Environmental Impact Statement
Georges Cove Marina

Volume 1 – Main report and appendices A to C

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Prepared for Benedict Industries Pty Ltd
May 2019



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Certification

For submission of an environmental impact statement (EIS) under Part 4, Division 4.1 of the NSW Environmental Planning and Assessment Act 1979.

EIS prepared by

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Applicant

Benedict Industries Pty Ltd

Description of development

Construction and operation of a marina and related facilities on the southern portion of Lot 7 DP 1065574 in the Liverpool City Council Local Government Area (LGA). The development would include the e following main elements:

1. a Maritime Building;
2. a wet berth facility predominately for small craft (ie boats less than 15 m long) and some vessels up to 20 m long;
3. three external carparks and two basement carparks providing a total of 637 car spaces;
4. a Private Marina Clubhouse; and
5. support infrastructure, including power, water and sewerage services.

Land to be developed

146 Newbridge Road, Moorebank, NSW 2170
Lot 7 DP 1065574

Certification

We certify that the contents of this EIS have been prepared in accordance with Part 4 of the *Environmental Planning and Assessment Act 1979*, Schedule 2 of the Environmental Planning and Assessment Regulation 2000 and the NSW Department of Planning and Environment Secretary's Environmental Assessment Requirements issued for the development. To the best of our knowledge, it contains all available information that is relevant to the environmental assessment of the development to which the statement relates. The information contained in this EIS is neither false nor misleading.



P. Towler
Associate Director
24 May 2019

Executive Summary

ES1 Introduction

ES1.1 Overview

Benedict Industries Pty Ltd (Benedict Industries) proposes to construct and operate a marina and related facilities on a southern portion of Lot 7 DP 1065574 (146 Newbridge Road, Moorebank, referred to in this report as the "marina site") in the Liverpool City Council Local Government Area (LGA). The proposed development will utilise about 13 ha of Lot 7 (22 ha). The overall site (ie Lot 7) has been used for sand extraction, dredging and recycling operations.

The proposed development will utilise an existing sand extraction dredge pond (approximately 6 ha) as the basis for forming the final marina basin. This will largely remove the need to import fill to restore the landform following the closure of the quarry, as is otherwise permitted by the existing quarry planning approval.

The architect-designed marina redevelopment (see Figure ES.1) will provide an alternative means to implement the final restoration of the extractive industry activity on the marina site. It is an innovative proposal which is sensitive to the high value riverine locality and will provide valuable community recreational infrastructure which will reconnect the community with the river foreshore.



Figure ES.1 View of proposed Maritime Building and wet berths from the marina basin (computer generated photomontage)

Development consent is required for the proposed development under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) pursuant to the provisions of the Liverpool Local Environmental Plan (LEP) 2008, other relevant environmental planning instruments, and the Liverpool Development Control Plan (DCP) 2008. The proposal is classified as designated development and integrated development under the EP&A Act. Liverpool City Council is the consent authority and the Sydney South West Planning Panel is the determining authority. Secretary's Environmental Assessment Requirements (SEAR 912) were issued for the project on 19 March 2015 and updated on 9 October 2018.

This environmental impact statement (EIS) has been prepared in accordance with the SEARs, Clauses 71 and 72 of the EP&A Regulation and advice provided by the Council and other stakeholders. It describes the existing environment, the proposal, the legislative and policy context, proposed environmental management measures and the impacts of the project.

The proponent, Benedict Industries, is acting for the land owner, Tanlane Pty Ltd (Tanlane).

ES1.2 Previous Georges Cove Marina development applications

A previous application for the proposed Georges Cove Marina by Benedict Industries (acting for the owner, Tanlane) was made to Liverpool City Council (DA-846/2012). Consent for the Georges Cove Marina was granted to Tanlane by the Sydney West Joint Regional Planning Panel (JRPP) on 22 August 2014 (JRPP Reference Number 2012SYW035).

The validity of the Consent was challenged in the NSW Land and Environment Court by the proposal's sole objector, Moorebank Recyclers. In 18 March 2015, the court ruled in favour of the objector, declaring that the Consent was invalid because the application did not include a contamination preliminary investigation. The judge ruled that Tanlane could commission a preliminary investigation, reapply for a consent and supply the investigation to the JRPP as part of the application.

In 2015, an updated EIS was prepared by EMM (2015a) to support the application for DA-781/2015. The EIS included a Preliminary Investigation and, at the request of the EPA, a Supplementary Preliminary Investigation (SPI) and a Remediation Action Plan (RAP). The marina design was unchanged from that described in the original 2012 EIS. This application was approved by the Sydney West JRPP on 29 September 2016 (DA-781/2015).

Again, a third-party appeal was made to the NSW Land and Environment Court (NSW LEC 1089, 2018) by Moorebank Recyclers under Section 79(5) of the EP&A Act. The Court Orders delivered on 28 February 2018 upheld the appeal and refused DA-781/2015. The judgement focused on the information presented as part of the application and not the merits of the marina development. Primarily, the court was concerned that the marina site was not entirely sited within the land owned by Tanlane, in particular works on the river bank. As explained in Section 2.7 and Appendix B2 the river bank is within land owned by Tanlane. To remove any doubt, this application excludes works on the Georges River bank and these works will be subject to a separate application.

As a result of this ruling, Benedict is re-applying for consent for the proposed Georges Cove Marina, 146 Newbridge Road, Moorebank. The proposal essentially unchanged from that approved by the JRPP on 29 September 2016 other than: to remove rock armouring of the Georges River bank to a separate application; the removal of the pedestrian bridge over the marina entrance; and an increase the construction period from 36 to 48 weeks. This updated EIS specifically addresses the matters raised by the NSW LEC:

- the site boundary;
- contamination: site history, landfill gas, asbestos, contamination in the dredge pond, and contamination management; and

- construction traffic.

ES2 Proposal overview

The proposed development includes the construction and operation of the following main elements:

1. the Maritime Building (see Figure ES1) located near the western boundary of the marina site. This structure will house:
    - a dry berth facility providing 250 berths for small craft;
    - a function centre;
    - tourist, entertainment and recreational and club facilities; and
    - an above ground petrol tank (about 60,000 L) and an above ground diesel tank (about 60,000 L).
2. a wet berth facility for 186 small craft (including casual berths) which will consist of:
    - a marina basin;
    - rock protection of the basin;
    - construction of public recreational facilities on the internal foreshore including bike paths, barbeque facilities and shelters;
    - floating berths and walkways;
    - fuel pumping facilities;
    - sewage pumpout facilities; and
    - emergency berth access.
3. three external carparking areas and basement carparking providing a total of 637 car spaces;
4. a Private Marina Clubhouse (see Figure ES.2) on the northern portion of the RE2 (private recreation) zoned land; and
5. support infrastructure - power, water and sewerage.



Figure ES.2 View of proposed Maritime Building and Private Marina Clubhouse from eastern bank of Georges River (computer generated photo montage)

It is proposed that operation of the marina berthing facilities occurs from 7.00 am to 10.00 pm seven days a week and that the Private Marina clubhouse, Marina Function Centre and associated venues operate from 7.00am to 12.00 midnight, as previously approved by the JRPP.

ES3 Statutory framework

An overview of the statutory framework relevant to the proposal including State and Commonwealth legislation, and State, regional and local plans, policies and guidelines is provided.

ES4 Consultation

An overview of stakeholder engagement for the proposal, a description of the engagement activities undertaken, and a description of proposed ongoing consultation is provided.

Consultation was undertaken during the preparation and assessment of the original EIS submitted in 2012 and the second EIS in 2015. In total, the previous development applications and EISs were placed on public exhibition on five separate occasions.

A total of six separate submissions (including agency submissions) were received in response to the exhibition of the 2012 EIS. Four expressed support for the proposal; and two submissions from the same author raised specific objection to vehicular access arrangements.

Of the community submissions received in response to the public exhibition of the 2015 EIS, two supported the marina (one noting concerns regarding boat speed limits), three objected and one raised broader flooding issues in the LGA. Agency submissions were also received.

Consultation was undertaken during the preparation of the 2015 EIS, including with: Environment Protection Authority (EPA), Office of Environment and Heritage (OEH), Department of Primary Industries (DPI), Department of Primary Industries - Water, Roads and Maritime Services (RMS), Liverpool City Council (LCC), community groups and neighbours.

These agencies and the Greater Sydney Commission were consulted as part the preparation of the current EIS.

There has been ongoing consultation with LCC throughout all of these applications. The community has also been consulted.

Moorebank Recyclers has sold the landholding directly south of the marina site to EQ Projects. On 26 November 2018, EMM wrote to EQ Projects, the new landowner to outline the marina proposal and to provide contact details. We understand that EQ Projects strongly supports the marina application.

ES5 Hazards

The air, noise, and water emissions from the proposal have been assessed to determine if it is classified as a potentially offensive industry under State Environmental Planning Policy (SEPP) No 33 – Hazardous and Offensive Development. It was determined that the proposal will not result in unacceptable levels of pollution that will impact the amenity of the area and is not a potentially offensive industry.

This EIS considers a range of potential hazards and describes proposed safeguards including for: fuel storage and dispensing; fire prevention and response; chemical storage; prevention of personal accidents; prevention of collisions; management of sewage, grey water or oil spills; and management of waste.

ES6 Impact assessment

ES6.1 Water

The impacts on sediment transport, tidal flow, water levels, water quality and flooding for the marina site were assessed.

The results of the flood modelling were used to conclude that:

- in a 20-year average return interval (ARI) flood, the impact of the planned development on flood hazard will be negligible except on the western side of the marina site where the proposed development will increase the ground level eliminating the flood hazard;
- in a 100-year ARI flood, the impact of the planned development on flood hazard will be negligible; and
- the proposed development will have a negligible impact on the behaviour of flooding in the flood storage area in the south-west of the marina site and nil or negligible impacts on other adjacent properties.

Comprehensive modelling of tidal hydrodynamics indicated that tidal exchange in the marina basin will be high due to the relatively wide entrance to the Georges River. Water flow velocities are predicted to be low. Banks can and will be designed to withstand waves generated by boats, this will include the installation of rock armouring. This will improve the aquatic environment.

The assessment of water quality found that with the implementation of the proposed environmental management measures, the proposed marina will not degrade water quality of the Georges River through discharges of copper from antifouling paints or from uncontrolled discharge of sewage. The potential impact of contamination to water quality is summarised in Section ES6.3.

The depth of sediment accumulation in the marina basin is estimated to be 120 mm over 100 years, so maintenance dredging will not be required within the basin.

ES6.2 Soils

Soil within the marina site typically comprises fill overlying brown to light grey, moderate plasticity clay and dark sandy loam. The presence of anthropogenic fill is consistent with historic land filling practices on the marina site.

The project area has been identified on the Liverpool LEP (2008) acid sulfate soils map, and reference to the Atlas of ASS indicates there is a high probability for ASS to occur. Excavation of the channel between the dredge pond and the Georges River will require the removal of the existing soils. These are likely to be acid sulfate soils and will be tested and managed appropriately based on the acid sulfate soils management plan (Appendix D6).

ES6.3 Contamination

The *Preliminary Investigation*, *Supplementary Preliminary Investigation* and the most recent *Preliminary Investigation* did not identify contamination issues that are considered to present an unacceptable risk to human and/or environmental health in the context of the proposed future land use. Recent sampling did not identify any exceedances of the NEPC (2013) human-health-based guideline values. A small number of exceedances of ecological assessment criteria were identified. These were either considered to be irrelevant, or present a low and acceptable risk, in the context of the proposed future land use.

The measured concentrations of landfill gas in the marina site are typical of natural soils with high organic content and/or 'typical fill'. The recorded gas concentrations are unlikely to be landfill gas that has migrated from the landfill located to the north, possibly with the exception of monitoring well MW101. Douglas Partners recommend further gas monitoring to assist in future landfill gas mitigation designs for structures proposed to be built at the site if required.

Asbestos has been identified on the site and an asbestos investigation to quantify the concentration of bonded ACM and fibrous asbestos and asbestos fines (FA and AF) against relevant screening criteria will be undertaken post-approval. If required, an asbestos management plan will be prepared during the Construction Certification stage. The plan will describe a cap and contain strategy. A long-term environmental management plan will also be prepared.

The historically elevated ammonia concentrations in the dredge pond have decreased to levels close to those in the Georges River, consistent with the removal of an ammonia source (buried decomposing timber) in the northern portion of the site, and monitoring is continuing. The ammonia concentrations in the basin are not considered to represent a risk to human health particularly as there will be no human exposure as ingestion of the basin water is unlikely in the context of a commercial marina.

A Statutory Site Audit Statement and Site Audit Report, were prepared by accredited site auditor Dr Ian C Swane under the *Contaminated Land Management Act 1997,* to address an LCC requirement that a Section B audit statement was prepared prior to determining the marina development application. The site audit statement considered:

- the nature and extent of contamination;
- the appropriateness of the remediation plan; and
- whether the land can be made suitable for the proposed uses.

The Statutory Site Audit Statement concludes that the proposed remediation measures are appropriate for the remediation of the site to make it suitable for the proposed Georges Cove marina development, subject to specified conditions.

The site audit report also considered whether the issues raised in SEARs 912 were addressed, and found "[t]he Site Auditor considers this SAR has addressed all issues raised in the SEAR 912 conditions."

ES6.4 Ecology

No significant impacts to threatened species, populations and communities are anticipated from the construction and operation of the marina. Overall, while the proposal will require the removal and modification of small areas of terrestrial habitat, it will result in an overall improvement in the quality and amount of available habitat within the marina site. Foreshore vegetation will be embellished and a vegetation management plan (VMP) will be prepared and implemented.

Application of the Biodiversity Assessment and Approvals Navigator found that a Biodiversity Development Assessment Report is not required to be submitted with the development application and that the proposed marina development does not trigger the biodiversity offset scheme threshold.

The marina can be constructed and operated without any significant impact on river water quality. There may be some impacts from the construction of the marina to aquatic ecosystems and species, particularly from opening the marina basin to the river. However, the proposal will result in an overall increase in the area and diversity of aquatic habitat in the locality. Management measures will include designing marina features to maintain and improve water quality, avoiding direct loss of existing seagrass and mangrove areas, staging of the marina entrance construction and providing natural, or near-natural, intertidal to riparian zone habitats that that support local native vegetation and linking of these habitats.

ES6.5 Traffic and parking

There will be 637 car parking spaces at the marina site. This parking will be a combination of 267 surface level car parking spaces located in parking areas A, B and C and 370 undercover car parking spaces located in two basement car park levels within the Maritime Building. This will be approximately 20% higher than the amount of car parking which was considered to be necessary (530) spaces in the formal assessment of the required car parking supply for the marina development approved in 2014. The detailed design of the car parks will consider the accessible car parking requirements of AS 2890.1.

The proposed development will increase traffic volumes by about 1% on Newbridge Road, Governor Macquarie Drive and the section of Brickmakers Drive south of the link road intersection. It will increase traffic volume by about 9.3% on the 300 m section of Brickmakers Drive north of the link road intersection. However, the traffic increases will remain well within the typical daily traffic capacity for Brickmakers Drive as a continuous two-lane road. Brickmakers Drive will not require additional traffic calming or other traffic management measures.

The intersection of the site access link road and Brickmakers Drive will be in accordance with the design approved by the NSW Land and Environment Court (NSW LEC 30141, 2013) or as per the Construction Certificate Plans that are currently being finalised by Mirvac in consultation with LCC (Application CCE-53/2018).

It is proposed that traffic signals will be installed during construction of the intersection. While these are not required for the Georges Cove Marina, the intersection is likely to require traffic signals in the longer term due to background traffic growth on Brickmakers Drive and future developments, such as the Mirvac Moorebank Cove residential estate that would use the link road. Installing these signals during the initial intersection construction will provide greater certainty regarding the adequacy of the intersection to cater for traffic from future developments and will be less disruptive than installing signals at a later date when the link road is opened to traffic. The intersection will operate at Level of Service A for the busiest times — the morning peak hour, afternoon peak hours and Friday and Saturday late evening peaks — including with the potential cumulative traffic from the proposed and planned developments.

Cyclists and pedestrians will be able to use the proposed link road pedestrian/cycle path and the riverfront pedestrian/cycle path. These paths will be 2.5 m or 3.0 m wide and will meet the DCP design width standard to permit use by both pedestrians and cyclists to access the marina, recreational areas and the foreshore.

There is appropriate public transport access available to and from the development for the future employees, customers and other visitors.

During the initial stages of construction, construction traffic will use the existing Newbridge Road site access, prior to the completion of the link road. The construction traffic impact assessment found that there will be no adverse traffic capacity, traffic safety or road congestion impacts during this period. Once access via the link road is available, all the site construction access should only occur via the link road. There will be no site traffic capacity or traffic safety constraints when construction traffic accesses the site using the link road.

ES6.6 Visual

The visual assessment concluded that the overall visibility of the structures and activities on the project area would be minimal. Mitigation of these minor impacts will include screen planting using appropriate tree species on the eastern boundary of the marina site adjacent to the river, as part of foreshore embellishment (works enshrined in a VPA with Council but bank stabilisation works are not part of this application) and the use of appropriate colours and materials for the Maritime Building and Private Marina Clubhouse.

Overall, the proposed development will result in an improvement to the vista when viewed from the river. In this regard, it is considered that the development would have a positive effect on the visual qualities compared to the site's current use. The Maritime Building will be partly visible over the trees on the boundary between the Georges Fair residential estate and the proposed development. However, the two-storey residential development on the Georges Fair residential estate minimises potential views and confines them to the fringe along a short section of Brickmakers Drive. The visual impacts of the proposed development will be low to moderate.

ES6.7 Noise

Project noise trigger levels (PTNLs) were determined according to the *Noise Policy for Industry* (NPfI) guidelines. Operational noise levels are predicted to satisfy the PTNLs at all assessment locations during calm and adverse meteorological conditions, with the exception of R10 (future residential location in the Moorebank Cove residential estate) during the evening period for calm and adverse weather conditions. For the closest residences in the future Moorebank Cove residential estate, it is anticipated that appropriate noise controls, such as distance buffers and acoustic screening, will be incorporated in the design of the development to provide appropriate noise amenity for occupants. Notwithstanding, the noise levels at George Cove generally include boat movements. Given the riverside locality and position near the subject site, and that boat movements will be generally short-term in nature, it is anticipated that such noise activity would be largely accepted by residents as being part of being close to an active marina. People seeking to buy the dwellings adjacent to the marina will be well aware of the Georges Cove Marina development and associated activities. Those who go on to buy one of these dwellings are expected to see being 'close to the action' as a positive attribute of the location.

Maximum noise level events during the night-time period are predicted to satisfy the EPA sleep disturbance criteria at all assessment locations during calm and worst-case meteorological conditions.

Music and patron noise is predicted to satisfy the Office of Liquor, Gaming and Racing (OLGR) criteria in most octave band centre frequencies at all assessment locations that are currently occupied during calm and worst case meteorological conditions. Music noise from function centres has been predicted to generate exceedances at 31.5 and 63 Hz octave band centre frequencies. This can be mitigated by fitting a noise limiter on public address systems or increasing the glazing thickness to function rooms, or a combination of both. Noise control strategies will be finalised in the project design phase.

The predicted noise levels above the OLGR criteria at R10 are predominantly related to patron noise on external balconies at the Marina Clubhouse. It is noted that the assessment assumed all function centre balconies are at capacity and adopted a conservative patron noise sound power level. There is scope to reduce patron noise levels with appropriate management. A noise management plan will be prepared and implemented that will detail strategies to control patron noise, especially during the night-time period.

Construction noise levels are predicted to satisfy the *Interim Construction Noise Guideline* (ICNG) highly affected noise management levels (NML) at all residential assessment locations. Construction noise levels above the NMLs have been predicted at most assessment locations, predominantly during site preparation earthworks and road construction. Construction noise will be proactively managed, especially when construction equipment is operating relatively close to surrounding receivers. This will primarily be achieved by limiting construction to ICNG standard construction hours. Further management and mitigation measures will be detailed in a construction noise management plan.

ES6.8 Air quality

The air quality assessment found that airborne emissions (particulates, odour and toxic substances) from the proposed operation will comply with NSW guidelines to prevent amenity and health impacts.

ES6.9 Heritage

No Aboriginal archaeological sites were identified in the project area during background research, database searches or a site survey. Due to past land use disturbances and major sub-surface destruction on the marina site, it was concluded that there is little to no potential for buried deposits.

A non-Aboriginal heritage assessment including historical research, database searches and a field survey found that marina site has been extensively disturbed by previous operations. No historic items or areas of archaeological potential were identified in the marina site.

ES6.10 Recreational boating

Use of Georges River for recreational boating and the potential impacts of boats stored at the proposed marina on river navigation were assessed.

The physical development of the marina will have very little impact on river navigation as the entire development will be on land owned by Tanlane and will be outside of the Georges River channel. No structures of any kind will be erected in the river channel. The marina will improve river access and foreshore accessibility.

The scheduling of departures and retrievals during peak periods, along with the operation of a marina tender/retrieval vessel, will ensure that there will be no adverse impacts on the existing recreational boating community.

ES6.11 Site accessibility

The proposed development will provide a recreational precinct of high scenic, amenity, and recreational value within easy walking distance of about 1,200 current and future households in the Georges Fair development and the planned Mirvac Moorebank Cove residential estate on the northern portion of Lot 7. Currently, no river or recreational access is possible or available due to the rehabilitation operations occurring on Lot 7. Hence, the development will provide an essential quality recreational precinct for adjoining residential developments and the region. It will include a high level of disabled access to the Maritime Building, Private Marina Clubhouse, wet marina and surrounding recreational areas, including to the river foreshore.

ES6.12 Economic impacts

The development will have minor positive impacts on regional economic activity and the local impacts will provide a significant economic boost and underpin a vibrant and attractive river foreshore precinct for the community.

It is expected that the development will employ about 45 people in about 12 full-time positions and 33 part-time/casual positions. As business patronage grows, additional staff will be required. There is ample on-site parking to accommodate additional staff.

The replacement of extractive and recycling industry from the precinct will result in greatly improved local amenity for adjoining residential lands. Given that these industries will be replaced with a recreational precinct designed to reconnect the community with the river foreshore, it is expected that the development will have a significant positive impact on adjoining land values.

ES7 Statement of commitments

It is proposed to construct and operate the marina development, if approved, generally in accordance with the previous conditions issued for the project, and as modified by the consent authority.

An environmental management plan (EMP) will be prepared during the detailed design of the marina based on project approval conditions. The EMP will be prepared prior to commencement of the development to ensure that the commitments in this EIS and Consent conditions are fully implemented.

Table ES.1 Key commitments

No.	Commitment	Reference
Water		
1	Floor levels of the building and marina facilities have been determined using the 100-year ARI flood levels produced in the Georges River Flood Study (adopted by Liverpool City Council) and will incorporate the appropriate freeboard.	Section 6.1.7
2	Water quality in the dredge basin will be tested during construction prior to breaking through the banks to the river. The bank will only be opened if the water quality in the basin is similar to, or better than, that in the Georges River.	Section 6.1.7
3	Water sensitive urban design elements will be incorporated into the design (including the provision of wetlands) to provide stormwater treatment to reduce nitrogen, phosphorus, total suspended solids and heavy metals concentrations.	Section 6.1.7
4	Bilge and sewage pump-out facilities will be provided in the marina and discharge of sewage from boats using the marina will be prohibited.	Section 6.1.7
5	Bank stabilisation will be undertaken as part of the development.	Section 6.1.7
Soils		
6	The acid sulfate soils management plan (Appendix D6) will be implemented.	Section 6.2.2
Contamination		
7	The recommendations of the Remediation Action Plan (Appendix D3) and Site Auditor Statement (Appendix D7) will be implemented.	Section 6.3.7
8	Any material in the stockpiles or fill mounds that are present at the marina site and that are proposed for on-site reuse will be characterised for land use suitability relative to the appropriate land use criteria in the ASC NEPM.	Section 6.3.8
9	Any material proposed for off-site disposal or reuse will be characterised for waste classification in accordance with the NSW EPA (2014) Was*te Classification Guidelines, Part 1: Classifying Waste*, or with regard to a relevant resource recovery order and exemption issued under the POEO Act.	Section 6.3.8
10	A daily record of all site works will be maintained by the construction or remediation contractor. This will include details of daily environmental inspections. The occurrence and management of all unexpected finds will be documented.	Section 6.3.8
11	Basin sediment resuspension from propeller wash will be prevented by providing adequate under keel clearance (2.9 m low tide water depth) and enforcing the speed limit within the marina basin (4 knots).	Section 6.3.8
Ecology		
12	A pre-clearance check will be undertaken to determine if active nests (ie containing eggs or chicks) are present in any trees to be felled – active nests will be bought down intact where possible.	Section 6.4.2
13	Any felled trees will be retained at the site as habitat for ground-dwelling fauna.	Section 6.4.2
14	The buffer zone between the marina basin and the Georges River foreshore will be embellished and a vegetation management plan will be prepared and implemented.	Section 6.4.2
15	The marina basin will be constructed in a manner that ensures that it is regularly flushed, that sediment accumulation is minimised, and that the entrance channel location avoids direct loss of existing seagrass patches or mangrove trees.	Section 6.4.4
16	Natural, or near-natural, intertidal to riparian zone habitats will be provided that that support local native vegetation and link these habitats.	Section 6.4.4
17	Traditional “slipway” activities that can result in chemicals (including anti-foul chemicals) entering the environment will not be undertaken – all environmentally sensitive maintenance works will be undertaken on a dedicated hardstand area fully under cover and within the marina building.	Section 6.4.4

Table ES.1 Key commitments

No.	Commitment	Reference
Noise		
18	A 2-m high acoustic barrier will be constructed to the west of the marina clubhouse carpark.	Section 6.7.3
19	Partial acoustic screening (eg louvres) will be installed on the north balconies of the Private Marina Clubhouse and Maritime Building.	Section 6.7.3
20	Music noise from the function centres will be managed and/or mitigated to limit low frequency noise in 31.5 and 63 Hz octave band centre frequencies.	Section 6.7.3
Recreational boating		
21	The scheduling of departures and retrievals during peak periods, along with the operation of a marina tender/retrieval vessel, will ensure that there will be no adverse impacts on the existing recreational boating community.	Section 6.11.3

ES7.1 Conclusion and justification

The proposed development will greatly improve the existing visual amenity of the local area by facilitating the rehabilitation of land impacted by quarrying and recycling activities. In particular, the proposed development will provide recreational facilities for the neighbouring Georges Fair residential estate and the planned Mirvac Moorebank Cove residential estate planned for the northern portion of Lot 7.

The proposed development has the following objectives:

1. to embellish and stabilise the former quarry dredge site in accordance with the objectives of the RE1 (public recreation) and RE2 (private recreation) zones which are set out in the LEP as follows:

    a) to enable land to be used for public open space or recreational purposes (RE1 and RE2);

    b) to provide a range of recreational settings and activities and compatible land uses (RE1 and RE2);

    c) to protect and enhance the natural environment for recreational purposes (RE1 and RE2);

    d) to provide sufficient and equitable distribution of public open space to meet the needs of residents (RE1 only);

    e) to ensure the suitable preservation and maintenance of environmentally significant or environmentally sensitive land (RE1 only); and

    f) to enable land uses that are compatible with, and complimentary to, recreational uses (RE2 only).

2. to develop recreational facilities to cater for the population in the western part of Sydney as well as people moving into the area with the development of the Georges Fair and future Moorebank Cove residential precincts;

3. to provide recreational and ancillary facilities for the growing population of boat owners and users in the western part of Sydney;

4. to address the demand for wet (floating) berths and dry berths;

5. to provide a range of public benefits including:

a) a land/water interface for the local community to enjoy the Georges River;

b) casual public berths for boats and water taxis to pick-up and drop-off passengers, and to access the marina facilities, including a function centre, kiosk, commercial, tourist and club facilities;

c) public access to fuel and sewage pumpout facilities which are currently unavailable in the upper reaches of the Georges River; and

d) access to recreational facilities for persons with disabilities.

6. to provide temporary emergency berth access for Marine Area Command (Water Police), NSW Roads and Maritime (RMS), medical evacuation and other emergency services; and

7. to improve the amenity and environmental quality in the upper reaches of the Georges River. In particular, the reconnection of the community with the Georges River foreshore.

The RE1 zoned river foreshore lands, once rock protected and regenerated, are to be dedicated to the Council and held in public ownership in perpetuity in accordance with the VPA already executed with LCC (these works are not part of this application). The proposed development will accelerate this process.

Having regard to the overall environmental impacts determined as part of this EIS, the proposed redevelopment is not considered likely to give rise to any significant adverse cumulative impacts on the environment. The assessment has found that any environmental impacts during construction or operation of the marina can be mitigated through normal operating procedures.

Overall, the proposed Georges Cove Marina will have biophysical, social and economic benefits. The development satisfies the four principles of ecologically sustainable development.

It is therefore recommended that the proposed Georges Cove Marina, is approved, subject to the mitigation measures outlined in this EIS.

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1 Introduction

1.1 Proposal overview

Benedict Industries Pty Ltd (Benedict) proposes to construct and operate a marina and related facilities on a southern portion of Lot 7 DP 1065574 (146 Newbridge Road, Moorebank, referred to in this report as the "marina site") in the Liverpool City Council Local Government Area (LGA) (Figure 1.1).

The proposed development will utilise about 13 ha of Lot 7 (22 ha)(Figure 1.2). The overall site (ie Lot 7) has been used for sand extraction, dredging and recycling operations. These have been undertaken by entities controlled by Benedict in accordance with all relevant regulatory requirements including planning consents, environmental protection licences and other permits.

The proposed development will utilise an existing sand extraction dredge pond (approximately 6 ha) as the basis for forming the final marina basin. This will largely remove the need to import fill to restore the landform following the closure of the quarry, as is otherwise permitted by the existing quarry planning approval.

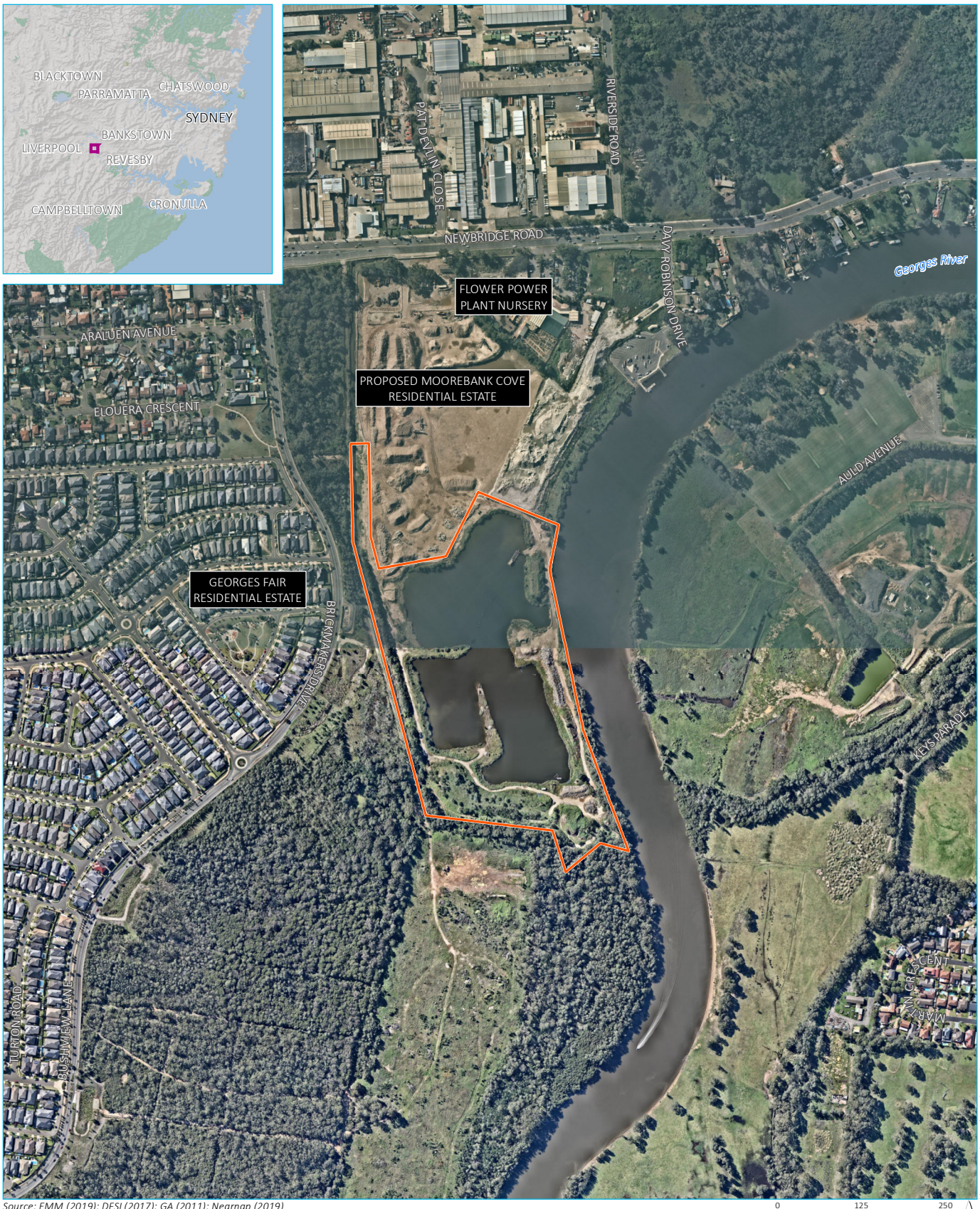
The architect-designed marina redevelopment will provide an alternative means to implement the final restoration of the extractive industry activity on the marina site. It is an innovative proposal which is sensitive to the high value riverine locality and will provide valuable community recreational infrastructure which will reconnect the community with the river foreshore.

There has been wide public support historically for the proposed development with only one objector, Moorebank Recyclers Pty Ltd. Moorebank Recyclers had approval to develop a 500,000 tonnes per year concrete crushing facility immediately south of the proposed marina site (State Significant Development MP 05_0157). However, the development has not been physically commenced and the land has been sold and is no longer owned by Moorebank Recyclers.

Following the gazettal of the Liverpool Local Environmental Plan (LEP) 2008 on 28 August 2008, Lot 7 was rezoned from Rural 1(a) to a combination of Medium Density Residential (R3), Private Recreation (RE1), Public Recreation (RE2) and Business Enterprise (B6) (Figure 1.3). The development of a marina and related recreational facilities is expressly permitted with consent within these zones.

Development consent is required for the proposed development under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) pursuant to the provisions of the Liverpool LEP 2008, other relevant environmental planning instruments (EPIs), and Liverpool Development Control Plan (DCP) 2008. The proposal is classified as designated development and integrated development under the EP&A Act. Liverpool City Council is the consent authority and the Sydney South West Planning Panel is the determining authority.

The proponent, Benedict Industries Pty Ltd (11 Narabang Way, Belrose, NSW 2085) is acting for the owner, Tanlane Pty Ltd, a related entity.



Source: EMM (2019); DFSI (2017); GA (2011); Nearnap (2019)

0 125 250 m

GDA 1994 MGA Zone 56

N

KEY

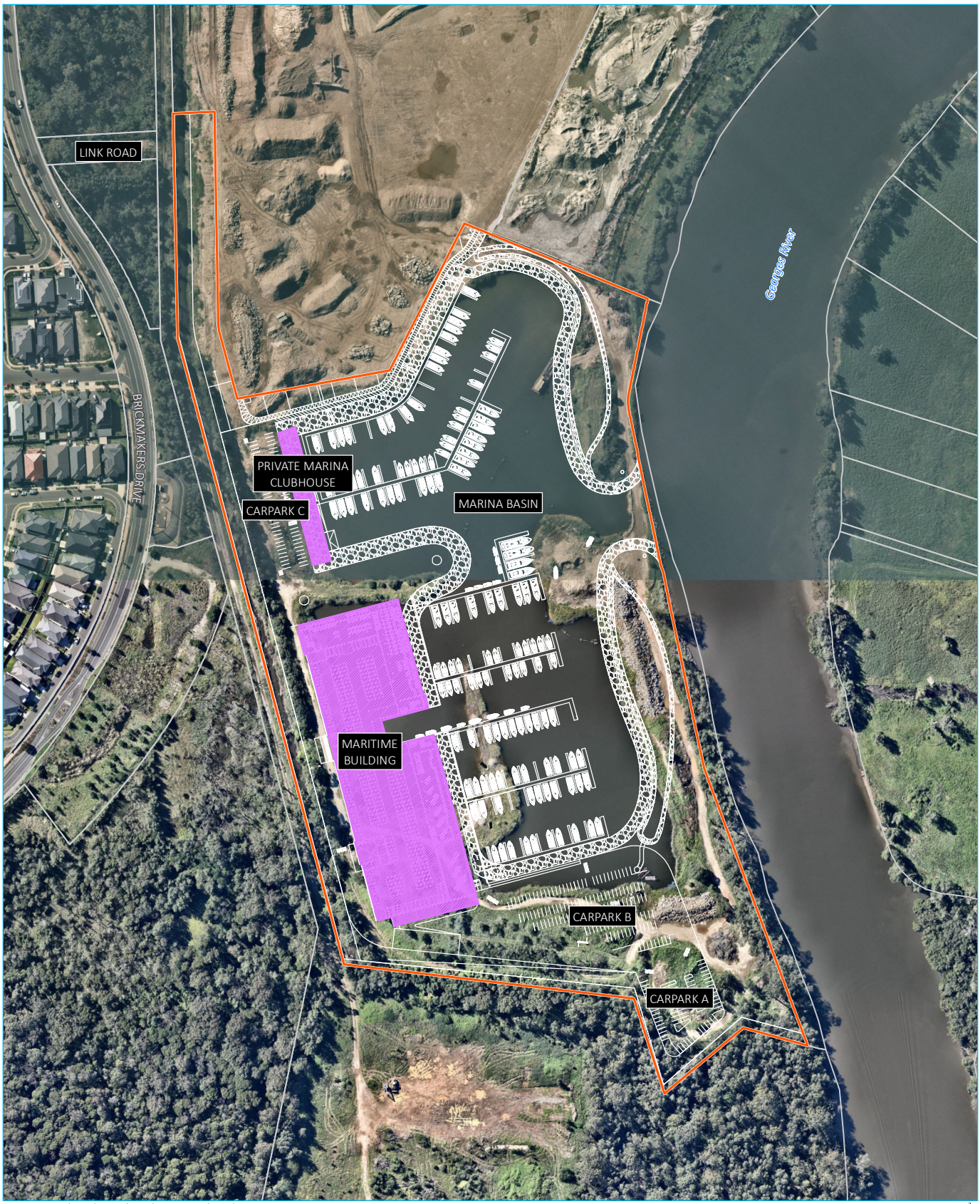
Subject site

Site location plan

Georges Cove Marina
Environmental impact statement
Figure 1.1

EMM
creating opportunities

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\\Emmsvr1\emm\Jobs\2018\J180179 - Georges Cove Marina 2018 EIS\GIS\02_Maps\EIS002_SiteLayout_20190510_06.mxd 10/05/2019

Source: EMM (2019); DFSI (2017); Nearmap (2019)

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GDA 1994 MGA Zone 56

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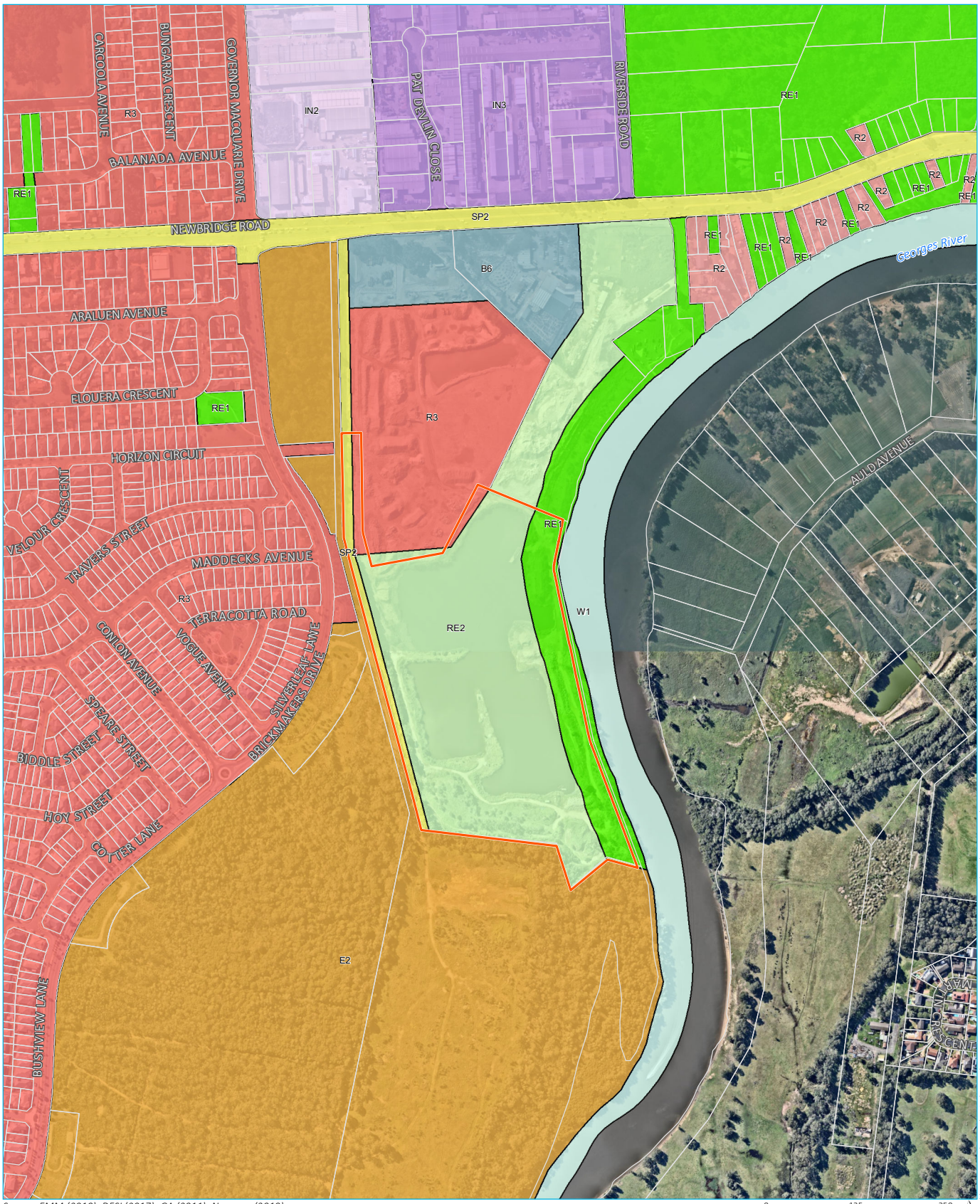
KEY

- Subject site
- Building
- Cadastre

Site layout

Georges Cove Marina
Environmental impact statement
Figure 1.2

EMM
creating opportunities



Source: EMM (2019); DFSI (2017); GA (2011); Nearmap (2018)

0 125 250 m

GDA 1994 MGA Zone 56

N

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KEY

- Subject site
- Cadastral boundary

Liverpool LEP zoning

- B6 Enterprise Corridor
- E2 Environmental Conservation
- IN2 Light Industrial
- IN3 Heavy Industrial
- R2 Low Density Residential
- R3 Medium Density Residential
- RE1 Public Recreation
- RE2 Private Recreation
- SP2 Infrastructure
- W1 Natural Waterways

Site zoning

Georges Cove Marina
Environmental impact statement
Figure 1.3

EMM
creating opportunities

1.2 Subject site

1.2.1 Topography

The marina site is in a generally flat landscape typical of the Georges River floodplain. Currently, the marina site is largely made up of a dredge pond created by extractive industry operations (see Section 1.3). The surface level of the marina site was 2.8 m on average before extractive industry operations started. Surveying records indicate that the marina site sloped gently from the riverbank (approximately 2 m Australian height datum (AHD)) to approximately 4 m AHD along the western boundary of the marina site.

1.2.2 Access

Existing vehicular access to the recycling facility site (Lot 7) is currently from Newbridge Road. This access will eventually be decommissioned and vehicular access to the marina development will only be permitted via an approved link road connecting to Brickmakers Drive which joins Newbridge Road (see Section 1.4).

1.2.3 Surrounding land uses

A Mirvac residential estate (the Moorebank Cove residential estate) is planned for the northern portion of Lot 7 DP 1065574. The development will result in the remediation of the northern portion of Lot 7, which will then provide site suitable the development of about 180 residential homes. Staged development applications for this development have been submitted to LCC, with further future applications to be made.

Newbridge Road (a six-lane Roads and Maritime Service (RMS) Class 1 Road) is adjacent to the northern boundary of Lot 7. There is an industrial area north of Newbridge Road.

The Georges River is east of the marina site. There is expansive recreational open space within the Canterbury Bankstown LGA to the east of the Georges River. This area is characterised by open grasslands with some rural sheds, outbuildings and three to four residential dwellings.

The Georges Fair residential estate (about 960 houses) is to the west of the marina site.

The land directly to the south of the marina site (previously owned by Moorebank Recyclers), is zoned Environmental (E2). Further to the south there is the Brighton Lakes golf course and other recreational facilities.

