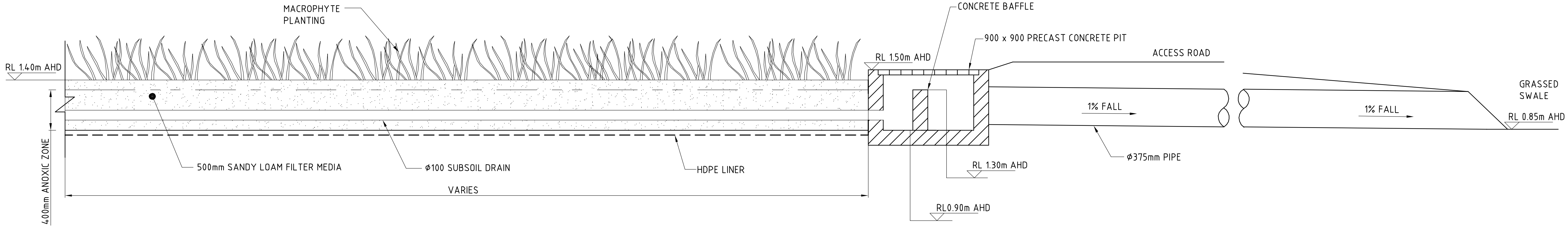
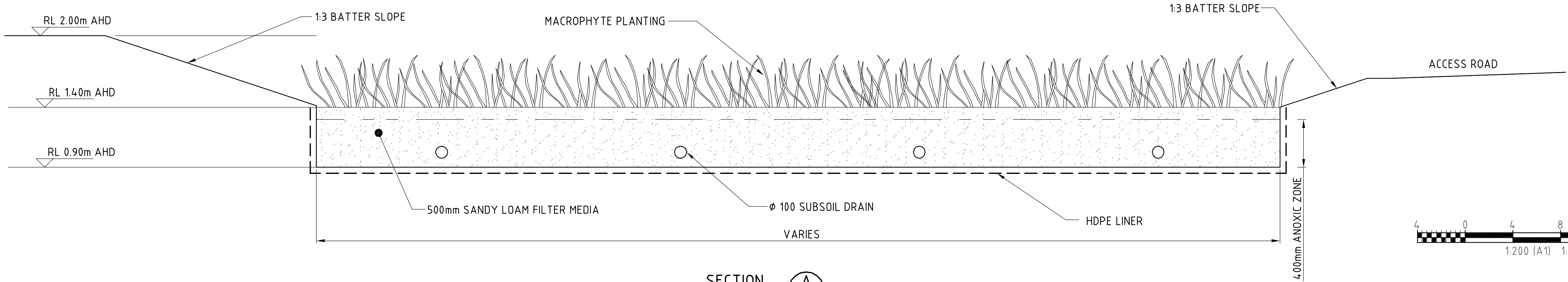
LEGEND

- GRASSED SWALE
- PIPE DRAINAGE LINE
- SUBSOIL DRAINAGE LINE
- CONCRETE CAUSEWAY



SECTION B
SCALE 1:20



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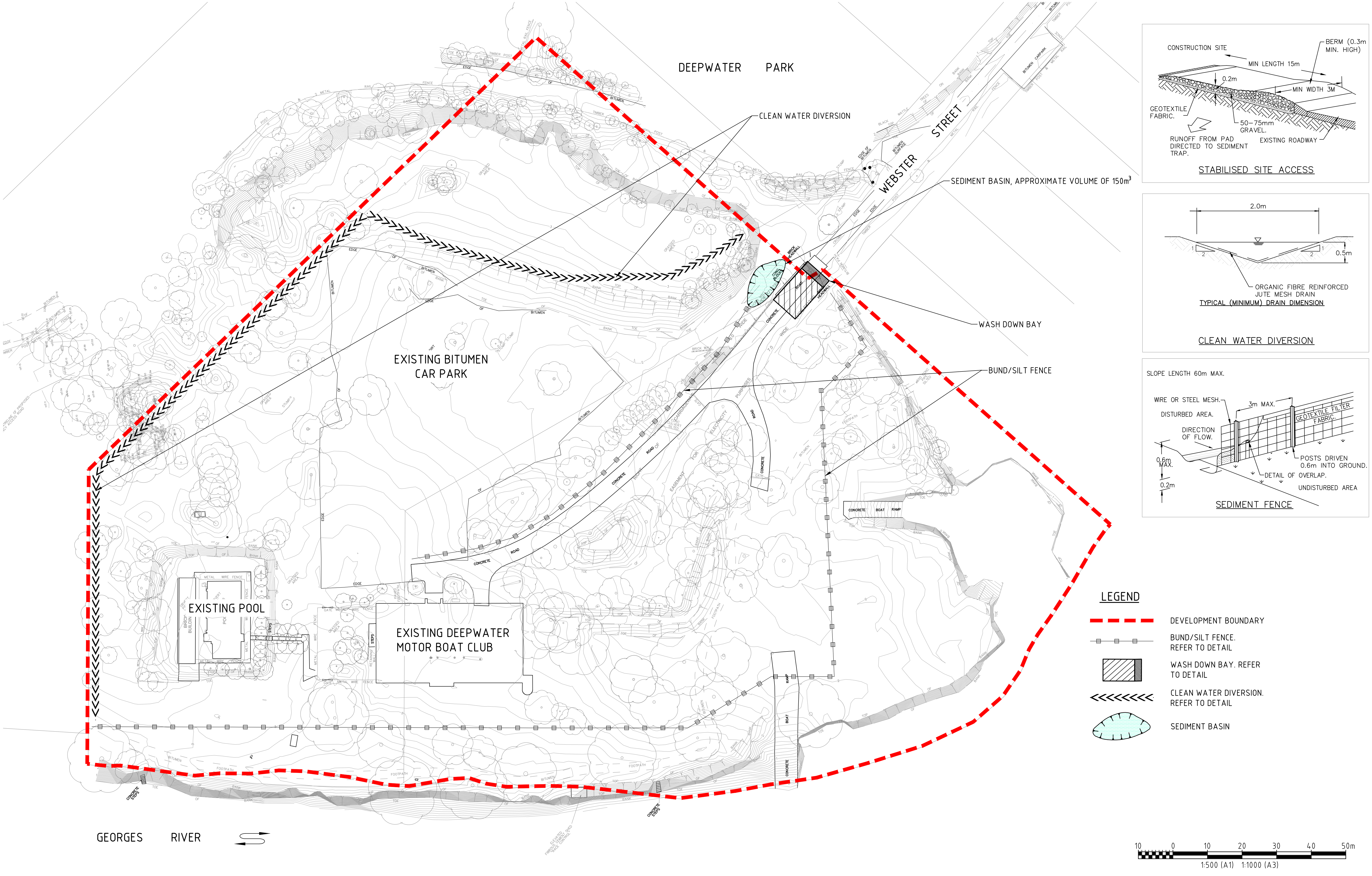
DOLTONE HOUSE DEEPWATER
BIO RETENTION BASIN DETAILS