1.3 Currently approved site activities

In 1993, the New South Wales Land and Environment Court approved (Maron Investments Pty Limited v Liverpool City Council NSW LEC 25, 1993) approved the extraction of sand from the overall site (Lot 7) via dredging and dry extraction methods. The approval requires the rehabilitation of the site (Lot 7) on cessation of extractive industries with the importation and processing of waste materials permitted to fill empty cells and return these areas to their natural landform.

The extractive industries on the site have reached the end of their economic life and are no longer operating. The quarry consent and Environment Protection Licences (EPLs) permit the restoration of the site back to natural surface levels via the importation of waste materials. It has been the long-held view of the applicant that, instead, a marina was a better outcome and as such did not fill the dredge void with waste. Approval of the proposed marina development will remove the need to restore the site back to natural surface levels via the importation of waste materials.

Final restoration of the marina site has not yet commenced and the dredge ponds created from the sand extraction operations remain. However, the final years of dredge operations have anticipated the development of the marina and current configuration of the dredge pond closely meets the requirements of the proposed marina basin.

Development of the marina requires the use of the existing dredge basin. This will greatly reduce the quantity of virgin excavated natural material (VENM) that would otherwise be needed to restore the site back to natural surface levels. However, some VENM and rocks (but no other waste materials) will still be imported to assist with shaping the marina basin, restoring landforms and for bank armouring.

1.4 Associated approvals

The following applications/approvals are associated with the development of the marina.

The alignment, design, construction and use of the link road have been approved by LCC (DA-61/2014 and DA 1552/2006/B).

CCE-53/2018 (submitted on 1 November 2018 by Mirvac Homes): for the construction of the link road and bridge crossing. The link road and bridge crossing will be dedicated to LCC for public use.

DA-843/2018 (submitted on 6 November 2018 by Mirvac Homes): proposed stratum subdivision of Lot 6 in DP 1065574 into two lots and use of both the road bridge, and link road over lots 309 & 310 in DP 118048.The purpose of stratum subdivision is to facilitate the construction of the link road and road bridge approved under DA-1552/2016 and to enable dedication of the bridge and link road to LCC as a public road. The strata subdivision involves air space over a portion of the “pan-handle” of Lot 6 the proposed stratum subdivision to create airspace easement over Lot 7.

VPA-11 (submitted on 15 January 2019 by Tanlane Pty Ltd and LCC): Voluntary Planning Agreement - Designated Land; Plan developed by consultants for initial planting and maintenance; Construction and dedication of road bridge and road to Brickmakers Drive; Embellishment of river foreshore land; Removal of noxious weeds; Restored and enhanced vegetation; Construction of Bike/Pedestrian pathway; Construction of passive recreation facilities; Construction and dedication of 'pedestrian access to Newbridge Road'; Conduct maintenance works described in the Vegetation Management Plan. The VPA applies to the marina site and contains a series of contributions/works which are summarised in Section 3.4.

NSW Land and Environment Court proceedings (NSW LEC 30141, 2013) approved an intersection design prepared by Cardno (2013a) for the link road intersection on Brickmakers Drive. This included the potential for traffic signals, as detailed in a plan of the intersection prepared by McLaren (2013). The proposed link road and its intersection with Brickmakers Road will be physically identical to that approved by the NSW Land and Environment Court (ie the layout prepared by Cardno) or as per the Construction Certificate Plans that are currently being finalised by Mirvac in consultation with LCC (Application CCE-53/2018).

1.5 Previous Georges Cove Marina development applications

1.5.1 2014 approval

A previous application for the proposed Georges Cove Marina was made to LCC by Benedict Industries (acting for the owner, Tanlane Pty Ltd) (Development Application DA-846/2012). The environmental impact statement (EIS) supporting this application was prepared in accordance with Director General’s Environment Assessment Requirements (DGR 563) received on 29 July 2011.

An EIS (Benedict 2012) and application for development of the marina was submitted to LCC and the Department of Planning in January 2012.

The assessment of the proposal included public exhibition of the EIS (Benedict Industries 2012). The development application was placed on public exhibition on three separate occasions from 28 March 2012 to 3 May 2012; 9 May 2012 to 8 June 2012; and from 3 July 2013 to 2 August 2013. Each exhibition period observed a minimum 30-day public exhibition period in accordance with the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation) and the relevant Development Control Plan (DCP). A total of six separate submissions were received. Four expressed support for the proposal and two submissions, from the same author (Moorebank Recyclers), raised specific objection to vehicular access arrangements.

Consent for the Georges Cove Marina was granted to Tanlane Pty Ltd by the Sydney West Joint Regional Planning Panel (JRPP) on 22 August 2014 (JRPP Reference Number 2012SYW035) with support from LCC.

The validity of the consent was challenged by the proposal's sole objector, Moorebank Recyclers Pty Ltd, in the NSW Land and Environment Court. Moorebank Recyclers held an approval to develop a concrete recycling facility on land immediately south of the marina site. On 18 March 2015, the Court ruled in favour of the objector, declaring that the Consent was invalid because the application did not include a Contamination Preliminary Investigation.

1.5.2 2016 approval

In 2015, an updated EIS, including appendices, was prepared by EMM (2015a) to support the application for DA-781/2015. The EIS was prepared in accordance with Secretary's Environmental Assessment Requirements (SEAR 912) that were issued on 19 March 2015. The EIS was included a Preliminary Investigation and, at the request of the EPA, a Supplementary Preliminary Investigation (SPI) and a Remediation Action Plan (RAP). The marina design was unchanged from that described in the original 2012 EIS. This application was approved by the Sydney West JRPP on 29 September 2016 (DA-781/2015).

Again, a third-party appeal was made to the NSW Land and Environment Court (NSW LEC 1089, 2018) by Moorebank Recyclers under Section 79(5) of the EP&A Act. The Court Orders delivered on 28 February 2018 upheld the appeal and refused DA-781/2015. The judgement focused on the information presented as part of the application and not the merits of the marina development. Primarily, the court was concerned that the marina site is not entirely sited within the land owned by Tanlane. As explained in Section 2.6 and Appendix B2 the boundary on the river bank is in fact within land owned by Tanlane.

As a result of this ruling, Benedict is re-applying for consent for the proposed Georges Cove Marina, 146 Newbridge Road, Moorebank. The proposal essentially unchanged from that approved by the JRPP on 29 September 2016 other than to remove rock armouring of the Georges River bank to a separate application; the removal of the pedestrian bridge over the marina entrance; and an increase the construction period from 36 to 48 weeks. This updated EIS specifically addresses the matters raised by the NSW LEC:

- the site boundary;
- contamination: site history, landfill gas, asbestos, contamination in the dredge pond, and contamination management; and
- construction traffic.

1.6 Proposal overview

The proposed development includes the construction and operation of the following main elements (Figure 1.4):

8. a Maritime Building;

9. a wet berth facility predominately for small craft (ie boats less than 15-m long) and some vessels up to 20-m long;

10. three external carparks and two basement carparks providing a total of 637 car spaces;

11. a Private Marina Clubhouse; and

12. support infrastructure, including power, water and sewerage services.

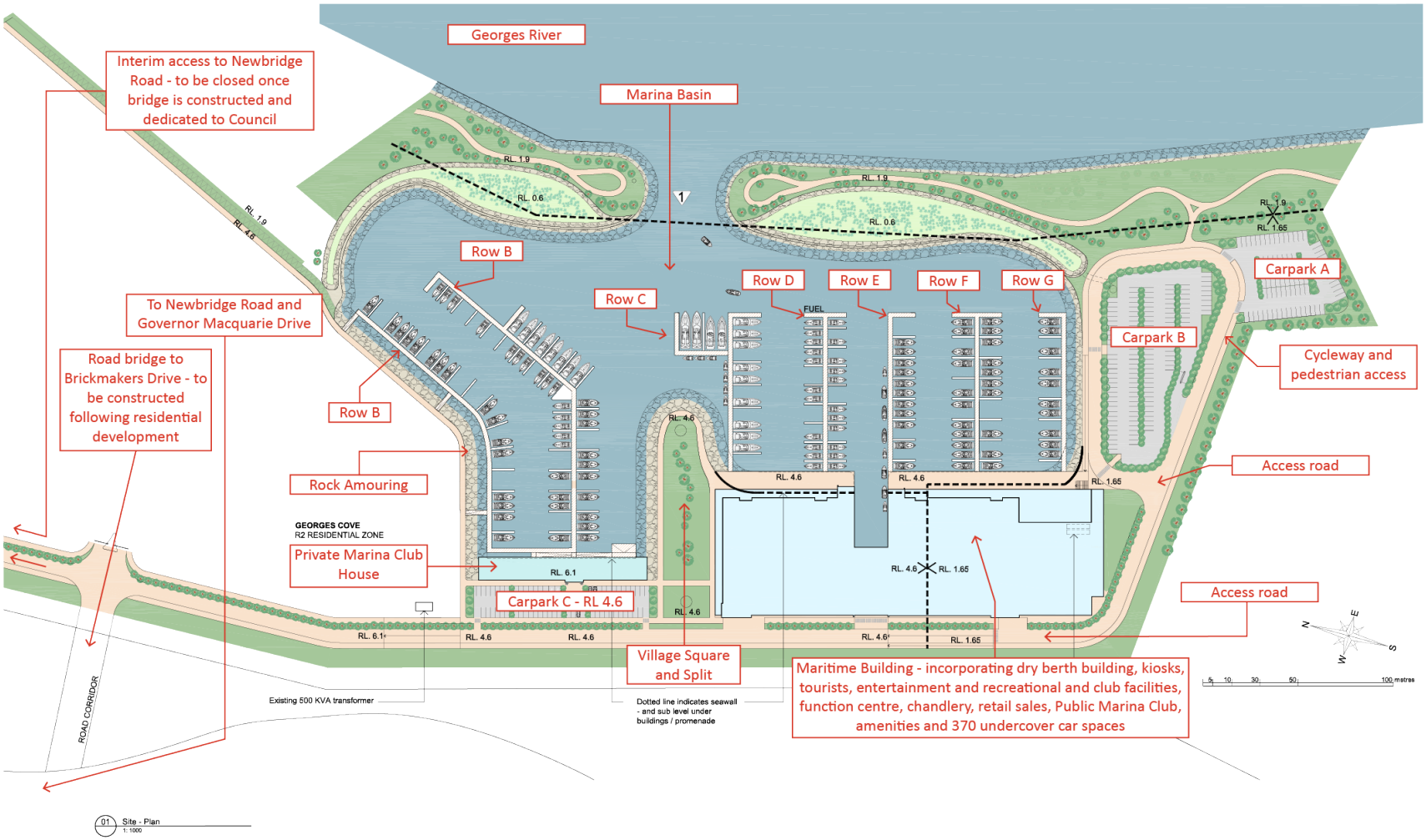


Figure 1.4 **Georges Cove Marina - key elements**

1.7 Benefits of the proposal

The proposed development will greatly improve the existing visual amenity of the local area by facilitating the rehabilitation of the site, including the removal of associated infrastructure which is incompatible with the ongoing development of the adjoining residential precincts. In particular, the proposed development will provide recreational facilities for the neighbouring Georges Fair residential estate (960 residences) and the Mirvac Moorebank Cove residential estate on the northern portion of Lot 7.

The proposed development has the following objectives:

13. to embellish and stabilise the former quarry dredge site in accordance with the objectives of the RE1 (public recreation) and RE2 (private recreation) zones which are set out in the LEP as follows:

    a) to enable land to be used for public open space or recreational purposes (RE1 and RE2);

    b) to provide a range of recreational settings and activities and compatible land uses (RE1 and RE2);

    c) to protect and enhance the natural environment for recreational purposes (RE1 and RE2);

    d) to provide sufficient and equitable distribution of public open space to meet the needs of residents (RE1 only);

    e) to ensure the suitable preservation and maintenance of environmentally significant or environmentally sensitive land (RE1 only); and

    f) to enable land uses that are compatible with, and complimentary to, recreational uses (RE2 only).

14. to develop recreational facilities to cater for the population in the western part of Sydney as well as people moving into the area with the development of the Georges Fair and future Moorebank Cove residential precincts;

15. to provide recreational and ancillary facilities for the growing population of boat owners and users in the western part of Sydney;

16. to address the demand for wet (floating) berths and dry berths;

17. to provide a range of public benefits including:

    a) a land/water interface for the local community to enjoy the Georges River;

    b) casual public berths for boats and water taxis to pick-up and drop-off passengers, and to access the marina facilities, including a function centre, kiosk, commercial, tourist and club facilities;

    c) public access to fuel and sewage pumpout facilities which are currently unavailable in the upper reaches of the Georges River; and

    d) access to recreational facilities for persons with disabilities.

18. to provide temporary emergency berth access for Marine Area Command (Water Police), NSW Roads and Maritime (RMS), medical evacuation and other emergency services; and

19. to improve the amenity and environmental quality in the upper reaches of the Georges River. In particular, the reconnection of the community with the Georges River foreshore.

The proposed development will reconnect the community with the Georges River foreshore which is currently inaccessible to the public and in a degraded state.

Once regenerated and stabilised, the RE1 zoned lands in the eastern part of the marina site, are to be dedicated to the Council and held in public ownership in perpetuity in accordance with the VPA executed with Liverpool City Council (see Section 3.4).

1.8 Environmental impact statement preparation

This EIS has been prepared by EMM Consulting Pty Limited[1] (EMM) in accordance with the *Guideline for Marinas and Related Facilities* (DUAP 1996), Clause 71 and 72 of the Environmental Planning and Assessment Regulation 2000 and the Secretary's Environmental Assessment Requirements (SEARs 912) for the proposal (updated on 9 October 2018).

This EIS is based on the EIS prepared by EMM (2015a). It has been updated to address the updated requirements in the SEARs issued on 9 October 2018. It consolidates the additional information that was provided to LCC following the public exhibition of the EIS. It provides also provides additional information in response to the NSWLEC 1089 (2018) judgement:

- the site boundary (see Section 2.7);
- contamination: site history, landfill gas, asbestos, contamination in the dredge pond, and contamination management (see Section 6.3); and
- construction traffic (see Section 6.5.8).

Further information is also provided to satisfy LCC requirements.

The proposal essentially unchanged from that described in the 2015 EIS (EMM 2015a) other than to remove rock armouring of the Georges River bank to a separate application; the removal of the pedestrian bridge over the marina entrance; and an increase the construction period from 36 to 48 weeks. The changed construction period does not have a significant input to any of technical assessments and does not materially change any of the predicted impacts of the project or proposed management measures.

This EIS also addresses changes to legislation and policy since the 2015 EIS was prepared.

1.9 Technical assessments

Given that the proposed development is essentially unchanged from that previously approved by the JRPP, the original technical assessments appended to the original EIS (Benedict 2012) generally remain valid. This EIS draws on these assessments. They have been reviewed and revised where required to ensure that the assessment methods and findings remain current. A number of additional assessments have also been undertaken. The technical assessments and reviews completed for this EIS; and the consultants engaged to prepare these assessments, are summarised in Table 1.1.

[1] Previously EMGA Mitchell McLennan Pty Ltd.

Table 1.1 Technical assessments

Appendix	Title	Author	Date	Contents	Currency
Secretary's Environmental Assessment Requirements					
A1	Georges Cove Marina, 146 Newbridge Road Moorebank, Liverpool LGA Secretary's Environmental Assessment Requirements 912	Secretary of DPE	April 2015	Secretary of DPE requirements and agency letters	These SEARs have been superseded by the updated SEARs. However, the attached agency assessment requirements remain current (see below).
A2	Georges Cove Marina – 146 Newbridge Road, Moorebank (Lot 7 DP 1065574) Updated Planning Secretary's Environmental Assessment Requirements 912	Secretary of DPE	October 2018	Secretary of DPE requirements and agency letters	Current.
Site plans					
B1	Georges Cove Marina Plans	Michael Fountain Architects	April 2015 May 2019	General layout, levels and contours, berths and carparking, cross-sections, plans and elevations.	The marina design is unchanged other than the removal of the pedestrian bridge across the marina entrance.
B2	George River Boundary Definition	JMD Development Consultants	May 2018	Documenting the actual position of the common boundary of the Georges River and Lot 7 in DP1065574. A figure showing the limit of works (which do not include armouring of the Georges River bank) is provided as well as a site survey plan.	Current.
Water assessments					
C1	Preliminary Marina Concept Design and Environmental Assessment	WorleyParsons	October 2010	Existing riverine environment, marina design, flooding, tidal hydrodynamics, water quality impacts from stormwater runoff and marina operations, and navigation.	The project design is essentially unchanged and the assessment remains current with the exception of the flood assessment which was updated in January 2013 (see Attachment C2). Additional information on navigation is provided in Appendix E3.

Table 1.1 Technical assessments

Appendix	Title	Author	Date	Contents	Currency
C2	Georges Cove Marina – New Development Application	National Project Consultants	March 2015	An overview of the flooding assessments provided in Attachments 1–3 of this appendix (see below).	
	Attachment 1: Assessment of the Impact of the Proposed Bridge on Flooding in the Vicinity of the Georges Cove Marina, Moorebank	Cardno (NSW/ACT)	May 2014	Flood impact assessment for the access road bridge.	The design of the access road bridge is unchanged and the assessment remains current.
	Attachment 2: Flood Risk Management Report	National Project Consultants	November 2013	Flood risk management assessment with reference to the *Floodplain Development Manual* (DIPNR 2005) and Liverpool 2008 LEP.	The Floodplain Development Manual has not been updated since 2005 and Liverpool LEP 2008 is the current LEP.
	Attachment 3: Flood Impact Assessment for the Proposed Georges Cove Marina, Moorebank	Cardno (NSW/ACT)	January 2013	Flood impact assessment for the marina.	The project design is essentially unchanged and the assessment remains current.
Contamination and soils					
D1	Preliminary investigation of contamination	EMGA Mitchell McLennan	July 2015	Preliminary contamination investigation, including site history and initial field investigations.	Additional information is provided in the Supplementary Preliminary investigation of contamination in Appendix D2.
D2	Supplementary Preliminary Investigation	EMM Consulting	March 2016	Additional contamination investigation, including further field investigations.	Remains current. Additional information is provided in Appendices D4 and D5.
D3	Remediation Action Plan	EMM Consulting	March 2016	Summary of site contamination, conceptual site model, remediation goals and remediation actions.	Remains current. Additional information is provided in Appendices D4 and D5 and EIS Section 6.3. The RAP is reviewed in the Site Assessment Report (Appendix D7).
D4	Preliminary Site Investigation, Proposed Rezoning (Area 1) and Georges Cove Marina (Area 2), 146 Newbridge Road, Moorebank	Douglas Partners	May 2018	Preliminary contamination investigation, including site history and initial field investigations, including additional assessment of asbestos and landfill gas.	Remains current.

Table 1.1 Technical assessments

Appendix	Title	Author	Date	Contents	Currency
D5	Landfill Gas Monitoring, November 2018 Proposed Rezoning (Area 1) and Georges Cove Marina (Area 2), 146 Newbridge Road, Moorebank	Douglas Partners	February 2019	Update on landfill gas monitoring program.	Current.
D6	Acid Sulfate Soil Management Plan	Benedict	2012	A description of the acid sulfate soils management techniques to be applied.	Remains current.
D7	Site Audit Report no. 282	Ian Swane & Associates	2019	A site audit report regarding the nature and extent of contamination, the appropriateness of the remediation plan (Appendix D3) and whether the site is suitable for the proposed development. Site Audit Statement no. 282 is provided as Appendix G of the Site Audit Report.	Current.
D8	Laboratory reports	Envirolab Watertest	2017–2018	Laboratory results	Current.
Ecology					
E1	Flora and Fauna Assessment	Total Earth Care	November 2011	A desktop and field survey of the terrestrial flora and fauna potentially present/present on the site and an assessment of the significance of the impacts of the proposed development.	The areas of River Flat Eucalypt Forest EEC (Cumberland Swamp Oak Riparian Forest) and Swamp Oak Floodplain Forest EEC (Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion) have generally reduced in area between 2011 and 2018 (see Appendix E5). The currency of the assessment was reviewed in 2015 (see Appendix E2).
E2	Proposed Georges Cove Marina – Terrestrial Ecological Assessments	EMGA Mitchell McLennan	April 2015	A review of Total Earth Care (2011) *Flora and Fauna Assessment* including an updated assessment of significance.	EMM reviewed the original assessment and prepared a letter confirming its findings remain current.

Table 1.1 Technical assessments

Appendix	Title	Author	Date	Contents	Currency
E3	Aquatic Ecology Aspects & Environmental Assessment of Marina Concept Design	Marine Pollution Research	March 2010	A desktop and field survey of the aquatic flora and fauna potentially-present/present on the site and an assessment of the significance of the impacts of the proposed development.	The currency of the assessment was reviewed in 2015 (see Appendix E4).
E4	Update of Aquatic Ecology Impact report for Georges Cove Marina	Marine Pollution Research	April 2015	A review of the Marine Pollution Research (2010) *Aquatic Ecology Aspects & Environmental Assessment of Marina Concept Design*, including a site inspection on 14 April 2015.	There have been no significant changes on site or in the Georges River since this time and the findings remain current.
E5	Bushfire Assessment	EMM Consulting	October 2015	A bushfire assessment prepared in accordance with the NSW Rural Fire Service's *Planning for Bush Fire Protection Guideline* (RFS 2006) (PBP) as sections of the lot are shown in the Liverpool Bushfire Prone Land maps as being bushfire prone.	A more recent version of the PBP was released in 2018. It is in a 'pre-release' stage and does not have legislative force. Prior to it being legislated, the 2006 PBP remains the legally referenced document (https://www.rfs.nsw.gov.au/plan-and-prepare/building-in-a-bush-fire-area/planning-for-bush-fire-protection). Sections of the lot are still shown in the Liverpool Bushfire Prone Land maps as being bushfire prone. Therefore, the bushfire assessment remains current.
E6	Biodiversity Assessment for the Planning Proposal at 146 Newbridge Road, Moorebank	Biosis	April 2018	A biodiversity assessment to determine the presence of any threatened flora, fauna, populations or ecological communities (biota) within Lot 7 and assess the impacts of development on any such species or their habitats, listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), NSW *Biodiversity Conservation Act 2016* and *Fisheries Management Act 1994*.	There have been no significant changes on site or in the Georges River since this time and the findings remain current.
E7	Proposed Georges Cove Marina - Biodiversity Conservation Act 2016 assessments of significance	EMM	May 2019	Assessments of significance in accordance with Section 7.3 of the *Biodiversity Conservation Act 2016* for two endangered ecological communities and two microbat species listed as vulnerable under the Act.	Current.

Table 1.1 Technical assessments

Appendix	Title	Author	Date	Contents	Currency
Traffic, parking and navigation					
F1	Transport Planning Assessment	EMGA Mitchell McLennan	July 2015	An assessment of the traffic impacts as a result of the operation of the marina on the new Link Road to Brickmakers Drive, Brickmakers Drive, Newbridge Road and Governor Macquarie Drive; carparking, public transport accessibility and bicycle and pedestrian movement.	There have been no significant changes to the proposed development, including the facilities and carparking spaces to be provided so the operational traffic assessment remains current.
F2	Traffic Signal Design Warrant Report	EMM Consulting	June 2016	An assessment of the required improvements to the intersection of the Link Road and Brickmakers Drive.	The assessment considered a range of future traffic scenarios (including with and without the development of the Moorebank Recycling Facility) so remains current.
F3	Navigation Assessment	EMM Consulting	April 2016	A description of the use of the Georges River for boating and the potential impact of the proposed development on river navigation and safety.	There have been no significant changes to the proposed development, including the location of the entrance to marina basin so the assessment remains current.
F4	Construction Access Routes and Traffic Impact Assessment	EMM Consulting	June 2018	An assessment of the impacts of construction traffic on safety, efficiency and ongoing operation on the surrounding roads in accordance with the requirements of the State Environmental Planning Policy (Infrastructure) 2007, Clause 101.	Current.
Landscape and visual					
G1	Projection Estimates of Plant Heights of Potential Native Vegetation Reconstruction Plantings at Benedict Industries Georges Cove Marina Site	EcoHort	August 2010	Preliminary planting list for the marina site.	This information was used to inform the *Visual Impact Assessment* (Appendix G2) and the *Landscape Plan* (Appendix G4).
G2	Visual Impact Assessment	Richard Lamb & Associates	September 2010	A visual impact assessment for the proposed development.	The currency of the assessment was reviewed in 2015 (Appendix G3).

Table 1.1 Technical assessments

Appendix	Title	Author	Date	Contents	Currency
G3	Addendum Visual Impact Review	Richard Lamb & Associates	April 2015	A review of Richard Lamb & Associates (2010), including a site inspection following the near-completion of the Georges Fair residential estate.	The marina design is essentially unchanged and there has been no significant additional development in the adjacent Georges Fair residential estate so the assessment remains current.
G4	Landscape Plan	EcoHort	December 2018	A landscape plan for the development showing site levels, landscape zones, species to be planted, and number of plants.	Current.
Noise					
H1	Noise Impact Assessment	EMM Consulting	April 2019	A noise impact assessment in accordance with assessment was conducted in accordance with the *Noise Policy for Industry* (EPA 2017) which includes consideration of residential development in the Moorebank Cove residential estate immediately north of the marina site.	Current.
Air quality					
I1	Air Quality Assessment for the Proposed Construction and Operation of the Georges Cove Marina	Todoroski Air Sciences	December 2011	An air quality and greenhouse gas assessment for the proposed construction and operation of the marina.	The currency of the assessment was reviewed in 2015 (Appendix H2).
I2	Air Quality and Greenhouse Gas Assessment for the Proposed Construction and Operation of the Georges Cove Marina	Todoroski Air Sciences	April 2015	Todoroski Air Sciences reviewed the original assessment and prepared a letter confirming its findings remain relevant.	There have been no changes to project design, construction or operations that would change the findings of the Air Quality and Greenhouse Gas Assessment.
Heritage					
J1	Aboriginal Archaeological Assessment	Mary Dallas Consulting Archaeologists	October 2004	A desktop and field survey assessment for Aboriginal heritage in consultation with Gandangara Local Aboriginal Land Council.	The currency of the assessment was reviewed in 2015 (Appendix J2).

Table 1.1 Technical assessments

Appendix	Title	Author	Date	Contents	Currency
J2	Aboriginal Heritage	EMGA Mitchell McLennan	April 2015	A review of the Mary Dallas Consulting Archaeologists (2004) *Aboriginal Archaeological Assessment* to determine if it satisfies the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW 2010) and a search of the AHIMS register.	The 2004 assessment and the updated AHIMS search fulfilled the requirements of the due diligence guidelines because: the project is on disturbed land; no Aboriginal sites have been recorded in the project area; and an archaeological survey of the entire project area did not identify any Aboriginal objects or areas of archaeological potential. The Aboriginal Heritage Assessment findings remain current.
J3	Non-Indigenous Heritage Assessment	Heritech Consulting	May 2003	A site survey and review was completed.	The currency of the assessment was reviewed in 2015 (Appendix J4).
J4	Non-Indigenous Heritage	EMGA Mitchell McLennan	May 2015	A review of the Heritech Consulting (2003) *Non-Indigenous Heritage Assessment* and a search of applicable registers.	The review confirmed that no listed historic heritage items will be impacted by the project and, as the project area has been highly disturbed, it is unlikely to have archaeological potential. The assessments remain current.
Waste					
K1	Waste Management Plan	Benedict	2016	An outline of waste and recycling materials during marina construction and operations.	Remains current.

1.10 Secretary's Environmental Assessment Requirements

The updated SEAR 912 (9 October 2018), and where they are addressed in this EIS, are summarised in Table 1.2.

Table 1.2 Secretary's Environmental Assessment Requirements (SEAR 912 – Updated)

Assessment requirement	Reference in EIS
The EIS must include an assessment of all potential impacts of the proposed development on the existing environment (including cumulative impacts if necessary) and develop appropriate measures to avoid, minimise, mitigate and/or manage these potential impacts. As part of the EIS assessment, the following matters must also be addressed.	Chapters 6 and 7
Strategic context – including:	
• a detailed justification for the proposal and suitability of the site for the development	Sections 1.7 and 8.5
• a demonstration that the proposal is consistent with all relevant planning strategies, environmental planning instruments, development control plans (DCPs), or justification for any inconsistencies	Chapter 3
• a list of any approvals that must be obtained under any other Act or law before the development may lawfully be carried out	Section 3.5
Air quality – including: • a description of all potential sources of air and odour emissions • an air quality impact assessment in accordance with relevant Environmental Protection Authority Guidelines • a description and appraisal of air quality impact mitigation and monitoring measures	Section 6.8 Appendices I1 and I2
Noise and vibration – including: • a description of all potential noise and vibration sources during construction and operation, including road traffic noise • a noise and vibration assessment in accordance with the relevant Environment Protection Authority Guidelines • a description and appraisal of noise and vibration mitigation and monitoring measures	Section 6.7 Appendix H1
Soil and water – including:	
• a description of local soils, topography, drainage and landscapes	Sections 1.2.1, 6.2 and 6.6 Appendices G1–G3
• details of water usage for the proposal including existing and proposed water licencing requirements in accordance with the *Water Act 1912* and/or the *Water Management Act 2000*	Section 2.9
• the details of sediment and erosion controls	Section 2.11
• a detailed site water balance	Section 6.1.7
• an assessment of impacts associated with dredging, reclamation and seawall construction and operation	Section 6.4.3 Appendices C1, C2, E3 and E4
• an assessment in accordance with ASSMAC Guidelines for the presence and extent of acid sulfate soils (ASS) and potential acid sulfate soils (PASS) on the site and, where relevant, appropriate mitigation measures	Section 6.2 Appendices D1, D3, D6 and D7
• an assessment of potential impacts on the quality and quantity of surface and groundwater resources	Sections 6.1 and 6.3 Appendices D1, D2, D3, D6 and D7

Table 1.2 Secretary's Environmental Assessment Requirements (SEAR 912 – Updated)

Assessment requirement	Reference in EIS
• details of the proposed stormwater and wastewater management systems (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts	Section 2.9
• a description and appraisal of impact mitigation and monitoring measures.	Sections 6.1, 6.2, 6.3 and 6.4 Chapter 7
Contamination – including: • a detailed assessment of the extent and nature of any contamination of the soil, groundwater and marine sediments • conceptual site model detailing the potential risks to human health and the environmental receptors in the vicinity of the site • the preparation of a Remedial Action Plan (RAP) for the site, in accordance with the relevant guidelines produced or approved under the *Contaminated Land Management Act 1997*	Section 6.3 Appendices D1–D7
Traffic and transport – including: • details of road transport routes and access to the site • road traffic predictions for the development during construction and operation • an assessment of impacts to the safety and function of the road network and the details of any road upgrades required for the development.	Section 6.5 Appendices F1, F2 and F4
Marine safety and navigation – including an assessment of the impacts on water-based traffic and the existing users of the Georges River in the vicinity of the marina.	Section 6.10 Appendix F3
Biodiversity – including: • accurate predictions of any vegetation clearing on-site or for any road upgrades • a detailed assessment of the potential impacts on any threatened species, populations, endangered ecological communities or their habitats, groundwater dependent ecosystems and any potential for offset requirements in accordance with the current Office of Environment and Heritage legislation and guidelines • a detailed assessment of potential impacts to fish stocks and fish habitat • details of weed management during construction and operation in accordance with existing State, regional or local weed management plans or strategies • a detailed description of the measures to avoid, minimise, mitigate and offset biodiversity impacts	Section 6.4 Appendices E1–E4 and E6
Waste Management – including: • details of waste handling including, transport, identification, receipt, stockpiling and quality control including off-site reuse and disposal • the measures that would be implemented to ensure that the proposed development is consistent with the aims, objectives and guidelines in the NSW Waste Avoidance and Resource Recovery Strategy 2014-21	Section 5.3.4 Appendix K1
Visual – including an impact assessment at private receptors and public vantage points.	Section 6.6 Appendices G1–G3
Heritage – including Aboriginal and non-Aboriginal cultural heritage.	Section 6.9 Appendices J1–J4

Table 1.2 Secretary's Environmental Assessment Requirements (SEAR 912 – Updated)

Assessment requirement	Reference in EIS
The EIS must assess the proposal against the relevant environmental planning instruments, including but not limited to: • State Environmental Planning Policy (Infrastructure) 2007 • State Environmental Planning Policy (Coastal Management) 2018 • State Environmental Planning Policy No. 33 – Hazardous and Offensive Development • State Environmental Planning Policy No. 55 – Remediation of Land • Greater Metropolitan Regional Environment Plan No. 2 – Georges River Catchment • Liverpool Local Environmental Plan 2008 • Greater Sydney Region Plan – A Metropolis of Three Cities Western City District Plan • relevant development control plans and section 94 plans.	Section 3.2 and 3.3 Section 5.1.1 and 5.5
During the preparation of the EIS you should consult the Department's Register of Development Assessment Guidelines which is available on the Department's website at planning.nsw.gov.au under Development Proposals/Register of Development Assessment Guidelines. Whilst not exhaustive, this Register contains some of the guidelines, policies, and plans that must be taken into account in the environmental assessment of the proposed development.	Chapter 3
During the preparation of the EIS, you must consult the relevant local, State and Commonwealth government authorities, service providers and community groups, and address any issues they may raise in the EIS. In particular, you should consult with the: • Environment Protection Authority • Office of Environment and Heritage • Department of Industry – Lands and Water • Department of Primary Industries • Roads and Maritime Services; • Greater Sydney Commission • Liverpool City Council • the surrounding landowners and occupiers that are likely to be impacted by the proposal. Details of the consultation carried out and issues raised must be included in the EIS.	Chapter 4

2 Project description

2.1 Proposal elements

The proposed development includes the construction and operation of the following main elements:

20. the Maritime Building located near the western boundary of the marina site. This structure will house:
    - a dry berth facility providing 250 berths for small craft;
    - a function centre;
    - tourist, entertainment and recreational and club facilities; and
    - an above ground petrol tank (about 60,000 L) and an above ground diesel tank (about 60,000 L).
21. a wet berth facility for 186 small craft (including casual berths) which will consist of:
    - a marina basin (layout provided in Appendix B1);
    - rock protection of the basin;
    - construction of public recreational facilities on the foreshore including bike paths, barbeque facilities and shelters;
    - floating berths and walkways;
    - fuel pumping facilities;
    - sewage pumpout facilities; and
    - emergency berth access.
22. three external carparking areas and basement carparking providing a total of 637 car spaces;
23. a Private Marina Clubhouse on the northern portion of the RE2 (private recreation) zoned land;
24. support infrastructure - power, water and sewerage; and
25. landscaping.

Each of the main elements are discussed further below.

2.2 Maritime Building

2.2.1 Overview

The Maritime Building will include the areas listed in Table 2.1.

Table 2.1 Maritime Building areas

Maritime Building area	Area (m^2)[1]
Dry berth store	5,946
Circulation	3,119
Hardstand storage	1,848
Small craft display	1,606
Function centre	1,355
Kiosks, commercial, tourist and recreational and club facilities	1,202
Undercroft - kiosks, commercial, tourist and recreational and club facilities	543
Public marina club lounge	450
Amenities	271
Workshops	249
Marina office	151
Function centre - kitchen	110
Function centre - bar/servery	96
Sub-total (gross floor area)	**16,946**
Carparking	11,994
Function centre - terrace	1,059
Public marina club lounge - terrace	127
Total	**30,127**

Note: 1. Areas are preliminarily based on the initial concept stage and may vary depending on the final mix of use determined in the internal fit out and designs to be undertaken at construction certificate stage.

The Maritime Building will comprise a concrete slab, steel framing, and colorbond cladding and has been architecturally designed to minimise visual impacts. The building will have a maximum height of 24.4 m AHD (from FFL 4.6 m AHD). The colours of the cladding (light greys and other suitable colours) were determined in consultation with visual assessment expert, Richard Lamb to minimise visual impact (see Appendices G2 and G3). In addition, panelling on the outside of the building will include a large component of translucent panels to maximise the use of natural light within the interior of the dry store building.

Blade walls will be a prominent architectural feature of the Maritime Building, seeking to create significant visual articulation of the building elevation when viewed from the public domain. The blade walls will traverse from ground level and will protrude past ridge height to create visual interest, which in combination with the substantial surface area and glazing, will create a modern appearance.

Significant attention has been paid to ensure that the design and implementation of the project maximises the connectivity between the marina/maritime precinct as well as the kiosks, tourist, entertainment, recreational and club facilities and function centre to provide the best outcome for the entire development and the planned Mirvac Georges Cove residential estate to the north.

Roof water will be harvested and stored in a large tank for irrigation and ground maintenance purposes as well as for use in grey water applications such as toilet flushing (see Section 2.9.2).

2.2.2 Dry berth facility

The dry berth facility has been designed to accommodate approximately 250 small craft between 4-m and 8-m long (Table 2.2) ('Small craft' are boats less than 15-m long).

Table 2.2 Dry berth capacity

Type	Boat length	Number of dry berths
Small craft	≥4 m to <6 m	125
Small craft	≥6 m to <8 m	125
Total		**250**

Boat launching and retrieval from the facility will be undertaken by a lifting device assisted by a large forklift or internal gantry crane which will operate on the ground floor of the dry berth facility. The forklift/gantry crane will remove small craft from the vertical lift for placement into the racking system in the building.

Dry berth facilities provide significant advantages over wet berths including:

- reduced maintenance and repair costs due to reduced exposure to the weather and the effects of saltwater corrosion;
- reduced environmental impact from the effects of anti-foul on boats' hulls as the small craft will be stored out of the water and so will not require anti-foul;
- reduced costs for owners from savings due to not having to use anti-foul; and
- quick and easy launching and retrieval, eliminating the need for trailering and storing on residential premises and removing the inconvenience and stress associated with towing and parking trailers as part of the normal launching and retrieval of small craft. Normal operations in such facilities involve the booking of launching and retrieval times in a similar fashion to booking tee off times for a round of casual golf.

2.2.3 Function centre

The function centre will include shared amenities and marina offices. These will cater for corporate events, weddings, celebrations and the like, in a similar fashion to traditional function centres.

2.2.4 Kiosk, commercial, tourist, recreational and club facilities

The kiosk, commercial, tourist, recreational and club facilities will be in the northern and eastern portion of the Maritime Building and will service casual visitors using the wider marina, including the Marina Spit Park between the main Maritime Building and the Private Marina Clubhouse (see Section 2.2.5).

2.2.5 Public Marina Clubhouse

The Public Marina Clubhouse portion of the Maritime Building will incorporate a public marina club lounge and a terrace for public marina members. This will be a separate clubhouse to the Private Marina Clubhouse (see Section 2.4). The Public Marina Club facilities will include male and female showers, change and locker rooms, bar and servery facilities and a dining space.

2.2.6 Chandlery, retail area and small craft sale showroom

The chandlery, retail area and small craft sale showroom will be split into two main areas within the Maritime Building:

- the chandlery and retail area that will provide for all the maritime, hardware and supplies required for day-to-day boat maintenance along the lines of a traditional "Whitworths" style store; and
- the small craft sales showroom and sales administration.

2.2.7 Workshop

A workshop will provide service and maintenance facilities for marina club members. The workshop will only be able to accommodate up to four small craft (ie craft less than 15-m long).

2.2.8 Fuel storage

Separate tanks storing about 60,000 L of diesel and about 60,000 L of petrol will be installed on the hardstand at RL 7.3 m and well above 1:100 year flood levels.

2.3 Wet berth (floating) facility

The wet (floating) berth facility is described below. The wet berth facility design was guided by the Australian Standard (AS) 3962-2001, *Guidelines for Design of Marinas*.

2.3.1 Marina basin

The marina basin will be about 150-m wide east to west and 350-m long north to south. The basin will open to the Georges River with a short entrance channel that will be 40-m to 50-m wide.

The marina basin will provide wet berths for small craft and vessels as listed in Table 2.3.

Table 2.3 Marina wet berth capacity

Type	Boat length	Number of wet berths
Small craft	≥8 m to <10 m	52
Small craft	≥10 m to <12 m	110
Small craft	≥12 m to <15 m	20
Vessels	≥15 m to <18 m	2
Vessels	<20 m	2
Vessels	≥20 m	0
Total wet berths		**186**

The marina basin has been designed to alleviate the potential for the formation of poorly flushed corners and will assist to maintain good water quality and visual appearance.

The marina basin will be located on a relatively straight section of the Georges River. These sections are generally more stable and less prone to the significant variations in flow velocity at bends in the river. These velocity variations typically result in sediment deposition on the inside of the bend and significant erosion on the outside of the bend. The location of the marina will provide more stable bank and bed conditions and less potential for sedimentation in the marina basin or entrance.

As described in Section 2.11.3, the marina basin will be formed by filling parts of the existing quarry basin to shape it to the final landform.

2.3.2 Floating berths and walkways

A floating berthing system is proposed rather than fixed jetties because it will be more convenient to users (including people with a disability) and will minimise the visual impact of the berths, particularly at low tide.

The marina berths will comprise a floating system of walkways, with finger units branching off at right angles to the walkways, creating the berthing pens and providing access alongside the moored boats. The floating berths will be held in place by flexible lines that extend to the basin bed which will stretch when flood loads occur, or will be attached to pylons (of a sufficient height to allow for floods) driven into the base of the basin.

The walkway widths will satisfy the requirements of AS 3962-2001, ie:

- walkways less than 100 m long will be at least 1.5-m wide;
- walkways 100 m to 200 m long will be at least 1.8-m wide; and
- walkways more than 200 m long will be at least 2.4-m wide.

The fingers leading from the walkways will be from 0.9 to 2-m wide. This will be dependent on the nominated size of the boat that the berth is servicing. These finger widths will comply with the AS 3962-2001 requirement for the purposes of safe embarkation and disembarkation. The finger length will equal the length of the longest boat that may use the berth.

The final widths of walkways and fingers may vary to a minor degree depending on the proprietary flotation system adopted for the marina, of which there are a number to select from, and the final detailed design.

2.3.3 Casual public berths

In addition to permanent berths, the marina will be accessible to the public who are generally making use of the marina facilities to pick-up and drop-off passengers during marina business hours.

2.3.4 Channel and fairways

A navigation channel at least 40-m wide will be created. This is well in excess of the minimum channel width required for safe navigation.

Adequate widths will be provided for boat manoeuvring at the fuel and sewage pumpout facilities and so that the berths are visually aesthetic. No mooring or anchoring will be allowed within the navigation channel or within the marina basin other than in the berths.

The width of internal channels ('fairways') within the marina will vary depending on the size of the craft in the adjoining berths. As a minimum, and as recommended by AS 3962-2001, fairways will be 1.5 times the length of the longest boat using that fairway.

2.3.5 Foreshore embellishment and rock armouring (subject to a separate application)

Foreshore embellishment and rock armouring for protection will be undertaken subject to a separate application associated with the VPA agreed between Liverpool City Council and Tanlane Pty Limited. These works will include:

- removal of surface waste and fill on the foreshore;
- removal of noxious weeds; and
- restoration and enhancement of vegetation in keeping with indigenous species.

The VPA requires a detailed vegetation management plan (VMP) to be submitted to Council. There is already a financial security mechanism and legally binding agreement in place to procure these works prior to the dedication of this embellished foreshore zone back to Council once they are completed.

An updated VPA was submitted on 15 January 2019 by Tanlane Pty Ltd and LCC.

2.3.6 Signage

The details and locations of proposed signage will be confirmed at construction certificate stage. The signage will include:

- individual marina berths including restricted berths where applicable;
- casual public berthing;
- maintenance holding area;
- no berthing or tie up;
- fuel/pumpout berths and safety instructions on usage;
- fire/safety notices; and
- placarding of fuel storage facilities.

2.3.7 Provision of services to berths

The wet berths will be supplied with potable water, power, lighting and communications (telephone, internet and cable television). These services will be available to the berths via low service pedestals (approximately 900 mm tall) (see example in Photograph 2.1). The service pedestals will be located at the junctions between fingers and the walkway. On the longer runs of the walkway, where there are no fingers, pedestals with lights only will be provided at a spacing of about 10 m.

Services to the pedestals will be supplied from the land-based infrastructure via pipework and conduits which will run down the access gangway (incorporating flexible couplings). These will be fitted under the floating walkway deck and will be out-of-view but accessible for inspection and maintenance.

Provision of services to the marina is described in Section 2.9.



Photograph 2.1 Services pedestal similar to that proposed for Georges Cove Marina (Jones Bay Wharf)

2.3.8 Fire fighting

Fire-fighting equipment will be provided to the wet berths and surrounds in accordance with AS 3962-2001 and to the requirements of relevant authorities. This will include the provision of fire hose reels, fire hydrants booster, fire extinguishers and signage as described below.

i Fire hose reels

Marina fire hose reels will be located to meet the following AS 3962-2001 requirements:

- the length of hose on any hose reel should be at least 36 m;
- at least one hose reel should be located on the shoreline side of the first berth;
- at least one hose reel should be located on the seaward end of each walkway;
- the maximum distance between any two reels should be 30 m;
- at least two reels should be accessible from each berth; and
- a fire hydrant should be located at the head of each access gangway.

The fire hose reels will be connected to the domestic water supply whereas the fire hydrants (see Section 2.9.2) will be connected to a special hydrant service.

2.3.9 Fire extinguishers

Fire extinguishers will be provided at appropriate locations (as noted in AS 3962-2001) that will be agreed upon with the relevant authorities. At least two extinguishers will be provided at each fuel and pumpout berth.

Extinguishers will be selected that are suitable for fire hazards which are not able to be contained by water from hose reels. These are likely to be a dry powder type and/or CO_2 type extinguishers. The holding capacity for each extinguisher will be approximately 9 L or 9 kg. Examples of fire extinguisher and hose reel facilities are shown in Photograph 2.2.



Photograph 2.2 Example fire extinguisher and hose

2.3.10 Security gates

The main walkways of the marina will be available to the public during marina opening hours. Access control gates will be located at the walkways leading to the marina berths. These will control access 24-hours a day. Access control gates will also be located at the base of each gangway (Photograph 2.3). These will be locked at night to provide security, particularly against vandalism, property damage and theft.

A key card system (or similar) will be available to boat owners and marina staff to operate the security gates.



Photograph 2.3 Example of main access control gate (proposed at base of gangways)

2.3.11 Fuel wharf

Fuel bowsers will be located on the dedicated fuel wharf on the end of berth row D (see Drawing DA-003 in Appendix B1). Fuel bowsers will be installed in accordance with the requirements of relevant authorities. In particular, the following requirements will be met:

- at least two fire extinguishers will be provided, selected from the following type and minimum size:
  - 9-kg dry chemical type;
  - 9-kg halogenated hydrocarbon type; and
  - 9-L foam type.
- drip trays will be provided under and around the bowsers. Trays will be of sufficient size to hold any jerry cans being filled;
- a holding tank will be provided onsite to collect and retain the wastes from the drip trays;
- provision will be made for regular emptying and disposal of the holding tank contents to a licensed system or site;
- oil/fuel booms will be provided to contain any accidental fuel spillage; and
- oil absorbent material will be provided to absorb petroleum products spilt on the water surface.

AS 3962-2001 notes the need for particular precautions when supplying fuel over water, such as use of double containment lines. All of these precautions will be adopted in the design and installation of relocated facilities.

An example of a floating fuel berth and safety and environmental equipment including fire-fighting equipment and spill kits is shown in Photograph 2.4.



Photograph 2.4 Example of a floating fuel berth (Empire Bay Marina, Bobbin Head)

2.3.12 Sewage pumpout

A sewage pumpout facility will be located adjacent to the fuel facilities to facilitate and encourage proper sewage disposal from boats. The pumpout facility will discharge into the existing sewer connections on Lot 7. The co-location of the sewage pumpout facilities with fuel facilities will result in high utilisation rates.

The sewage pumpout system will not have holding tanks in order to prevent an odour problem and normal cleaning and maintenance will ensure that there will be no other odour problems associated with the facility.

There are various proprietary pumpout systems available with a choice of pump size. Due to the number of connection points, and the pumping distance from the furthest berths to shore, the pump will be a vacuum type, enclosed and appropriately acoustically shielded to meet the project sound goals. A vacuum pump moves sewage by creating a vacuum between the hose nozzle and an accumulator tank. When the accumulator tank is full, the vacuum is reversed, sending pressurised air into the tank and pushing the sewage out to the sewer for disposal.

The sewage pumpout unit will incorporate a pump and accumulator tank located on the marina walkway adjacent to the pumpout berths. The pumpout unit will be approximately 1.5-m long by 1-m wide by 1.3 m-tall (dependant on the system selected), and enclosed within a cabinet. When not in use, the pumpout nozzle will be stored in a receptacle incorporating a drip tray. Only one user can be pumped out at any one time and marina staff will activate and manage pumpout of all vessels.

The sewage pumpout facilities will be for the use of all boats at the marina. The NSW Government has a policy requiring sewage holding tanks in all recreational boats fitted with a toilet so boats are generally expected to be fitted with an on-board holding tank allowing the sewage pumpout to be used.

No discharge of any nature from toilets or holding tanks will be tolerated in the marina or at the berths. This will be strictly enforced.

As the entire Lot 7 will be connected to the sewerage main during development. The marina will be connected onto that upgraded connection. Based on consultation with Sydney Water, it is understood that sewage from the pumpout facility can be discharged to the main sewers, as long as the discharge does not exceed 2 L/s. This far exceeds the anticipated discharge from the pumpout facility.

2.3.13 Bilge water pumpout

All marina berth holders will be inducted and supplied with a complimentary bilge water absorbing pad as part of the rules and regulations of the marina. Bilge absorbing pads will absorb any oil from the bilges. The bilge water pads will be disposed appropriately.

The discharge of bilge water within the marina basin will be prohibited. Signage to this effect will be displayed throughout the marina. A floating boom will be maintained at the site to contain any surface pollutants in the event of an accidental leakage of bilge water.

2.4 Private Marina Clubhouse

The Private Marina Clubhouse will include the areas listed in Table 2.4.

Table 2.4 Private Marina Clubhouse

Private Marina Clubhouse area	Area (m^2)[1]
Private Marina Clubhouse	216
Circulation	216
Kiosk	123
Amenities	108
Brokerage	72
Marina office	36
Sub-total (gross floor area)	**771**
Private Marina Clubhouse - terrace	194
Small craft store	117
Small craft circulation and ramp	278
Circulation on pontoons	221
Barbeque area	392
Kiosk - terrace	150
Total	**2,124**

Note: 1. Areas are preliminarily based on the initial concept stage and may vary depending on the final mix of use determined in the internal fit out and designs to be undertaken at construction certificate stage.

The Private Marina Clubhouse will provide the cornerstone for the marina precinct and will provide the waterfront access for the future Mirvac Georges Cove residential estate on the northern portion of Lot 7 (subject to separate development applications and approvals). The Private Marina Clubhouse will include office space, dining areas, amenities and access to the wet berths.

The Private Marina Clubhouse will use steel and Colorbond materials to create a modern, outdoor lifestyle feel. It will incorporate large glassed areas to utilise natural light wherever possible. It will have a maximum height of 13.1 m AHD from a FFL 2.8 m AHD.

As with the Maritime Building (see Section 2.2), all of the roof water from the clubhouse will be harvested and stored in a large tank for irrigation and ground maintenance purposes, as well as use in grey water applications such as toilet flushing.

2.5 Marina Spit Park

The Marina Spit Park will be between the main Maritime Building and the Private Marina Clubhouse facilities. It will be a grassed area with some plantings that will be accessible to the public and will be surrounded by a path, including a section facing the marina basin.

2.6 Public recreation facilities on the foreshore

The following public recreation facilities will be constructed on the river foreshore and, once complete, will be dedicated back to Council under the terms of the VPA (see Section 3.4):

- a bike/pedestrian path along the river foreshore land; and
- passive recreation facilities (eg picnic tables).

An access easement will be dedicated over land on the marina site to allow Council to undertake maintenance of the foreshore land.

2.7 Site boundary

A point located by survey out in the Georges River forms the eastern boundary of the marina site and Lot 7. The location of this boundary has been reassessed by JMD Development Consultants in relation to the proposed development. A letter describing the boundary location is provided in Appendix A2. In this letter, Paul M Daly, Registered Surveyor, concludes:

> It is my assessment that all proposed rock works for bank protection of the Georges River, assuming a standard 60 degree angle of repose, can be carried out completely within Lot 7 in DPI065574.

Nevertheless, given the proximity of the works to the boundary of Lot 7, landowner consent from Crown Lands has been sought to allow operational flexibility when undertaking the works on the banks of the Georges River. To remove any doubt, bank stabilisation and rock armouring of the banks do not form part of this application or proposal and a separate application will be made for these works. A plan showing the limit of works is presented in Appendix B2.

2.8 Access and parking

2.8.1 Public access

Public access to the marina (by car, bicycle and on foot) will be provided during normal operating hours from Brickmakers Drive.

Access to the wet berths will be controlled by access control gates (see Section 2.3.10).

Equipment and products to the marina will be delivered by road during normal working hours, Monday to Friday. Given that public use of the marina will be highest on weekends, no significant access conflicts are envisaged (see Section 6.10).

The Maritime Building, Private Marina Clubhouse and wet berth walkways design will comply with relevant disability access standards through the extensive use of ramps and the floating berth configuration. While further details will be included at the construction certificate stage, the relevant access guidelines that will be used to develop the detailed designs will include:

- *Australian Standard AS 1428.1 – 2009/Amendment 1 - 2010, Design for Access and Mobility, Part 1 General requirements for access – New Building Work*;
- *Australian Standard AS 1428.2 – 1992, Design for Access and Mobility, Part 2 Enhanced and additional requirements – Buildings and Facilities*;
- *Commonwealth Government 2002 – Disability Standards for Accessible Public Transport Guidelines*; and
- relevant NSW Maritime Guidelines.

2.8.2 Site access

Once constructed and commissioned, the link road from Brickmakers Drive will provide vehicular access to the marina during the operation of the marina and the latter stages of construction (see Appendices F1, F2 and F4). The existing access road to Lot 7 will be used from the start of construction until the commissioning of the link road. The construction of the link road is currently being assessed by Liverpool City Council (CCE-53/2018 submitted on 1 November 2018 by Mirvac Homes). The construction of this bridge and associated works will meet the VPA requirement for the construction and dedication of a road bridge over the drainage channel, embankment and road to Brickmakers Drive. The link road and bridge crossing will be dedicated to LCC for public use. It is understood that contractors employed by Mirvac are commencing the link road/bridge construction works shortly as part of the R3 zoned Residential development portion of Lot 7.

A combined pedestrian and cycle access path from Brickmakers Drive will be constructed along the northern side of the link road. This will be the primary pedestrian and cycle access route between the marina site and Newbridge Road, where the existing traffic signals allow pedestrians to cross at the Governor Macquarie Drive and Brickmakers Drive intersection.

As previously agreed with Liverpool City Council, the path along the link road will extend to the Georges River foreshore. In combination with the foreshore path within the Flower Power site (also agreed with the Council), these paths will provide public access to the Georges River foreshore from the marina site to the recreation area on Davy Robinson Drive.

2.8.3 Carparks

Many marina facilities in the Sydney basin contend with parking, traffic and congestion problems associated with the lack of access and appropriate parking. Therefore, the provision of ample carparking was an important consideration in the Georges Cove Marina design. The development will incorporate about 637 car spaces which will easily accommodate the parking demands for the development. These will be provided in a series of three external parking areas and in basement carparks.

2.8.4 Emergency access

The marina site is conveniently located for access to ambulance and local hospitals.

The areas allocated for casual public berthing will be available to Marine Area Command (Water Police), NSW Roads and Maritime (RMS), medical evacuation and other emergency services. The main walkway width will provide ample space for emergency evacuation.

2.9 Support infrastructure

The marina site is currently serviced by electricity, water supply and sewerage connections which will be upgraded as part of the overall redevelopment from rural/extractive industry to private recreation, public recreation, medium density residential and business enterprise.

2.9.1 Electricity

Endeavour Energy supplies power along Newbridge Road. There is currently a 600-kVA electricity substation on the site that is used to supply the sand extraction plant.

Consultation with Endeavour Energy has established that the substation will meet the predicted power demand for Georges Cove Marina. Integral Energy was prepared to allow the proposed development to become a high voltage customer and install, operate and manage its own substations.

2.9.2 Water supply

The site has an existing Sydney Water connection with a 40-mm hydrant service and a 20-mm domestic service. This will be upgraded to a 100-mm hydrant service and a 50-mm domestic service (fire hose reels will be connected to the domestic service). This will be completed as part of the upgrading of services to Lot 7. It is understood that the pressure within the upgraded Sydney Water supply system will be sufficient to meet fire-fighting requirements (see Section 2.3.8) without the need for additional booster pumps.

It is proposed to store about 50,000 L of rainwater from the Maritime Building and Private Marina Clubhouse roofs. A site water balance is provided in Section 6.1.7

2.9.3 Stormwater

Sydney Water has indicated that there is sufficient capacity in the existing stormwater infrastructure to cater for the needs of the marina. The marina basin will incorporate a large constructed wetland for polishing and treatment of storm water runoff from the development.

2.9.4 Sewerage

Sydney Water has indicated that there is sufficient capacity in the existing sewerage network to cater for the needs of the marina.

Sewage pumpout facilities will be installed as part of the development and will be connected to the mains sewer (see Section 2.3.12).

2.9.5 Telecommunications

A Telstra main telecommunications cable extends along Newbridge Road and will be connected to the site.

2.10 Hours of operation

The proposed hours of the marina berthing operations are as follows:

- Summer (daylight saving): seven days a week, 7.00 am to 10.00 pm; and
- Winter (non-daylight saving): seven days a week, 7.00 am to 10.00 pm.

It is proposed that the Private Marina clubhouse, Marina Function Centre and associated venues be permitted to operate from 7 am to 12 midnight, as previously approved by the JRPP.

2.11 Site preparation and construction

2.11.1 General

Construction activities will involve a range of different types of construction methods and equipment. The main activities will be the construction of the hardstands, installation of piling, installation of the pontoon units, installation of services and access gangways, and building construction.

There are no existing structures on the marina site to be removed.

2.11.2 Indicative construction program

Construction will commence once development approval is granted. Construction is expected to take about 48 weeks.

2.11.3 Marina basin and entrance construction

The marina basin will be formed by rock armouring the existing quarry basin to shape it to the final landform using the existing quarry dredge and land-based earth moving machinery. This has been largely completed as part of recent quarry operations although final rehabilitation of the basin has not yet started.

Excavated sand and other suitable materials will be used to form the entrance channel and associated land areas required for the marina. Some VENM (but no other waste materials) and rock will be imported to assist with shaping the marina basin.

Modification of the quarry basin to form the marina basin and entrance channel will commence on the landward (eastern) side of the basin wall prior to breaking through the banks to the river. The breakthrough to the river will be undertaken as the last activity in the construction of the marina basin after the water quality in the basin has stabilised and is suitable for connection to the river. In this way, works in the basin will not impact on river water quality.

2.11.4 Pile installation

Steel piles may be installed for the floating berths (as considered in the acoustic assessment – Appendix H1).

2.11.5 Installation of pontoon units

All pontoon units and ramps will be manufactured offsite, brought in by truck and craned onto the water for installation.

2.11.6 Installation of services and access ramp

Access ramps will be delivered to the site by truck as one unit and installed by crane. Installation of service pedestals, fire-fighting equipment and the like, including services cables and pipework, will essentially be a manual task.

2.11.7 Concrete works

In situ concrete works using concrete trucks and pumping units will be required for the various stages of building the Maritime Building and Private Marina Clubhouse.

2.11.8 Timber work

Timber for use as headstocks, girders and decking for the boardwalk/jetty will be delivered to the site by truck, and installed from the land.

2.11.9 Erosion and sediment control

A range of well accepted erosion prevention and sediment control measures (eg those described in the *Managing Urban Stormwater: Soils & Construction* (Landcom 2004), the 'Blue Book') will be implemented during construction works to minimise sediment generation and control dispersal.

As described in Section 2.11.3, all marina basin construction will be completed prior to the opening of the basin to the Georges River ensuring any construction-related runoff is captured within the enclosed basin.

2.11.10 Construction hours

Construction will be restricted to the following hours:

- Monday to Friday: 7.00 am to 5.00 pm; and
- Saturday: 7.00 am to 1.00 pm.

No construction will take place on Sundays or public holidays.

2.12 Consideration of alternatives

This is a site-specific project. Consideration of the development of other sites is neither applicable nor realistic. In reality, the site will be developed to accommodate a modern, well designed marina that could not be developed in the same manner on another site.

The proposed land use as a marina was selected because it presented the best outcome in terms of highest and best value land use. In addition, the site was selected for a marina development because it met the critical location criteria which are discussed below.

2.12.1 Location of existing and proposed marinas

The *Guidelines for Marinas and Related Facilities EIS Guideline* (DUAP 1996) require that, where applicable, the proponent outlines:

- the nature of any past or existing marinas or other facilities on the proposed site or other sites within the immediate locality;
- past environmental performance, including the impacts of the operation on the environment and the effectiveness of any impact mitigation; and
- the relationship of the proposed development to previous or existing operations.

These issues are addressed below.

i Existing marinas on the site

There are no existing or proposed marinas on the site. No proposed marinas nearby have been identified.

ii Existing marinas in the locality

The inner sections of Botany Bay and the upper reaches of the Georges River are poorly serviced by maritime facilities such as those proposed at the Georges Cove Marina. The nearest marina with a level of service (eg berthing, fuel supply, slipping and chandlery) comparable to that of the proposed development is at Lugarno, about 15-km downstream of the Georges Cove Marina site. This EIS considers the proposed environmental impacts of the operation of the proposed Georges Cove Marina, including the proposed management measures.

iii Relationship of proposed development to existing operations

The proposed development (and associated development of the residential and business enterprise zoned lands in the north of the marina site) will replace the previous sand extraction, processing, and waste recycling operations undertaken on the site.

2.12.2 Proposed location

The location of the proposed development is driven by a range of factors, including the following:

- the location of existing marinas (see Section 2.12.1);
- boat navigatability:
    - the required depth of water in berths and fairways;

- required width of fairways; and
- surface area required for the berthing facility.

- the surrounding environment and the ability to avoid or manage environmental impacts, including:
  - visual impacts;
  - aquatic ecology impacts; and
  - noise impacts.
- site access – most critically carparking; and
- site ownership.

As described in this EIS, the proposed development is ideally located based on these factors.

The proposed development is wholly on private land. No structures are required on public land or existing waterways.

2.12.3 Marina demand

The Georges River is spanned by a number of bridges downstream of the marina site (clearances are at average mean high tide as specified by RMS):

- Tom Uglys Bridge: 5.7-m clearance;
- M5 Motorway Overpass: 7.5-m clearance; and
- Como Rail Bridge: 7.0-m clearance.

Accordingly, very few (if any) sail craft are expected to use the marina which will be predominantly used by small craft (ie powerboats). Data obtained from NSW Maritime (now RMS) indicate that there are in excess of 15,000 small craft registered within a 10 km radius of the proposed development.

The berth size distribution proposed has been developed with reference to data provided by NSW Maritime as well as logistic and engineering constraints relating to the facility.

2.12.4 Fuel capacity

It is proposed to install fuel storage for unleaded petrol (60,000 L) and marine diesel (60,000 L) based on typical fuel storage capacities of marinas of a similar size. The fuel storage capacity of marinas of a similar size to the proposed development are summarised in Table 2.5.

Table 2.5 Marina fuel storage in NSW

Marina	Location	Date installed	Fuel capacity (L)
Rushcutters Bay	Sydney Harbour	1979	60,000
The Spit	Middle Harbour	1982	40,000
Akuna Bay	Ku-Ring-Gai Chase National Park	1986	75,000
Nelson Bay	Port Stephens	1988	60,000

2.12.5 'No project' alternative

Should the proposed development not proceed, the objectives listed in Section 1.7 will not be achieved. Further, a suitable alternative economic final land use for the quarry would need to be identified. This would need to be developed, designed and approved. No such alternatives have been identified.

3 Statutory framework

This chapter provides an overview of the statutory framework relevant to the proposal including State and Commonwealth legislation, and State, regional and local plans, policies and guidelines.

3.1 NSW and Commonwealth legislation

An overview of the relevant legislative framework is provided in Table 3.1.

Table 3.1 NSW and Commonwealth legislation

Legislation	Summary
Environmental Planning and Assessment Act 1979 **(NSW)**	
Type of development and development consent required	Development consent is required under Part 4 of the EP&A Act, pursuant to the provisions of the Liverpool LEP, relevant environmental planning instruments (EPIs) and the DCP. Liverpool Council is the consent authority and the Sydney South West Planning Panel is the determining authority.
Environmental impact statement	An EIS is required to allow the consent authority to have regard to the environmental impacts of development and assess development in accordance with the requirements of the SEARs, relevant EPIs, DCPs and policies. The information required in the EIS is specified in Schedule 2 of the EP&A Regulation.
Integrated development	Pursuant to Section 4.46 of the EP&A Act, the application is defined as 'Integrated Development' as: • it requires a Controlled Activity Approval pursuant to Section 91 of the *Water Management Act 2000*; • it may require a licence, or licences, for scheduled development work and/or scheduled activities pursuant to Part 3.2 of the *Protection of the Environment Operations Act 1997* where 'Marinas and boat repairs' are listed as a Scheduled Activity pursuant to Schedule 1 of the Act; and • it will need to obtain a permit to cover harm of marine vegetation pursuant to Section 205 of the *Fisheries Management Act 1994.* Concurrence pursuant to the applicable legislation will need to be sought from the following authorities: • Natural Resources Access Regulator – *Water Management Act 2000*; • Environment Protection Authority – *Protection of the Environment Operations Act 1997*; and • Fisheries NSW – *Fisheries Management Act 1994*. The previous development applications (see Section 1.5) were referred to these agencies, who issued their General Terms of Approval for the proposed development.

Table 3.1 NSW and Commonwealth legislation

Legislation	Summary
Designated development	The proposed development has been identified as 'Designated Development' pursuant to Section 4.10 of the EP&A Act and Schedule 3 of the EP&A Regulation, which includes: Marinas or other related land and water shoreline facilities." (Clause 23), defined as: (1) Marinas or other related land or water shoreline facilities that moor, park or store vessels (excluding rowing boats, dinghies or other small craft) at fixed or floating berths, at freestanding moorings, alongside jetties or pontoons, within dry storage stacks or on cradles on hardstand areas: (a) that have an intended capacity of 15 or more vessels having a length of 20 m or more; or (b) that have an intended capacity of 30 or more vessels of any length; and (i) are located in non-tidal waters, or within 100 m of a wetland or aquatic reserve; or (ii) require the construction of a groyne or annual maintenance dredging; or (iii) the ratio of carpark spaces to vessels is less than 0.5:1; or (c) that have an intended capacity of 80 or more vessels of any size. (2) Facilities that repair or maintain vessels out of the water (including slipways, hoists or other facilities) that have an intended capacity of: (a) one or more vessels having a length of 25 m or more, or (b) 5 or more vessels of any length at any one time. The proposed development has an intended capacity exceeding 80 vessels of any size and therefore, the application is considered to be Designated Development.
Construction certificate	A construction certificate (or certificates) will need to be obtained for all works associated with the proposed development.
Occupation certificate	An occupation certificate (or certificates) will need to be obtained prior to marina operations commencing.
Voluntary Planning Agreement (VPA)	Liverpool City Council's Strategic Planning Division has been consulted over a number of years regarding this development. The landowner and Council have executed a VPA to facilitate the marina development. This includes an easement for boats to pass through the foreshore RE1 (public recreation) land that the proponent is bound to dedicate to Council upon the development of the R3 (medium density residential) land on the marina site (see Section 3.4).

Table 3.1 NSW and Commonwealth legislation

Legislation	Summary
***Biodiversity Conservation Act 2016* (NSW)**	
	The NSW *Biodiversity Conservation Act 2016* commenced on 25 August 2017. It repealed the following: • *Threatened Species Conservation Act 1995*; • sections of the *National Parks and Wildlife Act 1974*; and • *Native Vegetation Act 2003*. The Act provides a regulatory framework for assessing and offsetting biodiversity impacts for proposed developments. Where development consent is granted and vegetation clearing exceeds defined thresholds, the consent authority may impose as a condition of consent, an obligation to retire a number and type of biodiversity credits determined under the Biodiversity Assessment Method (BAM). The Act is supported by the Biodiversity Conservation Regulation 2017 and the Biodiversity Conservation (Savings and Transitional) Regulation 2017, which outline the methods to be used in applying the BAM. No significant impacts to threatened species, populations and communities are anticipated from the construction and operation of the marina (see Section 6.4.1). Vegetation clearing thresholds will not be exceeded so biodiversity offsets will not be required.
***Fisheries Management Act 1994* (NSW)**	
Harm of marine vegetation	*The Fisheries Management Act 1994* aims to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. The proposal will be referred to Fisheries NSW pursuant to Section 205 of the Act to obtain a permit to harm of marine vegetation during construction of the marina entrance.
***Water Management Act 2000* (NSW)**	
Controlled Activity Approval	A Controlled Activity Approval is required for works carried out on waterfront land under the *Water Management Act 2000* and the Water Management Amendment (Controlled Activities) Regulation 2008. The proposed works are deemed to be on waterfront lands and a Controlled Activity Approval will be required.

Table 3.1 NSW and Commonwealth legislation

Legislation	Summary
***Protection of the Environment Operations Act 1997* (NSW)**	
Environment Protection Licence	The *Protection of the Environment Operations Act* 1997 includes statutory provisions for the management and prevention of environmental harm from pollution. An Environment Protection Licence (EPL) is required to authorise the carrying out of 'scheduled' activities or development work (as specified in Schedule 1 of the Act). The proposed development will not include: • boat construction/maintenance (dry/floating docks): capacity to handle vessels 25-m or longer; or • boat construction/maintenance (general): capacity to handle more than 5 vessels longer than 5-m (excluding rowing boats, dinghies and other small craft) at any time; or • boat moorings and storage: capacity to handle more than 80 vessels (excluding rowing boats, dinghies and other small craft) at any time. On this basis, it is understood that the marina would not be a scheduled facility and would not require an EPL. However, previous advice from EPA indicates that an EPL will be required.
***Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)**	
EPBC Act referral	The *Commonwealth Environmental and Biodiversity Conservation Act 1999* provides an assessment and approvals system for actions that have significant impact on matters of national environmental significance, on the environment of Commonwealth land and actions carried out by the Commonwealth Government. The proposed development will not have a significant impact on matters of national environmental significance as listed in the EBPC Act and, accordingly, a referral to the Commonwealth Minister for the Environment is not required.

3.2 State environmental planning policies, other policies and guidelines

The key State environmental planning policies, other policies and guidelines that are relevant to the marina development are summarised in Table 3.2.

Table 3.2 Key planning instruments and guidelines

Planning instrument/guideline	Summary
State Environmental Planning Policy No 19 – Bushland in Urban Areas	SEPP No 19 aims to protect and preserve bushland within the urban areas and maintain its value to the community as part of the natural heritage and its aesthetic value and recreational, educational and scientific resource. As described in Section 3.2.1, the proposed development is considered to comply with the provisions of SEPP No 19.
State Environmental Planning Policy No 33 – Hazardous and Offensive Development	SEPP No 33 identifies potentially hazardous and offensive development and provides for risk threshold screening and preliminary hazard analysis to determine site suitability and potential impacts. The proposed development has been assessed and it has been determined that the development is not potentially hazardous (see Section 5.1.1) or offensive (see Section 5.5).
State Environmental Planning Policy No 55 – Remediation of Land	SEPP No 55 provides that a consent authority must consider contamination and remediation in determining the determining development application. A series of contamination assessments have been undertaken and a remediation action plan prepared. The marina site is suitable for the proposed future land use (the marina development) or will be suitable for this use with minor remediation (see Section 6.3).

Table 3.2 Key planning instruments and guidelines

Planning instrument/guideline	Summary
State Environmental Planning Policy (Coastal Management) 2018	The Coastal Management SEPP aims to ensure development within the coastal zone is managed in a manner consistent with the objects of the *Coastal Management Act 2016*. To achieve this the Coastal Management SEPP provides for development controls and heads of consideration for development proposed within any of the four coastal management areas. Three of the four coastal management areas are relevant to the proposed development. • coastal wetlands and littoral rainforest area; • coastal environment area; and • coastal use area. It is noted that the site is partly within the proximity area for a coastal wetland and not within a mapped coastal wetland area itself. For land in proximity to coastal wetlands, the consent authority must be satisfied that the proposed development will not significantly impact on the biophysical, hydrological or ecological integrity of the adjacent coastal wetland, or the quantity and quality of surface and groundwater flows to and from the adjacent coastal wetland. For development on land within the coastal environment area, the proposed development needs to consider the integrity and resilience of the biophysical, hydrological and ecological environment, coastal environmental values and natural coastal processes, the water quality of the marine estate, marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms, existing public open space and safe access to and long the foreshore, beach, headland or rock platform for members of the public, Aboriginal cultural heritage, and the use of the surf zone. For development on land within the coastal use area, the proposed development is required to consider whether the development is likely to cause an adverse impact on existing, safe access to and along the foreshore, beach, headland or rock platform for members of the public, overshadowing, wind funnelling and loss of views from public places to foreshores, the visual amenity and scenic qualities of the coast, Aboriginal cultural heritage, cultural and built environment heritage. Water, ecological, visual, Aboriginal heritage and access assessments have been undertaken in response to the above considerations. The assessment results conclude that the proposed development, with appropriate design and mitigation measures, will not have adverse environmental and social impacts. All of these matters are considered in Chapter 6.

Table 3.2 Key planning instruments and guidelines

Planning instrument/guideline	Summary
State Environmental Planning Policy (Infrastructure) 2007	Schedule 3 Clause 104 of this SEPP identifies traffic generating development that requires referral to the RMS for comment. It is understood that the marina development will be referred to RMS accordingly.
NSW Sea Level Rise Policy Statement Flood Prone Land Policy Floodplain Development Manual Coastline Management Manual Coastal Design Guidelines for NSW Georges River Coastal Zone Management Plan	The *Coastal Management Manual* (OEH 2018) requires local councils to prepare a coastal management plan. The *Floodplain Development Manual* (DIPNR 2005) guides local government in managing flood risk in their communities. Liverpool City Council has considered all these issues in the making of the Liverpool LEP. The LEP included the rezoning of the marina site for medium density residential development and the determination of the 1:100 flood levels. The proposed marina has been designed to accommodate potential flood impacts in accordance with these policies. The Georges River Coastal Zone Management Plan (GRCCC 2013) aims to "preserve and enhance the environmental values of the estuary amid the burgeoning urban development across the catchment, which presently accommodates more than 1.2 million people." The primary goal of this document has been defined as "to conserve and improve the existing natural environment of the Georges River Estuary, and to improve the water quality of the estuary through targeted pollution reduction". The proposed development would meet these aims and objectives for the future management of the Georges River estuary.
Australian Standard AS3962-2001: *Guidelines for Design of Marinas*	This standard provides designers, manufacturers and operators of marina and berthing facilities with a guidelines for recreational marinas and small commercial vessels up to 50 m long. Guidance is also given for onshore facilities such as dry berth storage, boatlifts, boat ramps and associated parking facilities. Michael Fountain Architects considered the standard in designing the marina and the proposed development to ensure that it complies with the standards requirements.

Table 3.2 Key planning instruments and guidelines

Planning instrument/guideline	Summary
Greater Metropolitan Regional Environmental Plan No 2 – Georges River Catchment Biodiversity of the Georges River Catchment Georges River Catchment Built Environment and Foreshore Access Study Georges River Catchment: Better Practice Guidelines for Foreshore Works	The Greater Metropolitan Regional Environmental Plan No 2 – Georges River Catchment specifies the types of development which significant impacts on water quality and river flows in the Georges River and its tributaries. It sets out general principles and planning controls in relation to the developments specified. Associated reports include: • *Georges River Catchment Built Environment and Foreshore Access Study* – provides planning and management measures to improve of the scenic environment and access to the waterways; • *Biodiversity of the Georges River Catchment* – provides a regional context for biodiversity planning guidelines for biodiversity management; and • *Georges River Catchment: Better Practice Guidelines for Foreshore Works* – provides guidelines to assist practitioners during the planning and implementation of works on the foreshores of the Georges River and its tributaries. An assessment against the principles of the Regional Environmental Plan and associated documents is provided in Section 3.2.6. The proposed development will comply with this Regional Environmental Plan.
Greater Sydney Region Plan – Metropolis of Three Cities Western City District Plan	The objective of the Greater Sydney Region Plan – Metropolis of Three Cities ('the Plan') is to balance growth and deliver benefits equitably to residents across Greater Sydney. It has been prepared concurrently with *Future Transport 2056* and the State Infrastructure Strategy, and aligns land use, transport and infrastructure planning to reshape Greater Sydney as three connected cities. The Plan is built on a vision of three cities, where most residents live within 30 minutes of their jobs, education and health facilities, services and great places. Liverpool LGA is located within the Western Parkland City and Liverpool is identified as a metropolitan cluster. There are ten key directions for Greater Sydney in the Plan. Each key direction includes objectives relevant to that particular direction. An assessment against the relevant directions and planning priorities is provided in Section 3.2.7. The Western City District Plan (District Plan) advances the outcomes of A Metropolis of Three Cities at a District level, through Productive City, Liveable City and Sustainable City priorities. An assessment of consistency against the relevant Western City Planning Priorities is provided in Section 3.2.8.

3.2.1 State Environmental Planning Policy No 19 – Bushland in Urban Areas

State Environmental Planning Policy No 19 – Bushland in Urban Areas aims to protect and preserve bushland within the urban areas and maintain its value to the community as part of the natural heritage and its aesthetic value and recreational, educational and scientific resource.

The SEPP includes the following relevant definition:

> bushland means land on which there is vegetation which is either a remainder of the natural vegetation of the land or, if altered, is still representative of the structure and floristics of the natural vegetation.

The marina site both adjoins and contains land zoned RE1 Public Recreation under the LEP. Accordingly, a merit assessment of the proposed development against Clause 9 "Land adjoining land zoned or reserved for public open space" has been undertaken. The following table summarises the matters for consideration in determining development application and compliance.

Table 3.3 SEPP No 19 – Bushland in Urban Areas

Clause 9 Land adjoining land zoned or reserved for public open space	Comment
This clause applies to land which adjoins bushland zoned or reserved for public open space purposes.	The marina site adjoins and contains RE1 Public Recreation land.
Where a public authority: • proposes to carry out development on land to which this clause applies; or • proposes to grant approval or development consent in relation to development on land to which this clause applies; and • the public authority shall not carry out that development or grant the approval or development consent unless it has taken into account.	The application involves granting of development consent on land to which this clause applies.
The need to retain any bushland on the land.	A VPA has been executed with the property owner and Liverpool City Council and contains work which requires the property owner to re-vegetate the river foreshore in accordance with a VMP to be submitted in accordance with the agreement (see Section 3.5). The VMP will demonstrate how weeds will be removed and now the remediated marina site will managed in the future.
The effect of the proposed development on bushland zoned or reserved for public open space purposes and, in particular, on the erosion of soils, the siltation of streams and waterways and the spread of weeds and exotic plants within the bushland.	A VMP is to be prepared as mandated by the VPA. The conditions issued for the previous development applications considered the general terms of approval issued from the WaterNSW; Fisheries NSW and EPA. The VMP and other approvals required to carry out work will sufficiently address these matters.
Any other matters which, in the opinion of the approving or consent authority, are relevant to the protection and preservation of bushland zoned or reserved for public open space purposes.	The VMP is considered to be sufficient in preserving and embellishing bushland areas with the intent to enhance these areas for public benefit.

The proposed development is, therefore, considered to comply with the provisions of SEPP No 19.

3.2.2 State Environmental Planning Policy No 55 – Remediation of Land

State Environmental Planning Policy No 55 – Remediation of Land (SEPP No 55) provide aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment.

As described in Section 6.3, a series of contamination assessments have been prepared in accordance with the *Guidelines for Consultants Reporting on Contaminated* (OEH 2011) (Appendices D1 to D7).

The contamination and remediation to be considered in determining development application as described in clause 7(2) of SEPP No 55. These found that with remediation and suitable management measures, the land will be suitable for the proposed uses.

The statutory Site Audit Statement provided in Appendix D7 concludes that the proposed remediation measures are appropriate for the remediation of the site to make it suitable for the proposed Georges Cove marina development, subject certain conditions (see Section 6.3.1ii).

3.2.3 State Environmental Planning Policy (Coastal Management) 2018

There are two key elements to the State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP) – the provisions relating to development controls and matters for consideration, and the maps which indicate where those provisions apply.

i Coastal wetlands and littoral rainforests area

There are no coastal wetlands or littoral rainforests mapped under the Coastal Management SEPP for the marina site. Wetlands are mapped on adjoining land downstream and across the river, both at a distance of approximately 80 m.

A small portion of the site (Figure 3.1) is within the 100-m perimeter area for coastal wetlands. Therefore, the development controls applicable to the perimeter area of coastal wetlands apply to this small portion of the site.



Coastal Wetlands and Littoral Rainforest areas hatched.
Indicative site boundary only.

Figure 3.1 Coastal Wetlands and Littoral Rainforest areas

Compliance with the Development controls set out under the Coastal Management SEPP that apply to land mapped as being within a proximity area for coastal wetlands is summarised in Table 3.4.

Table 3.4 Coastal Management SEPP – Development on land in proximity to coastal wetlands or littoral rainforest

	Clause	Compliance
(1)	Development consent must not be granted to development on land identified as "proximity area for coastal wetlands" or "proximity area for littoral rainforest" on the *Coastal Wetlands and Littoral Rainforests Area Map* unless the consent authority is satisfied that the proposed development will not significantly impact on:	
(a)	the biophysical, hydrological or ecological integrity of the adjacent coastal wetland or littoral rainforest, or	The results of hydrological model shown that the water level increase of 0.1 m for local catchment flooding area is considered minor. Only small areas of poor condition vegetation communities will be removed for the proposed marina (see Section 6.4). However, such removal or indirect impacts are not considered important for the long-term survival of the ecological communities in the locality. The VPA and associated VMP will provide measures to improve vegetation within the marina site.
(b)	The quantity and quality of surface and ground water flows to and from the adjacent coastal wetland or littoral rainforest.	The water quality in the basin is of a similar quality to that in the Georges River. Breakthrough of the bank from the marina to the Georges River would not significantly affect the water quality of either receiving waters. Furthermore, the operation of the marina would not have a significant impact on the water quality (including existing copper concentrations) in the Georges River. Appropriate mitigation measures will be incorporated in the design to provide stormwater treatment.
(2)	This clause does not apply to land that is identified as "coastal wetlands" or "littoral rainforest" on the *Coastal Wetlands and Littoral Rainforest Area Map*	This land is not mapped as "coastal wetlands" or "littoral rainforest" on the *Coastal Wetlands and Littoral Rainforest Area Map*.

ii Coastal environment area

The Coastal Management SEPP maps the coastal environment area for all tidal waters within estuaries, including the Georges River. The coastal environment area includes the estuary (Georges River bed) plus 100-m landward from the edge of the river (Figure 3.2).



100-m buffer from river shaded.
Indicative site boundary only.

Figure 3.2 Coastal Environment Area Map

Compliance with the development controls set out under the Coastal Management SEPP for land mapped as being within a coastal environment area is summarised in Table 3.5.

Table 3.5 Coastal Management SEPP – Development on land within the coastal environment area

	Clause	Compliance
(1)	Development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following:	
(a)	the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,	The land within the coastal environment area is predominantly land which is highly modified due to historical use of the area for extractive industry activity. The results of hydrological model shown that the water level increase of 0.1 m for local catchment flooding area, which is considered to be minor. Only small areas of poor condition vegetation communities will be removed for the proposed marina (see Section 6.4). However, such removal or indirect impacts are not considered important for the long-term survival of the ecological communities in the locality. The VPA and associated VMP will provide measures to improve vegetation within the marina site.

Table 3.5 Coastal Management SEPP – Development on land within the coastal environment area

	Clause	Compliance
(b)	coastal environmental values and natural coastal processes,	The bank of the Georges River will be stabilised as part of a separate application. The development does not propose to introduce structures which could interrupt coastal processes, such as tidal flow. The maintenance of the general bank alignment will ensure that natural coastal processes continue unimpeded. The stormwater treatment measures and the measures in the VMP will contribute to maintaining and improving environmental values and natural coastal processes.
(c)	the water quality of the marine estate (within the meaning of the *Marine Estate Management Act 2014)*, in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,	The water quality of the marine estate, in this instance, lands in the immediate proximity of the coastal waters of the State, would not significantly be impacted by the marina development. Appropriate mitigation measures will be incorporated in design to provide stormwater treatment for water flows to and from the marine estate. There are no sensitive coastal lakes (identified in Schedule 1) near the development.
(d)	marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,	Construction as part of the proposed foreshore works (not part of this application) requires consent from NSW Fisheries for the harming of marine vegetation. Even under the do-nothing option, it is likely that the masonry fill currently used for shore protection would need to be removed, which would still put the adjacent marine vegetation at risk. Most of the site is devoid of vegetation, with the original native vegetation been removed during current and past land use practices. Removal of some remaining trees and native vegetation do not comprise a significant area of canopy within the locality and consequently do not comprise a significant area of foraging habitat within the locality. The proposed landscaping within the coastal environment area will, on balance, improve the existing capacity of the land to support appropriate habitat. The proposed marina development is unlikely to significant impact on native flora and fauna in the project area.
(e)	existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,	As a result of the development, a combined pedestrian and cycle access path from Brickmakers Drive will be constructed. These paths will provide primary pedestrian and cycle access route between the site and Newbridge Road. The path along the link road will extend to the Georges River foreshore. These paths will together provide public access to the Georges River foreshore from the marina site.
(f)	Aboriginal cultural heritage, practices and places,	Aboriginal sites have not been recorded and are not likely to exist in the marina site.
(g)	the use of the surf zone.	There is no surf zone near the marina site.
(2)	Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:	
(a)	the development is designed, sited and will be managed to avoid an adverse impact referred to in subclause (1), or	See below.
(b)	if that impact cannot be reasonably avoided – the development is designed, sited and will be managed to minimise that impact, or	The development is designed, sited and will be managed to minimise impacts as described above in the responses to subclause (1).

Table 3.5 Coastal Management SEPP – Development on land within the coastal environment area

	Clause	Compliance
(c)	if that impact cannot be minimised – the development will be managed to mitigate that impact.	The development is designed, sited and will be managed to mitigate impacts as described above in the responses to subclause (1). This will include the preparation of through mechanisms such as the VPA and a construction environmental management plan.
(3)	This clause does not apply to land within the Foreshores and Waterways Area within the meaning of *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005.*	This land is not within the Foreshores and Waterways Area within the meaning of *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005*.

iii Coastal use area

The coastal use area is mapped as a 100-m ribbon of land which runs adjacent to tidal waters, such as the Georges River estuary (Figure 3.3). It does not include the riverbed.



The heads of consideration and development controls specified for the coastal use area apply to the land mapped as coastal use area under the Coastal Management SEPP (100-m buffer from river shaded).
Indicative site boundary only.

Figure 3.3 Coastal Use Area Map

Compliance with the development controls set out under the Coastal Management SEPP for land mapped as being within a coastal use area and preliminary investigation finding is summarised in Table 3.6.

Table 3.6 Coastal Management SEPP – Development on land within the coastal use area

	Clause	Compliance
(1)	Development consent must not be granted to development on land that is within the coastal use area unless the consent authority:	
(a)	has considered whether the proposed development is likely to cause an adverse impact on the following:	-
(i)	existing, safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability.	A combined pedestrian and cycle access path from Brickmakers Drive will be constructed as a result of the development. These paths will provide primary pedestrian and cycle access route between the site and Newbridge Road. The path along the link road will extend to the Georges River foreshore. These paths will together provide public access to the Georges River foreshore that is presently unavailable.
(ii)	overshadowing, wind funnelling and the loss of views from public places to foreshores,	The overall visual effects of the development on its visual catchment are low to moderate. The views from existing residential areas to the foreshore will be very restricted due to foreground vegetation and buildings.
(iii)	the visual amenity and scenic qualities of the coast, including coastal headlands,	The scenic quality of the visual catchment of the development as it currently exists is low to moderate quality. The marina development and the residential development will increase the scenic quality. The buildings associated with the marina are not within the coastal use area. The development in the coastal use area is generally at ground level and comprises improvements such as parking bays, cycleway and landscaping.
(iv)	Aboriginal cultural heritage, practices and places,	Aboriginal sites have not been recorded and are not likely to exist in the marina site.
(v)	cultural and built environment heritage, and	There are no heritage items in the project area which meet local or State historic listing criteria. Furthermore, no indication of structures such as, wharfs, jetties or retaining walls were identified and no maritime historic structures related to the Georges River.
(b)	Is satisfied that:	-
(i)	the development is designed, sited and will be managed to avoid an adverse impact referred to in paragraph (a), or	See above.
(ii)	if that impact cannot be reasonably avoided – the development is designed, sites and will be managed to minimise that impact, or	The development is designed, sited and will be managed to minimise impacts referred to in paragraph (a).
(iii)	if that impact cannot be minimised – the development will be managed to mitigate that impact, and	The development is designed, sited and will be managed to mitigate impacts referred to in paragraph (a) such as extending the path along the link road to the Georges River foreshore to provide public access linkages to the foreshore.
(c)	has taken into account the surrounding coastal and built environment, and the bulk, scale and size of the proposed development.	The development has taken into account the surrounding coastal and built environment, and the bulk, scale and size of the proposed development. It is noted that buildings associated with the marina development are not within the coastal use area

Table 3.6 Coastal Management SEPP – Development on land within the coastal use area

	Clause	Compliance
(2)	This clause does not apply to land within the Foreshores and Waterways Area within the meaning of *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005*.	This land is not within the Foreshores and Waterways Area within the meaning of *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005*.

iv Coastal hazards

The Coastal Management SEPP does not map a coastal vulnerability area but there is a general provision within the SEPP (Clause 15), which requires:

> 15 Development in coastal zone generally—development not to increase risk of coastal hazards
>
> Development consent must not be granted to development on land within the coastal zone unless the consent authority is satisfied that the proposed development is not likely to cause increased risk of coastal hazards on that land or other land.