FIGURE 05



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DOLTONE HOUSE DEEPWATER

PRELIMINARY SEDIMENT & EROSION CONTROL PLAN

FIGURE 06

LOCATION: W:_INFRASTRUCTURE\PROJECTS\301015\02379 - DEEPWATER MOTOR BOAT CLUB REDEVELOPMENT\110 DRAWINGS\SKETCHES\301015-02379-FIGURE 06_A.DWG

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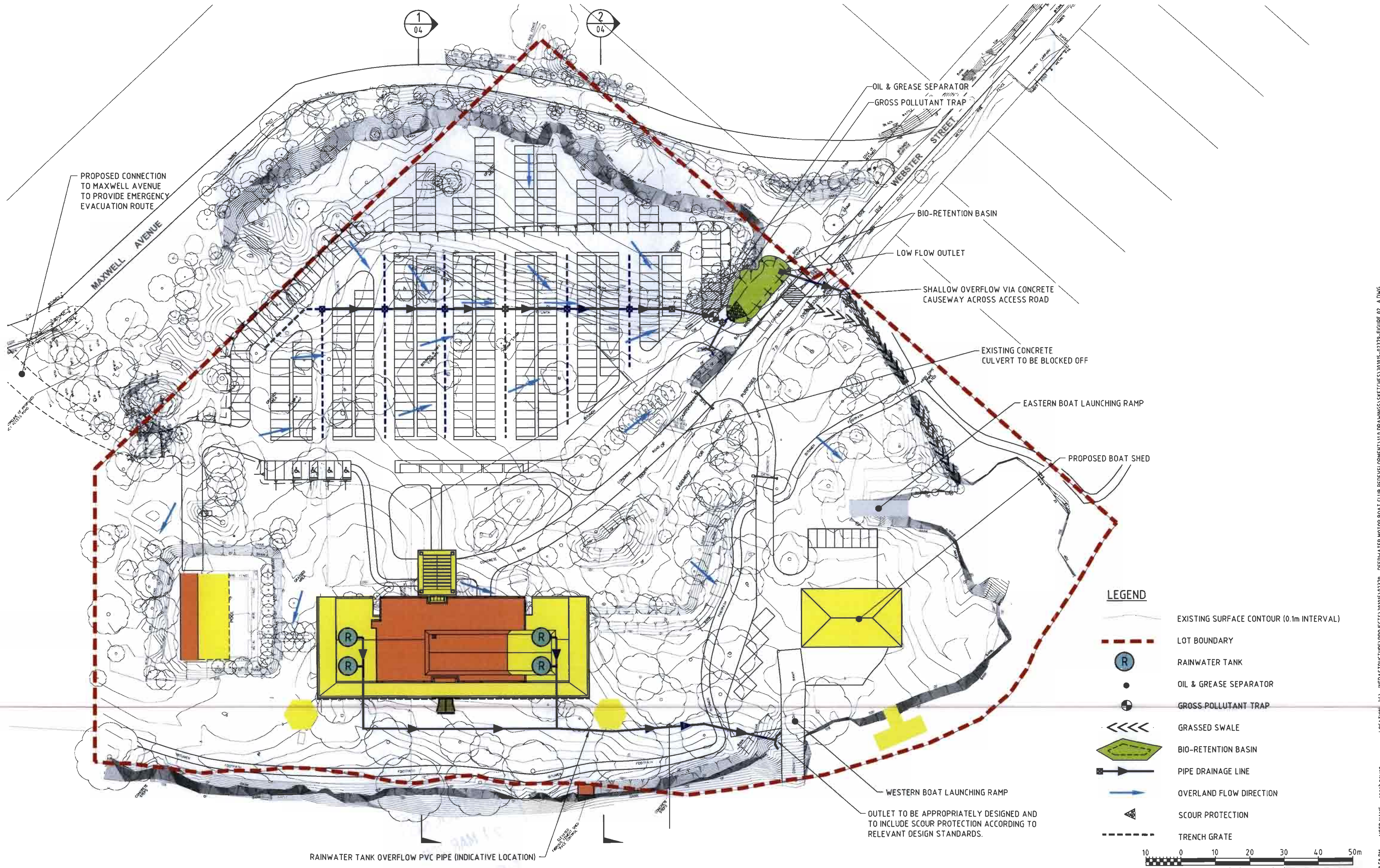

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DOLTONE HOUSE DEEPWATER
LAYOUT OF PROPOSED
STORMWATER MANAGEMENT SYSTEM
FIGURE 02

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