Land within the site which is mapped as being within the coastal wetlands proximity area, coastal environment area or coastal use area constitutes the 'coastal zone' as defined by section 5 of the *Coastal Management Act 2016*. Clause 15 of the Coastal Management SEPP therefore applies to these portion of the marina site.

As indicated above, the proposed marina development would not cause adverse impacts on biophysical, hydrological, ecological, quantity and quality of water, visual amenity and public access to the Georges River foreshore. Appropriate mitigation measures have been implemented such as VPA and management plans to minimise potential impacts and minimise risk of coastal hazards.

v Coastal management plans

The Coastal Management SEPP includes a general provision that coastal management programs should be considered:

> 16 Development in coastal zone generally—coastal management programs to be considered
>
> Development consent must not be granted to development on land within the coastal zone unless the consent authority has taken into consideration the relevant provisions of any certified coastal management program that applies to the land.

We understand that LCC will consider the objectives of the *Georges River Estuary Coastal Zone Management Plan* (GRCCC 2013) in considering this application.

3.2.4 State Environmental Planning Policy (Infrastructure) 2007

The proposal includes a club and recreational facilities and parking for in excess of 200 vehicles; which is identified in Schedule 3 of State Environmental Planning Policy (Infrastructure) 2007 as a traffic generating development.

Vehicular access and the link road intersection design in Brickmakers Drive does not form part of the marina application. However, information with respect to road and intersection design and traffic modelling to allow an assessment of traffic impact as part of the application has been submitted as part of this EIS (Appendices F1, F2 and F4).

It is proposed to install the traffic signals during construction of the link road/Brickmakers Drive intersection. While these are not required immediately for the Georges Cove Marina alone, the intersection is likely to require traffic signals in the longer term due to background traffic growth on Brickmakers Drive and future developments, such as the Mirvac Georges Cove residential estate that will use the link road. Installing these signals during the initial intersection construction will provide greater certainty regarding the adequacy of the intersection to cater for traffic from future developments and will be less disruptive than installing signals at a later date when the link road is opened to traffic.

3.2.5 State Environmental Planning Policy No. 33 – Hazardous and Offensive Development

SEPP No 33 identifies potentially hazardous and offensive development and provides for risk threshold screening and preliminary hazard analysis to determine site suitability and potential impacts. The proposed development has been assessed and it has been determined that the development is not potentially hazardous (see Section 5.1.1) or offensive (see Section 5.5).

3.2.6 Greater Metropolitan Regional Environmental Plan No 2 – Georges River Catchment

The Greater Metropolitan Regional Environmental Plan No 2 – Georges River Catchment (GMREP No 2) aims to maintain and improve the water quality and river flows of the Georges River and its tributaries. The plan (Part 2, Clause 7) provides planning principles to be applied by a consent authority when determining a development application. Compliance with the general and specific planning principles provided in Part 2, clauses 8 and 9, is summarised in Table 3.7.

Table 3.7 Greater Metropolitan Regional Environmental Plan No 2 principles

Principles	Compliance
Clause 8 General Principles	
(a) the aims, objectives and planning principles of this plan	The proposed development seeks to maintain and improve the water quality of the Georges River.
(b) the likely effect of the proposed plan, development or activity on adjacent or downstream local government areas	The proposal will provide soil and erosion control measures; embellish river foreshore land; and provide site drainage. Therefore, it will improve the environmental performance of the marina site. The proposed development will not impact the eastern bank foreshore of the Georges River which is part of Canterbury Bankstown LGA. There will be no downstream hydrological or water quality impacts so downstream LGAs will not be impacted.
(c) the cumulative impact of the proposed development or activity on the Georges River or its tributaries	The VMP will describe embellishment of the river foreshore. Conditions recommended by the EPA, WaterNSW and Fisheries NSW in response to the previous applications contain requirements which will address acid sulfate soils, contamination, vegetation, aquatic impact, erosion and sediment control and existing basin water. These requirements will be addressed prior to construction.

Table 3.7 Greater Metropolitan Regional Environmental Plan No 2 principles

Principles	Compliance
(d) any relevant plans of management including any River and Water Management Plans approved by the Minister for Environment and the Minister for Land and Water Conservation and best practice guidelines approved by the Department of Urban Affairs and Planning (all of which are available from the respective offices of those Departments)	**Biodiversity of the Georges River Catchment** The development will assist biodiversity in the Georges River catchment by restoring the existing extractive industry site to provide habitat in the RE1 zone. This area will be embellished in accordance with the VMP. The bank stabilisation works do not form part of this application. **Georges River Catchment Built Environment and Foreshore Access Study** This study identified planning and management measures to improve of the scenic environment and access to the waterways. In a specific local context, it is noted that the Boat ramp on Davey Robinson Drive was identified as demonstration site for future development and enhancement. The demonstration sites are intended to illustrate the widest range of development and design opportunities for foreshore improvements, to consider access, recreation, built form, environment, cultural heritage and scenic quality. The proposed marina development meets the main criteria for future development as reflected in the suggested demonstration sites as it will: • provide a range of levels of access to the river; • enhance the natural values and recreational amenity of the foreshore areas and reduces adverse impacts on the waterway; • provide existing or potential links between access points and recreation areas; • link existing open space with foreshore bushland and enhance the riparian zone; • build on existing programs and projects in the area; • enhance the focus on the river; • improve the ecological environment by controlling access; and • have significant scenic amenity values. **Georges River Catchment: Better Practice Guidelines for Foreshore Works** The foreshore embellishments will be conducted in a manner consistent with the principles set out in these guidelines.
(e) the Georges River Catchment Regional Planning Strategy (prepared by, and available from the offices of, the Department of Urban Affairs and Planning)	The proposal will meet the initiatives of this strategy.
(f) all relevant State Government policies, manuals and guidelines of which the council, consent authority, public authority or person has notice	The previous applications were provided to EPA, WaterNSW and Fisheries NSW which issued general terms of approval.
(g) whether there are any feasible alternatives to the development or other proposal concerned	The marina site currently accommodates an extractive industry. The locality has been rezoned to accommodate for residential, business and recreational uses which is in keeping with the surrounding residential area. Alternative land-uses are discussed in Section 2.12.

Table 3.7 Greater Metropolitan Regional Environmental Plan No 2 principles

Principles	Compliance
Clause 9 specific principles:	
(1) acid sulfate soils	The marina site has been identified on the LEP Acid Sulfate Soils map. An acid sulfate soil management plan is provided in Appendix D6.
(2) bank disturbance	No disturbance of the bank or foreshore along the Georges River and its tributaries is proposed other than during construction when the marina entrance will be opened (see Section 2.11.3).
(3) flooding	The marina site contains flood prone land. Flooding risk is addressed in Section 3.3.3.
(4) industrial discharges	There will be no industrial discharges from the marina site.
(5) land degradation	The proposed development will provide a stable landform with appropriate drainage, including along the foreshore. Erosion prevention and sediment control measures will be implemented during construction (see Section 2.11.9).
(6) onsite sewage management	The marina site will be connected to the sewer mains (see Section 2.9.4).
(7) river-related uses	River foreshore land to be embellished as per the VPA.
(8) sewer overflows	All site sewage will be discharged to the mains sewer. Onsite sewerage will be designed to prevent sewage discharge to the river in the event of an overflow.
(9) urban/stormwater runoff	Water management measures are described in Section 6.1.8. Drainage details will be provided with the Construction Certificate application.
(10) urban development areas	The provision of pumpout facilities will reduce nutrients and pathogens entering the river from boats.
(11) vegetated buffer areas	River foreshore land will be embellished as per the VPA which will include vegetation enhancement.
(12) water quality and river flows	The development is unlikely to impact on water quality.
(13) wetlands	River foreshore land will be embellished as per the VPA.
Clause 10 Consultation	
(1) Required consultation	The Liverpool City Council will consult with the authorities listed in Clause 11 'marinas and slipways'.
(2) Consultation procedure	The Council will consult in accordance with this clause.
Clause 11 Planning control table	
(a) marinas and slipways	The previous application was provided to EPA, WaterNSW and Fisheries NSW which issued general terms of approval regarding acid sulfate soils, contamination, vegetation, aquatic impact, erosion and sediment control and existing basin water. This EIS addresses: • potential impacts on the aquatic environment (see Section 6.4.3); • onsite sewage management (Section 2.9.4); • management of fuels and other chemicals (Sections 2.2.8, 5.1 and 5.2); • navigation (Section 6.10.2); • bank stability (Section 6.1.2); and • acid sulfate soils (Section 6.2.1).

3.2.7 Greater Sydney Region Plan – A Metropolis of Three Cities

In March 2018, the NSW Government released *A Metropolis of Three Cities – The Greater Sydney Region Plan* (the Plan) which effectively replaces the previous strategic plan for *Sydney, A Plan for Growing Sydney*. The objective of the Plan aims to balance growth and deliver the benefits of the Plan more equally and equitably to residents across Greater Sydney. It has been prepared concurrently with *Future Transport 2056* and the *State Infrastructure Strategy*, and aligns land use, transport and infrastructure planning to reshape Greater Sydney as three connected cities.

The Plan is built on a vision of three cities, where most residents live within 30 minutes of their jobs, education and health facilities, services and great places.

To meet the needs of a growing changing population, the vision seeks to transform Greater Sydney into a metropolis of three cities (Plate 3.1). These being:

- The Western Parkland City;
- The Central River City; and
- The Eastern Harbour.

Liverpool LGA is located within the Western Parkland City and Liverpool is identified as a metropolitan cluster.



Plate 3.1 A Metropolis of Three Cities

There are ten key directions for Greater Sydney in the Plan. Each key direction includes objectives relevant to that particular direction. Consistency of the proposed development with the Plan's objectives key directions is outlined in Table 3.8.

Table 3.8 Assessment of consistency against Metropolis of Three Cities objectives

Objective	Relevance	Comments
Liveability: a city of great places		
Objective 12: Great places that bring people together	The plan identifies that Greater Sydney's cities, centres and neighbourhoods each have a unique combination of people, potential, history, culture, arts, climate, built form and natural features creating places with distinctive identities and functions. Great places build on these characteristics to create a sense of place that reflects shared community values and culture. Great places focus on the public realm and open spaces that attract residents, workers, visitors, enterprise and investment. They recognise and celebrate the local character of the place and its people, and include the green infrastructure that supports the sustainability of the region and people's wellbeing	The proposed marina is consistent with this objective in that it will see a unique marina development that will compliment other retail and commercial uses. It is an innovative proposal which is sensitive to the high value riverine locality and will provide valuable community recreational infrastructure which will reconnect the community with the river foreshore. It includes the construction of public recreational facilities on the foreshore buffer lands including bike paths, barbeque facilities and shelters. These public facilities will attract residents, workers and visitors, enterprise and investment to the locality. A well planned and well designed development can improve the feel of a place, its vitality and sense of community. It can make the local environment more attractive and improve services. The development proposal will compliment the future residential use of the Moorebank Cove residential estate.
Productivity: jobs and skills for the city		
Objective 22: Investment and business activity in centres	Growing the global competitiveness of Greater Sydney is fundamental to the vision of a *Metropolis of Three Cities*. The urban structure to support the metropolis of three cities needs to give people access to a large number and range of jobs and services delivering a well connected city. The new Western Parkland City includes four centres to create a metropolitan cluster extending for 54 kilometres. Liverpool is identified as one of these centres which will deliver the metropolitan function of providing concentrations of higher order jobs and a wide range of goods and services.	The Plan builds on the existing strengths of each centre with a common framework to deliver on the wider productivity and liveability objectives to grow jobs across Greater Sydney and improve communities' access to goods and services. Growing the global competitiveness of Greater Sydney is fundamental to the vision of *A Metropolis of Three Cities*. The proposed marina will provide a range of jobs and services in support of this objective.

Table 3.8 Assessment of consistency against Metropolis of Three Cities objectives

Objective	Relevance	Comments
Objective 22.1	Provide access to jobs, good and services in centres by: • diversifying the range of activities in all centres; • creating vibrant, safe places and a quality public realm; and • focusing on a human-scale public realm and locally accessible open space.	The proposed development is consistent with this objective as it diversifies the range of activities within Liverpool and facilitates access to public open space with the construction of public recreational facilities including bike paths, barbeque facilities and shelters along the foreshore.

The proposed development will contribute to the achievement of a number of the specific objectives and planning directions within the Plan.

3.2.8 Western City District Plan

The *Western City District Plan* (the District Plan) advances the outcomes *of A Metropolis of Three Cities* at a District level, through Productive City, Liveable City and Sustainable City priorities.

The District Plan mandates a 0–5 year housing target of 8,250 dwellings for Liverpool LGA, reinforcing its role as a leading metropolitan cluster in the region. Liverpool CBD will play a significant role in the transformation and development of the Western City District. It identifies that the health and education precinct alone will create 7,000 new jobs over the next 20 years, contributing to the 2036 higher target of 39,000 jobs for the LGA.

Consistency of the proposed development with the District Plan's objectives key directions is outlined in Table 3.9.

Table 3.9 Assessment of consistency against Western City Planning Priorities

Priority	Relevance	Comments
3 Liveability		
Planning Priority W6: Creating and renewing great places and local centres, and respecting the District's heritage	Improving liveability is about creating and renewing great places, neighbourhoods and centres. This requires place-based planning and design excellence that builds on local strengths and focuses on public places and open spaces. Great places are walkable – this means they are designed, built and managed to encourage people of all ages and abilities to walk or cycle for leisure, transport or exercise. This requires fine grain urban form and land use mix at the heart of neighbourhoods. Places that demonstrate these characteristics promote healthy, active lifestyles and social interaction and can better support the arts, creativity, cultural expression and innovation.	The proposed development is an architect-designed marina redevelopment that will provide an alternative means to implement the final restoration of the extractive industry activity on the marina site. It is an innovative proposal which is sensitive to the high value riverine locality and will provide valuable community recreational infrastructure which will reconnect the community with the river foreshore. The proposed development promotes leisure activities as cyclists and pedestrians will be able to use the proposed link road pedestrian/cycle path and the riverfront pedestrian/cycle path. These paths will allow both pedestrians and cyclists to access the marina, recreational areas and the foreshore.

Table 3.9 Assessment of consistency against Western City Planning Priorities

Priority	Relevance	Comments
		The construction of public recreational facilities on the foreshore including bike paths, barbeque facilities and shelters will improve liveability within the local neighbourhood. The proposed development incorporates Marina Spit Park which is located between the main Maritime Building and the Private Marina Clubhouse facilities. It will be a grassed area with some plantings that will be accessible to the public. A public marina clubhouse will incorporate a club lounge and terrace for public marina members. Significant attention has also been paid to ensure that the design and implementation of the project maximises the connectivity between the marina/maritime precinct as well as the kiosks, tourist, entertainment, recreational and club facilities and function centre to provide the best outcome for the entire development and Moorebank Cove residential estate to the north.
4 Productivity		
Planning Priority W9: Growing and strengthening the metropolitan cluster Objective 22: Investment and business activity in centres	Liverpool is one of the four identified locations which will be the main focus for access to goods and services; entertainment; leisure; and recreational activities. The Plan highlights the importance of improving urban liveability and Liverpool's sense of place, as well as the environmental outcomes around the Georges River.	Refer to Planning Priority W6 above. The proposed development has been designed to maximise the connectivity between the marina/maritime precinct as well as the kiosks, tourist, entertainment, recreational and club facilities and function centre to provide the best outcome for the entire development and Moorebank Cove residential estate to the north.

3.3 Liverpool Local Environmental Plan and Development Control Plan

3.3.1 Liverpool Local Environmental Plan zoning

Lot 7 DP 1065574 is part zoned B6 Enterprise Corridor, R3 Medium Density Residential, SP2 Infrastructure, Public Recreation RE1 and Private Recreation RE2 pursuant to the LEP.

The LEP states that marinas are permissible with consent within the RE1 and RE2 zones.

The LEP further provides that:

> marina means a permanent boat storage facility (whether located wholly on land, wholly on a waterway or partly on land and partly on a waterway), and includes any of the following associated facilities:
>
> a) any facility for the construction, repair, maintenance, storage, sale or hire of boats;
>
> b) any facility for providing fuelling, sewage pump-out or other services for boats;
>
> c) any facility for launching or landing boats, such as slipways or hoists;
>
> d) any carparking or commercial, tourist or recreational or club facility that is ancillary to the boat storage facility; and
>
> e) any berthing or mooring facilities.

The proposal involves the short- and long-term storage of vessels on land along the Georges River. Functions carried out at the marina site will be consistent with the facilities detailed in the land use definition. Accordingly, the proposal is permitted in the applicable zones with Development Consent.

3.3.2 Liverpool Local Environmental Plan Principle Development Standards

There are a number of applicable principle development standards within the LEP as described below.

i Clause 4.3: height of buildings

Clause 4.3(2) - Height of buildings-states the following:

> The height of a building on any land is not to exceed the maximum height shown for the land on the Height of Buildings Map.

The marina site contains a partial maximum height requirement of 15 m and 21 m. The majority of the proposed buildings at the marina site are to be located on land identified within the maximum height requirement of 21 m.

The proposed Maritime Building will be the largest built form (see Appendix B1, Drawing DA-020). At basin level of 2.8 m AHD, the Maritime Building will have a maximum ridge height of 23.8 m AHD. With consideration of architectural blade walls, the Maritime Building will have a maximum height of 24.4 m AHD which represents a maximum building height of 21.6 m.

The proposal will exceed the maximum building height of 0.6 m. Notwithstanding, consideration of architectural roof features is outlined LEP and enables such roof features to exceed 0.6 m.

Clause 5.6, Architectural roof features, are prescribed in part as follows:

> Architectural roof features.
>
> …
>
> (2) Development that includes an architectural roof feature that exceeds, or causes a building to exceed, the height limits set by clause 4.3 may be carried out, but only with development consent.
>
> (3) Development consent must not be granted to any such development unless the consent authority is satisfied that:

(a) the architectural roof feature:

(i) comprises a decorative element on the uppermost portion of a building, and

(ii) is not an advertising structure, and

(iii) does not include floor space area and is not reasonably capable of modification to include floor space area, and

(iv) will cause minimal overshadowing, and

(b) any building identification signage or equipment for servicing the building (such as plant, lift motor rooms, fire stairs and the like) contained in or supported by the roof feature is fully integrated into the design of the roof feature

A portion of the building that exceeds the maximum building height meets this criterion. As described in Section 2.2.1, blade walls will be a prominent architectural feature of the Maritime Building, seeking to create significant visual articulation of the building elevation when viewed from the public domain.

The blade walls traverse from ground level with protrusion past ridge height to create visual interest with the combination of substantial surface area for glazing to create a modern appearance.

In regard to the previous application Liverpool City Council (September 2016) concluded that:

> Council's Design Excellence Panel has reviewed the proposal in accordance with Councils adopted Design Excellence Panel Charter, and is supportive of the design.
>
> It is considered that the increase in building height is relatively minor and relates to architectural roof features which seeks to create visual distinction having regard to the bulk and scale of the proposed development. Accordingly, the use of the architectural roof feature is supported in this instance.

ii Clause 4.4: floor space ratio

Clause 4.4(2) – Floor space ratio states "the maximum floor space ratio for a building on any land is not to exceed the floor space ratio shown for the land on the Floor Space Ratio Map". The minimum floor space ratio applicable to the marina site is 0.25:1.

The proposal has a development footprint of 131,470 m^2 and has a gross floor area of 17,717 m^2 (ie excluding carparking and terraces and balconies with outer walls less than 1.4 m high). It, therefore, will have a floor space ratio of 0.13:1 which will meet the minimum floor space ratio applicable to the marina site requirement.

3.3.3 Liverpool Local Environmental Plan Miscellaneous Provisions

i Clause 5.1: relevant acquisition authority

Portions of the subject property are zoned SP2 Drainage and RE1 Public Recreation under the LEP. Liverpool City Council is required to acquire these portions of land once a subdivision is registered creating separate Lots in a DP. The acquisition of these Lots would be financed through the Section 7.11 Contribution fund within that area.

These types of acquisitions fall under the provisions of the *Land Acquisition (Just Terms Compensation) Act 1991*. In regard to the previous application LCC (2016) states that:

> Council is required to acquire these portions of land and a Voluntary Planning Agreement has been executed between the land owner and Council to facilitate the dedication of the required land.

ii Clause 5.1A: development on land intended to be acquired for a public purpose

Land zoned RE1 Public Recreation is identified as per Clause 5.1 of the LEP to be acquired by Council. The acquisition process would commence once the subdivision of those portions of land is granted consent. Until such time that this process commences, earthworks and recreation areas are permitted only on that portion of RE1 land.

The proposal involves earthworks to enable the rehabilitation of the marina site and establishment of a seawall which is consistent with Clause 5.1A. Moreover, recreation areas are proposed along this portion of land comprising of grassed open space and footpaths.

iii Clause 5.7: development below mean high water mark

Clause 5.7 of the LEP prescribes the following:

- the objective of this clause is to ensure appropriate environmental assessment for development carried out on land covered by tidal waters; and
- development consent is required to carry out development on any land below the mean high water mark of any body of water subject to tidal influence (including the bed of any such water).

The river foreshore land is to be embellished for the purposes of public land under an existing VPA with Council (bank stabilisation will be subject to a future application). The development includes a basin entry of approximately 40 to 50 m wide leading into the marina.

A tidal hydrodynamic model for tidal movements in the Georges River from Picnic Point, downstream of the marina site, to Lansvale upstream of the Chipping Norton lakes system (and upstream of the marina site) was developed by Worley Parsons. The Worley Parsons assessment report (Appendix C1) found that:

> The model results indicated that a high degree of exchange will occur between the river and the marina, due to the relatively wide marina entrance. The river is approximately 80 m wide in this location, while the entrance is at least 40 m wide. The water levels in the marina mimic those in the river, indicating that the entrance does not control flows entering and leaving the marina basin.
>
> The model indicated that flow velocities due to tidal flows were low. Velocities in the marina basin were below 0.05 m/s and velocities in the river adjacent to the proposed marina were generally less than 0.3 m/s.
>
> Although the tidal flow velocities are low, other factors also affect bank stability. The 1.5 year ARI flow is considered to be the “bank forming” flow, during which velocities will likely be higher than those during tidal flow conditions. Waves generated by boats on the river also affect bank stability. The bank protection will be designed to withstand these forces.

iv Clause 5.89: preservation of trees

A series of ecological assessments have been completed for the marina site (Section 6.4). While the proposal will require the removal and modification of small areas of terrestrial habitat, it will result in an overall improvement in the quality and amount of available habitat within the site, in part due to the implementation of the VPA and associated VMP.

v Clause 7.6: environmentally significant land

The marina site has environmentally significant land shown on the environmentally sensitive land map in the LEP (the RE1 Public Recreation). However, the development proposed to this land is mandated by the VPA.

vi Clause 7.7: acid sulfate soils

The marina site has been identified on the LEP Acid Sulfate Soils map. An acid sulfate soil management plan is provided in Appendix D6. The site is currently licensed by EPA for the disposal of acid sulfate soils as well as VENM. LCC (2016) included conditions recommended by EPA in regard to acid sulfate soils. In regard to the previous application LCC (2016) found "[t]he provisions of Clause 7.7 have therefore been met".

vii Clause 7.8: Flood planning

An extensive flood assessment as well as detailed hydraulic modelling has been undertaken by Worley Parsons, Cardno and NPC (Appendices C1 and C2).

During the previous assessment of the proposal, minor amendments were made to the development to permit the passage for flood flows onto Council reserve to ensure flood storage areas are fully utilised during flood events. The flood reports confirmed that the proposed development will have a negligible impact on the behaviour of flooding in the flood storage area located south-west of the proposed marina and nil or negligible impacts on any other adjacent properties. In regard to the previous application LCC (2016) found "[t]he proposal therefore has satisfied the provisions of Clause 7.8."

viii Clause 7.9: Foreshore building line

The marina site is affected by a foreshore building line as set out in the LEP maps. This provision applies to the land that is zoned RE1 – Public Recreation. The only works within the RE1 – Public Recreation zone will be associated with the restoration of the river foreshore and recreational facilities such as paths, picnic shelters, bike paths as prescribed in the VPA. Consequently, the development will comply with this requirement.

ix Clause 7.31: earthworks

The marina site has been subject to extractive industry for a number of years and, in its current state, is highly modified. As part of the original development consent granted for extractive industry activities at the site, the rehabilitation of the land was also approved in ensuring that the marina site be returned to a restored landform. The proposed development utilises part of the existing landform to create the marina basins as well as some works to accommodate the proposed development of both the natural and built environment.

Concurrence approvals issued by WaterNSW, EPA and Fisheries NSW for the previous applications contained requirements for vegetation, earthworks and water quality. In regard to the previous application LCC (2016) stated, "Council's heritage officer has advised that there are no identified Aboriginal sites and that the site is highly disturbed that there is practically no possibility of in-situ Aboriginal cultural heritage deposits."

3.3.4 Section 79C(1)(a)(ii): any draft environmental planning instrument

No draft planning instruments apply to the marina site.

3.3.5 Liverpool Development Control Plan

Liverpool City Council determined (LCC 2016) that the previously proposed development was "considered satisfactory in respect to the LDCP 2008". The proposed development is essentially unchanged.

The following parts of DCP are applicable to the proposed development:

- Part 1.1 – General Controls for all Development;

- Part 1.2 – Additional General Controls for Development; and
- Part 2.10 – Moorebank East (Benedict Sands).

Each of the are addressed in detail below.

3.3.6 Liverpool Development Control Plan - Part 1.1: General Controls

i Tree preservation

Tree preservation is addressed in Section 3.3.3. The development will comply with this DCP requirement.

ii Landscaping and incorporation of existing trees

Where possible, the mature trees on-site will be preserved, see Section 6.4.2. The location of the marina entrance has been designed to avoid existing trees. The revegetation of the foreshore area will be carried out in accordance with the VMP. Accordingly, the development will comply with this DCP requirement.

iii Bushland and fauna habitat protection

Bushland and fauna habitat protection is addressed in Section 3.2.1. Accordingly, the development will comply with this DCP requirement.

iv Bushfire risk

Part of the marina site is identified as bushfire prone land on the LEP Bushfire Prone Land Map. A bushfire assessment report is provided in Appendix E5. The report describes measures to enable the project to comply with the objectives of the NSW Rural Fire Service's *Planning for Bush Fire Protection Guideline* (RFS 2006) (PBP). Specifically, APZs will be provided and managed to enable fire fighting vehicle access and to distance project buildings from vegetation which represents a fire hazard. The risk of the project initiating a bushfire will be minimised through the implementation of management measures.

As part of the previous application, the RFS responded (7 March 2016) that "The New South Wales Rural Fire Service advises that this response is deemed to be a bushfire safety authority subject to compliance with the Bushfire Assessment prepared by EMM Consulting Pty Ltd, Report J14149RP10 and dates 26th October 2015." This letter is Attachment 5 of LCC (2016).

v Water cycle management

The Maritime Building and the Private Marina Clubhouse (being the major built forms on the marina site) will harvest roof water for storage and use. Additionally, the design of the marina basin has incorporated the construction of large wetlands for polishing and treatment of storm water run-off from the development. However, most storm water runoff from the marina site will be directed to the large stormwater channel running along the eastern boundary of the site. Accordingly, the development will comply with this DCP requirement.

vi Development near creeks and rivers

The development near creeks and rivers control applies to the marina site as works are occurring within 40 m of a watercourse, creek or river.

The proposed development is identified as Integrated Development under Section 4.46 of the EP&A Act as it requires a Controlled Activity Approval under the *Water Management Act 2000*.

The previous applications were referred to the NSW Office for Water and DPI Water, which issued general terms of approval that also noted the requirement for a Controlled Activity Approval.

In addition, conditions recommended by EPA and Fisheries NSW included vegetation, water quality and erosion and sediment control requirements.

Embellishment of foreshore land and the preparation of a VMP is required as part of the VPA. Bank stabilisation works will be applied for in a separate application. The VMP will be prepared in accordance with the general terms of approval and the applicable controls in this clause. Accordingly, the development will comply with this requirement of the DCP.

vii Erosion and sediment control

Erosion and sediment control measures will be implemented during construction (see Section 2.11.9).

There will be no discharges to natural watercourses prior to thorough testing and certification of the water quality of the marina basin prior to the opening of the marina basin to the Georges River as detailed in Section 6.3.8.

Accordingly, the development will comply with this requirement of the DCP.

viii Flooding risk

Flooding risk is addressed in Section 3.3.3. The development will comply with this DCP requirement.

ix Contaminated land risk

Contaminated land risk is summarised in Section 3.2.2 and addressed in detail in Section 6.3. The development will comply with this DCP requirement.

x Salinity risk

An assessment of salinity risk has been undertaken by Douglas Partners with a view to determining the need to undertake an investigation in accordance with the *Western Sydney Salinity Code of Practice* (DIPNR 2003). Douglas Partners advised that:

> The site is not within high salinity potential area as evidenced by the DIPNR Western Sydney Salinity Hazard Map. The site is in an area as identified on this plan only as a moderate salinity potential area. However, given the location of the site on a flood plain it is inappropriate to undertake any investigation; as such an investigation will serve no purpose. This is because salinity is a function of rising water tables. This site is clearly in the flood plain and the water table is naturally high in this environment. More importantly, the water table will remain high for as long as the site remains in the flood plain.

In light of the above, a detailed salinity assessment had not been carried out as the groundwater conditions are noted to be dictated by the marina site being in a flood plain and directly adjacent to the Georges River. In regard to the previous application, LCC (2016) stated that

> It is recommended that all applicants make their own independent inquiries as to appropriate protection against the current and future potential affect of Salinity to ensure the ongoing structural integrity of any work undertaken. Liverpool City Council will not accept any liability for damage occurring to any construction of any type affected by soil and or ground water Salinity.

xi Acid sulfate soils risk

Acid sulfate soils are addressed in Sections 3.3.3 and 6.2.1. The development will comply with this DCP requirement.

xii Weeds

Noxious weeds have not been identified on-site. Removal of noxious weeds (if found) is required as part of the VPA. These works will be detailed in the VMP and the development will comply with this DCP requirement.

xiii Demolition of existing developments

No demolition of any existing buildings is proposed as part of this development application so the development will comply with this DCP requirement.

xiv Aboriginal archaeology

The Aboriginal heritage assessment and review (Appendices J1 and J2) found that there are no Aboriginal archaeology items or sites on the marina site so the development will comply with this DCP requirement.

xv Heritage and archaeological sites

The historic heritage assessment and review (Appendices J3 and J4) found that there are no heritage or archaeology items or sites on the marina site so the development will comply with this DCP requirement.

3.3.7 Development Control Plan – Part 1.2: Additional General Controls for Development

i Car parking and access

It is proposed that 637 car parking spaces will be provided as part of the development. In regard to the previous application, LCC (2016) stated that:

> A total of 637 parking spaces are provided. Council's Traffic Engineering Department has reviewed the proposal and notes that sufficient demonstration has been made that the total contingent of parking is sufficient for the needs of the proposed development. In addition, the access to the site from an internal road connecting to the approved road bridge is included in this application as is the connection of the link road to Brickmakers Drive. The access to Newbridge Road will be discontinued.

ii Water and energy conservation

The development proposal includes the use of the roofs of the proposed Maritime Building and the Private Marina Clubhouse to harvest water for reuse on-site. In addition, the Maritime Building in particular will incorporate significant use of translucent/clear panels to provide the maximum amount of natural light to use inside the structure. Additional energy saving features will be identified in the detailed design and construction certificate stages.

iii Landfill

The landfill section of the DCP does not apply to land where cut and fill occurs in conjunction with a development application for a building(s).

iv Waste management

Benedict is one of the largest recyclers of construction and demolition materials in Sydney. Benedict has a 3.2 ha facility on Riverside Road, Chipping Norton. This facility will receive all the construction generated from the redevelopment proposed in this EIS. It is expected that the recycling rate achieved from these materials will be approximately 88% based on the performance of the recycling facility to date. A Waste Management Plan – Construction is provided in Appendix K1.

There will be no demolition of existing structures or residential development so waste management plans for these activities are not required.

v Outdoor advertising

No advertising structures are proposed as part of the application.

3.3.8 Development Control Plan – Part 2.10: Moorebank East

It is noted that Part 2.10 of the DCP relates primarily to residential development. However, the proposed development complies with this part of the DCP, in particular the road network planned for the precinct.

i Street network

Vehicular access to the proposed marina will be provided from Brickmakers Drive once the link road is commissioned that is consistent with the DCP.

ii Pedestrian and cyclist amenity

In accordance with the VPA, pedestrian/bicycle access will be provided throughout the marina site, including:

- on the future link road bridge from Brickmakers Drive; and
- along the river foreshore area.

iii Open space

Access to public open space areas with frontage to the Georges River will be provided by the embellishment of the river foreshore area and construction of a pedestrian/cycleway and dedicated for public use as required by the VPA.

iv Foreshore access

Access to the Georges River foreshore will be provided by with the embellishment of the river foreshore area and construction of a pedestrian/cycleway and dedicated for public use as required by the VPA.

v Drainage

A drainage channel to service the development will be provided as required by the VPA.

3.4 Voluntary planning agreement

A VPA pursuant to Section 93F of the EP&A Act was executed between Liverpool City Council and Tanlane Pty Ltd on 11 June 2008. The VPA applies to the marina site and, in summary, requires the following contributions/works:

1. embellishment of river foreshore land;
2. dedication of river foreshore land to the Council subject to a 50-m wide easement for maritime vessel access as well as two easements for the drainage of water;
3. development of a VMP;
4. completion of works described in the VMP;
5. conducting maintenance works described in the VMP;
6. construction of a bike/pedestrian path along the river foreshore land;
7. construction of passive recreation facilities on the river foreshore land;
8. dedication of a drainage channel;
9. construction and dedication of a road bridge over the drainage channel, embankment and road to Brickmakers Drive;
10. construction and dedication of pedestrian access to Newbridge Road and a pedestrian path within the public verge along the entire length of the land frontage to Newbridge Road; and
11. dedication of an easement over land for access for the purpose of allowing Council to undertake maintenance to the river foreshore land.

The VPA contains the timeframes for completion of the various items and are noted to be activated either by the registration of subdivision of residential land or on completion of embellishment of river foreshore land.

It is likely that the items outlined in the VPA will be carried out in conjunction with the construction of the proposed marina development once the development is approved and following approval of a separate application for the rock armouring of the foreshore. These works will include:

- removal of waste and fill, visible surface waste on foreshore, and any contamination (subject to a future application);
- stabilisation of the riverbank/wall (subject to a future application;
- removal of noxious weeds if identified;
- restoration and enhancement of vegetation in keeping with indigenous species;
- construction of the pathway along the river foreshore;
- installation of street furniture comprising of benches and covered areas; and
- provision of flood free vehicular access.

The VPA contains the timeframes for completion of the various items and are noted to be activated either by the registration of subdivision of residential land or on completion of embellishment of river foreshore land.

3.5 Summary of required approvals

In summary, the following approvals will be required for the marina:

- development consent under Part 4 of the EP&A Act;
- a Controlled Activity Approval under the *Water Management Act 2000*;
- a construction certificate (or certificates); and
- an occupation certificate (or certificates).

An EPL under the *Protection of the Environment Operations Act 1997* may be required.

4 Consultation

4.1 Overview

This chapter provides an overview of stakeholder engagement for the proposal, a description of the engagement activities undertaken, and a summary of the findings that have been incorporated into this EIS.

Stakeholder engagement and consultation forms a key platform for the preparation of environmental impact assessments such as EISs and is a requirement of the SEARs for the project.

Consultation was undertaken during the preparation and assessment of the original 2012 EIS (Benedict 2012) and the 2015 EIS (EMM 2015a). Matters raised during the consultation process are detailed in the following sections.

Further consultation was undertaken during the preparation of this updated EIS in accordance with the updated SEAR 912 issued on 9 October 2018.

The original EIS was placed on public exhibition on three separate occasions from 28 March 2012, from 9 May 2012 and from 3 July 2013. Each exhibition period observed a minimum 30-day public exhibition period in accordance with the Environmental Planning and Assessment Regulation 2000 and the DCP. A total of six separate submissions were received. Four expressed support for the proposal and two submissions (from the same author) raised specific objection to vehicular access arrangements.

The 2015 EIS was placed on public exhibition twice, from 7 December 2015 and from 7 June 2016. Of the community submissions received, two supported the marina (one noting concerns regarding boat speed limits), three objected and one raised broader flooding issues in the LGA. Agency submissions were also received.

The proponent has maintained ongoing contact with the Georges Fair Community as to the progress of this re-application. They have indicated that they continue to support the marina proposal.

4.2 Commonwealth government

The proposal is not predicted to have a significant impact on a matter of national environmental significance listed in the EPBC Act. Therefore, the Commonwealth Department of the Environment was not consulted regarding the proposal.

4.3 State and local government

4.3.1 Previous applications

State government agencies were consulted during the preparation of the original EIS and the 2015 EIS. Consultation outcomes and comments from these agencies are summarised in Table 4.1.

Table 4.1 Agency consultation

Agency	Method	Issues raised
DPE	Submission in relation to development	Provided Director General's Environmental Assessment Guidelines (DGR 563).
Liverpool City Council	Pre-lodgement meeting	Concept plans were discussed with the Director of Planning as well as representatives from Council's Strategic Planning Department.
	Meeting	Confirmed the applicability of the existing flood data and published 1:100 year flood levels.
	Voluntary planning agreement	A VPA was agreed to between Liverpool City Council and Tanlane Pty Ltd on 11 June 2008.
	Submission in relation to development	No objections were raised, subject to conditions. The general terms of approval issued by the EPA, NOW and Fisheries NSW provided sufficient opportunity to address matters relating to aquatic ecology and vegetation.
Department of Lands	Meeting	Confirmation that beyond the boundary of the site, the LPMA is the owner of the riverbed. There will be no structures or any other type of building structures or encroachments upon the riverbed. LPMA indicated that they had no comments or inputs into this development process.
EPA	Submission in relation to development	General terms of approval issued.
	Meetings	The preliminary contamination investigation methods and findings were discussed and it was decided to prepare the supplementary preliminary investigation and remediation action plan to provide greater certainty regarding the level of contamination (low) and contamination management.
WaterNSW	Submission in relation to development	General terms of approval issued.
Fisheries NSW	Submission in relation to development	General terms of approval issued.
RMS	Submission in relation to development	No objections raised subject to vehicular access arrangement being confirmed.
Maritime services/ RMS	Submission in relation to development	No objections subject to a condition relating to a boating management plan.
Liverpool Local Area Command	Submission in relation to development	No objections raised subject to conditions.
Integral Energy (now part of Endeavour Energy)	Meeting	Established that the existing 600-kVA electricity substation will satisfy the predicted power demand. Integral Energy would be prepared to allow the proposed development to become a high voltage customer and install, operate and manage its own substations.
Sydney Water	Meeting	Sydney Water had no objection to the proposal discharging to sewerage mains, so long as the discharge into the existing sewers does not exceed 2 L/s which is easily achievable.

Benedict Industries met with Liverpool City Council in March 2015 to discuss reapplying for approval for the Georges Cove Marina.

During the preparation of the 2015 EIS, EMM wrote to DPE requesting SEARs for the project on 19 March 2015. In turn, DPE requested input from EPA, OEH, DPI, NOW, and RMS regarding the SEARs. Each of these agencies, with the exception of OEH, provided information on the issues that require consideration in the EIS. These matters were considered in the preparation of the 2015 EIS.

The SEARs were issued on 24 April 2015 and the agency letters were received by EMM on 28 April 2015. During the preparation of this EIS, EMM wrote to EPA, OEH, DPI, NOW, and RMS asking if there were any further matters that we should address in the EIS or if there are other matters for discussion. No additional matters were raised.

Moorebank Recyclers were the only party to submit an objection to the 2012 application and initiated the Land and Environment Court proceedings, leading to the consent being invalidated. A letter was sent to Moorebank Recyclers on 6 May 2015 informing them of the intent to re-submit the application and asking whether there were any new issues that they wished to raise regarding the assessment of the proposal. Moorebank Recyclers replied on 12 May 2015 that they required all the documents to be lodged in support of the application in order to provide any response. Moorebank Recyclers provided a submission in response to the EIS exhibition.

4.3.2 2018 application

Following the NSW LEC decision to refuse the project application (NSW LEC 1089, 2018), Benedict Industries have continued to consult with LCC regarding this current application. In particular, LCC provided written advice on 25 October 2018 regarding matters to be considered in the EIS and met with Benedict Industries on 8 November 2018 to discuss these matters. A summary of the outcomes of this consultation is summarised in Table 4.2.

Table 4.2 Outcomes of consultation with Liverpool City Council in October and November 2018

Council matter summary	Response
An EIS that addresses the updated SEARs should be prepared rather than an addendum to the 2015 EIS.	This EIS addresses the SEARs in full (see Table 1.2) and is not an addendum to the earlier EIS.
The matters raised by LCC should be considered as consultation required as part of addressing the SEARs.	This EIS has attempted to address all matters raised by LCC.
Additional contamination assessment should be provided, including information on the site history, landfill gas, dredge pond contamination and asbestos.	Additional contamination assessment (compared to that provided in the previous application) is provided: • site history (Section 6.3.1); • landfill gas (Section 6.3.6 and Appendix D5); • dredge pond (Sections 6.3.4 and 6.3.5.); and • asbestos (Section 6.3.3). These matters are also addressed in the Site Audit Report (Appendix D7).
A Section B site audit statement and site audit report should be provided if a Stage 2 detailed site investigation report is not prepared.	Site Audit Report no 282 (including a Site Audit Statement), prepared by I. Swane, an EPA-accredited site auditor, is provided in Appendix D7.
A long-term environmental management plan should be provided.	A long-term environmental management plan will be prepared following development approval.
Water quality	Additional information (compared to that provided in the previous application) regarding water quality is provided in Sections 6.3.4 and 6.3.5.

Table 4.2 Outcomes of consultation with Liverpool City Council in October and November 2018

Council matter summary	Response
An updated air quality assessment addressing minor changes to air quality assessment methods and impacts to the receptors within the marina site is required.	The 2011 air quality and greenhouse gas assessment (Appendix I1) found that "…the current use of the site and the significant separation distances to receptors, it is not anticipated that any tangible increase in dust levels would arise from construction activities." It also found that: • "[a]nalysis of the dust generating activities for the proposed operation reveals only some occasional sanding and therefore no major dust generating activities that could significantly elevate particulate levels in the local air shed"; • "…with the application of the best practice mitigation techniques outlined in Section 2.2 [of the2011 air quality report], it is unlikely that the proposed operation will cause any odour nuisance in the surrounding areas."; and • that predicted 1-hour average maximum ground level concentrations of a range of volatile organic compounds would be between 4 and 16,000 times lower that the OEH criteria. In short, airborne emissions (particulates, odour and toxic substances) from the proposed operation will comply with NSW guidelines to prevent amenity and health impacts. This confirmed by the 2015 review (Appendix I2). The minor changes to the air quality assessment methods would not significantly change the outcomes of these assessments and therefore the assessment was not updated.
Timing of construction and dedication of the road bridge linking the site to Brickmakers Drive.	We understand that Construction Certificate Plans for the road bridge are currently being finalised by Mirvac in consultation with LCC (Application CCE-53/2018).
Potential amenity impacts of the marina on future residences in the Moorebank East residential estate.	The potential noise impacts of the marina on future residences in the Moorebank East residential estate are considered in Section 6.7.2 and Appendix H1. See response above regarding air quality.
A landscape plan is required.	A landscape plan is provided in Appendix G4.
A current Aboriginal heritage assessment that complies with the Aboriginal Due Diligence Guidelines is required.	It was subsequently agreed with LCC that the Aboriginal heritage assessments provided in the 2015 EIS meets this requirement. These reports are provided in Appendices J1 and J2.

EMM consulted with DPE regarding the status of SEAR 912 and, after consulting with the relevant government agencies and LCC, DPE issued updated SEARs on 9 October 2018.

EMM wrote to the following agencies regarding the proposed development in October 2018 requesting any further input:

- Department of Industry – Lands and Water: no response received;
- Department of Primary Industries – Fisheries: no additional assessment requirements beyond those in the SEAR 912;

- EPA: noted that an EPL may be required, and provided matters for consideration in the air quality, contamination, acid sulfate soil, noise, waste and chemical assessments; the requirements to be met for the installation of underground petroleum storage systems; and for the management of incidents.

- OEH: no response received.

- Greater Sydney Commission: no response received.

- RMS: noted that RMS will comment on the traffic impact assessment reports as part of the Council referral process.

Canterbury Bankstown Council commented that "there are no details on the bank stabilisation construction works. Our concern is the wave rebounding on the concrete walls being proposed along the foreshore, which will cause bank erosion on the other side of the Georges River." Armouring of the western bank of the Georges River will be the subject of a separate application. However, it is noted that this bank is currently largely straight with poor wave dissipation, while the irregular shoreline created by rock armouring is expected to improve wave dissipation. Further, boat traffic entering and leaving the marina will be subject to a 4 knot speed limit.

4.4 Community

Extensive consultation has been undertaken with the local residents in the Moorebank Residents Action Group. In a letter to Benedict Industries (28 November 2011), Moorebank Residents Action Group stated:

> The Moorebank Residents Action Group has inspected the plans for the development and note the layout of the proposal as depicted in the attached document marked as Key Elements of the Proposal. Based on these documents we support the development which we understand will replace the existing quarrying and recycling activities which are currently undertaken on the site. Our support is based on the undertakings set out in the application that if the development is approved then:
>
> - the existing quarrying and recycling facilities which are currently undertaken on the site will cease;
> - the development will provide public access to the Georges River foreshore via pedestrian and bike paths as well as sections of the marina itself; and
> - the river foreshore will be embellished and restored and eventually dedicated back to the Council.
>
> Overall we believe the development will considerably improve the local amenity and provide attractive community recreational infrastructure which will directly benefit the Georges Fair precinct as well as the Liverpool and Western Sydney Region.

A representative of Benedict Industries visited residences along Brickmakers Drive adjacent to the site on in June 2015 to introduce (or reintroduce) the project and to provide contact details for further details or to address any questions. Benedict Industries has continued to consult with the Georges Fair Residents group since this time. Issues raised during this community consultation included:

- other construction works currently occurring in the area – these are not associated with the proposed Georges Cove Marina;

- if Benedict Industries is associated with the proponent for the proposed Materials Recycling Facility, Moorebank (Moorebank Recyclers) – Benedict Industries has no association with Moorebank Recyclers, which has now sold the land it owned south of the marina site;

- the road access to the proposed Materials Recycling Facility – this land has been sold and there are no longer plans to develop a recycling facility; and
- anticipated timeframes for the completion of the marina – development of the marina has been delayed by court action brought against Benedict Industries by Moorebank Recyclers.

Moorebank Recyclers has sold the landholding directly south of the marina site to EQ Projects. On 26 November 2018, EMM wrote to EQ Projects, the new landowner, to outline the marina proposal and to provide contact details. We understand that EQ Projects strongly support the marina application.

4.5 Proposed consultation

This EIS will be placed on public exhibition by Liverpool City Council. Benedict will respond to any submissions regarding the proposal. This may also highlight the need to further consult with any individuals or groups with a particular interest in the proposal.

Ongoing consultation is planned with the following:

- Liverpool City Council, including regarding this EIS, development approval and subsequent consents;
- Natural Resources Access Regulator – including regarding the requirement for a Controlled Activity Approval;
- Fisheries NSW regarding a permit to harm marine vegetation;
- EPA for comment on this EIS and regarding licensing requirements;
- RMS for comment on this EIS;
- other agencies providing comment on this EIS;
- the Moorebank Residents Action Group;
- neighbours – ongoing one-on-one consultation regarding the EIS and upcoming activities at the site; and
- utilities (water, sewerage and power) regarding services to the site.

5 Hazards

5.1 Fuel and hazardous material storage

5.1.1 SEPP No 33 hazard assessment

As described in Section 2.2.8, separate above-ground tanks storing 60,000 L of diesel and 60,000 L of petrol will be installed on the Maritime Building hardstand at RL 7.3 m and well above 1:100 year flood levels. The proposal does not include storage of any significant quantities of other types of fuels or of hazardous chemicals on the marina site although small quantities may be used in the workshop and for facility maintenance.

The fuel tanks will be approximately 50 m from the western boundary of the marina site. Petrol is a dangerous good as it is classified as a Class 3 Flammable Liquid under the *Australian Code for the Transport of Dangerous Goods by Road and Rail Edition 7.3* (Commonwealth of Australia 2014). Diesel is not listed in the code and is, therefore, not regarded as a dangerous good.

Facilities which store petrol could qualify as potentially hazardous development. This is determined by comparing the quantities stored and the distance of the storage from the facility boundary using figures 8 and 9 of *Applying SEPP 33 – Hazardous and Offensive Development* (Department of Planning 2011). The proposed facility does not qualify as a potentially hazardous development as storage of 60,000 L (about 45 tonnes) of petrol 50 m from the facility boundary does not fall in the "potentially hazardous region" in the above figures. Therefore, the facility is not considered to be "potentially hazardous" and a preliminary hazard analysis (PHA) for the proposed facility is not required.

The EPA has previously provided conditions for roofing and bunding to be installed for the fuel loading and unloading facility at the marina site (LCC 2016). This will ensure that any leaks or spills are contained and isolated from the stormwater system. The Council recommended that should any chemicals or flammable liquids listed in the Australian Dangerous Goods Code be stored at the site in excess of relevant requirements, then further approval will be required.

Notwithstanding, the storage of petrol and diesel could be hazardous to employees and customers of the facility if there is a spill and/or fire. Therefore, fuel storages and dispensing equipment will be constructed and operated in accordance with relevant Australian standards and NSW work health and safety legislation.

5.1.2 Fuel storage and dispensing safeguards

The specific safeguards which have been incorporated into the development to reduce hazards relating to refuelling facilities include:

- portable fire extinguishers will be provided, selected from dry chemical, halogenated hydrocarbon and foam types;
- drip trays will be provided under and around the bowsers - trays will be of sufficient size to hold any jerry cans being filled;
- a holding tray will be provided on-site to collect and retain the wastes from the drip trays;
- provision will be made for regular emptying and disposal of the holding tray to an approved system or site;
- oil/fuel booms will be provided to contain any accidental fuel spillage; and

- an oil absorbent material will be provided to absorb petroleum products spilt on the water surface.

All fuel systems will be secured, and only operated by marina employees.

AS 3962-2001 notes the need for particular precautions when supplying fuel over water such as the use of double containment lines. All of these precautions have been adopted in the design and installation of the facilities.

5.1.3 Fire prevention and response

i General

All components of the marina development will be designed to meet all required fire standards and will also have specific emergency procedures. Fire-fighting equipment will be provided in accordance with AS 3962-2001 and to the requirements of relevant authorities. The equipment provided will include fire hose reels, hydrants and fire extinguishers. Fire-fighting equipment will be provided with the aim of rapidly extinguishing any fire in its initial stages.

Advisory notices outlining safety procedures will be prominently displayed at a number of strategic locations around the development.

A safety committee will be formed and appropriate emergency procedures will be developed in consultation with the local fire brigade. Staff will be familiar with:

- the procedures to follow in the event of a fire;
- the layout of the installation;
- the location of fire-fighting equipment; and
- the principles of fire-fighting, the use of extinguishers and fire-fighting appliances.

These procedures will be reinforced on a regular basis. Boats using the marina will be required to have handheld extinguishers onboard.

ii Refuelling area

The risk of fire at the marina will be primarily associated with the refuelling area. Specific procedures will be enforced in this area. These will include the following procedures that will be provided on a notice at the refuelling berth:

- contact marina staff for fuel;
- before fuelling:
    a) put all passengers ashore;
    b) close all hatches etc, to prevent fumes entering the hull and lying in the bilges;
    c) ensure no naked flames or sparks;
    d) turn off the pilot light to a gas refrigerator; and

e) cut off any electric supply at the main switch.

- during fuelling:

  f) maintain contact between the hose nozzle and filler pipe to prevent static sparks;

  g) carefully clean up any spilled fuel; and

  h) ensure correct breather operation and absorbent cloth is on hand.

- after fuelling:

  i) open all hatches and ventilate the boat;

  j) sniff in the bilges for traces of fumes;

  k) if fuel is spilt, soak up with oil absorbent material and leave boat wide open for at least 30 minutes; and

  l) when satisfied that the boat is free of fumes start engine before bringing the passengers aboard.

5.2 Chemical storage

All other chemicals (eg paints and cleaning products) will be stored securely in accordance with all WorkCover and other legislated requirements.

Should any chemicals or flammable liquids listed in the Australian Dangerous Goods Code be stored at the marina site in excess of relevant requirements, further approval will be required.

5.3 Other risks and safeguards

5.3.1 Personal accidents

The risk of personal accidents, in particular drowning or injury, is a hazard that can be significantly reduced by the incorporation of the following safeguards into the design and operation of the marina and associated facilities:

- limiting public access to daylight hours;
- implementation of a regular safety awareness program;
- provision of a suitable first aid kit that is readily accessible;
- provision of rescue equipment such as rescue buoys (life rings) and life preservers;
- illumination of all walkways and waterfront structures and provision of non-slip surfaces where practicable on all structures to prevent accidents and to facilitate rescue; and
- provision of hand railing on ramps and gangways.

5.3.2 Collisions

The risk of collisions between boats using the marina will be minimised through the implementation of the following safeguards:

- training and induction of all marina users;
- provision of suitable signs and other forms of advice to users regarding operating measures to be adopted to avoid interference with passing traffic;
- provision of weather information on an appropriate noticeboard;
- enforcement of maximum speed regulations within the berthing area; and
- provision of channels, fairways and berths of appropriate dimensions.

5.3.3 Sewage, grey water or oil spills

The risk of sewage, grey water or oil spills (accidental or deliberate discharge) from holding tanks or bilges into the waterway impacting water quality, biota and visual aesthetics will be minimised through the implementation of the following safeguards:

- a sewage pumpout facility will be incorporated at the marina refuelling facility;
- marina staff will be trained to inspect all holding tanks during fuelling. As this pumpout service will be free there is no incentive to dump or illegally dispose of these wastes in the marina basin or elsewhere;
- appropriate conditions will be included in the Marina Occupation Agreement to prohibit direct discharge of sewage; and
- all customers will be inducted and supplied with a complimentary bilge absorbing pad.

5.3.4 Wastes

Waste materials and rubbish will be generated during operation of the marina.

All wastes produced by the proposed activities will be classified, stored and handled in accordance with the *Waste Classification Guidelines – Part 1: Classifying Waste* (EPA 2014).

The risk that waste is released into the surrounding environment will be minimised through the implementation of the following safeguards:

- rubbish receptacles will be strategically located and emptied at regular intervals; and
- a waste oil storage facility will be provided for the use of patrons of the marina and associated facilities to dispose of containers of waste oils, bilge absorbing pads, etc. The collection drums will be serviced periodically by a commercial waste collector.

5.4 Marina occupation agreement – incorporating key safeguards

The risks associated with boats using the marina will be minimised through the implementation of Marina Occupation Agreements between the marina owner and the marina members. The agreements will apply to every small craft and vessel berthed at the marina and will include the general marina rules. This agreement will include a number of specific obligations which will be enforced through a compliance bond system and specific inspections and monitoring. The marina manager will be able to levy penalties and charges in accordance with the Marina Occupation Agreements in relation to breaches of key obligations such as:

- no flushing of heads at moorings;
- no pumping of bilges at moorings;
- no excessive speed and wash creation;
- inappropriate waste storage and management;
- storage of dangerous substances on vessels;
- unauthorised operation of sewage and fuel pumping equipment;
- unacceptable creation of noise;
- unauthorised work being undertaken on vessels;
- non-compliance with emergency procedures in respect of spills and hazardous materials; and
- failure to attend a compulsory induction program.

Compliance will be enforced by implementing a range of fines, using termination of the agreement as a final deterrent. However, an incentive system will be put in place with discounts for occupiers who comply with key obligations (eg an extra month of free rental to reward compliance).

5.5 Potentially offensive industry

The air, noise, and water emissions from the proposal have been assessed to determine if it is classified as a potentially offensive industry. In summary:

- air quality: the assessment (Section 6.8) found that air quality will comply with the relevant criteria at sensitive receptors and will not lead to any unacceptable impacts on the amenity of the area;
- noise: the assessment (Section 6.7) found that noise levels will generally not exceed the relevant criteria and will not lead to any unacceptable impacts on the amenity of the area; and
- water: the assessment (Section 6.1) found that with the implementation of the proposed environmental management measures, the proposed marina will not degrade water quality of the Georges River.

Therefore, the proposal will not result in unacceptable levels of pollution that will impact the amenity of the area and is not a potentially offensive industry.

6 Impact assessment

This chapter provides an assessment of the likely environmental impacts of the proposal as required by Section 4.15(1b) of the EP&A Act.

6.1 Water

Worley Parsons (2010) assessed impacts of sediment transport, tidal flow, water levels, water quality and flooding for the project area and proposed development (Appendix C1). In 2013 and 2014, Cardno was engaged to re-evaluate the flood impact assessment for the proposed development (Appendix C2) for the link road bridge.

The potential for existing contamination at the marina site to contaminate surface water and groundwater is discussed in Section 6.3.

6.1.1 Flooding

i Assessment

The Cardno (2013b) flood impact assessment (Appendix C2) assessed flooding for the 20-year and 100-year average return interval (ARI) floods. The following existing flood data for the Georges River were estimated from the *Georges River Floodplain Risk Management Study* (Bewsher 2004) to be:

- 20-year ARI: RL 4.6 m AHD;
- 100-year ARI: RL 5.6 m AHD; and
- probable maximum flood (PMF): RL 10.2 m AHD.

A two-dimensional hydraulic model covering 744 ha upstream and downstream of the project area was developed by Worley Parsons (2010) (Appendix C1). The model incorporated digital elevation with 2-m by 2-m grids of surface roughness, boundary conditions and three inflows: the Georges River, Milperra drain and Newbridge Road drain. The model was calibrated against the Bewsher (2004) study. Pre-development and post-development scenarios were modelled for the flood impact assessment.

The results of the flood modelling were used to conclude that:

- in a 20-year ARI flood, the impact of the planned development on flood hazard will be negligible except on the western side of the marina site where the proposed development will increase the ground level eliminating the flood hazard;
- in a 100-year ARI flood, the impact of the planned development on flood hazard will be negligible; and
- the proposed development will have a negligible impact on the behaviour of flooding in the flood storage area in the south-west of the marina site and nil or negligible impacts on other adjacent properties.

ii Supplementary assessment

Subsequent to the Worley Parsons (2010) assessment, Cardno (2014) specifically addressed flooding impacts of the link road bridge in the north of the development (Appendix C2). The following scenarios were modelled with and without the bridge:

- a 100-year ARI flood in the Georges River;
- a 100-year ARI local storm event in combination with two Georges River flooding scenarios:
  - a 20-year ARI Georges River flood; and
  - a Georges River base flow of 200 m^3/s.

The impact of the bridge on the 100-year ARI flood is predicted to be negligible (<0.01 m), with minor peak velocity increases (<0.05 m/s) in the vicinity of the bridge, with decreases in velocity south of the bridge.

The bridge would reduce some flood storage compared to the original assessment (Worley Parsons 2010, Appendix C1). However, the assessment showed that this will have no impact.

An NPC (2015) review of the assessments (Appendix C2) found the flood modelling remains contemporary and flood impacts are unchanged and negligible.

6.1.2 Tidal flow and bank stability

Comprehensive modelling of tidal hydrodynamics by Worley Parsons (2010) (Appendix C1) incorporating the tidal exchange and flow velocities, determined the flushing characteristics of the marina basin. Bank stability was also assessed.

The model indicated that tidal exchange was high due to the relatively wide proposed development entrance to the Georges River. Flow velocities are predicted to be low. Banks can and will be designed to withstand waves generated by boats, this will include the installation of rock armouring in the marina as part of this application and on the bank of the Georges River as part of a separate application.

6.1.3 Water quality

A water quality assessment was completed for the operation of the marina site (Worley Parsons 2010) (Appendix C1). The potential for contamination to impact surface water quality is addressed in Section 6.3.

The Georges River encompasses a large part of the Sydney urban area catchment and, therefore, receives pollutant loads from urban runoff and sewage overflows/discharges from the sewerage system and sewage treatment works.

Other than the Georges River or groundwater inflow (see below), potential pollutant sources in the marina basin will be from runoff from the land, copper from antifouling paints on the hulls and uncontrolled discharge of sewage from craft while at the marina berths (discharge of sewage will be banned). Therefore, the key pollutants considered in the water quality assessment were copper, suspended solids, nitrogen and phosphorus. Water quality in the marina was modelled for these parameters. Particular attention was paid to stormwater quality as well as the impact of copper leaching from antifouling. Water quality trigger values were identified with reference to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC/ARMCANZ 2000). A summary of the modelled loads of key pollutants is provided in Table 6.1.

Table 6.1 Modelled pollutant loads during marina operations

Pollutant	Load (kg/year)
From stormwater	
Total nitrogen	103
Total phosphorus	12.4
Total suspended solids	1,864
Total copper	4.1
Discharged from water craft	
Total nitrogen	1,094
Total phosphorus	175
Suspended solids	52.3
Copper	0.005
Copper from antifouling	123
Total copper	127

'Flushing' is the exchange of water between a marina and the river, and it is an important mechanism for removal of pollutants from marinas. Natural flushing is driven by tidal flows, wind, density currents, stormwater inflows and diffusion. The impact of these discharges at Georges Cove Marina will depend upon the extent of flushing of the marina basin. Tidal and stormwater flows will be the most important flushing processes for the proposed marina. The hydrodynamic modelling indicated that the marina basin, layout and entrance configuration will not constrain tidal flushing (Appendix C1).

Based on the conservative (effectively, worst-case) modelling, the labile copper concentration in the marina basin is predicted to meet the ANZECC/ARMCANZ (2000) trigger value for the protection of 90% of marine species and to be just above the trigger value for the protection of 95% of marine species. It is predicted that the copper concentrations in the marina basin will be slightly lower than the concentrations recorded in the Georges River close to the marina site. The conservative analysis shows the development of the marina would not have a significant impact on the existing copper concentrations in the Georges River.

With the implementation of the proposed environmental management measures, the proposed marina will not degrade water quality of the Georges River through discharges of copper from antifouling paints or from uncontrolled discharge of sewage.

6.1.4 Groundwater

Six groundwater monitoring wells were installed in 1994 around the marina site. Four monitoring wells are located along the riparian buffer between the project area and the river, one well is on the western side of the project area and one has been destroyed. The wells in the riparian buffer zone are less than 10 m from the river.

The bank of the Georges River at the marina site is made up of a sequence of silty and sandy alluvial sediments with thin gravels and overlaying shale bedrock. The thickness of the sediments ranges from 11 to 17 m thinning towards the north and west (Dames and Moore 1994).

Medium and coarse sands predominate in the riparian zone. Measured permeability ranges from 12 to 47 m/day averaging 30 m/day. Groundwater levels in the wells were closely correlated with, and slightly above, the river tidal levels. Dames and Moore (1994) inferred that there was an overall flow of groundwater in a south-easterly direction towards the Georges River and the unnamed creek to the south of the marina site. Dames and Moore (1994) concluded that groundwater flows in the zone adjacent to the river were likely to be influenced by intrusion of brackish/saline river water at depth in the aquifer, with fresh water flows towards the river concentrated in the shallow zone at approximately 5 to 6 m depth.

The potential for contamination to impact groundwater quality is addressed in Section 6.3.

6.1.5 Sedimentation

Sand-size sediments transported along the bed of the river by tidal and flood processes may be deposited in the marina basin, while fine sediments may be deposited from floodwaters (Appendix C2).

The depth of sediment deposited in the marina basin over 100 years was estimated using the following parameters:

- an average suspended solids concentration of 30 mg/L;
- an average particle size of 2 µm (clay);
- a fluid density of 1,000 kg/m^3;
- a sediment density of 2,500 kg/m^3; and
- a fluid viscosity of 0.01 Pa.s.

The depth of sediment accumulation in the marina basin was estimated to be 120 mm over 100 years so maintenance dredging will not be required within the marina basin.

6.1.6 Navigation and safety

The marina basin will be recessed into the riverbank with a short entrance channel (approximately 50 m long). Sufficient water depth will be provided at low water for the types and size of vessels likely to use the marina so the entrance will be navigable at all tide states.

Further information on navigation is provided in Section 6.11.

6.1.7 Site water balance

The main water inflows to the marina site will be from:

- rainwater; and
- mains water

The main water outflows from the marina site will be:

- runoff; and
- sewage via the mains sewerage system.

Some rainwater will be captured and reused on site.

A site water balance for the marina development is presented below.

i Potable water

The marina will be serviced with potable water from a 100 mm diameter Sydney Water main (see Section 2.9.2).

ii Reused rain water

Runoff from the Maritime Building and Private Marina Clubhouse roofs will be collected in rainwater tanks (see Section 2.9.2).

Given a roof area of approximately 13,140 m^2, an average annual rainfall of 654 mm and an average annual volumetric runoff coefficient of 0.7, the average annual runoff volume would be approximately 6,015 m^3. There are an average of 82 wet days per year in Moorebank. Therefore, an average of approximately 70 m^3 (70,000 L) of water will be discharged from the roofs on each wet day. Of this, up to 50,000 L will be captured in the rainwater tanks for irrigation of landscaped areas and/or for use as recycled water use within the buildings. Overflows from the rainwater tanks will discharge into the marina basin.

iii Stormwater runoff

The bitumen carparks and roads will have an area of approximately 19,900 m^2. The average annual runoff from these surfaces would be approximately 8,400 m^3 based on an average annual volumetric runoff coefficient of 0.65. Runoff from carparks and roads will be directed to the southern wetland for treatment prior to discharge into the marina basin.

The landscaped areas will consist of grasses, native grasses, shrubs and trees over an area of approximately 17,900 m^2. The major part of the landscaped areas will be the 40-m wide riparian area located along the river front. The average annual runoff from this area would be approximately 3,500 m^3 assuming an annual volumetric runoff coefficient of 0.3. Runoff from the riparian area will drain towards the river.

There is an existing stormwater channel along the western boundary of the site. This channel has an area of approximately 9,853 m^2. This is an existing vegetated area which convers stormwater runoff from sites that are north of the marina site. The channel allows these external flows to bypass the subject site. No site runoff would be discharged into this channel.

The marina basin is the largest area within the marina site, with an area of approximately 53,500 m^2. Rainfall onto the marina basin would become part of the Georges River flows.

iv Sewage

Sewage from the marina, including from boat pumpout, would be disposed to the mains sewer (see Section 2.9.4).

6.1.8 Water management measures

The proposed development has incorporated the following measures to address flooding, tidal hydrodynamics, water quality and navigation issues:

- floor levels of the building and marina facilities have been determined using the 100-year ARI flood levels produced in the Georges River Flood Study (adopted by LCC) and incorporate the appropriate freeboard;
- tidal hydrodynamics have been assessed through hydraulic modelling to ensure there is a high degree of tidal exchange between the marina and the river;
- water quality in the dredge basin will be tested during construction prior to breaking through the banks to the river. The bank will only be opened if the water quality in the basin is similar to, or better than, that in the Georges River;
- water sensitive urban design elements will be incorporated into the design (including the provision of wetlands) to provide stormwater treatment to reduce nitrogen, phosphorus, total suspended solids and heavy metals concentrations;
- bilge and sewage pump-out facilities will be provided in the marina;
- the marina entrance channel will be navigable available in all tide states;
- safety measures will be implemented outside the marina entrance channel; and
- bank stabilisation will be undertaken as part of the development.

6.2 Soils

The *Soil Landscape Map of Penrith, Soil Landscape Series Sheet 9030*, scale 1:100,000, prepared by the Soil Conservation Service of NSW (Hazelton et al. 1989), indicates that the marina site is located within the "Richmond Landscape Area" and typically consists of clays, clay loams, sands and ironstone nodules. During the borehole drilling program undertaken in 1994 (Dames and Moore 1994), sequences of fine to coarse sands, silty sands, silts and sandy silts with thin gravel lenses overlying shale bedrock were recorded.

Test pits were excavated as part of the contamination investigations (Section 6.3). The soil excavated from the test pits typically comprised fill overlying brown to light grey, moderate plasticity clay and dark sandy loam. The presence of anthropogenic fill is consistent with historic land filling practices on the marina site (see Section 6.3). Road base and debris, including plastic and pipe fragments, were present in places in the fill layer as well as light brown organic matter. The location and thickness of fill and organic matter appears to vary widely across the site.

A small quantity of virgin excavated natural material (VENM) was used to assist in restoring landforms on the marina site. The source and the exact location of fill is unknown. It is understood that one to two metres of topsoil has also been stripped and sold from the site.

6.2.1 Acid sulfate soils

The project area has been identified on the Liverpool LEP (2008) *Acid Sulfate Soils Map*, and reference to the Atlas of ASS indicates there is a high probability for ASS to occur. Approximately 1,000 tonnes of potential ASS has been disposed of on-site (pers comms Mark Morris, Production Manager, 29 May 2015).

Excavation of the channel between the dredge pond and the Georges River will require the removal of the existing soils. These are likely to be acid sulfate soils and will be tested and managed appropriately (see Section 6.2.2).

6.2.2 Management measures

An acid sulfate soils management plan has been prepared (Appendix D6). This includes methods for the characterisation and management of potential and actual acid sulfate soils. The marina site is currently licensed for the disposal of ASS as well as VENM.

The main acid sulfate soils mitigation measure will entail over-excavation and treatment or replacement of soils immediately adjacent to the proposed channel (see Appendix D6). This will aim to prevent long-term drainage of acid from the adjacent, potentially impacted soils. Surface features such as drains will be designed to avoid areas of acid sulfate soils.

6.3 Contamination

6.3.1 Background

i Relevant reports

There have been a range of investigations related to contamination or potential contamination of Lot 7 between 1994 and 2019. These investigations have been undertaken by Douglas Partners, Dames and Moore Pty Ltd (D&M), Environmental Investigation Services (EIS), Jeffery and Katauskas Pty Ltd (J&K) and EMM.

Most recently, the following contamination reports have been prepared regarding the marina site:

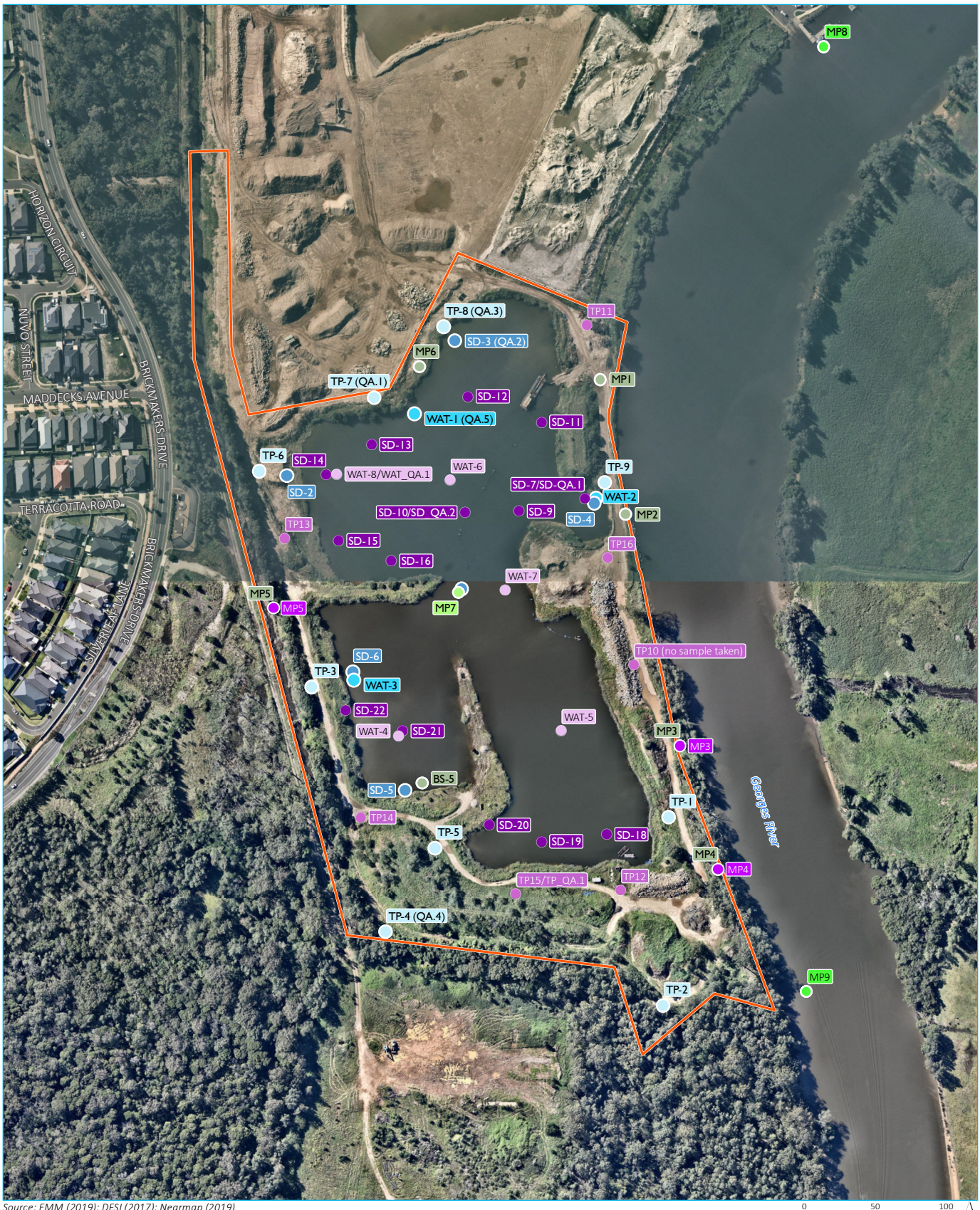
- *Proposed Georges Cove Marina Preliminary Investigation of Contamination* (EMM 2015b) – provided in Appendix D1;
- *Proposed Georges Cove Marina Supplementary Preliminary Investigation of Contamination* (EMM 2016a) – provided in Appendix D2;
- *Proposed Georges Cove Marina Remediation Action Plan* (EMM 2016b) – provided in Appendix D3;
- *Preliminary Site Investigation, Proposed Rezoning (Area 1) and Georges Cove Marina (Area 2), 146 Newbridge Road, Moorebank* (Douglas Partners 2018) – provided in Appendix D4; and
- *Landfill Gas Monitoring, November 2018 Proposed Rezoning (Area 1) and Georges Cove Marina (Area 2), 146 Newbridge Road, Moorebank* (Douglas Partners 2019) – provided in Appendix D5.

EMM assessed whether the marina site is suitable for the use of the site for a marina and considered the environmental risk from contamination associated with groundwater, surface water, soil, and water and sediment from the dredge pond (EMM 2015b [Appendix D1] and EMM 2016a [Appendix D2]). Sampling locations are shown in Figure 6.1.

The *Remediation Action Plan* (EMM 2016b [Appendix D3]) is based on the findings of the previous EMM reports (EMM 2015b and EMM 2016a) and a review of earlier reports. The plan describes proposed management actions and monitoring associated with converting the dredge pond to a marina basin open to the Georges River. It also provides a protocol for managing unexpected contamination, if found within the marina site.

The preliminary site investigation report (Douglas Partners 2018) is provided in Appendix D4 and considers the potential for contamination within the marina site and it includes additional information on the potential for asbestos to occur and an assessment of landfill gas. Updated gas monitoring information is provided in November 2018 in Douglas Partners (2019) (Appendix D5).

A summary of earlier relevant reports is provided in Section 3 of the Douglas Partners (2018) *Preliminary Site Investigation* (Appendix D4).



Source: EMM (2019); DFSI (2017); Nearmap (2019)

0 50 100 m

GDA 1994 MGA Zone 56

N

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KEY

Subject site

Historic sampling locations
- Dredge pond water
- Georges River
- Groundwater
- Stormwater

PI sampling location
- Sediment
- Soil
- Dredge pond water

SPI sampling location
- Soil
- Dredge pond water
- Sediment

Preliminary and supplementary investigations sampling locations (EMM 2016a & 2016b)

Georges Cove Marina
Environmental impact statement
Figure 6.1

EMM
creating opportunities

ii Site Audit Report

A Site Audit Report and a statutory Site Audit Statement, prepared by accredited site auditor Dr Ian C Swane under the *Contaminated Land Management Act 1997,* is provided in Appendix D7. This was prepared to address an LCC requirement that a Site Audit Report and a Section B Audit Statement was prepared prior to determining the marina development application.

The site audit report and statement considered:

- the nature and extent of contamination;
- the appropriateness of the remediation plan (EMM 2016b); and
- whether the land can be made suitable for the proposed uses.

iii Site history

A history of the site and surrounding area has been prepared based on the following information:

- land ownership records;
- aerial imagery;
- environmental licences and legal notices; and
- previous site investigations.

iv Historical land ownership

The historical land ownership of Lot 7 is summarised in Table 6.2.

Table 6.2 Historical land ownership

Year	Owner
1884–1924	Private citizens, The Church of England Property Trust Diocese of Sydney and Perpetual Trustee Company Limited (1920–1923).
1923–1947	New Bankstown Limited, The Greenacre Park Limited and private citizens (1924–1965).
1947–1954	Echo Dairies Pty Ltd and private citizens including Anthony Francis Brady, dairyman and Mary Agnes Brady, wife.
1954–1960	Anthony Francis Brady.
1960–1997	Echo Dairies Pty Ltd.
1997–current	Tanlane Pty Ltd.

Source: Land and Property Information - NSW Government (2015) and Douglas Partners (2016).

v Aerial imagery

Historical aerial imagery was obtained in 2015 from NSW Land and Property Information (LPI). The imagery was taken at approximately 10 year intervals from 1951. Aerial imagery of the marina site and the surrounding area is described in Table 6.3.

Table 6.3 Review of aerial imagery

Year	Marina site	Changes to surrounding area (approximately 500 m radius)
1951	Mostly cleared of vegetation with some vegetation present at site boundaries; no visible development.	Some vegetation clearance to the north and south. Georges River to the east. Shed to the north of the site. Vegetation and unsealed tracks, to the west of the western boundary of Lot 7.
1961	Evidence of further vegetation clearance.	Further vegetation clearance to the south and west. Shed to the north of the site has been expanded. Quarry (operated by Clark Bricks) present to the west of the site. Some agricultural development and unsealed access tracks to the north-west.
1970	Unchanged from previous.	Further vegetation clearance to north and west and expansion of quarry and access tracks.
1978	Unchanged from previous.	Further vegetation clearance to north and west, and expansion of quarry and access tracks. Residential development present beyond vegetation to the north-west.
1986	Unchanged from previous.	Further vegetation clearance to the north and west, with expansion of the quarry to the west, and no remaining vegetation north of the site. Garden centre present further to the north.
1998	Two sand dredge ponds present in the centre of marina site. Further vegetation clearance on the southern and western part of the marina site.	Area immediately north of the marina site (Lot 7) cleared and developed as waste facility. Access tracks present on cleared site immediately south of marina site
2005	Dredge ponds increased, taking up approximately 70% of the marina site	Waste facility present immediately north of the marina site. Evidence of further development of access tracks immediately south of marina site. Significant expansion of quarry to the west of its previous footprint.
2015	The extent of the dredge ponds extends to the northern boundary of the marina site; while infill has taken place on parts of the southern portion of the marina site. Overall, the dredge ponds take up approximately 60% of the marina site.	Quarry to the west has been replaced by residential properties (Georges Fair).

vi Land use

Development consent was granted in 1993 to the current owner, Tanlane, to extract sand by dredging, and to fill the dredged void with 'clean fill' back to natural ground level. This required the surrender of the 1972 land-filling consent that permitted the use of Lot 7 as a landfill.

The 2012 EIS (Benedict Industries 2012) notes that prior to the grant of the 1993 development consent, a small quantity of clean fill (clay) was used to restore landforms on the marina site. The source and the exact location of the clay fill is unknown. It is also understood that one to two metres of topsoil was originally stripped and sold from the marina site by the previous owners, Echo Dairies P/L. This was prior to the current owners extracting sand from the site using a dredging, creating the marina basin.

There is also evidence that parts of the marina site were used as a landfill between 1972 and 1993, likely for the disposal of construction and demolition waste. Approximately 1,000 tonnes of potential acid sulphate soil (PASS) was disposed of on the marina site (pers comms Mark Morris, Production Manager, 29 May 2015). The only visible evidence of landfilling from aerial photography was a patch of cleared land in the northern part of the marina site in the 1978 aerial photograph, with an access track connecting it to what appeared to be an operational area of the waste facility to the north of the marina site. Manufacturing and industrial processes have not occurred on the marina site. There is no evidence of underground storage tanks (USTs) in the marina site. Benedict personnel indicated that fuel and chemicals for use in the waste facility were stored on the northern portion of Lot 7 (ie north of the marina site). There is no chemical or fuel storage on marina site, which is consistent with the results of a search of the WorkCover NSW stored chemical information database. There was a bio-septic sewerage system on the northern portion of Lot 7, approximately 300 m to the north of the marina site. It was professionally decommissioned and removed.

vii Environment Protection Licenses

Benedict Industries holds two environmental protection licences (EPLs) for Lot 7:

- EPL 4612 for:
  - crushing, grinding or separating; and
  - extractive activities (land and water based).
- EPL 10490: Recovery, storage and processing (non-thermal treatment) of general waste including virgin excavated natural material (VENM); general solid waste (non-putrescible); general or specific exempted waste; wood waste; waste; paper or cardboard; gyprock; glass; building and demolition waste; asphalt waste (including asphalt resulting from road construction and waterproofing works); and waste tyres.

A license variation was issued (Notice Number 1046512) to Maron Investments Pty Ltd (trading as Benedict Reclamations) in May 2005. The EPL includes the storage/disposal of VENM, including PASS underwater, on the marina site and lists monitoring requirements. Less than 1,000 tonnes of PASS has been disposed of on-site.

viii Historical waste facility to the north

The northern portion of Lot 7 was used as a landfill by the previous landowners, Echo Dairies P/L. Land-filling is listed in Table 1 of the C*ontaminated Land Planning Guidelines* (DUAP and EPA 1998) as an activity with the potential to cause contamination. As with the marina site, the historical land uses of the northern part of the site included vegetable farming prior to 1965 and use as a dairy from 1960 to 1972. The northern portion of Lot 7 was used as a registered landfill between 1972 and 1990. It is not known if land-filling occurred continuously. Although the landfill is not on the marina site, it was considered as a potential off-site source of contamination that might adversely affect the site given the groundwater flow direction and the migration of landfill gas. This area was rezoned to permit residential development and landfill activities are no longer taking place. The northern portion of Lot 7 has also been used as a recycling centre prior to ongoing rehabilitation preceding the proposed Mirvac Moorebank Cove Residential estate.

ix Clean up notice

A clean up notice (No. 1051596) was issued to Benedict Reclamations under section 91 of the *Contaminated Land Management Act 1997* in October 2005. The notice was for the clean-up of bonded asbestos containing material (ACM) that was encountered in some recycled aggregate stockpiles at the site. This notice was promptly and properly complied with and the notice removed.

x Recent site history and future plans

a Marina site

Dredging on the marina site ceased in 2016. Since this time, the only activities on the marina site have been environmental investigations and stockpiling of rock material.

b Northern portion of Lot 7

The northern portion of Lot 7, north of the marina site is cleared and undergoing geotechnical improvement (compaction), remediation and levelling.

A *Remediation Action Plan* has been prepared for the northern portion of Lot 7 (Douglas Partners 2017). The northern portion of Lot 7 is currently subject to a Statutory Site Audit by a NSW EPA Accredited Site Auditor under the Contamination Land Management Act as part of the remediation works. The remediation strategy aims to render the site suitable for Mirvac's proposed Georges Cove residential estate.

Remediation of the northern part of Lot 7 includes removal of localised soil contamination 'hotspots' and the placement of a physical barrier (eg capping) to prevent the exposure of receptors (human and ecological) to the soil contamination. Groundwater contamination will be addressed by monitoring and various contingency options. Excavation and removal of buried waste from the large hotspot in the northern portion of the site occurred between approximately February and September 2016. Several other small hotspots have since been remediated. These hotspots are areas where timber had been buried that created gas while decomposing. Gas monitoring was used to locate these hotspots and since removal/remediation of this waste, gas levels are low.

A 3.0 m thick engineered cap, of which the upper 2.0 m will be imported VENM, will be installed. The residual soil contamination on this northern portion of the site will be contained under this engineered barrier.

Landfill gas monitoring data presented in the Douglas Partners (2017) RAP for the northern portion of Lot 7 indicates that there was an unacceptable risk of the migration of landfill gas into structures (eg dwellings) associated with proposed residential development. The recent monitoring conducted as part of the Douglas Partners (2016) *Detailed Site Investigation* (DSI) indicates that a CGS of 3 ('moderate risk') is appropriate for the northern part of the site.

The Douglas Partners (2017) RAP for the northern section of Lot 7 describes the preferred option for landfill gas concentration/volume reduction as being is the partial removal of the landfill gas source "hot spots" (already undertaken) and passive engineered landfill gas mitigation measures for each proposed structure (eg venting and/or gas resistant membranes beneath concrete slabs). Douglas Partners (2017) considers that passive measures are appropriate for this development as opposed to active measures which would require home owners to maintain an active system.

The removal of unacceptable landfill gas sources and associated waste from the fill have the following added benefits (Douglas Partners 2017):

- A reduction in the degree of reliance on landfill gas mitigation measures since landfill gas levels remaining at depth at the site would be reduced to the extent practicable.
- A reduction in greenhouse gas emissions to the extent practicable.
- A reduction in leachate generation of the landfill waste to the extent practicable.
- The removal of a portion of metal waste by screening some metal out of the fill prior to its use as backfill. The metal waste in fill is leached dissolved metals into groundwater and is likely to be have had a net adverse impact on groundwater quality beneath the site.
- The removal of a portion of timber and other general waste by screening timber and other general waste out of the fill prior to its use as backfill. The timber and other general waste in fill wasleaching contaminants such as dissolved metals, degradable by-products (ammonia and nutrients), organochlorine pesticides (assuming discarded organochlorine pesticides containers are present) and dissolved solids into groundwater and is likely to have had a net adverse impact on groundwater quality beneath the site.
- Removal and disposal of bonded ACM from excavated waste.

Reduced landfill gas and leachate generation, which has already significantly slowed as a result of current remediation activities, will further reduce the volume that could theoretically migrate to the marina site. The concentrations of landfill gas encountered in the gas monitoring wells on the marina site are considered to be typical of the existing ground conditions (ie 'natural soils with high organic content' and/or 'typical fill') (Douglas Partners 2019, Appendix D5).

xi Summary of site history

A summary of the site history information is provided below:

- 1884–1924: the marina site was undeveloped prior to 1930.
- 1923–1947: the marina site and parts of the surrounding area were used as a dairy farm, with areas cleared for grazing.
- 1947–1997: the marina site and surrounding area continued to be used as a dairy farm with areas cleared filled and levelled for grazing until approximately 1982. Buildings associated with the dairy (haysheds/warehouses) north of the marina site were constructed and a dam was excavated and subsequently filled. The drain running on the western boundary of the marina site was excavated during this time. Dredging activities at the marina site commenced in late 1995. Large sections of the waste facility to the north of the marina site were filled between 1982 and 1991 and used for stockpiling associated with waste processing and recycling activities. The northern portion of the waste processing and recycling site was capped with VENM (clay) in 1993/1994.
- 1997–2016: Tanlane Pty Ltd, owned by Benedict Industries, acquired the Lot 7, including the marina site and waste facility to the north, and continued sand dredging and waste processing/recycling. Council records indicate that a DA was submitted for the construction of a new road bridge at the marina site. A statement of environmental effects was prepared and submitted to council for the proposed development.

- 2016–present: sand dredging in the marina site ceased in 2016 and restoration commenced of the waste processing and recycling site to the north of the marina site.

6.3.2 Soil

There is a layer of fill material in parts of the marina site (notably, adjacent to material recycling activities on the northern site boundary, along the western site boundary and to the immediate south of the dredge pond). The fill averages about 0.5 m thick, and some observations of anthropogenic debris were reported in the fill profile.

Fill material, including anthropogenic debris, is widespread across the site to an average depth of approximately 2.5 m BGL, and was greater than 4 m thick in one test pit (TP-10, on the eastern border between Georges River and the dredge pond).

The soil analytical results reported in the *Preliminary Investigation* (EMM 2015b) and the *Supplementary Preliminary Investigation* (EMM 2016a) indicated seven exceedances of soil assessment criteria. Two exceedances were for the National Environment Protection Measure (NEPM), Assessment of Site Contamination (ASC), Ecological Screening Levels (ESL) for benzo(a)pyrene (0.7 mg/kg) in soil samples containing fill. The maximum concentration was 1.5 mg/kg at TP-15 (3.1 m BGL, near the southern site boundary) and the other exceedance was 0.8 mg/kg at TP-3 (0.5 m BGL, near the western site boundary). Both of these test pits included anthropogenic debris such as plastic (Table 4.1). The remaining five exceedances were for the ASC NEPM EIL for copper and zinc at TP-3, TP-5 and TP-12. Again, these test pits contained anthropogenic debris.

The proposed marina development will consist predominantly of parking lots, buildings and roadways close to the western and southern marina site boundaries. Each of the areas with soil assessment criteria exceedances (TP-3, TP-5, TP-12 and TP-15) will be covered by road, carpark or building footprint.

Minor exceedances of ESLs are considered to be of low relevance in areas that will be beneath sealed surfaces. Therefore, the elevated soil benzo(a)pyrene and metals concentrations are of low ecological relevance. The potential aesthetic soil impacts posed by anthropogenic debris in the fill material are considered to be of limited relevance as the majority of the existing fill will either be below sealed surfaces or building footprints, or will be removed from the marina site to prepare the landform for development.

6.3.3 Asbestos

Douglas Partners assessed the potential for ACM to be present on the marina site as described in the *Preliminary Site Investigation, Proposed Rezoning (Area 1) and Georges Cove Marina (Area 2)* – provided in Appendix D4. This included:

- excavation of two test pits (TP101 and TP102), to a depth of 3.0 m below ground level (bgl), and collection of soil samples from regular depth intervals; and

- laboratory analysis for asbestos in soil samples and two fragments of fibre cement.

The test pits (TP101 and TP102) contained silty sand, clayey sand and clay filling with some gravel to a depth of at least 3.0 m bgl. Anthropogenic inclusions including brick, glass, tile, wood, fragments of fibre cement were present within fill in TP101 and TP102. Potential bonded ACM occurred in both locations. One fragment of fibre cement from each test pit was tested for asbestos both fragments tested positive for chrysotile and amosite asbestos.

In regards to ACM, Douglas Partners (Appendix D4) concluded that additional asbestos investigation is required or a cap and contain strategy with a long-term environmental management plan (EMP) and an amendment to the RAP (EMM 2016b) if required.

6.3.4 Groundwater

Groundwater analytical results reported in the *Preliminary Investigation* (EMM 2015b, Appendix D1) and the *Supplementary Preliminary Investigation* (EMM 2016a, Appendix D2) indicated the groundwater is marginal to moderately saline and acidic to slightly alkaline.

Historical groundwater monitoring found total petroleum hydrocarbons (TPH) (medium fraction) concentrations were frequently above the laboratory limits of reporting. However since 2011, these TPH concentrations have been below the laboratory limits of reporting. Hydrocarbon impacted groundwater is likely to have originated from offsite sources as there are no site activities or practices associated with TPH contamination. As there has been no groundwater TPH detected in groundwater since 2011, it is not a potential contamination issue of concern.

The dissolved aluminium, cadmium, copper, manganese, nickel and zinc concentrations in the groundwater were above the ANZECC/ARMCANZ (2000) trigger values for the 95% protection of freshwater species in some groundwater samples.

Sampling indicates that groundwater is enriched with ammonia and concentrations typically exceed the ANZECC/ARMCANZ (2000) trigger values for the protection of 95% of freshwater and marine species. Since 2002, concentrations of ammonia results at MP5 have fluctuated, while at the other monitoring wells, ammonia concentrations increased since 2009. The source of ammonia is likely to be from outside the marina site.

6.3.5 Dredge pond

The contamination status of the dredge pond on the marina site was assessed in the *Preliminary Investigation* (EMM 2015b, Appendix D1) and the *Supplementary Preliminary Investigation* (EMM 2016a, Appendix D2). A conceptual model is provided in the Remediation Action Plan (EMM 2016b, Appendix D3).

i Human health risks

The elevated nutrient concentrations measured in the dredge pond water and the groundwater were not considered to represent a risk to human health as swimming in the pond water (leading to potential ingestion of pond water/groundwater) is unlikely in the context of a commercial marina EMM (2015b and 2016a).

The elevated benzo(a)pyrene and total mercury concentrations measured in the dredge pond water were associated with very high total suspended solids concentrations. The concentrations measured in the samples with low TSS concentrations were not considered to represent an unacceptable risk to human health. Therefore, these contaminants were not considered to represent an unacceptable risk to human health if sediment remains on the floor of the marina basin and is not resuspended into the water column.

ii Ecological risks

While the ecological assessment criteria for benzo(a)pyrene, zinc and copper were exceeded in five soil samples, the exceedances are considered to present a low and acceptable risk in the context of the operation of a commercial marina. The design of the marina, incorporating sealed concrete or tarmac surfaces (ie car parks, roads and buildings) will limit the mobility of contaminants and further reduce the risk level. No other ecological criteria applicable to soils were exceeded.

The highest ecological toxicant risks contaminants in the groundwater, dredge pond water and dredge pond sediments were a result of:

- lead and pyrene in the dredge pond sediment;
- ammonia in the groundwater when the groundwater is discharging to the Georges River; and
- total mercury and ammonia in the dredge pond water.

The highest eutrophication risks are a result of:

- ammonia in the groundwater; and
- ammonia, total nitrogen and total phosphorus concentrations in the dredge pond water.

A series of measures are presented in the *Remediation Action Plan* (EMM 2016b, Appendix D3) to minimise the risk to human health and the environment. These included measures to prevent mobilisation of sediments in the dredge pond and a recommendation that the entrance of the dredge pond not be opened to the Georges River unless site-specific water quality criteria are met. These site-specific water quality criteria are to be based on monitoring of the Georges River. Monitoring parameters to provide a contemporary baseline were to include:

- pH, temperature, electrical conductivity (EC), dissolved oxygen (DO) and turbidity;
- total suspended solids (TSS);
- dissolved aluminium (Al), cadmium (Cd), copper (Cu), nickel (Ni), lead (Pb) and zinc (Zn);
- total and dissolved mercury (Hg);
- polyaromatic hydrocarbons (PAHs);
- ammonia, total phosphorus and total nitrogen; and
- biochemical (BOD) and chemical oxygen demand (COD).

A specific monthly monitoring program commenced in October 2017. The relevant results are discussed below.

iii Additional dredge pond monitoring

a Ammonia

Ammonia in dredge pond water is considered to be a key ecological risk (EMM 2016a). As discussed in Section 6.2.2i of the *Remediation Action Plan* (EMM 2016b), the ammonia concentration in the dredge pond water generally decreased between September 2015 and January 2016, corresponding with the decreasing dredging activity.

Fortnightly ammonia monitoring of the dredge pond is ongoing. The results for September 2015 to July 2017 are presented in Figure 6.2. These analyses are based on composite samples collected from three locations within the pond (September 2015 to January 2016) or the mean of the results from locations within the pond (February 2016 to July 2017). Where the concentration was lower than the limit of detection (LOD), a value of half of the LOD was used to determine the mean.

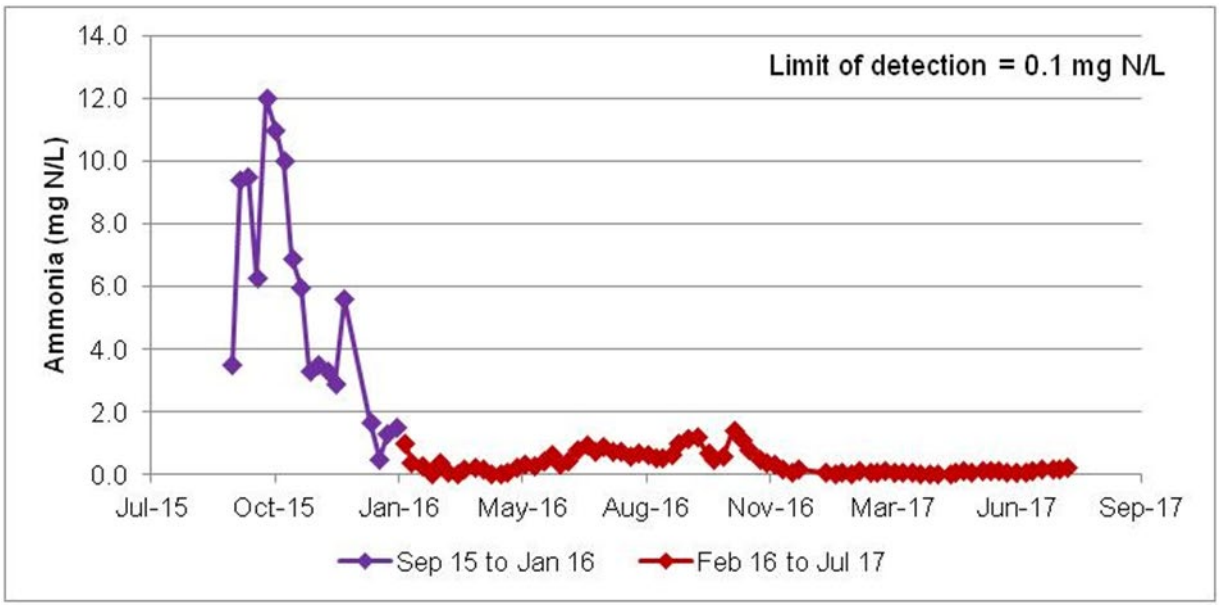


Figure 6.2 Ammonia concentration in the dredge pond water (September 2015 to July 2017)

The changes to ammonia concentrations in the dredge pond (Figure 6.2) are consistent with:

- September 2015 to December 2015: the ammonia concentration was highly variable (2.9 to 12 mg N/L) with a mean concentration of 6.7 mg N/L while dredging continued;
- January 2016 to December 2016: the ammonia concentration was variable (<0.1 to 1.7 mg N/L) with a mean concentration of 0.6 mg N/L after dredging ceased but while land-filled material in the hotspot was being removed (WHEN), allowing for groundwater movement; and
- January 2017 to July 2017: the ammonia concentration was low (<0.1 mg/L to 0.2 mg/L) with a mean concentration of 0.1 mg N/L (ie the limit of detection) following removal of the land-filled material in the hotspot.

As presented in the Site Audit Report (Swane 2019, Appendix d7), ongoing monitoring from August 2017 showed elevated ammonia concentrations (<0.1 to 0.7 mg N/L) to November 2017 and then low concentrations (<0.1 mg/L to 0.2 mg/L) from December 2017.

In addition to this program to monitor ammonia concentrations in the dredge pond, the concentrations of a wider suite of contaminants were measured in pond water and river samples collected between May 2017 and May 2018 (Table 6.4). Laboratory reports are provided in Appendix D8 and sampling locations are shown in Figure 6.3.

This monitoring included analysing ammonia concentrations with a method with a lower detection limit (0.05 mg N/L). Ammonia concentrations in the Georges River and dredge pond measured using the lower detection limit method are presented in Table 6.4.

Table 6.4 Ammonia concentrations in Georges River and dredge pond water (May 2017–March 2018)

Date	Ammonia concentration (mg N/L)			
	SW1	**SW4**	**SW2**	**SW3**
	Georges River at Davy Robinson Drive boat ramp	Georges River adjacent to northern end of marina site	Dredge pond	Dredge pond
Default trigger values				
Freshwater[1]	0.90			
Marine[1]	0.91			
Stressor (low land river)[2]	0.020			
Stressor (estuarine)[2]	0.015			
Georges Cove monitoring results				
17 May 2017	0.005	0.012	0.11	0.096
27 July 2017	<0.005	<0.005	0.15	0.11
13 December 2017	0.030	0.029	0.04	0.21
30 January 2018	0.007	0.008	0.014	0.033
21 March 2018	0.029	0.012	0.014	0.023
Mean (May 2017–March 2018)	0.014		0.080	
Mean (January–March 2018)	0.014		0.021	

Notes: 1. ANZECC/ARMCANZ (2000) default trigger value for slightly–moderately disturbed ecosystems.

2. ANZECC/ARMCANZ (2000) default trigger value for ammonia as a chemical stressor in South-east Australia.



Source: EMM (2019); DFSI (2017); Nearmap (2019)

0 50 100 m

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KEY

- Sampling location
- Subject site
- Cadastre

Dredge pond and Georges River sampling locations

Georges Cove Marina
Environmental impact statement
Figure 6.3

EMM
creating opportunities

The monitoring results show that the ammonia concentration in the dredge pond has remained low (<0.033 mg N/L, a mean concentration of 0.021 mg N/L) since May 2017 and was lowest in the two samples collected in 2018 (Figure 6.4). This is well below the toxicity-based freshwater and marine default trigger values (0.90 mg N/L and 0.91 mg N/L respectively) for the protection of slightly-moderately disturbed ecosystems.

These results are consistent with the removal of an ammonia source in the northern portion of the site.

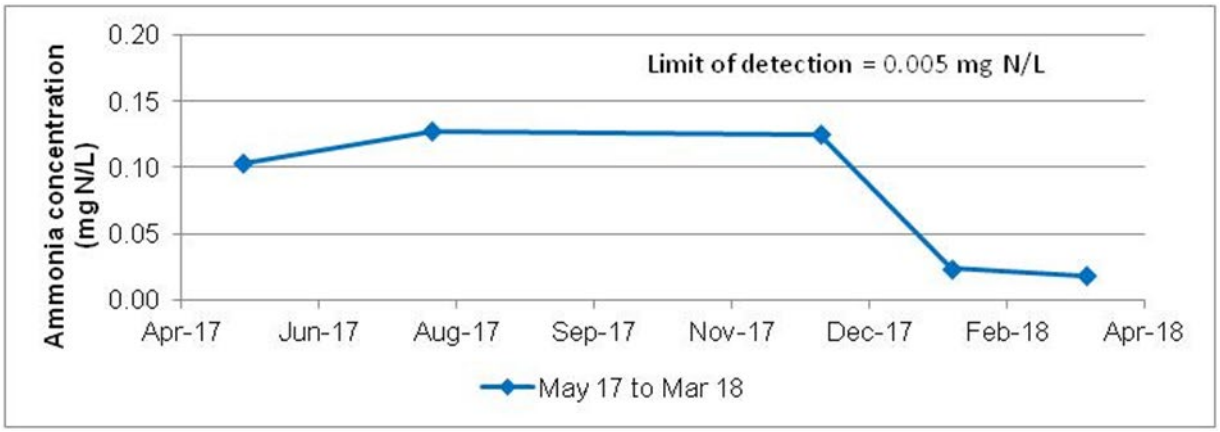


Figure 6.4 Mean ammonia concentration in the dredge pond water (May 2017 to March 2018)

The mean ammonia concentration in the dredge pond in 2018 (0.021 mg N/L) exceeded the ANZECC/ARMCANZ (2000) stressor default trigger value for estuaries (0.015 mg N/L) and marginally exceeds the default trigger value for low land rivers (0.020 mg N/L).

While the dredge pond is not a completely closed system, the rate of water exchange between the dredge pond and the river (ie via groundwater movement) is relatively slow compared to the rate of exchange expected the pond is opened to the river as a marina basin and subject to tidal flushing. The marina basin will be flushed by tidal movements, with approximately 40 to 60% of the water exchanged each tide.

Given the current slow exchange rate for the dredge pond, any contaminants leaching from the sediment to the overlying water in the pond are expected to accumulate to higher concentrations in the closed pond than in the open marina basin. The low ammonia concentrations measured in the pond indicate that there is no appreciable leaching of ammonia from the dredge pond sediments.

The ammonia concentrations measured in samples collected from two monitoring sites on the Georges River: SW4 (adjacent to the north end of the marina site) and at SW1 (300 m upstream of SW4), see Figure 6.3. The ammonia concentrations were similar at both sites (Table 6.4). The mean ammonia concentration was 0.014 mg/L in the Georges River, ie slightly lower that the mean ammonia concentration for dredge pond samples collected in 2018.

b Other potential toxicants

As noted in Section above, the toxicants previously identified as having the highest ecological toxicant risks (other than ammonia) were lead and pyrene in the dredge pond sediment and total mercury in the dredge pond water (see Table 5.2 of EMM (2016a), Appendix D2).

The measured lead concentrations in dredge pond water were less than the detection limit (ie <1 µg/L) in the four dredge pond samples collected on 27 July 2017 and 30 January 2018 (see Appendix D2). This is lower than the ANZECC/ARMCANZ (2000) default trigger values for the protection of slightly to moderately disturbed ecosystems for freshwater (3.4 µg/L) and marine water (4.4 µg/L).

The measured pyrene concentrations in dredge pond water were less than the detection limit (<1 µg/L) in the four dredge pond samples collected on 27 July 2017 and 30 January 2018. There are no ANZECC/ARMCANZ (2000) default trigger values for pyrene.

The measured mercury concentrations in dredge pond water were less than the detection limit (ie <0.05 µg/L) in the four dredge pond samples collected on 27 July 2017 and 30 January 2018. This is lower than the ANZECC/ARMCANZ (2000) default trigger values for the protection of slightly to moderately disturbed ecosystems for freshwater (0.06 µg/L) and marine water (0.1 µg/L).

As for ammonia, these results indicate that there is no appreciable leaching of lead, pyrene or mercury from dredge pond sediments into the overlying water.

c Eutrophication risks

The nutrients previously identified as having the highest eutrophication risks (other than ammonia) were total nitrogen and total phosphorus in the dredge pond water (see Table 5.2 of EMM (2016a), Appendix D2).

Total nitrogen concentrations have not been measured in the dredge pond as part of recent sampling. However, nitrate and nitrite concentrations have been measured. These indicate that the concentration of oxidised nitrogen in the dredge pond is generally lower than in the Georges River (Table 6.5).

A high nitrate concentration (1.3 mg/L) was reported in one sample (SW2 collected on 30 January 2018). The reported result appears to be wrong when compared to the result from a sample collected at SW3, also collected from the northern part of the dredge pond about 50 m from SW2 during the same sampling event, and compared to the results from 17 May 2017 (0.03 mg/L) and November 2015 (0.03 to 0.32 mg/L) as reported in the *Supplementary Preliminary Investigation* (Appendix D2). However, there is insufficient information to allow it to be removed from the dataset.

Table 6.5 Nitrate concentrations in Georges River and dredge pond water (May 2017–May 2018)

	Oxidised nitrogen concentration (mg N/L)			
	SW1	**SW4**	**SW2**	**SW3**
	Georges River at Davy Robinson Drive boat ramp	Georges River adjacent to northern end of marina site	Dredge pond	Dredge pond
Default trigger values				
Stressor (low land river)[1]		0.040		
Stressor (estuarine)[1]		0.015		
Georges Cove monitoring results				
17 May 2017	0.295[2]	0.275[2]	0.03[2]	0.03[2]
9 October 2017	<0.1[3]	-	-	-
6 November 2017	0.10[3]	-	-	-
18 December 2017	0.08[2]	-		
15 January 2018	0.11[3]	-		
30 January 2018	0.045[2]	0.055[2]	1.3[2]	0.01[2]

Table 6.5 Nitrate concentrations in Georges River and dredge pond water (May 2017–May 2018)

	Oxidised nitrogen concentration (mg N/L)			
	SW1	**SW4**	**SW2**	**SW3**
	Georges River at Davy Robinson Drive boat ramp	Georges River adjacent to northern end of marina site	Dredge pond	Dredge pond
15 February 2018	<0.1[3]	-	-	-
12 March 2018	0.19[3]	-		
13 April 2018	<0.1[3]	-	-	-
18 May 2018	0.13[3]			
Mean (nitrate and oxidised nitrogen)	0.12		0.02/0.34[4]	

Notes: 1. ANZECC/ARMCANZ(2000) default trigger value for oxidised nitrogen as a chemical stressor in South-east Australia.
2. Calculated from measured nitrate and nitrite concentrations assuming that the nitrite concentration was 0.005 mg/L where it was less than the LOR (0.005 mg/L).
3. Measured as oxidised nitrogen (ie nitrate + nitrite).
4. Mean is 0.02 mg/L based on reliable results or 0.34 mg/L if the measurement at SW2 on 30 January 2018 is included.

The measured total phosphorus concentrations in dredge pond water were less than the detection limit (<0.05 mg/L) in the four dredge pond samples collected on 27 July 2017 and 30 January 2018. This detection limit is too high to allow direct comparison to the ANZECC/ARMCANZ (2000) default trigger value for the protection for slightly to moderately disturbed ecosystems for eastwards flowing NSW low land rivers (0.025 mg/L) or for the protection of estuaries (0.030 mg/L). However, the total phosphorus concentrations in dredge pond water were less than the concentrations in the Georges River (Table 6.6).

Table 6.6 Total phosphorus concentrations in Georges River and dredge pond water (May 2017–April 2018)

	Total phosphorus (mg/L)			
	SW1	**SW4**	**SW2**	**SW3**
	Georges River at Davy Robinson Drive boat ramp	Georges River adjacent to northern end of marina site	Dredge pond	Dredge pond
Default trigger values				
Stressor (low land river)[1]	0.025			
Stressor (estuarine)[1]	0.030			

Table 6.6 Total phosphorus concentrations in Georges River and dredge pond water (May 2017–April 2018)

	Total phosphorus (mg/L)			
	SW1 Georges River at Davy Robinson Drive boat ramp	**SW4** Georges River adjacent to northern end of marina site	**SW2** Dredge pond	**SW3** Dredge pond
Georges Cove monitoring results				
17 May 2017	0.07	0.08	<0.05	<0.05
9 October 2017	0.04	-	-	-
6 November 2017	0.05	-	-	-
30 January 2018	0.07	0.07	<0.05	<0.05
15 February 2018	0.06	-	-	-
13 April 2018	0.12	-	-	-
Mean	0.07		<0.05	

Notes: 1. ANZECC/ARMCANZ(2000) default trigger value for total phosphorus as a chemical stressor in South-east Australia.
2. Results where the analytical method had an LOR of <0.1 mg/L are not presented (all these results were <0.1 mg/L).

iv Dredge pond summary

In summary, recent water quality monitoring in the dredge pond and Georges River indicates that:

- the concentrations of contaminants identified in the *Preliminary Investigation* and the *Supplementary Preliminary Investigation* as having a high environmental risk (ammonia, total nitrogen, total phosphorus, lead, mercury and pyrene) generally no longer exceed the applicable default trigger values, or where these are exceeded, the levels are lower than the background concentrations in the Georges River, and therefore do not pose an additional risk; and
- there is no evidence that significant concentrations of these contaminants are being leached from dredge pond sediments.

The decrease in the concentrations of these contaminants in dredge pond water can be attributed to a combination of:

- the cessation of dredging in the pond that resulted in high suspended solid concentrations and followed by leaching of contaminants from particles in the water column to the water column;
- removal of extraction and recycling activities from the northern portion of Lot 7 with corresponding improvement in the water quality of surface water runoff entering the pond; and
- improvement in groundwater quality due to the removal of the hotspots on the northern portion of Lot 7.

6.3.6 Landfill gas

Douglas Partners investigated the presence and potential risk of landfill gas (hazardous ground gases) on the marina site based on sampling in as described in the *Preliminary Site Investigation, Proposed Rezoning (Area 1) and Georges Cove Marina (Area 2)* (provided in Appendix D4). Additional monitoring was competed in November 2018 as described in *Landfill Gas Monitoring, November 2018 Proposed Rezoning (Area 1) and Georges Cove Marina (Area 2), 146 Newbridge Road, Moorebank* (provided in Appendix D5).

This investigation included:

- development of a conceptual site model;
- installing three gas monitoring wells on the marina site at MW101, MW102 and MW103 to depths below 4.0 and 5.5 m below ground level;
- monitoring of gas concentrations and flow rates on 20 March, 9 April and 23 November 2018;
- determining the gas screening value (GSV) and characteristic gas situation (CGS); and
- evaluation of landfill gas data based on the GSV and CGS to assess potential impacts and proposed mitigation measures.

The landfill gas monitoring wells were installed in the western portion of the marina site where ground gas was most likely to be present and where the marina buildings are proposed.

The landfill gas results indicated that there were generally low landfill gas concentrations and flows with a calculated CGS of 1 to 2 ('very low' to 'low' risk) for all three monitoring wells.

In regard to landfill gas, Douglas Partners (2019) (Appendix D5) concluded that:

> Whilst there has been some general variability in concentrations and flow rates between monitoring events, overall the results are generally consistent. As discussed in Section 3 [of Douglas Partners (2019)], the concentrations of landfill gas encountered are considered to be typical of the existing ground conditions (i.e. 'natural soils with high organic content' and/or 'typical fill'). Recorded gas concentrations are considered unlikely to be landfill gas that has migrated from the landfill located to the north, possibly with the exception of MW101, which is located in close proximity to the boundary of the two areas within the overall Lot.
>
> Substantially higher concentrations of methane have been recorded in some monitoring wells and some probes that were located on the landfill to the north, suggesting different landfill gas/ground conditions between the two areas within the same overall Lot.
>
> In summary, the current results indicate that the conclusions and recommendations in DP (2018) [Douglas Partners (2019 [Appendix D5]] remain valid, including the recommendation that:
>
> - "Further gas monitoring is undertaken and demonstrates that mitigation systems can be suitably installed and operated within the proposed building designs. Preliminary landfill gas monitoring indicates that the residential use envelope may require landfill gas mitigations. If continued monitoring indicates that mitigations are required, an addendum to the EMM (2016b) RAP must be prepared to address this specific issue. Further to this, it is understood that buildings currently being proposed involves suspended slabs under which mitigation systems could be readily incorporated into the design, if necessary."

Accordingly, additional monitoring events should be undertaken to confirm any trends (e.g. stable, increasing or decreasing concentrations or flow rates) and to assist in future landfill gas mitigation designs for structures proposed to be built at the site.

The following management and monitoring are proposed in Douglas Partners (2018):

- landfill gas is continued to be monitored in the three wells;
- on the basis of the monitoring results and if required, the site's RAP is updated to address mitigation of landfill gas; and
- a post-filling detailed site investigation is completed across the marina site.

6.3.7 Summary of site contamination assessments

The *Preliminary Investigation* (EMM 2015b, Appendix D1), *Supplementary Preliminary Investigation* (EMM 2016a, Appendix D2) and the most recent *Preliminary Investigation* (Douglas Partners 2018, Appendix D4) did not identify contamination issues that are considered to present an unacceptable risk to human and/or environmental health in the context of the proposed future land use. Recent sampling did not identify any exceedances of the NEPC (2013) human-health-based guideline values. A small number of exceedances of ecological assessment criteria were identified, that were either considered to be irrelevant, or present a low and acceptable risk, in the context of the proposed future land use.

The measured concentrations of landfill gas are typical of natural soils with high organic content and/or 'typical fill'. The recorded gas concentrations are unlikely to be landfill gas that has migrated from the landfill located to the north, possibly with the exception of MW101. Douglas Partners recommend further gas monitoring to assist in future landfill gas mitigation designs for structures proposed to be built at the site if required.

Asbestos has been identified on the site and an asbestos investigation to quantify the concentration of bonded ACM and fibrous asbestos and asbestos fines (FA and AF) against relevant screening criteria will be undertaken post-approval. If required, an asbestos management plan will be prepared during the Construction Certification stage. The plan will describe a cap and contain strategy. A long-term environmental management plan will also be prepared and the RAP updated if required.

The historically elevated ammonia concentrations in the dredge pond have decreased to levels close to those in the Georges River, consistent with the removal of an ammonia source in the northern portion of the site, and monitoring is continuing. The ammonia concentrations in the basin are not considered to represent a risk to human health particularly as there will be no human exposure as ingestion of the basin water is unlikely in the context of a commercial marina.

The marina site is suitable for the proposed future land use (the marina development) or will be suitable for this use with minor remediation that may be the outcome of the recommended investigations (see Section 6.3.7).

6.3.8 Management measures

Management measures recommended in the contamination assessments (Appendices D1–D5) and the Site Audit Report and accompanying Site Audit Statement (Swane 2019, Appendix D7) prepared for the marina site are summarised below.

i Following development consent

The following measures recommended in the Site Audit Statement (Appendix D7) be implemented:

1. Prior to the commencement of remediation work, a detailed design program is completed involving:

    a) A building design for the proposed development. Elements of the design relevant to the remediation of the site include, among other things, site layout plans, elevations and plan views, cross-sections, foundation design, use of suspended slabs and natural ventilation under buildings, areas to be sealed by pavement and building slabs, and buried service corridors.

    b) An earthworks plan for the proposed development. Elements of this plan relevant to the remediation of the site include, among other things, a detailed earthworks design, plans showing the areas of the site to be excavated and filled, the types of fill needing to be imported to the site, construction strategies, material management procedures, and accurate surveys of the existing and final ground surface.

    c) Data gap investigations for Area 2 and other fill areas at the site (Figure 3 [of Appendix D8]) based on the needs of the earthworks plan developed in 1(b). The investigations are to involve asbestos in soil, groundwater quality along southern boundary, soil gas monitoring.

    d) Preparation of a Construction Environmental Management Plan (CEMP) that provides detailed plans consistent with the construction strategy proposed by the appointed contractor. The CEMP is to include, among other things, environmental criteria, an Asbestos Management Plan, environmental protection measures, protocols for opening the pond to the Georges River, material tracking from cradle-to-grave, contingency planning, validation and monitoring program.

2. The results of the detailed design program are to be in a Detailed Design Report.

3. No remediation work is to commence until a Section B SAS has been issued by the Site Auditor concluding that the plans and strategies included in the Detailed Design Report meet NSW EPA guidance and will allow the site to be made suitable for the intended land uses.

4. Any modification to the Detailed Design Report or the RAP should not be implemented without prior written approval of the Site Auditor.

5. A Section A SAS is issued by the Site Auditor for a remediated area confirming that it is suitable for its intended land uses prior to commencement of the built form in that area.

In addition, the following management measures are proposed following the receipt of development approval:

- an asbestos investigation to quantify the concentration of bonded ACM and fibrous asbestos and asbestos fines (FA and AF) against relevant screening criteria.

- if required, an asbestos management plan will be prepared that describes a cap and contain strategy to be implemented.

- a long-term environmental management plan will be prepared.

ii Construction

The following management measures will be taken during construction:

- Any material in the stockpiles or fill mounds that are present at the marina site and that are proposed for on-site reuse will be characterised for land use suitability relative to the appropriate land use criteria in the ASC NEPM (SPI, EMM 2016a).
- Any material proposed for off-site disposal or reuse will be characterised for waste classification in accordance with the NSW EPA (2014) Waste Classification Guidelines, Part 1: Classifying Waste, or with regard to a relevant resource recovery order and exemption issued under the POEO Act (SPI, EMM 2016a).
- The unexpected finds protocol in Section 6.1.2 of the RAP (EMM 2016b) will be implemented.
- During marina basin construction (RAP, EMM 2016a):
    - Complete all marina construction activities that may result in sediment resuspension and then allow time for metals to be adsorbed and for particles in the water column to settle to the bed sediment.
    - Excavate the marina entrance to a depth that leaves a 'lip' at the entrance that extends above the base of the basin and river. This will be within Lot 7.
    - Armour the lip with rock to prevent erosion by water moving into and out of the basin.
    - Monitor Georges River water quality to establish a contemporary baseline and establish site-specific water quality assessment criteria (programme underway).
    - Monitor basin water prior to opening basin, only opening the basin once concentrations in the basin are in the range occurring in the river.
    - Use silt curtains to minimise water with high TSS concentrations entering the river surface water from the marina basin.
    - If required, investigate contingencies to reduce contaminant concentrations in the basin to meet site-specific water quality assessment criteria.
    - Monitoring results representative of the total dredge pond water body will be provided to the EPA and EPA approval will be sought prior to releasing waters from the dredge pond to the Georges River as a result of constructing the marina channel opening.
- A daily record of all site works will be maintained by the construction or remediation contractor. This will include details of daily environmental inspections. The occurrence and management of all unexpected finds will be documented.

iii Operations

The following management measures will be taken during marina operations (RAP, EMM 2016a):

- Prevent basin sediment resuspension from propeller wash by: providing adequate under keel clearance (2.9 m low tide water depth) and enforcing the speed limit within the marina basin (4 knots).
- Prevent surface water runoff from offsite running directly into the basin.

- Direct surface runoff to the treatment area in north-west of the basin to minimise solids, organic matter and nutrients entering the basin.

- Monitor Georges River water quality and sediment quality for five years to validate that marina operations are not an unacceptable risk to the ecology of river or to recreational users.

6.4 Ecology

6.4.1 Terrestrial ecology

i Assessment (2004–2011)

A flora and fauna assessment was completed by Total Earth Care (2004) as part of the 2006 rezoning application. This information was incorporated and updated in the *Flora and Fauna Assessment* by Total Earth Care (2011) (Appendix E1). Since these assessments were completed, the *Threatened Species Conservation Species Act 1995* has been replaced the *Biodiversity Conservation Act 2016*.

Desktop ecological searches were completed within a 5 km radius from the study area in 2004 and 2011. Four field surveys of the whole of Lot 7 (the study area) were undertaken: 23 August 2004, 11 January 2005, 5 September 2011 and 11 January 2018 (see below).

The Total Earth Care (2011) assessment (Appendix E1) recorded 87 plant species, including 49 introduced species. Four plant communities were identified. Of the four communities, two met the description of endangered ecological communities (EECs) listed under the *Threatened Species Conservation Species Act 1995*: River Flat Eucalypt Forest and Swamp Oak Floodplain Forest. These are also EECs listed under the *Biodiversity Conservation Act 2016.* An assessment of significance under the then Section 5A of the EP&A Act was not completed for the EECs as only a small area of each occurred within the study area (the whole of Lot 7) and these areas were degraded.

Four plant species of regional significance were identified in the study area: Blue Blue Box (*Eucalyptus baueriana*), River Peppermint (*Eucalyptus elata*), Fringed Wattle (*Acacia fimbrata*) and Gosford Wattle (*Acacia prominens*). These occurred along the western and southern drainage channels. None of these were listed as Rare or Threatened Australian Plants (ROTAP) species or as threatened species under the TSC Act or the EPBC Act.

No threatened fauna species were identified during the 2004–2011 surveys. However, the riparian woodland along the Georges River was considered to provide potential habitat for number of species recorded in the adjacent Boral site prior to the development of the Boral site to become the Georges Fair residential estate:

- Cumberland Plain Land Snail (*Meridolum corneovirens*);

- Eastern Bentwing Bat (*Miniopterus schreibersii oceansis*);

- Southern Myotis (*Myotis macropus*);

- Eastern Freetial-bat (*Mormopterus norfolkensis*);

- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*); and

- Grey-headed Flying Fox (*Pteropus poliocephalus*).

An assessment of significance under the then Section 5A of the EP&A Act was completed for potential impacts on the Eastern Freetail-bat and Yellow-bellied Sheathtail Bat. The assessment concluded that potential impacts would not be significant on these species.

The Total Earth Care (2011) assessment (Appendix E1) concluded that the proposed marina was unlikely to have a significantly impact on native flora and fauna in the marina site. However, a number of recommendations were made to reduce the potential ecological impacts of the proposal.

ii Assessment (2015)

a Threatened species

EMM (2015c) completed updated desktop ecological searches on 8 April 2015 and prepared a supplementary flora and fauna assessment (Appendix E2). An additional eight threatened species that could occur in the area, but that which had not been considered in the previous assessments, were identified during the searches:

- Australasian Bittern (*Botaurus poiciloptilus*);
- Eastern Osprey (*Pandion cristatus*);
- Koala (*Phascolarctos cinereus*);
- *Marsdenia viridiflora* R. Br. subsp. *viridiflora* population;
- Netted Bottle Brush (*Callistemon linearifolius*);
- Scarlet Robin (*Petroica boodang*);
- Spotted Harrier (*Circus assimilis*); and
- Tadgell's Bluebell (*Wahlenbergia multicaulis*) population.

All the species listed above were considered to have low potential or are unlikely to be impacted by the proposed development.

More recent records in proximity to the marina site were found for the following species:

- Little Lorikeet (*Glossopsitta pusilla*) – recorded adjacent to the marina site;
- Varied Sittella (*Daphoenositta chrysoptera*) – recorded on the other side of the Georges River; and
- Little Eagle (*Hieraaetus morphnoides*) – recorded adjacent to the marina site.

As these species are highly mobile and habitat is available in areas adjacent to where they were recorded, the impacts of the proposed development on these species will be minimal.

Site surveys completed for the 2004–2011 assessments were not adequate to identify some of the threatened flora and fauna species that could occur on the site. To compensate for this, and as no nocturnal surveys were completed, the EMM (2015c) assessment assumed that threatened microbats would occur at the marina site. The assessments of significance for the species listed above, including threatened microbats, ensured that all threatened species that have the potential to occur at the site had been adequately assessed (Appendix E2). It was found that impacts were unlikely to be significant.

b Vegetation communities

Four vegetation communities were identified:

- River Flat Eucalypt Forest (River-flat Eucalypt Forest on Coastal Floodplains of the News South Wales North Coast, Sydney Basin and South East Corner Bioregions, EEC (River-flat Eucalypt Forest);
- Swamp Oak Floodplain Forest (Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, EEC);
- Reconstructed Vegetation (previously identified as Riparian Scrub); and
- Cleared and Disturbed vegetation.

Both the River Flat Eucalypt Forest and Swamp Oak Floodplain Forest met the description of endangered ecological communities (EECs) listed under the Threaten Species Conservation Act. An assessment of significance under the then Section 5A of the EP&A Act was not completed for the EECs as only a small area of each occurs within the project area and the areas are degraded. However, assessments of significance have subsequently been completed (see below).

No significant impacts to threatened species, populations and communities were anticipated from the construction and operation of the marina.

iii Assessment (2018)

Most recently, Biosis (2018) prepared a biodiversity assessment (Appendix E5) for a separate planning proposal for the site. This included a site survey on 11 January 2018. The areas of River Flat Eucalypt Forest and Swamp Oak Floodplain Forest on the marina site were mapped as part of this assessment (Figure 6.5). This vegetation all occurs along the bank of the Georges River. These vegetation communities are listed as endangered under the Biodiversity Conservation Act. Both communities were found to be in low condition.

The Biosis (2018) assessment also recorded six hollow-bearing trees and one stag (Figure 6.5). A total of thirteen hollows were recorded among the six hollow-bearing trees and the stag. Some hollows observed were small enough to provide potential roosting habitat for microbats, which may occur within the study area, however most hollows are considered more suitable for common fauna species including Common Brushtail Possum, *Trichosurus vulpecula*. Moderate levels of coarse woody debris were also identified throughout the areas of River flat Eucalypt Forest EEC.

The Biosis (2018) assessment noted that a pair of White-bellied Sea Eagles (*Hailaeetus leucogaster*) had been recorded hunting along the Georges River by Total Earth Care (2011). This species was listed as vulnerable in 2016 under the former *Threatened Species Conservation Act 1995,* and is now listed under the Biodiversity Conservation Act.



Source: EMM (2019); Biosis (2018); DFSI (2017); Nearmap (2019)

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KEY

- Subject site
- Hollow-bearing tree

Vegetation communities

- Cumberland Swamp Oak Riparian Forest (River Flat Eucalypt Forest EEC)
- Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Biogregion (Swamp Oak Floodplain Forest ECC)
- Highly disturbed weeds and exotics

Mapped vegetation (Biosis 2018)

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Figure 6.5

EMM
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In regards to the EECs, Biosis (2018) recommended:

- impact to these areas containing EEC should be avoided where feasibly possible;
- hollow-bearing trees should be retained if possible; and
- impacts to River-flat Eucalypt Forest, Swamp Oak Floodplain Forest and the White-bellied Sea-eagle, listed under the Biodiversity Conservation Act should be assessed with a five-part test.

As described in Section 3.1, a Controlled Activity Approval will be required. Avoidance, minimisation and the need for biodiversity offsets are discussed below (Section v).

iv Assessment (2019)

In line with the recommendations of Biosis (2018), assessments of significance have been completed for River Flat Eucalypt Forest, Swamp Oak Floodplain Forest and the White-bellied Sea-eagle (Appendix E7). The assessments of significance concluded that the proposed activity will not result in significant impacts on the species or ecological communities. These assessments of significance are provided in Appendix E7.

The characteristics of Swamp Oak Floodplain Forest were also compared with the listing and conservation advice for Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and South-east Queensland (TSSC 2018), listed in 2018 as an endangered ecological community. Swamp Oak Floodplain Forest at the site does not represent this community as the patch size is less than 0.5 ha. Accordingly, no further assessment of this ecological community is required.

v Avoidance

Impacts to the vegetation communities along the riverbank have been avoided as far as practicable through the design of the marina. However, heavy earthmoving equipment will need to operate in the narrow strip containing River-flat Eucalypt Forest and Swamp Oak Floodplain Forest along portions of the riverbank as part of landscaping in the foreshore area (part of this application) and to remove anthropogenic materials along the riverbank and to install rock armouring (as part of a separate application).

While impacts to will be avoided as far as possible through design and management measures. However, the actual amount of clearing required cannot be accurately quantified as it will depend on the operational requirements of the earthmoving equipment in relation to the adjacent trees and other vegetation. Therefore, it has been assumed that all native vegetation in the foreshore area will need to be removed.

vi Minimisation

A range of measures will be implemented to minimise impacts to biodiversity. Key measures are provided in Section 6.4.2. These will be incorporated into the VMP.

vii Compensation

As noted above, impacts to River-flat Eucalypt Forest and Swamp Oak Floodplain Forest will be avoided and minimised as far as possible through design and management measures. However as noted above, because the amount of clearing required for bank restoration and stabilisation cannot be accurately quantified, it has been assumed that all of the River-flat Eucalypt Forest (0.37 ha) and Swamp Oak Floodplain Forest (0.017 ha) will need to be cleared as part of the development.

The requirement for offsets to compensate for this clearing has been assessed in accordance with the *Biodiversity Assessment and Approvals Navigator* (Office for Local Government 2019). This provides a series of questions to determine "What vegetation clearing assessment and approvals apply to me?". These questions and responses for the proposed Georges Cove Marina application are provided in Table 6.7.

Table 6.7 Biodiversity Assessment and Approvals Navigator responses

Question	Response	Explanation
Question 1 - Are you carrying out a development that requires development consent from a council (under Part 4 of the *Environmental Planning and Assessment Act 1979*)?	Yes	This EIS is prepared to support an application under Part 4 of the EP&A Act (see Section 3.1).
Question 6a – Is your proposed development fulfilling the purpose of a subdivision that was approved prior to 25 August 2017 in a R1 to R4, RU5, B1 to B8 or IN1 to IN3 zone?	No	The marina site is zones RE1 and RE2 (see Section 3.3.1).
Question 6b – Will any part of your proposed development take place on land included on the Biodiversity Values Map? Note: The "parts" of a proposed development includes any land required for buildings, landscaping, access roads, bushfire asset protection zones, fencing and any associated infrastructure whether temporary or permanent.	No	See Figure 6.6.
Question 7a – Will your proposed development involve clearing native vegetation (not including 'Category 1' land under the *Local Land Services Act 2013*) in excess of the area clearing thresholds?	No	The proposed development will result in the clearing of a maximum of 0.387 ha of native vegetation (0.37 ha of River-flat Eucalypt Forest and 0.017 ha of Swamp Oak Floodplain Forest). The minimum lot size associated with Lot 7 is "1 ha to less than 40-ha". The "threshold for clearing, above which the BAM and offsets scheme apply" for this lot size range is 0.5 ha. Therefore, the required (maximum) clearing is below the threshold.
Question 8 – Is your proposed development likely to significantly affect threatened species or ecological communities, or their habitats, or being carried out in a declared area of outstanding biodiversity value?	No	The site has not been declared as an "area of outstanding biodiversity value". Tests of significance have been conducted for the threatened species and ecological communities on the marina site (see discussion above). These found that it is unlikely that the development will not have a significant impact on threatened species or ecological communities.



Biodiversity values shaded in mauve.

Figure 6.6 Biodiversity values map and threshold tool – marina site

Application of the Biodiversity Assessment and Approvals Navigator (Table 6.7) found that a Biodiversity Development Assessment Report is not required to be submitted with the development application and that the proposed marina development will not trigger the offset scheme threshold.

6.4.2 Terrestrial ecology management measures

As described in the VPA (see Section 3.4), the foreshore vegetation will be embellished and a VMP will be prepared and implemented. Key biodiversity management measures will include:

- retention of the large, isolated eucalypt in accordance with the site's VPA;
- retention of native vegetation and hollow-bearing trees if possible;
- signage will be installed on trees to be retained;
- a pre-clearance check will be undertaken to determine if active nests (ie containing eggs or chicks) are present in any trees to be felled – active nests will be bought down intact where possible;
- hollow-bearing trees will be cleared in two stages:

1. Vegetation to be cleared around the hollow-bearing tree will be cleared first, and/or the hollow-bearing tree will be tapped with an excavator bucket (or similar) to encourage fauna to self-relocate. The hollow-bearing tree will be left untouched for 24 hours.
2. The hollow-bearing tree will be felled after 24 hours under the supervision of a suitably qualified ecologist that will relocate healthy fauna to suitable habitat nearby, and take injured and/or juvenile fauna to a veterinarian or wildlife carer.

- any felled trees will be retained at the site as habitat for ground-dwelling fauna.

These will be detailed in the VMP.

Overall, while the proposal will require the removal and modification of small areas of terrestrial habitat, it will result in an overall eventual improvement in the quality and amount of available habitat within the marina site.

6.4.3 Aquatic ecology

An aquatic ecology assessment was completed by Marine Pollution Research (2010) (Appendix E3). The assessment included a review of literature and water quality monitoring data as well as field studies to identify the aquatic ecological attributes of the marina site and surrounds. The Marine Pollution Research (2010) work was reviewed by Marine Pollution Research (2015) (Appendix E4) to determine if there have been any changes to the aquatic environment that would change the findings of the original assessment.

The preliminary contamination investigation (Appendix D1) and supplementary preliminary investigation (Appendix D2) also considered potential ecological risks, particularly to the aquatic and marine environment.

The Marine Pollution Research (2010) aquatic ecology field surveys included:

- a preliminary survey on 11 August 2004;
- a detailed survey of aquatic habitats on 30 April 2007; and
- an aquatic ecology survey of the quarry pond on 30 May 2007.

Marine Pollution Research (2015) included a site visit on 14 April 2015 to inspect the current state of the aquatic ecology habitats.

Aquatic habitats identified in the marina site and in the proximal Georges River include:

- earth banks and masonry intertidal banks on the Georges River edge which support small stands of Grey Mangrove (Avicennia marina) and River Mangrove (Aegicerus corniculatum);
- intermittent shallow sub-tidal banks along the toe of the intertidal bank which support small patches of seagrass (Zostera capricorni);
- riparian cover along the unnamed creek to the south of the marina site which is freshwater for most of its length, with grassy banks; and
- three drainage ponds (these ponds have now been combined to form a single pond) which contains benthic sediment, water pools and pond riparian edge habitats.

One of the quarry ponds was brackish and supported vigorous growth of Ruppia spp. The quarry ponds also supported a number of fish species including the Dusky Flathead (Platycephalus fuscus), Mullet (Mugil cephalus) and introduced species including the European Carp (Cyprinus carpio) and Mosquito Fish (Gambusia affinis) that also occur in the Georges River.

No species listed under the FM Act or the EPBC Act were noted or observed during the field surveys. Given the aquatic habitats available, none are considered likely to occur. While individual saltmarsh plants were identified along the margins of the internal waterways, these were not considered to form a viable saltmarsh community, which would meet the description of the EEC listed under the Biodiversity Conservation Act.

While the Georges River once supported a thriving oyster farming industry there are now no aquaculture activities in the Georges River. The closest aquaculture operations are located in Botany Bay - native Sydney Rock and triploid Pacific oyster farming in Woolooware Bay and Mulloway farming off Silver Beach.

Marine Pollution Research (2010) concluded that the marina can be constructed and operated without any significant impact on river water quality. This was confirmed by the Marine Pollution Research (2015) review. There may be some impacts from the construction of the marina to aquatic ecosystems and species, particularly from opening the pool to the river. However, the proposal will result in an overall increase in the area and diversity of aquatic habitat in the locality.

Potential ecological risks as a result of currently elevated ammonia concentrations in groundwater and the dredge pond water are discussed in Section 6.1.3.

6.4.4 Aquatic ecology management measures

A range of design and mitigation measures are described in Appendix E3 to prevent or minimise potential impacts to aquatic ecology during construction and operation of the marina. These include the following design features:

- use of hydrodynamic modelling to design the marina basin so that it is regularly flushed and so that sediment accumulation is minimised;
- incorporation of freshwater wetlands in the design to treat stormwater from the marina site; and
- locating the marina entrance channel so that it avoids direct loss of existing seagrass patches or mangrove trees.

Construction mitigation measures will include the following:

- harvesting aquatic plant resources where appropriate for later use in riparian or aquatic remediation or enhancement works;
- testing for PASS/ASS, and management of ASS during construction (see Section 6.2.2);
- staging of the marina entrance construction and water quality monitoring during construction to prevent short-term water quality degradation in the Georges River (see Section 2.11.3);
- provision of natural, or near-natural, intertidal to riparian zone habitats that support local native vegetation and linking these habitats through:
    - the provision of rock revetments planted with intertidal marine vegetation such as reeds, saltmarsh or mangroves;
    - enhancement of the existing riparian foreshore land by planting of suitable local littoral species;
    - rehabilitation of the creek bank vegetation between the marina and the un-named southern creek to provide a native vegetated barrier between the marina and creek; and
    - rehabilitation of the levee bank vegetation between the marina and western stormwater drain to provide a native vegetated barrier between the marina and drain.

Operations mitigation measures will include the following:

- implementation of measures to prevent spills occurring within the marina site and if they occur to prevent any spilled materials (eg fuel) from entering the environment (see Section 5.3);
- implementation of marina occupation agreements to prohibit activities such as direct discharge of sewage from boats using the marina (see Section 5.4);
- not undertaking traditional "slipway" activities that can result in chemicals (including anti-foul chemicals) entering the environment – all environmentally sensitive maintenance works will be undertaken on a dedicated hardstand area fully under cover and within the marina building; and
- storage of boats in the dry berths so that these boats will not need anti-foul paint.

6.5 Traffic and parking

Traffic and parking impacts were assessed by EMM (2015d) (Appendix F1). This assessment considered the potential impacts of the marina on traffic in the surrounding areas and included cumulative impacts of other nearby developments. In response to RMS comments on the previous application, A *Traffic Signal Design Warrant Report* was prepared by EMM (2016c) (Appendix F2). This considers whether traffic signals are required at the intersection of the link road and Brickmakers Drive. While marina traffic will use this intersection, construction of the intersection is not part of the current application.

Construction traffic impacts from the use of the existing access to Lot 7 from Newbridge Road and from the use of the link road, once commissioned, were assessed by EMM (2018) (Appendix F4). The assessment considers the impacts of construction traffic on safety, efficiency and ongoing operation on the surrounding roads in accordance with the requirements of the State Environmental Planning Policy (Infrastructure) 2007 (the Infrastructure SEPP).

6.5.1 Existing access

Newbridge Road is adjacent to the northern boundary of Lot 7. It provides an east-west arterial road past the proposed development. At present, access to Lot 7 is via a left-in, left-out access at Newbridge Road. This incorporates an RMS approved deceleration and turn-in lane.

There is currently adequate space onsite to enable heavy vehicle manoeuvring and parking. No traffic issues have been identified in relation to historical operations within Lot 7.

6.5.2 Site access and traffic circulation

Once constructed, access to the marina site will be via the approved link road and bridge (see Section 2.8.2) which will be constructed between the site and Brickmakers Drive. The intersection between the link road and Brickmakers Drive will be about 300 m south of Newbridge Road. Prior to this, the existing access point of Newbridge Road will be used.

All internal site roads will comply with the Council's design standards (DCP 2008 Part 2.10) and *Parking Facilities - Off-street Car Parking* AS 2890.1. Therefore, internal site access arrangements will be efficient and safe.

6.5.3 Operational impacts on road traffic

i Current traffic volumes

Background traffic volumes (2015) on Brickmakers Drive, Newbridge Road and Governor Macquarie Drive are approximately:

- 54,000 vehicle movements daily for Newbridge Road east of Governor Macquarie Drive;
- 40,000 vehicle movements daily for Newbridge Road west of Governor Macquarie Drive;
- 16,000 vehicle movements daily for Governor Macquarie Drive north of Newbridge Road; and
- 12,500 vehicle movements daily for Brickmakers Drive south of Newbridge Road.

ii Traffic generation

There will be a total of 637 car parking spaces at the marina site. This parking will be a combination of 267 surface level car parking spaces located in parking areas A, B and C and 370 undercover car parking spaces located in two basement car park levels within the Maritime Building.

The proposed development of the marina site boat storage, boat showroom, function centre, cafe, clubhouse and boat repair workshop users will generate approximately 1,289 additional daily traffic movements. It is estimated that there will be approximately 98 additional car traffic movements during the weekday morning peak hours and 197 additional car traffic movements during the weekday afternoon peak hours. During the later evening peak periods on both Friday and Saturday evenings, there may be higher peak hour traffic movements. These will primarily be generated by the site club/restaurant and function centre uses which may generate up to 220 hourly car traffic movements.

iii Future traffic volumes

Marina operations will increase traffic volumes by about 1% on Newbridge Road, Governor Macquarie Drive and the section of Brickmakers Drive south of the link road intersection. This will have a negligible impact on traffic flows, traffic safety and residential amenity along these routes.

Marina operations will increase traffic volume by about 9.3% on the 300 m section of Brickmakers Drive north of the link road intersection. However, the traffic increases will remain well within the typical daily traffic capacity for Brickmakers Drive, as a continuous two-lane road. Brickmakers Drive will not require additional traffic calming or other traffic management measures.

6.5.4 Impacts on intersections

NSW Land and Environment Court proceedings (NSW LEC 30141, 2013) approved an intersection design prepared by Cardno (2013a) for the link road intersection on Brickmakers Drive. This included the potential as detailed in a plan of the intersection prepared by McLaren (2013). The proposed link road and its intersection with Brickmakers Road will be physically identical to that approved by the NSW Land and Environment Court (ie the layout prepared by Cardno) or as per the Construction Certificate Plans that are currently being finalised by Mirvac in consultation with LCC) (Application CCE-53/2018).

It is proposed to install the traffic signals during construction of the intersection. While these are not required for the Georges Cove Marina, the intersection is likely to require traffic signals in the longer term due to background traffic growth on Brickmakers Drive and future developments, such as the Mirvac Georges Cove residential estate that would use the link road. Installing these signals during the initial intersection construction will provide greater certainty regarding the adequacy of the intersection to cater for traffic from future developments and will be less disruptive than installing signals at a later date when the link road is opened to traffic.

The locations of the traffic signal posts, intersection signage and line markings will be determined as part of detailed design of the intersection.

The impacts of additional traffic on the link road and Brickmakers Drive intersection have been assessed using estimated hourly development traffic volumes for the normal weekday morning and afternoon traffic peak periods and the Friday and Saturday evening peak recreational traffic flows. The assessment included the additional traffic flows which would be using Brickmakers Drive from the completion of the Georges Fair residential development (967 dwellings) and the residential and clubhouse traffic from the recently approved New Brighton Golf Course development.

The intersection traffic assessments for the marina development showed that the intersection will operate at Level of Service A for the morning peak hour, afternoon peak hours and Saturday late evening peaks (with the average intersection traffic delay for all movements of 5.4, 10.1 and 1.5 seconds respectively).

The future intersection weekday peak hour degrees of saturation will be between 0.588 and 0.674 during the morning and afternoon peak hours and will be lower during the late evening peaks.

The assessments of the potential cumulative impacts of the Georges Cove Marina and Georges Cove residential estate found that the intersection will operate at Level of Service A but with marginally higher degrees of saturation and marginally longer queues.

6.5.5 Car parking

The 637 car parking spaces will be approximately 20% higher than the amount of car parking which was considered to be necessary (530) spaces in the formal assessment of the required car parking supply for the originally approved marina development (LCC 2014).

The detailed design of the car parks will consider the accessible car parking requirements of AS 2890.1.

6.5.6 Pedestrian and cycling access

The marina site footpaths along the main site link road way will comply with the DCP requirements and will be adequate for the anticipated volumes of pedestrian movement and circulation within the marina site.

Cyclists will be able to use the proposed link road pedestrian/cycle path and the riverfront pedestrian/cycle path. These paths will be 2.5 m or 3.0 m wide and will meet the DCP design width standard (2.5 m) to permit use by both pedestrians and cyclists. Bicycle parking will be provided in accordance with Liverpool City Council and AS 2890.1 requirements.

6.5.7 Public transport

There is appropriate public transport access available to and from the development for the future marina employees, customers and other visitors.

6.5.8 Construction traffic

The construction traffic assessment (Appendix F4) found that prior to the completion of the link road, there will be no adverse traffic capacity, traffic safety or road congestion impacts when construction traffic uses the existing Newbridge Road site access. Therefore, in accordance with the requirements of Infrastructure SEPP, Clause 101 (2) (b), the marina construction traffic should be permitted to have continuing use of the existing vehicular access via Newbridge Road until the alternative access via the link road is opened.

Once access via the link road is available, all the site construction access should only occur via the link road in accordance with the requirements of Infrastructure SEPP, Clause 101 (2) (a). The construction traffic assessment found that there will be no site traffic capacity or traffic safety constraints when construction traffic accesses the site using the link road.

6.6 Visual

A *Visual Impact Assessment* was prepared by Richard Lamb and Associates (2010) (Appendix G2). The assessment included the development of computer-generated photomontages using the design drawings and plans for the marina. The photomontages were used to assess the potential visual impacts of the proposed development. Given the residential development to the west of the site, an *Addendum Visual Impact Review* was prepared by Richard Lamb and Associates (2015) (Appendix G3). This included re-visiting the marina site and the locality and assessing the potential for change in impact on views from the selected locations.

6.6.1 Existing environment

The marina site is located on a broad, low-lying floodplain of the Georges River. Currently, the northern portion of Lot 7 was used for processing and recycling activities and the the marina site was used for sand extraction. The marina site has been cleared of vegetation except along the site boundaries. As a result, the landform of the marina site has been extensively modified and has low visual amenity.

The marina site has low external visibility due to the relatively level landscape in which it is located, as well as the presence of screening vegetation along the property boundaries and the river. This screening prevents views to the site from surrounding land uses and the river.

6.6.2 Visual assessment

The following potentially impacted vistas were identified:

- the Georges River itself or from the banks of the river directly to the east of the development; and
- from the Georges Fair residential development directly to the west of the marina site.

The visual assessment concluded that the overall visibility of the structures and activities on the project area would be minimal based on the heights of the proposed buildings. Mitigation of these minor impacts will include screen planting using appropriate tree species on the eastern boundary of the marina site adjacent to the river as part of foreshore embellishment and the use of appropriate colours and materials for the Maritime Building and Private Marina Clubhouse.

Overall, the proposed development will result in an improvement to the vista when viewed from the river. In this regard, it is considered that the development would have a positive effect on the visual qualities compared to the site's current use.

The Richard Lamb and Associates (2015) review of the visual assessment (Appendix G3) found that project area and proposed development remained the same as assessed in Richard Lamb and Associates (2010), aside from minor changes as a result of continued quarrying. The only significant change in the visual environment has been the development of the Georges Fair residential estate to the west.

The Richard Lamb and Associates (2015) review confirmed that the proposed development will have minimal external visibility. The Maritime Building will be partly visible over the trees on the boundary between the Georges Fair residential estate and the proposed development. However, the overall visibility from this area will be lower than had been assessed in Richard Lamb and Associates (2010) as a result of predominantly two-storey residential development on the Georges Fair residential estate which minimises potential views and confines them to the fringe along a short section of Brickmakers Drive.

The visual impacts of the proposed development will be low to moderate.

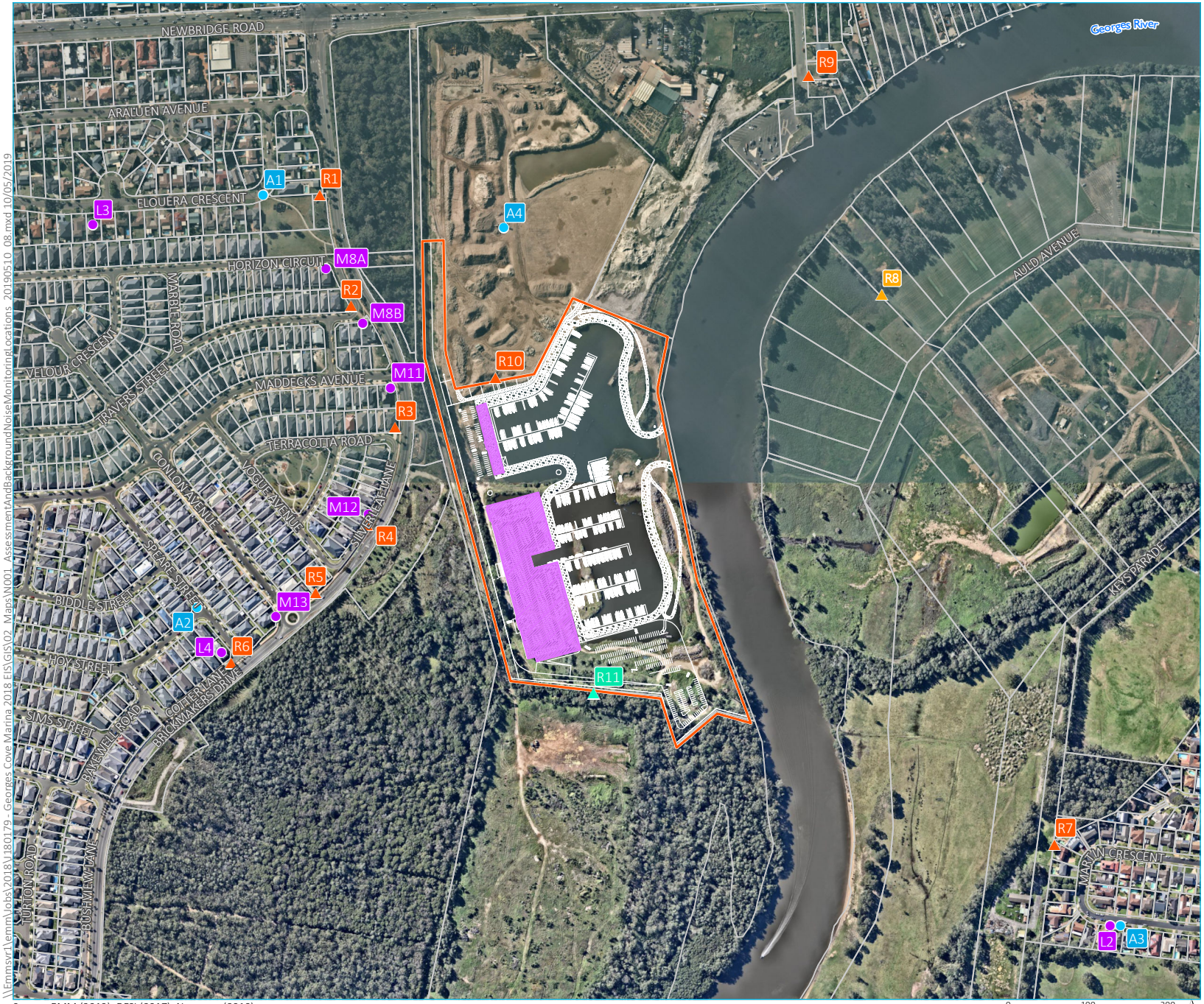
6.7 Noise

A noise impact assessment was prepared by EMM (2019) (Appendix H1) in accordance with the SEARs and contemporary guidelines and standards. The assessment is summarised in the following sections.

6.7.1 Existing environment

The marina site is surrounded by noise sensitive land uses including residential properties and recreational land (Figure 6.7). The Georges Cove residential estate is planned for the area immediately north of the marina.

A series of unattended and short-term operator attended noise surveys have been conducted in areas around the marina site (Figure 6.7). Noise levels in the area are dominated by distant and local traffic, typical suburban noise occasional aircraft noise and natural noise sources such as birds and wind in trees. The monitoring shows that background noise levels during the day decrease as distance from Newbridge Road increases. Background noise levels during the night stay consistent irrespective of the distance from Newbridge Road.



KEY

- Subject site
- Building
- Cadastre

Assessment location

- Residential
- Active recreation
- Industrial

Noise monitoring location

- Attended
- Long-term

Source: EMM (2019); DFSI (2017); Nearmap (2019)

0 100 200 m

GDA 1994 MGA Zone 56

N

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Noise monitoring and assessment locations

Georges Cove Marina
Environmental impact assessment
Figure 6.7

EMM
creating opportunities

6.7.2 Noise impact assessment

Noise levels were assessed at representative locations for residential, future residential and active recreation uses.

i Criteria

a Industrial noise

Noise from industrial sites or processes in NSW are regulated by the local council, DPE and/or the EPA. Noise limits are generally derived from operational noise trigger levels applied at assessment locations. They are based on the *Noise Policy for Industry* (NPfI) guidelines (EPA 2017) or noise levels that can be achieved at a specific site following the application of all reasonable and feasible noise mitigation. These limits are to protect the community from excessive intrusive noise and preserve amenity for specific land uses. To ensure these objectives are met, the EPA provides two separate noise trigger levels: intrusiveness noise level and amenity noise level.

The project noise trigger levels (PNTLs) are the lower of the calculated intrusive or amenity noise trigger levels. The PNTLs for the marina development are provided in Table 6.8 for all assessment locations.

Table 6.8 Project noise trigger levels

Assessment location	Intrusiveness $L_{Aeq,15min}$ noise level, dB			Amenity $L_{Aeq,15min}$ noise level[1], dB			PNTL $L_{Aeq,15min}$, dB		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
R1 - Residence	**55**	**45**	**40**	58	48	43	55	45	40
R2 - Residence	**56**	**45**	**40**	58	48	43	56	45	40
R3 - Residence	**56**	**48**	**42**	58	**48**	43	56	48	42
R4 - Residence	**49**	**48**	**42**	58	**48**	43	49	48	42
R5 - Residence	**50**	**48**	**42**	58	**48**	43	50	48	42
R6 - Residence	**46**	**46**	**42**	58	48	43	46	46	42
R7- Residence	**44**	**44**	**39**	58	48	43	44	44	39
R8 - Milperra sports fields	N/A	N/A	N/A	58 (when in use)			58 (when in use)		
R9 - Residence	**47**	**45**	**40**	58	48	43	47	45	40
R10 - Future residences	**56**	**45**	**40**	58	48	43	56	45	40

Notes: 1. Project amenity $L_{Aeq,15min}$ noise level is the recommended amenity noise level $L_{Aeq,period}$ + 3 dB as per the NPfI (EPA 2017).
2. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; evening: 6 pm to 10 pm; night is the remaining periods.
3. Value in bold font and underlined is the lower of the intrusiveness and amenity noise levels.

b Sleep disturbance

The marina site will operate during the night-time period from 10 pm to 12 am. Therefore, assessment of sleep disturbance was undertaken in accordance with the NPfI and guidance provided in the *Road Noise Policy* (DECCW 2011).

The sleep disturbance noise trigger levels for the residential assessment locations are shown in Table 6.9.

Table 6.9 Sleep disturbance noise trigger levels - residential assessment locations

Assessment location	Adopted RBL, dB(A)[1]	Recommended sleep disturbance noise trigger levels	
		$L_{Aeq,15min}$, dB	L_{Amax}, dB
		Standard or RBL +5	Standard or RBL +15
R1 - Residence	35	40	52
R2 - Residence	35	40	52
R3 - Residence	37	42	52
R4 - Residence	37	42	52
R5 - Residence	37	42	52
R6 - Residence	37	42	52
R7- Residence	34	40	52
R9 - Residence	35	40	52
R10 - Future residences[1]	35	40	52

Notes: 1. Night-time RBLs adopted.

c Music and people noise

Noise from licensed venues is governed by the Office of Liquor, Gaming and Racing (OLGR).

Music and patron noise have been assessed at all assessment locations for the day, evening and night (between 10 pm and 12 am only) periods. The OLGR noise criteria for each period has been set by offsetting the measured short-term $L_{A90,15min}$ spectrum with the respective adopted RBL derived using the long-term noise monitoring results and are shown in Table 6.10.

Table 6.10 OLGR music and patron noise criteria

ID	Period	Octave band centre frequency (Hz) noise criteria ($L_{10,15min}$)									Overall dB(A)
		31.5	63	125	250	500	1k	2k	4k	8k	
R1 (A2 Spectra)	Day	12	31	37	37	41	44	35	22	19	55
	Evening	10	5	5	5	5	5	5	5	5	45
	Night	8	3	3	3	3	3	3	3	3	43
R2 (A3 Spectra)	Day	23	33	39	39	43	46	37	24	21	56
	Evening	12	33	39	39	43	46	37	24	21	45
	Night	10	32	38	38	42	45	36	23	20	43
R3 (A3 Spectra)	Day	23	39	46	49	50	51	41	32	31	56
	Evening	15	31	38	41	42	43	33	24	23	48
	Night	12	28	35	38	39	40	30	21	20	45
R4 (A3 Spectra)	Day	16	32	39	42	43	44	34	25	24	49
	Evening	15	31	38	41	42	43	33	24	23	48
	Night	12	28	35	38	39	40	30	21	20	45

Table 6.10 OLGR music and patron noise criteria

ID	Period	Octave band centre frequency (Hz) noise criteria ($L_{10,15min}$)									Overall dB(A)
		31.5	63	125	250	500	1k	2k	4k	8k	
R5 (A3 Spectra)	Day	17	33	40	43	44	45	35	26	25	50
	Evening	15	31	38	41	42	43	33	24	23	48
	Night	12	28	35	38	39	40	30	21	20	45
R6 (A3 Spectra)	Day	13	29	36	39	40	41	31	22	21	46
	Evening	15	31	38	41	42	43	33	24	23	48
	Night	12	28	35	38	39	40	30	21	20	45
R7 (A3 Spectra)	Day	11	27	34	37	38	39	29	20	19	44
	Evening	11	27	34	37	38	39	29	20	19	44
	Night	10	26	33	36	37	38	28	19	18	42
R9 (A1 Spectra)	Day	10	26	33	36	37	38	28	19	18	47
	Evening	8	24	31	34	35	36	26	17	16	45
	Night	6	22	29	32	33	34	24	15	14	43
R10 (A3 Spectra)	Day	23	42	48	48	52	55	46	33	30	56
	Evening	12	31	37	37	41	44	35	22	19	45
	Night	10	29	35	35	39	42	33	20	17	43

Notes: 1. For the OLGR assessment, the day period of 7 am to 6 pm, evening period of 6 pm to 10 pm and night period of 10 pm to 12 am (midnight) have been adopted.
2. Night-time L_{A90} octave band noise spectra have been adopted for all periods and offset to the respective day, evening and night RBL from Table 3.4. For the night period, the RBL from 10 pm to 12 am (midnight) has been adopted to align with the proposed operating hours and the OLGR assessment periods.

d Construction noise

A quantitative construction noise assessment was undertaken using the *Interim Construction Noise Guidelines* (ICNG) (DECC 2009) approach. The ICNG provide noise management levels (NMLs) for residential receivers for day and out-of-hours periods. The construction NMLs for residential and other land uses for the proposal are provided in Table 6.11.

Table 6.11 Construction NMLs (standard hours)

Assessment location (land use)	Day RBL, dB(A)	NML, $L_{Aeq,15min}$, dB
R1 (residential)	50	60
R2 (residential)	51	61
R3 (residential)	51	61
R4 (residential)	44	54
R5 (residential)	45	55
R6 (residential)	41	51
R7 (residential)	39	49
R8 (active recreation)	n/a	65
R9 (residential)	42	52
R10 (future residential)	51	61

e Construction vibration

Construction vibration was assessed against a range of commonly use guidelines and standards including the German Standard DIN 4150 Part 2-1975; the NSW *Environmental Noise Management – Assessing Vibration: A Technical Guideline* (DEC 2006); and *Evaluation of Human Exposure to Vibration in Buildings* (1–80Hz) (British Standards BS 6472-2008).

f Road traffic noise

The potential impacts of traffic noise resulting from both construction and operational related traffic on public roads are assessed against criteria defined in the *Road Noise Policy* (RNP) (DECCW 2011). The application of appropriate criteria for the subject site has followed the two-step process identifying the assessment and relative increase criteria as outlined in Section 3.4.1 of the RNP.

The adopted road traffic noise assessment criteria for residential land uses are presented in Table 6.12.

Table 6.12 Road traffic noise assessment criteria for residential land uses

Road category	Type of project/development	Assessment criteria dB	
		Day (7 am–10 pm)	Night (10 pm–7 am)
Freeway/arterial/ sub-arterial roads	Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors. Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors. Existing residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use developments.	$L_{Aeq,15hr}$ 60 (external)	$L_{Aeq,9hr}$ 55 (external)
Local roads	Existing residences affected by noise from new local road corridors. Existing residences affected by noise from redevelopment of existing local roads. Existing residences affected by additional traffic on existing local roads generated by land use developments.	$L_{Aeq,1hr}$ 55 (external)	$L_{Aeq,1hr}$ 50 (external)

Source: Table 3 of the RNP (DECCW 2011).

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2 dB.

The $L_{Aeq,1hr}$ is the road traffic noise level associated with the peak one-hour traffic period of interest, day or night. The 'local roads' category for Brickmakers Drive has been conservatively adopted, although this road joins sub-arterial roads at both ends and takes traffic from one locality to another.

ii Modelling method

Construction, operations and traffic noise levels were modelled using Brüel and Kjær Predictor software. Predictor calculates total noise levels at assessment locations from the concurrent operation of multiple noise sources. Noise levels were calculated using meteorological parameters for the area based on weather data from the Holsworthy Control Range. These calculations considered temperature inversions that are a feature of the area during winter.

iii Assessment results

a NPfI and sleep disturbance assessment

The operation noise assessment modelled noise emissions from a range of vehicles, equipment and activities including idling and moving boats; the fuelling pump; chillers; light and heavy vehicle movements; workshop activities and a forklift.

The operational noise model assumed:

- boats will be spread evenly at worst-case operating locations relative to surrounding assessment locations and are assumed to operate for 5 minutes in any 15-minute period;
- workshop activity and the forklift use are assumed in the marina buildings continuously for 15 minutes with all windows and doors (as applicable) closed;
- all other noise sources are assumed to operate continuously for 15 minutes at typical worst-case operating locations relative to assessment locations; and
- a 2 m high acoustic barrier is proposed to be constructed to the west of the carpark as indicated in Figure 6.8. This is to mitigate carpark activity during the night-time period (10 pm to 12 am only).

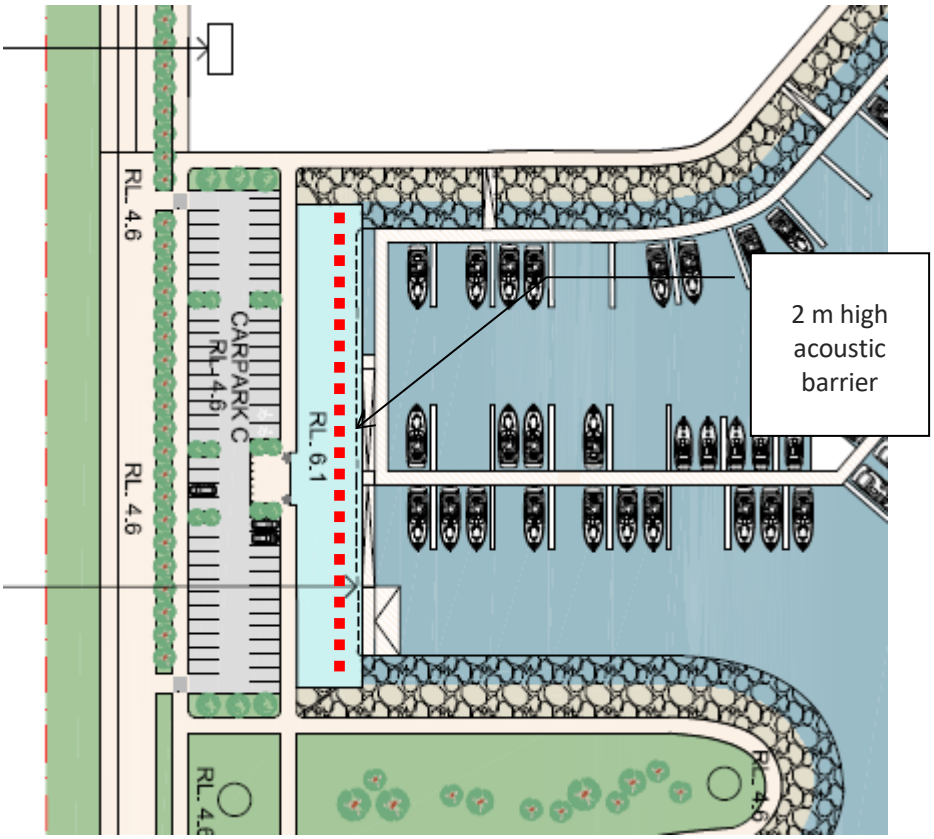


Figure 6.8 Indicative acoustic barrier location

Predicted operational $L_{Aeq,15min}$ and maximum (night-time) L_{Amax} noise levels from the site at all assessment locations are provided in Table 6.13.

Table 6.13 Operational and sleep disturbance noise level predictions

Assessment location	Period	Predicted $L_{Aeq,15min}$ noise level, dB		Predicted L_{Amax} noise level, dB		Criteria		
		Calm	Adverse	Calm	Adverse	PNTL, $L_{Aeq,15min}$	Sleep disturbance	
							$L_{Aeq,15min}$	L_{Amax}
R1	Day	38	n/a	n/a	n/a	55	n/a	n/a
	Evening	37	39	n/a	n/a	45	n/a	n/a
	Night	33	35	41	43	40	40	52
R2	Day	41	n/a	n/a	n/a	56	n/a	n/a
	Evening	41	42	n/a	n/a	45	n/a	n/a
	Night	38	39	46	47	40	40	52
R3	Day	43	n/a	n/a	n/a	56	n/a	n/a
	Evening	41	42	n/a	n/a	48	n/a	n/a
	Night	38	39	45	47	42	42	52
R4	Day	42	41	n/a	n/a	49	n/a	n/a
	Evening	39	41	n/a	n/a	48	n/a	n/a
	Night	37	38	44	46	42	42	52
R5	Day	34	n/a	n/a	n/a	50	n/a	n/a
	Evening	32	34	n/a	n/a	48	n/a	n/a
	Night	31	33	37	39	42	42	52
R6	Day	34	32	n/a	n/a	46	n/a	n/a
	Evening	31	34	n/a	n/a	46	n/a	n/a
	Night	30	33	38	40	42	42	52
R7	Day	34	37	n/a	n/a	44	n/a	n/a
	Evening	34	37	n/a	n/a	44	n/a	n/a
	Night	<30	<30	33	36	39	40	52
R8	When in use	39	41	n/a	n/a	58	n/a	n/a
R9	Day	36	38	n/a	n/a	47	n/a	n/a
	Evening	36	38	n/a	n/a	45	n/a	n/a
	Night	<30	<30	31	34	40	40	52
R10	Day	54	54	n/a	n/a	56	n/a	n/a
	Evening	**54**	**54**	n/a	n/a	45	n/a	n/a
	Night	37	38	45	46	40	40	52

Notes: 1. Predicted noise level shown in bold with grey shading indicated exceedance of the PSNL.

Predicted noise levels satisfy the PNTLs at all assessment locations during all periods, with the exception of R10 during the evening period for calm and adverse weather conditions.

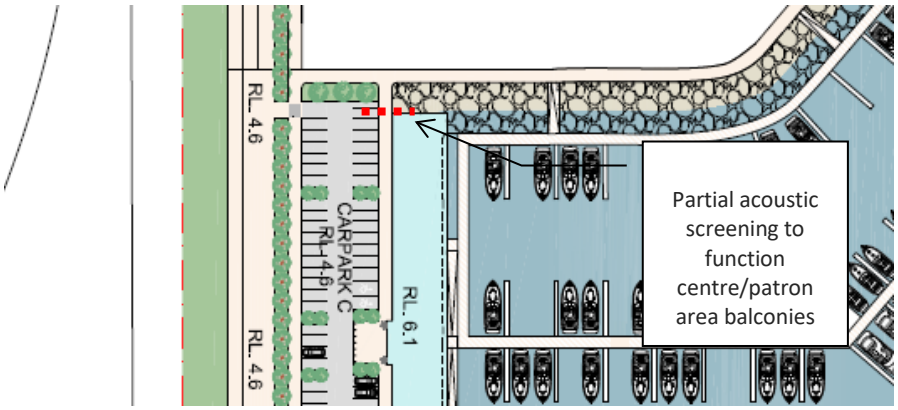
The predicted noise level above the PNTL at R10 is caused by boat movements directly south of this assessment location. It is anticipated that noise controls (eg buffers, architectural noise screening etc) would be incorporated in the future Moorebank East residential development (represented by R10) which would mitigate marina noise activity. We understand that development of the marina and the Moorebank East residential area will likely be completed by the same or related entity. Hence there is good opportunity to work collaboratively to achieve a practical outcome for noise.

Predicted noise levels satisfy the sleep disturbance criteria at all assessment locations.

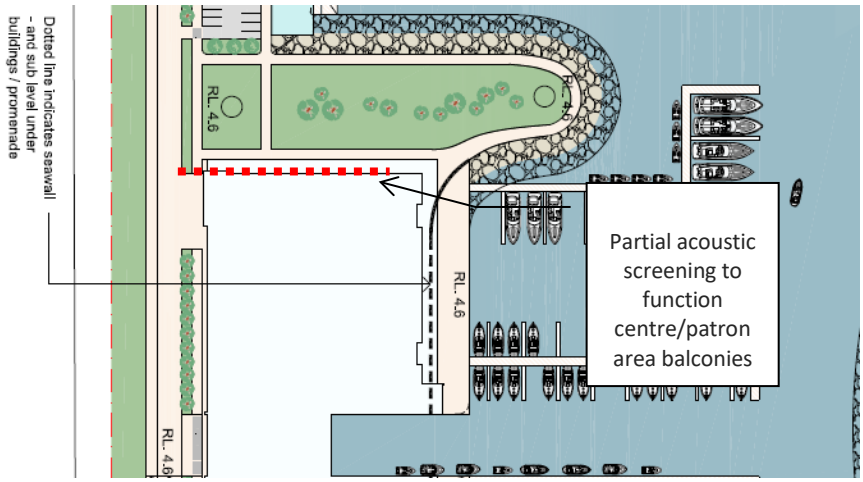
b Music and patron noise

Music and patron noise levels from the site were predicted at the nearest boundary of all assessment locations. The predictions are based on the following main assumptions:

- a live band (or similar) is located inside each function room;
- function room windows are assumed closed with standard 4 mm glazing;
- patrons are located externally on outdoor areas and are at capacity; and
- the north outdoor areas indicated in Figure 6.9 have the option for partial screening (eg louvres) providing at least 7 dB of patron noise reduction.



Clubhouse



Marina Building

Figure 6.9 Acoustic screening

A comparison of modelled noise levels at each assessment location to OLGR criteria is presented in Table 6.14. The results provided in Table 6.14 represent the level of noise above the OLGR criteria. Compliance with the OLGR criteria is therefore indicated by a zero.

Table 6.14 Predicted music and patron octave band centre frequency noise levels

Description	Period	Predicted noise level above OLGR criteria ($L_{A10,15min}$), Hz, dB									Overall, dB(A)
		31.5	63	125	250	500	1k	2k	4k	8k	
R1	Day	-6	0	0	0	0	0	0	0	0	0
	Evening	6	0	0	0	0	0	0	0	0	0
	Night	8	0	0	0	0	0	0	0	0	0
R2	Day	-6	0	0	0	0	0	0	0	0	0
	Evening	7	0	0	0	0	0	0	0	0	0
	Night	9	0	0	0	0	0	0	0	0	0
R3	Day	-2	0	0	0	0	0	0	0	0	0
	Evening	7	-2	0	0	0	0	0	0	0	0
	Night	12	3	0	0	0	0	0	0	0	0
R4	Day	5	0	0	0	0	0	0	0	0	0
	Evening	7	-3	0	0	0	0	0	0	0	0
	Night	12	2	0	0	0	0	0	0	0	0
R5	Day	-4	0	0	0	0	0	0	0	0	0
	Evening	-1	0	0	0	0	0	0	0	0	0
	Night	4	0	0	0	0	0	0	0	0	0
R6	Day	0	0	0	0	0	0	0	0	0	0
	Evening	-3	0	0	0	0	0	0	0	0	0
	Night	2	0	0	0	0	0	0	0	0	0
R7	Day	8	0	0	0	0	0	0	0	0	0
	Evening	8	0	0	0	0	0	0	0	0	0
	Night	9	0	0	0	0	0	0	0	0	0
R9	Day	8	0	0	0	0	0	0	0	0	0
	Evening	10	0	0	0	0	0	0	0	0	0
	Night	12	0	0	0	0	0	0	0	0	0
R10	Day	1	-4	-4	-8	-2	0	3	3	0	0
	Evening	12	7	7	3	9	11	14	14	0	9
	Night	14	9	9	5	11	13	16	16	0	11

Note: 1. Blue shading indicates exceedance predominantly generated by music noise; orange shading indicates exceedance predominately generated by patron noise; grey shading indicates exceedance of the overall $L_{A10,15min}$ criterion.

Noise level predictions indicate that energy in 31.5 Hz octave band centre frequency has the potential to exceed the OLGR criteria at all assessment locations for the majority of periods. Some exceedances of up to 3 dB are also predicted for energy in 63 Hz octave band centre frequency at two assessment locations during the night period. These exceedances are generally predicted to be due to music noise in function areas. These can be mitigated/managed by limiting the low frequency noise output of the public address system or increasing the glazing thickness, or a combination of both. Such measures should be designed and specified at the project detailed design stage.

The predicted noise levels above the OLGR criteria at R10 are predominantly related to patron noise on external balconies at the Marina Clubhouse. It is noted that the assessment assumed all function centre balconies are at capacity and adopted a conservative patron noise sound power level. There is scope to reduce patron noise levels with appropriate management. This includes limiting the use or number of patrons at the north balconies, especially during the evening and night periods, to reduce noise levels at R10.

It is also anticipated that a distance buffer, acoustic screening, or similar would be incorporated in the Moorebank East residential development design to mitigate against noise from this area of the marina. Purchasers of dwellings adjacent to the marina will be made aware of the marina development (it will be a selling point) and the associated noise generation. This development of dwellings near entertainment areas is common, and being 'close to the action' is valued by many purchasers, for example in Darling Harbour.

c Construction noise

Construction noise levels have been assessed for earthworks, road construction and building construction stages of the project.

Predicted $L_{Aeq,15min}$ noise levels from the site construction at all assessment locations are provided in Table 6.15.

Table 6.15 Predicted construction noise levels

Assessment location	Predicted $L_{Aeq,15min}$ noise level, dB						NML, dB(A)	Highly affected NML, dB(A)
	Excavation		Road works		Building construction			
	Calm	Adverse	Calm	Adverse	Calm	Adverse		
R1	**55**	n/a	**55**	n/a	43	n/a	52	75
R2	**58**	n/a	**60**	n/a	46	n/a	49	75
R3	**62**	n/a	**61**	n/a	**50**	n/a	49	75
R4	**61**	n/a	**57**	n/a	**51**	n/a	49	75
R5	**57**	n/a	**51**	n/a	46	n/a	49	75
R6	**54**	n/a	48	n/a	46	n/a	49	75
R7	**51**	**54**	48	**50**	40	43	49	75
R8	56	58	50	52	43	45	65	n/a
R9	**53**	**68**	48	51	40	43	52	75
R10	**65**	**65**	**64**	**64**	**51**	**51**	49	75

Notes: 1. Predicted noise level shown in bold with grey shading indicated exceedance of the NML.
2. n/a indicates that the calm condition represents the worst case, or adverse, weather condition.

Construction noise results are summarised as follows:

- Predicted construction noise levels are below the ICNG highly noise affected 75 dB NML at all residential assessment locations for all construction activities.
- Predicted construction noise levels during excavation/earthworks stage are above the noise affected NMLs at all residential assessment locations for calm and adverse weather conditions.
- Predicted construction noise levels during road works are above the NMLs at most residential assessment locations for calm and adverse weather conditions, the exception being locations R6 and R9.

- Predicted construction noise levels during building construction are below the NMLs at most residential assessment locations for calm and adverse weather conditions, the exception being locations R3, R4 and R10 where marginal noise levels above the NMLs are predicted.

- Predicted construction noise levels are below the NML for non-residential assessment location R8.

Given the above, construction noise will have to be appropriately managed by adopting feasible and reasonable measures. The primary method of managing noise is to limit construction to standard hours which is proposed. Additional construction noise management and mitigation measures are provided in Appendix H1.

d Construction vibration

Safe working distances for typical items of vibration intensive plant are listed in Table 6.16. The safe working distances are quoted for both "Cosmetic Damage" (refer British Standard BS 7385) and "Human Comfort" (refer British Standard BS 6472-1).

Table 6.16 Recommended safe working distances for vibration intensive plant

Plant item	Rating/description	Safe working distance	
		Cosmetic damage (BS 7385)	Human response (BS 6472)
Vibratory Roller	<50 kN (typically 1–2 tonnes)	5 m	15 to 20 m
	<100 kN (typically 2–4 tonnes)	6 m	20 m
	<200 kN (typically 4–6 tonnes)	12 m	40 m
	<300 kN (typically 7–13 tonnes)	15 m	100 m
	>300 kN (typically 13–18 tonnes)	20 m	100 m
	>300 kN (>18 tonnes)	25 m	100 m
Small hydraulic hammer	(300 kg, 5–12 tonnes excavator)	2 m	7 m
Medium hydraulic hammer	(900 kg, 12–18 tonnes excavator)	7 m	23 m
Large hydraulic hammer	(1600 kg – 18–34 tonnes excavator)	22 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	20 m
Pile boring	≤800 mm	2 m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Source: Transport Infrastructure Development Corporation Construction's Construction Noise Strategy (Rail Projects) (November 2007).

The safe working distances presented in Table 6.16 are indicative and will vary depending on the particular item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions. In relation to human comfort (response), the safe working distances in Table 6.16 relate to continuous vibration and apply to residential receivers. For most construction activities, vibration emissions are intermittent in nature and hence higher vibration levels occurring over shorter periods are allowed, as specified in British Standard BS 6472-2008.

The nearest building to the site in the Georges Fair estate is approximately 65 m from the eastern property boundary. Therefore, cosmetic damage to nearby structures is unlikely. At such distance however, human response can be expected for construction activities that include the use of a large vibratory roller (ie >6 tonnes). The safe working distances provided in Table 6.16 should be followed in the first instance and management of vibration levels may be required when the vibratory roller is proposed to be used.

There is potential for vibration impact at future Moorebank East estate residences (immediately to the north of the subject site) if the residential development is constructed and occupied before the start of the marina construction. It is unclear at this stage if this will be the case. Notwithstanding, the safe working distances provided in Table 6.16 should be followed in the first instance and management of vibration levels may be required if a small (ie <6 tonnes) or a large vibratory roller (ie >6 tonnes) is proposed to be used within 40 m or 100 m respectively, from the nearest future Moorebank East residence. As noted earlier, we understand that the development of the Moorebank East residential area and the marina will be developed cooperatively and by the same or related entity, and hence opportunities to address such issues will be available.

Management and mitigation measures should be implemented to minimise vibration impact during the construction phase of the development, as recommended in Appendix H1.

e Road traffic noise

The road traffic noise modelling results are summarised in Table 6.17 and Table 6.18 for weekday and weekend traffic volumes respectively. Both daytime and night-time traffic noise criteria are shown in the event that peak movements occur from the proposed marina outside of 7 am to 10 pm (ie outside daytime hours). The assessment conservatively adopted the local road category for Brickmakers Drive. The predicted $L_{Aeq,1hr}$ noise levels from future road traffic on Brickmakers Drive is representative of peak movements (worst-case) for the marina.

Table 6.17 Predicted traffic noise modelling results – weekday

Receiver		Criteria, dB(A)		Predicted $L_{Aeq,1hr}$, peak traffic noise level dB		
Name	**Receiver number[1]**	**Daytime**	**Night-time**	**Existing[2] (Brickmakers Dr)**	**Marina local road[3]**	**Total (future)**
Georges Fair residences west of Brickmakers Drive (existing and future)	1	55	50	64	51	64
	2	55	50	51	47	52
	3	55	50	64	48	64
	4	55	50	68	51	68

Notes: 1. Refer to Figure 6.7.
2. Brickmakers Drive existing weekday traffic noise shown.
3. Noise levels shown are for 197 vehicle per hour for marina to southern carparks.

Table 6.18 Predicted traffic noise modelling results – weekend

Receiver		Criteria, dB(A)		Predicted $L_{Aeq,1hr}$, peak traffic noise level dB		
Name	**Receiver number[1]**	**Daytime**	**Night-time**	**Existing[2] (Brickmakers Dr)**	**Marina local road[3]**	**Total (future)**
Georges Fair residences west of Brickmakers Drive (existing and future)	1	55	50	61/60	51	61/60
	2	55	50	48/46	44	49/48
	3	55	50	62/60	47	62/61
	4	55	50	65/64	51	65/64

Notes: 1. Refer to Figure 6.7.
2. Noise levels shown are for existing Friday and Saturday evening traffic on Brickmakers Drive.
3. Noise levels shown are for 220 vehicle per hour for marina to northern carparks.

The proposed marina's weekday peak hour traffic noise contributions are relatively minor in comparison to existing noise levels from Brickmakers Drive for all nominated assessment locations. Total future road traffic noise levels for Georges Fair residences are shown to be similar to existing levels. Predicted traffic noise levels from vehicles accessing the marina will satisfy the RNP allowance criterion of no more than 2 dB increase where existing traffic noise is above acceptable levels.

The proposed marina's weekend peak hour traffic noise contributions are relatively minor in comparison to existing levels from Brickmakers Drive for all nominated assessment locations. Total future road traffic noise levels for Georges Fair residences are shown to be similar to existing levels. Predicted traffic noise levels from vehicles accessing the marina will satisfy the RNP allowance criterion of no more than 2 dB increase where existing traffic noise is above acceptable levels.

6.7.3 Management and mitigation

Mitigation measures to minimise potential noise impacts include:

- a 2-m high acoustic barrier will be constructed to the west of the marina clubhouse carpark;
- partial acoustic screening (eg louvres) will be installed on the north balconies of the marina clubhouse and marina building. The screening will be operable to allow additional acoustic screening during large functions when the respective function centres are in use;
- music noise from the function centres will be managed and/or mitigated to limit low frequency noise in 31.5 and 63 Hz octave band centre frequencies so that the criteria in Table 6.10 are met. This can be achieved by fitting the public address system with a noise limiter or increasing the glazing thickness at function centres, or a combination of both measures. This and other alternate measures will be detailed in the project design stage; and
- a noise management plan will be prepared and implemented, outlining procedures for patron management, paying attention to more sensitive evening and night-time periods.

Noise management measures for the construction phase are provided in Appendix H1.

6.8 Air quality

6.8.1 Air quality assessment

An air quality and greenhouse gas assessment was conducted by Todoroski Air Sciences (2011) (Appendix I1). The assessment found that airborne emissions (particulates, odour and toxic substances) from the proposed operation will comply with NSW guidelines to prevent amenity and health impacts.

The air quality assessment was reviewed by Todoroski Air Sciences (2015) (Appendix I2). This confirmed that the project will comply with the relevant guidelines for amenity and health.

6.8.2 Management measures

Mitigation measures to minimise potential impacts are provided in Appendix I1, these include:

- installation of vapour recovery systems to minimise the volatile emissions from petrol sales;
- implementation of measures to avoid potential odour nuisance regarding sewage;
- implementation of measures to minimise the potential dust emission from boat maintenance operations; and
- the use of a paint booth with a small stack for the release of volatile organic compounds from paint operations.

6.9 Heritage

6.9.1 Aboriginal heritage

i Aboriginal heritage assessment

An Aboriginal archaeological assessment and field survey was undertaken by Mary Dallas Consulting Archaeologists (2004) (Appendix J1) of Lot 7 accompanied by a site officer from the Gandangara Local Aboriginal Land Council (GLALC).

No Aboriginal archaeological sites were identified in the Lot 7 during background research or the survey. Due to past land use disturbances and major sub-surface destruction on the lot, it was concluded that there was little to no potential for buried deposits.

The Mary Dallas Consulting Archaeologists (2004) assessment (Appendix J1) was reviewed by EMM (2015e) (Appendix J2). This included an updated search of the Aboriginal Heritage Information Management System (AHIMS) register. The search of AHIMS register covered a 1 by 2 km area. This confirmed that Aboriginal sites have not been recorded, and are not likely to exist, in Lot 7. No further field survey was required because the marina site is within the area surveyed for the Mary Dallas Consulting Archaeologists (2004) assessment.

The EMM (2015e) review found that the Mary Dallas Consulting Archaeologists (2004) assessment and updated AHIMS register search fulfil the requirements of the due diligence guidelines.

ii Aboriginal heritage management measures

Although no Aboriginal objects are expected to occur in the marina site, the following procedures will be implemented to avoid harming any unknown Aboriginal objects.

- If during the course of construction, Benedict or any subcontractors become aware of any previously unidentified Aboriginal object(s), all work likely to affect the object(s) will cease immediately and the GLALC and an archaeologist will be contacted for further advice.
- If suspected human skeletal remains are identified, all work likely to affect the remains will cease immediately. The find will be reported to the police (as required for all human remains discoveries) and the OEH contacted for advice on the identification of the skeletal material as Aboriginal and management of the material. If the remains are Aboriginal ancestral remains, the GLALC will be contacted and consultative arrangements will be made to discuss ongoing care of the remains.

- Heritage awareness training will be part of the induction program for all on-site personnel.

6.9.2 Non-Aboriginal heritage

i Non-Aboriginal heritage assessment

A non-Aboriginal heritage assessment was undertaken by Heritech Consulting (2003) (Appendix J3). The assessment involved historical research and a field survey of Lot 7. The site was noted to be extensively disturbed by previous operations on the north of Lot 7 and sand processing operations on the south of Lot 7. No historic items or areas of archaeological potential were identified in Lot 7.

The Heritech Consulting (2003) assessment was reviewed by EMM (2015f) (Appendix J4). This included searching relevant statutory historic heritage databases to determine if protected heritage items have been listed in Lot 7. Aerial imagery from 1943 was referenced to identify any historic items or potential archaeological deposits. No historical items were identified within Lot 7.

No listed historic heritage items will be impacted by the project. It is unlikely to have archaeological potential as the marina site has been highly disturbed. Therefore, no further investigation or field surveys are required.

ii Non-Aboriginal heritage management measures

Although historic items are not expected to occur in the project area, the following procedures will be implemented to avoid harming any unknown historic items:

- If during the course of construction, Benedict or any subcontractors become aware of any previously unidentified historic structures or archaeological deposits, all work likely to affect the object(s) will cease immediately an archaeologist will be contacted for further advice.

- Heritage awareness training will be part of the induction program for all on-site personnel.

6.10 Recreational boating

A navigation assessment was prepared by EMM (2016d) (Appendix F3). This considers the use of Georges River for recreational boating and the potential impacts of boats stored at the proposed marina on river navigation.

6.10.1 Current boat use

While no formal river traffic usage statistics are available from authorities such as RMS, research on Georges River traffic on weekends during peak summer usage has indicated surprisingly low levels of river traffic. Aerial photos taken on Saturdays in summer on days where the temperature was more than 30°C indicate that there were:

- 3 to 4 vehicles parked in the Davey Robinson Boat Ramp and Park carpark to the north of the marina site; and

- 4 to 5 small craft on the river over a 15 km stretch of the river downstream of Newbridge Road Bridge.

6.10.2 River navigation

The physical development of the marina will have very little impact on river navigation as the entire development will be on land owned by Benedict and will be outside of the Georges River channel. No structures of any kind will be erected in the river channel.

Currently, boats are launched backwards at Davey Robinson boat ramp. These craft either remain at idle in the river channel while the trailers are parked or manoeuvre across to the public jetty where they are tied up to await the return of the driver after parking the vehicle and boat trailer. In either case, a considerable portion of the channel can be occupied with boats manoeuvring at low speed, often in reverse. These boats present safety risks in the river channel.

Boats entering the river from the marina will do so via an entrance about 40-m wide. They will be travelling forward, will not need to wait in the river for the car driver to return, and will quickly integrate with any other boat traffic on the river (subject to speed limits).

Modelling based on internationally recognised survey data for general marina usage rates indicate that:

- up to 60% of vessels leave their berth very rarely or never; and
- recreational craft will be in their berths 95% of the time.

Peak berth usage has been predicted by calculating a weighted average of about 16.8% usage in peak summer periods contrasting with 0.16% during winter periods. This is based on survey data from other marinas in Sydney in publically available studies.

On the busiest days, Christmas, New Year, Easter, October Long Weekend and Australia Day, a maximum of only 73 boats are expected to leave the marina. As at least half of these small craft movements will occur on a pre-booked departure time (and pre-booked retrieval times upon return) for the dry berth facility, small craft traffic flows into the river will be easily managed. This will be assisted by the overall marina basin design, with generous widths provided for general small craft movement including manoeuvring at the fuel and pumpout facilities. No mooring or anchoring will be permitted in the marina and a no-wash zone (4 knots) will be implemented within the marina. This will be policed with the marina facility tender/retrieval vessel which will be responsible for implementing no-wash rules and retrieving small craft owned by marina members that have experienced engine or other mechanical failure.

6.10.3 Davy Robinson Boat Ramp and Park

The Davey Robinson Boat Ramp and Park was specifically identified as a potential demonstration site as part of the *Georges River Catchment Built Environment Foreshore Access Study* (DIPNR 2004) (referred to the report as the 'Newbridge Boat Ramp'). The access criteria for selecting demonstration sites included:

- provides a range of levels of access to the river;
- enhances the natural values and recreational amenity of the foreshore area and reduces adverse impacts on the waterway;
- provides existing or potential links between access points and recreational areas;
- exhibits the potential to provide a physical link/crossing of the river or tributary. A potential to promote an integrated cross Council approach to management;
- enhances the focus on the river;
- improves the ecological environment by controlling access;
- has significant amenity values, and community values; and

- exhibits high visibility from the river and from surrounding roads.

The access study report notes that "it is not intended that the choice of these demonstration sites should supersede other important foreshore improvements already in train or planned for the Georges River. Rather, the intention is to illustrate typical opportunities and a project that could be applied at these and other sites".

The proposed marina precisely meets the design goals and strategy for river access and foreshore accessibility.

6.10.4 Deepwater motorboat club

The Deepwater Motorboat Club conducted races on the Georges River. The club is no longer situated on the Georges River.

6.10.5 Vessel clearances for safe navigation

The majority of boats using the marina will be less than 15-m long. There will be four berths for boats between 15-m and 20-m long and no berths for boats more than 20-m long. Power boats 15- to 20-m long have draughts of up to 2.0 m (JBA Planning 2008). An under-keel clearance of 0.3 m plus half the significant wave height is required to allow safe boat movement (JBA Planning 2012) where the bed is soft sediment.

The marina basin will be 2.92 m deep at low tide and there will be no waves. Therefore, there will be 0.92 m clearance for the longest boats using the marina at low tide. A speed limit of 4 knots in the marina will be enforced.

6.11 Impacts of Georges Cove Marina on navigation and safety

6.11.1 Construction

Rock armouring will be installed along the marina basin foreshore to protect the bank against the effects of waves and vessel wake. Armouring will span the entire marina basin and there will be a 40-m wide marina entrance.

A floating silt curtain will be installed to contain and control silt and sediment runoff during construction of the marina entrance where necessary. Georges River is approximately 125-m wide at this point and therefore, it is unlikely that commercial or recreational boating activities will be affected by these works. The silt curtain will be marked by buoys and, being close to the bank, will not be a significant safety hazard. Opening the basin to the Georges River will be the last part of the marina basin construction works.

6.11.2 Marine structures

The physical layout of Georges Cove Marina will have very little impact on river navigation as the entire development will be outside of the Georges River channel. No structures of any kind will be erected in the river channel.

6.11.3 Management measures

A boating management plan will be prepared that includes:

- internal speed limits within the marina basin (4 knots);
- navigation in the marina basin for the sizes of watercraft using the marina;
- a description of access and egress from the marina basin to the Georges River;

- marking of the marina entry in accordance with RMS standards;
- principles for scheduling of boat departures and retrievals during peak periods; and
- operation of the marina tender/retrieval vessel.

Implementation of the boating management plan will ensure that there will be no adverse impacts on navigation or safety in the Georges River.

6.12 Site accessibility

6.12.1 Access and amenity for residents in neighbouring areas

The development will provide a recreational precinct of high scenic and recreational value within easy walking distance of about 1,200 current and future households in the Georges Fair development and the Mirvac Georges Cove residential estate on the northern portion of Lot 7. Currently, no river or recreational access from Lot 7 is possible or available due to the previous extractive and recycling operations. Hence, the impact of the development will be to provide an essential quality recreational precinct for adjoining residential developments and the region.

6.12.2 Disabled access

The use of floating berths and a ramp system will allow a high level of disabled access. The need for specialised hoists will be assessed as part of the detailed design undertaken at construction stage with reference to Australian Standard:1428-2009 (*Design for Access and Mobility*), Part D3 of the Building Code of Australia and the Commonwealth *Disability Discrimination Act 1992*.

It is expected that full compliance with disability access standards will be implemented at the facility.

6.13 Economic impacts

6.13.1 General

The development, while an important local facility, does not warrant a full economic impact assessment. The new marina and related facilities will provide:

- small craft storage and boat berthing facilities;
- fuel and sewage pumpout services which are currently not available to the general boating public in the area;
- maintenance and chandlery facilities;
- sales and brokerage services; and
- recreational facilities including a function centre and other amenities (eg kiosks).

While the development is not expected to have a major positive impact on regional economic activity, the local impacts will provide a significant economic boost and underpin a vibrant and attractive river foreshore precinct for the community.

Economic benefits of the development include:

- current market demand for services being offered;
- construction and operational employment;
- the potential impact on land values; and
- the impact of the proposed development on other marinas.

These are addressed below.

6.13.2 Demand for infrastructure and associated services

The facility will cater for the demand for marina and associated services that are not currently met in the area. Small craft storage is a significant problem for the tens of thousands of boat owners across Sydney with many trailered craft being stored in streets and backyards. There are 17,000 small craft (5-m to 10-m long) alone registered to owners within a 10-km radius of the marina site (based on RMS data).

In addition, specialist boat brokerage and other maritime services for boat owners who live locally are in short supply.

6.13.3 Employment

i Operational employment

It is expected that employment initially generated from the development will be as follows:

- 1 Marina Precinct Manager (full time);
- 3 administration staff (full time);
- 1 brokerage sales staff (full time);
- 1 chandlery sales staff (full time);
- 3 chandlery sales staff (part time);
- 6 marina staff (casual part time);
- 2 workshop manager/staff (full time);
- 1 function centre manager (full time);
- 15 casual function centre staff (part time);
- 3 kiosk operators (full time); and
- 9 kiosk operators (part time).

As business patronage grows, additional staff will be required. There is ample on-site parking to accommodate additional staff.

ii Construction employment

The number of construction employees will vary over the duration of the project, dependant on the particular activities taking place at any one time. It is expected that between 20 and 35 equivalent full-time construction jobs will be created over the construction period of about 48 weeks.

6.13.4 Land values

The replacement of the historical extractive and recycling industry and removal of heavy vehicle movements from the precinct will result in greatly improved local amenity for adjoining residential lands. Given that these industries will be replaced with a recreational precinct designed to reconnect the community with the river foreshore, it is expected that the development will have a significant positive impact on adjoining land values.

6.13.5 Other marinas

It is not expected that the Georges Cove Marina will have any significant impact on the operation of other marinas given the considerable distances separating these facilities (to the next existing facility is almost 15 km downstream).

7 Statement of commitments

7.1 Previous application conditions

The JRPP issued development consent (subject to conditions) for the Georges Cove Marina to Tanlane Pty Ltd on 26 September 2016. It is proposed to construct and operate the marina development, if approved, generally in accordance with these previous conditions as modified by the consent authority.

7.2 Environmental management plan

An environmental management plan (EMP) will be prepared during the detailed design of the marina based on the approval conditions. The EMP will be prepared prior to commencement of the development to ensure that the commitments in this EIS and Project Approval conditions are fully implemented.

The EMP will include:

- a summary of the proposed development;
- a summary of required licenses;
- the environmental management strategy for the marina;
- long-term contamination management measures; and
- the environmental management measures in this EIS.

As described in this EIS, the EMP will include the following plans:

- Vegetation Management Plan;
- Acid Sulfate Management Plan;
- Noise Management Plan; and
- Boating Management Plan.

7.3 Commitments

The key commitments described in this EIS are summarised in Table 7.1.

Table 7.1 Key commitments

No.	Commitment	Reference
Water		
1	Floor levels of the building and marina facilities have been determined using the 100-year ARI flood levels produced in the Georges River Flood Study (adopted by Liverpool City Council) and will incorporate the appropriate freeboard.	Section 6.1.7
2	Water quality in the dredge basin will be tested during construction prior to breaking through the banks to the river. The bank will only be opened if the water quality in the basin is similar to, or better than, that in the Georges River.	Section 6.1.7
3	Water sensitive urban design elements will be incorporated into the design (including the provision of wetlands) to provide stormwater treatment to reduce nitrogen, phosphorus, total suspended solids and heavy metals concentrations.	Section 6.1.7
4	Bilge and sewage pump-out facilities will be provided in the marina and discharge of sewage from boats using the marina will be prohibited.	Section 6.1.7
5	Bank stabilisation will be undertaken as part of the development.	Section 6.1.7
Soils		
6	The acid sulfate soils management plan (Appendix D6) will be implemented.	Section 6.2.2
Contamination		
7	The recommendations of the Remediation Action Plan (Appendix D3) and Site Auditor Statement (Appendix D7) will be implemented.	Section 6.3.7
8	Any material in the stockpiles or fill mounds that are present at the marina site and that are proposed for on-site reuse will be characterised for land use suitability relative to the appropriate land use criteria in the ASC NEPM.	Section 6.3.8
9	Any material proposed for off-site disposal or reuse will be characterised for waste classification in accordance with the NSW EPA (2014) Wa*ste Classification Guidelines, Part 1: Classifying Waste*, or with regard to a relevant resource recovery order and exemption issued under the POEO Act.	Section 6.3.8
10	A daily record of all site works will be maintained by the construction or remediation contractor. This will include details of daily environmental inspections. The occurrence and management of all unexpected finds will be documented.	Section 6.3.8
11	Basin sediment resuspension from propeller wash will be prevented by providing adequate under keel clearance (2.9 m low tide water depth) and enforcing the speed limit within the marina basin (4 knots).	Section 6.3.8
Ecology		
12	A pre-clearance check will be undertaken to determine if active nests (ie containing eggs or chicks) are present in any trees to be felled – active nests will be bought down intact where possible.	Section 6.4.2
13	Any felled trees will be retained at the site as habitat for ground-dwelling fauna.	Section 6.4.2
14	The buffer zone between the marina basin and the Georges River foreshore will be embellished and a vegetation management plan will be prepared and implemented.	Section 6.4.2
15	The marina basin will be constructed in a manner that ensures that it is regularly flushed, that sediment accumulation is minimised, and that the entrance channel location avoids direct loss of existing seagrass patches or mangrove trees.	Section 6.4.4
16	Natural, or near-natural, intertidal to riparian zone habitats will be provided that that support local native vegetation and link these habitats.	Section 6.4.4

Table 7.1 Key commitments

No.	Commitment	Reference
17	Traditional “slipway” activities that can result in chemicals (including anti-foul chemicals) entering the environment will not be undertaken – all environmentally sensitive maintenance works will be undertaken on a dedicated hardstand area fully under cover and within the marina building.	Section 6.4.4
Noise		
18	A 2-m high acoustic barrier will be constructed to the west of the marina clubhouse carpark.	Section 6.7.3
19	Partial acoustic screening (eg louvres) will be installed on the north balconies of the Private Marina Clubhouse and Maritime Building.	Section 6.7.3
20	Music noise from the function centres will be managed and/or mitigated to limit low frequency noise in 31.5 and 63 Hz octave band centre frequencies.	Section 6.7.3
Recreational boating		
21	The scheduling of departures and retrievals during peak periods, along with the operation of a marina tender/retrieval vessel, will ensure that there will be no adverse impacts on the existing recreational boating community.	Section 6.11.3

8 Conclusion and justification

8.1 Introduction

This chapter provides justification for the carrying out of the proposal against the principles of ecologically sustainable development (ESD). It also discusses the suitability of the marina site, any submissions made and whether the proposal is in the public interest as required by Section 4.15 of the EP&A Act.

8.2 Principles of ecologically sustainable development

The principles of ESD are defined in Clause 7(4) of Schedule 2 to the EP&A Regulation and include the following:

(a) the precautionary principle, namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:

  (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and

  (ii) an assessment of the risk-weighted consequences of various options.

(b) inter-generational equity, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations;

(c) conservation of biological diversity and ecological integrity, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration; and

(d) improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as:

  (i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement;

  (ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste; and

  (iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

Consideration of the proposal against the four principles of ESD is given below.

8.2.1 The precautionary principle

The precautionary principle states that “if there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.”

Consideration of the precautionary principle requires two things. First, that the proponent properly assesses all potential impacts using plausible worst-case assumptions and, either, avoids them in project planning or incorporates effective safeguards into the project design. Second, that the relevant authorities make a well-informed decision about the project based on a sound knowledge of the project's implications and impacts, including any limitations on the accuracy of impact predictions.

The redevelopment of the marina site will have a beneficial outcome and there are no significant risks arising to community health.

No "threats of serious or irreversible damage" from the proposal have been identified and the project's planning and design meets the first test above. These design and management measures are described in Chapters 2 and 6 this EIS. The Statement of Commitments (Chapter 7), highlights the main measures that will be implemented under the proposal to avoid, manage or mitigate predicted environmental impacts.

The second test will be satisfied by the comprehensive decision-making processes to be followed by the government, including LCC and Sydney South West Region Planning Panel.

8.2.2 Inter-generational equity

Inter-generational equity requires that the "present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for benefit of future generations". The requirement for equity between generations binds or integrates the other principles of ecologically sustainable development.

Inter-generational equity implies that the present generation should ensure that its local environment is maintained or enhanced for the benefit of future generations.

The marina redevelopment, which will provide boat storage facilities and services to meet demand, and incorporate best practice environmental controls, is consistent with the objective of social equity including inter-generational equity. In particular, the development aims to ensure that the riverine environment of the Georges River is maintained or enhanced for the benefit of future generations.

8.2.3 Conservation of biological diversity and ecological integrity

Biological diversity refers to the diversity of genes, species, populations, communities and ecosystems and the linkages between them. Biological resources provide food, many medicines, fibres and industrial products. Maintenance of biological diversity will ensure life support functions and can be considered a 'minimal' requirement for inter-generational equity.

The impact of the proposal on flora and fauna species and communities is addressed in detail in Section 6.4. These impacts will be minimal. The proposed marina will provide a number of benefits to biological diversity and ecological integrity enhance foreshore vegetation, allow the possible removal of river swing moorings on seagrasses and provide additional fish habitat such as floating pontoon structures.

8.2.4 Improved valuation, pricing and incentive mechanisms

The principle of improved valuation, pricing and incentive mechanisms is a component of "inter-generational equity" and establishes the need to determine economic values for services provided by the natural environment, such as the atmosphere's ability to receive emissions, the cultural values of a site and its visual amenity.

The value of the environmental resources affected by the proposal has been acknowledged and provided for through the examination of environmental consequences of the proposal and identification of mitigation measures to address potential impacts, including any short-term construction impacts.

8.2.5 The suitability of the site for the development

The proposal negates the need for large amounts of filling material to be imported to undertake the restoration of the quarry void and the attendant impacts relating to noise and traffic that this would entail. As described in Section 1.7, the marina provides the highest and best value use for the completed site and returns a highly degraded site back to the economy.

In regard to the previous application, LCC (2016) found:

> The land is zoned for open space both in public and private recreation. The proposed development is in keeping with the vision of the site as anticipated in the zoning of the land and support and complements the surrounding uses identified for the Moorebank East precinct.
>
> The proposed development has demonstrated that the potential impacts have been addressed and a number of measures and safeguard are to be implemented to manage any impacts. The development would seek to embellish the area both in terms of the natural and built environment through the agreement of Council and the property owner with works that would see the land return to the community with a high quality outcome.
>
> The proposed development represents an opportunity to rehabilitate the highly degraded site which is currently used for extractive industry. The cessation of this industrial use and expedition of the rehabilitation of the site is a significant benefit for the land and would fast track the use of the land for the benefit of the community. Accordingly, it is considered that the proposed development is suitable for the site.

There has been no substantial change to the proposed development so it is believed that the Council's statement remains current.

8.3 Submissions

Submissions on the previous applications for the marina development are described in Chapter 4.

The EIS for the proposal will be placed on public exhibition. During this period, the public will be invited to provide submissions on the proposal. These submissions will be considered by the Council in its assessment report and the Sydney South West Region Planning Panel in their determination of the proposal.

8.4 Public interest

In regard to the previous application, LCC (2016) found that:

> The proposed development is considered to provide for substantial social benefit. These benefits include:
>
> - The proposal would see the cessation of extractive industries on the subject site which has degraded the land and rendered it inaccessible to the public for a number of years. The current use is incompatible with the surrounding context of the area which is predominantly characterised with residential development and natural vegetation. The current impact of traffic generation from heavy vehicles and noise, dust and air emanation would cease on conclusion of extractive industry activities at the site.

- The approval granted for the site enables the rehabilitation of the land with waste material to facilitate the formation and return of the land to its natural landform. Waste management uses would not be carried out as a result of the proposed development and would therefore remove the continued environmental impact of what is essentially an industrial use.

- The proposal is considered to be a significant project for Liverpool and would exhibit a high quality design benchmark and be an iconic development for the local area and the greater region.

- The proposed development represents a significant opportunity to reactivate an inaccessible and highly degraded stretch of the Georges River and would seek to return the natural landscape to the community though a development.

- The development would provide for numerous active and passive forms of recreation that represents substantial economic and social benefits for the Liverpool and the greater community.

- The development encourages a new recreational facility to the area with casual public berths for small craft and water taxis to pick-up and drop-off passengers and access provisions from the marina facilities. Public access to fuel and sewage pump out facilities would be made available to boat users and thereby encourage patronage to the area.

- The development would be made accessible for all people and those with a disability.

- The development would increase the environment quality of the area through managed revegetation with species endemic to the area. The ongoing management of these areas along the river foreshore coupled with the provision of embellished public open space in the form of pedestrian and cycleway, bridge [no longer proposed] and street furniture would provide a sense of place for the area and create ownership of residents and users of the development.

- The proposed development is anticipated to increase economic activity of retail sales of marine equipment, leisure activities and recreational uses by way of function/receptions spaces, food and beverage option both casual and high-end and storage of vessels.

- The number of construction employees would vary over the duration of the project dependant on the particular activities taking place at any one time. It is expected that between and 35 equivalent full time construction jobs would be created over the construction period.

- The proposed would increase local employment opportunities in management, brokerage and chandlery sales, marine staff, workshop, the function centre and food and beverage operators.

There has been no substantial change to the development so it is believed the Council's assessment remains current.

8.5 Justification and conclusion

Justification for the proposal based on biophysical, economic and social considerations is provided in Section 1.7.

This EIS has been prepared in accordance with the SEARs, Clauses 71 and 72 of the EP&A Regulation and advice provided by the Council and other stakeholders. It describes the existing environment, the proposal, the legislative and policy context, proposed environmental management measures and the impacts of the project.

Having regard to the overall environmental impacts determined as part of this EIS, the proposed redevelopment is not considered likely to give rise to any significant adverse cumulative impacts on the environment. The assessment has demonstrated that any environmental impacts during construction or operation of the marina can be mitigated through normal operating procedures.

Overall, the proposed Georges Cove Marina will have biophysical, social and economic benefits. The development satisfies the four principles of ecologically sustainable development.

Abbreviations

AHD	Australian height datum
AHIMS	Aboriginal Heritage Information Management System
ARI	Average reoccurrence interval
ASS	Acid Sulfate Soils
Benedict	Benedict Industries Pty Ltd
CNVMP	Construction noise and vibration management plan
DA	Development Application
DCP	Development Control Plan
DECCW	Department of Environment, Climate Change and Water
DIPNR	Department of Infrastructure, Planning and Natural Resources
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
EBPC Act	*Environmental and Biodiversity Conservation Act 1999*
EECs	Endangered ecological communities
EIS	Environmental impact statement
EMM	EMGA Mitchell McLennan Pty Ltd
EMP	Environmental Management Plan
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	Environmental Planning and Assessment Regulation 2000
EPA	Environment Protection Authority
EPL	Environment protection license
ESD	Ecologically sustainable development
FM Act	*Fisheries Management Act 1994*
GLALC	Gandangara Local Aboriginal Land Council
GMREP	Greater Metropolitan Regional Environmental Plan
JRPP	Joint Regional Planning Panel
LCC	Liverpool City Council
LEP	Local Environmental Plan
LGA	Local Government Area
MOAs	Marina Occupation Agreements
NOW	NSW Office of Water
NPC	National Project Consultants Pty Ltd
NSW	New South Wales
NSWCA	NSW Court of Appeal
NSWLEC	NSW Land and Environment Court
OEH	Office of Environment and Heritage
PHA	Preliminary hazard analysis

PMF	Probable maximum flood
RMS	Roads and Maritime Service
ROPAP	Rare or Threatened Australian Plants
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement

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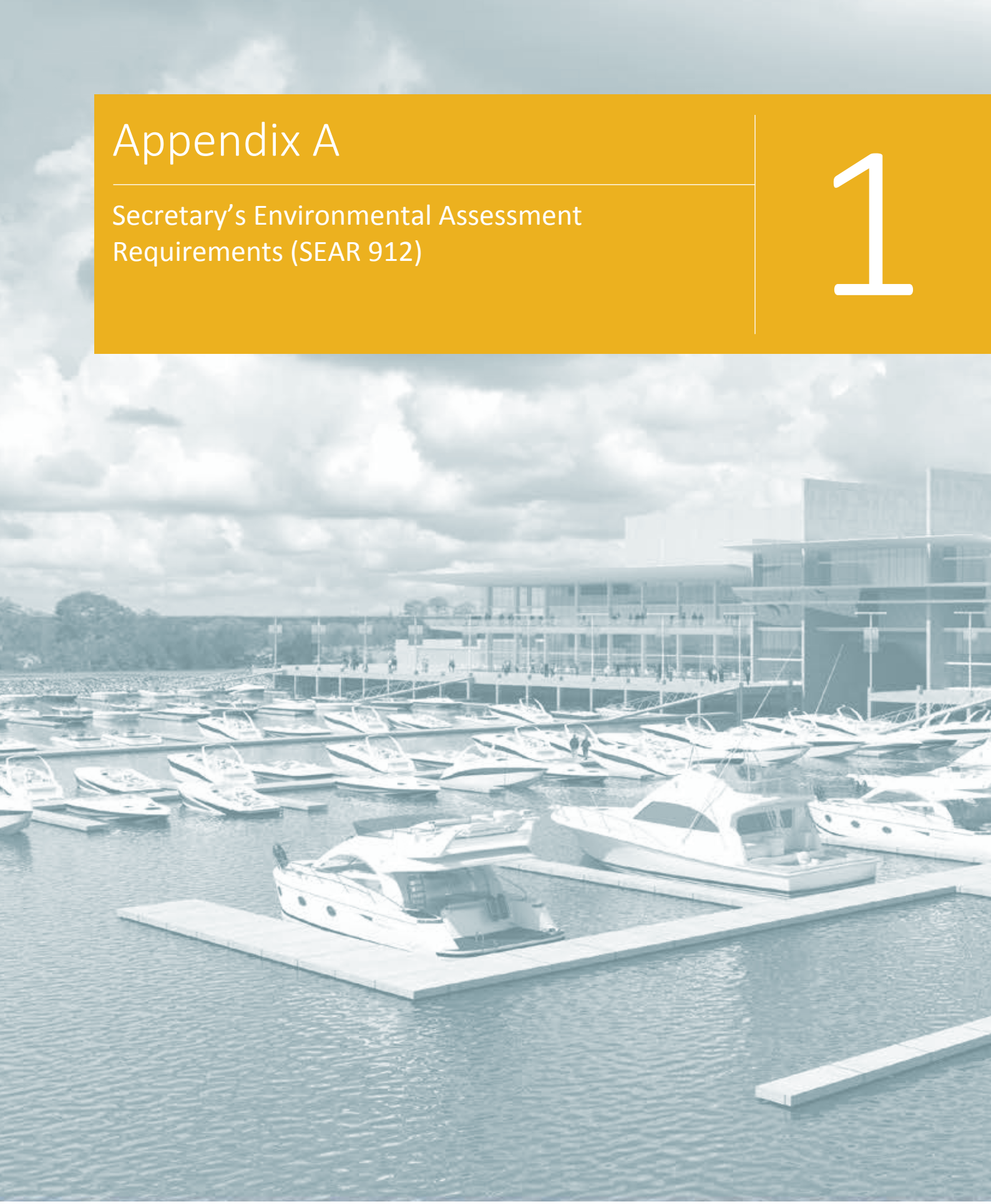
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Appendix A

Secretary's Environmental Assessment Requirements (SEAR 912)

1



Appendix A1

SEAR 912 (DPE 2015)

1

NSW GOVERNMENT | Planning & Environment

Industry Assessments
Contact: Matthew Meyerson
Phone: (02) 9228 6378
Fax: (02) 9228 6455
Email: matthew.meyerson@planning.nsw.gov.au

Mr Phillip Towler
EMGA Mitchell McLennan
20 Chandos Street
ST LEONARDS NSW 2065

15/05521

Dear Mr Towler

Georges Cove Marina, 146 Newbridge Road Moorebank, Liverpool LGA
Secretary's Environmental Assessment Requirements (SEAR) 912

Thank you for your request for the Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an Environmental Impact Statement (EIS) for the above development proposal. I have attached a copy of these requirements.

In support of your application, you indicated that your proposal is both designated and integrated development under Part 4 of the *Environmental Planning and Assessment Act 1979* and requires an approval under the *Protection of the Environment Operations Act 1997, Roads Act 1993* and *Water Management Act 2000*. In preparing the SEARs, the Department has consulted with the Environment Protection Authority, Roads and Maritime Services and the Department of Primary Industries. Copies of their requirements for the EIS are attached.

If any integrated approvals are identified before the Development Application is lodged, you must undertake your own direct consultation with the relevant agencies, and address their requirements in the EIS.

If your proposal contains any actions that could have a significant impact on matters of National Environmental Significance, then it will require an additional approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This approval is in addition to any approvals required under NSW legislation. If you have any questions about the application of the EPBC Act to your proposal, you should contact the Commonwealth Department of the Environment on (02) 6274 1111.

Should you have any further enquiries, please contact Matthew Meyerson, Planning Services, at the Department on (02) 9228 6378.

Yours sincerely

24.4.15

David Mooney
A/Manager
Industry Assessments
as delegate of the Secretary

Environmental Assessment Requirements

Section 78A (8) of the *Environmental Planning and Assessment Act 1979.*

Designated Development

SEAR Number	912
Proposal	A marina comprising of the following components: A dry berth facility providing 250 berths for small craft, a wet berth for 186 small craft berths, construction off three carparks providing approximately 489 car spaces, construction of a private marina club house and construction of support infrastructure.
Location	146 Newbridge Road, Moorebank. Lot 7 DP 1065574
Applicant	Benedict Industries Pty Ltd
Date of Issue	April 2015
General Requirements	The Environmental Impact Statement (EIS) must meet the minimum form and content requirements in clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.*
Key Issues	The EIS must include an assessment of all potential impacts of the proposed development on the existing environment (including cumulative impacts if necessary) and develop appropriate measures to avoid, minimise, mitigate and/or manage these potential impacts. As part of the EIS assessment, the following matters must also be addressed. • **strategic context** – including: – a detailed justification for the proposal and suitability of the site for the development; – a demonstration that the proposal is consistent with all relevant planning strategies, environmental planning instruments, development control plans (DCPs), or justification for any inconsistencies; and – a list of any approvals that must be obtained under any other Act or law before the development may lawfully be carried out. • **air quality and odour** – including: – a description of all potential sources of air emissions and odour; – an air quality impact assessment in accordance with relevant Environment Protection Authority Guidelines; and – a description and appraisal of air quality impact mitigation and monitoring measures. • **noise and vibration** – including: – a description of all potential noise and vibration sources during construction and operation, including road traffic noise; – a noise and vibration assessment in accordance with the relevant Environment Protection Authority Guidelines; and – a description and appraisal of noise and vibration mitigation and monitoring measures. • **soil and water** – including: – a description of local soils, topography, drainage and landscapes; – the details of stormwater and wastewater management; – the details of sediment and erosion controls; – the details of water usage including water supply and licences; – impacts associated with dredging, reclamation and seawall construction and operation; – an assessment of impacts to surface and groundwater resources, flooding

	impacts, and impacts to groundwater dependant ecosystems; and – a description and appraisal of impact mitigation and monitoring measures. • **traffic and transport** – including: – details of road transport routes and access to the site; – road traffic predictions for the development during construction and operation; and – an assessment of impacts to the safety and function of the road network; and the details of any road upgrades required for the development. • **contamination** – including a contamination investigation in accordance with *State Environmental Planning Policy No. 55 – Remediation of Land*. • **marine safety** – including a Navigational Assessment of the impacts of additional vessels within the waterway. • **biodiversity** – including: – accurate predictions of any vegetation clearing on site or for any road upgrades; – a detailed assessment of the potential impacts on any threatened species, populations, endangered ecological communities, impacts on any aquatic species, protected species, threatened species or their habitats, groundwater dependent ecosystems and marine vegetation; – a detailed assessment of potential impacts to fish stocks and fish habitat; and – a detailed description of the measures to avoid, minimise, mitigate and offset biodiversity impacts. • **visual** – including an impact assessment at private receptors and public vantage points. • **heritage** – including Aboriginal and non-Aboriginal cultural heritage.
Environmental Planning Instruments and other policies	The EIS must assess the proposal against the relevant environmental planning instruments, including but not limited to: • *Liverpool Local Environmental Plan 2008*; • *Greater Metropolitan Regional Environment Plan No. 2 – Georges River Catchment*; • *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development*; • *State Environmental Planning Policy 55 – Remediation of Land*; • *State Environmental Planning Policy (Infrastructure) 2007*; and • Relevant development control plans and section 94 plans.
Guidelines	During the preparation of the EIS you should consult the Department's Register of Development Assessment Guidelines which is available on the Department's website at planning.nsw.gov.au under Development Proposals/Register of Development Assessment Guidelines. Whilst not exhaustive, this Register contains some of the guidelines, policies, and plans that must be taken into account in the environmental assessment of the proposed development.
Consultation	During the preparation of the EIS, you must consult the relevant local, State and Commonwealth government authorities, service providers and community groups, and address any issues they may raise in the EIS. In particular, you should consult with the: • Environment Protection Authority; • Office of Environment and Heritage; • Department of Primary Industries; • New South Wales Office of Water; • Roads and Maritime Services; • Liverpool City Council; and • The surrounding landowners and occupiers that are likely to be impacted by the proposal. Details of the consultation carried out and issues raised must be included in the EIS.

NSW EPA

Our reference: DOC15/111855
Contact: Alex Bowlay 02 9995 5257

Mr Matthew Meyerson
Industry Assessments
Department of Planning & Environment
GPO Box 39
SYDNEY NSW 2001

Dear Matthew,

Proposal - Georges Cove Marina, Liverpool SEARs ID No. 912

The Environment Protection Authority (EPA) refers to your email dated 25 March 2015 requesting input to **the Secretary's Environmental Assessment Requirements (SEARs) for the Georges Cove Marina** project based on information provided by EMGA Mitchell McLennan (the Applicant) on behalf of Benedict Industries Pty Ltd (the Proponent).

The EPA has identified a range of environmental issues from supporting information provided in the email that require consideration in the Environmental Impact Statement (EIS). These are outlined in Attachment A.

The EPA also notes that the types of work to be undertaken for the project and their proximity to a number of sensitive receivers and to commercial and recreational vessels operations on the Georges River will present certain challenges. Accordingly, the EPA recommends that the EIS includes comprehensive consideration of the following issues:

- odour and other air emission controls (e.g. dust) throughout land restoration processes and operation of the marina
- noise from both mobile and stationary sources used in any aspect of the development
- sediment controls during the excavation of any material at the site during the construction phase
- the discharge of treated wastewater and stormwater from the site to the Georges River
- contaminated soil and water issues relating to prolonged historical use of the site for extractive activities, and proposed connection of dredged ponds with the Georges River
- incident risks and contingencies in the event that the planned mitigation measures are insufficient
- marine foreshore construction and the need to use uncontaminated material

Should you wish to discuss any of the above information please contact Operations Officer Alex Bowlay on 9995 5257.

Yours sincerely

7 April 2015

JAMES GOODWIN
Unit Head, High Risk Facilities Unit
Environment Protection Authority

PO Box 668 Parramatta NSW 2124
Level 13, 10 Valentine Avenue, Parramatta NSW 2150
Tel: (02) 9995 5000 Fax: (02) 9995 6900
ABN 43 692 285 758
www.epa.nsw.gov.au

Attachment A

Request for Secretary's Environmental Assessment Requirements – SEAR 912 – Liverpool LGA - Georges Cove Marina Project, Moorebank

Environment Protection Licence and Appropriate Regulatory Authority role

The EPA has identified likely requirements for licensing under the *Protection of the Environment Operations Act* (POEO Act) and the need to identify the agency that will be the Appropriate Regulatory Authority for any non-licensed activities. The EPA has determined that at least some aspects of the project will likely require an Environment Protection Licence (EPL). The EPA will work with Liverpool City Council and the proponent to determine the most appropriate regulatory arrangement for administering the POEO Act requirements as they relate to the project.

It is possible that the project will involve undertaking scheduled development works requiring a scheduled development work licence under the POEO Act. The proposed provision of dry and wet berthing facilities for the number of small water craft indicated in the supporting information indicates that an environment protection licence (premises-based) may be required if the activity qualifies as a 'Marinas and boat repairs' scheduled activity under Schedule 1 of the POEO Act.

Under Schedule 1, a licence is required if the facility has the capacity to handle more than 80 vessels (excluding rowing boats, dinghies and other small craft) at any time as per the 'boat moorings and storage' activity threshold. Supporting information (Figure 8 Marina layout – parking and berth details) is unclear on the detail in this regard as the layout plan contains blurred details on proposed craft type, length and numbers however overall the number of proposed berths is known to exceed 430. It is not known whether maintenance of water craft will occur at the site, which has further implications for licencing depending on the nature of the craft.

The supporting information also makes reference to sewage pump out facilities and provision of support infrastructure that may require authorisation under an EPL.

Odour/ Air quality

Dust management from transportation of materials including untreated stockpiles, must be taken into specific consideration given the proximity to a range of sensitive receivers and commercial and recreational vessels on the George River. Any odour and/or dust suppressants being considered for use in operations must be detailed in the EIS and include investigation of low toxicity options.

An Air Quality Impact Assessment ("AQIA") should be undertaken for the project with the level of assessment being proportionate to the likely level of odour impacts and should consider the requirements of the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (2005).*

The AQIA should also make appropriate reference to the *Assessment and Management of Odour from Stationary Sources in NSW: Technical Framework (2006)* and *Management of Odour from Stationary Sources in NSW: Technical Notes (2006).*

The AQIA should also consider the requirements of the *Protection of the Environment Operations (Clean Air) Regulation 2010* if applicable.

Remediation/Contamination

The proposal is known to have received prior development consent from Liverpool City Council on 22 August 2014 however an adjoining landowner successfully challenged the consent on the grounds of clause 7 of State Environment Planning Policy 55 – Remediation of Land (SEPP 55).

A finding of the Land and Environment Court was that neither the preliminary investigation of the land nor the report of the preliminary investigation was carried out, and was not in compliance with relevant clauses of SEPP 55. The consent was declared invalid on 18 March 2015. The proponent is to carry out a preliminary investigation of the land and submit a report to the JRRP, and the JRRP is to undertake consideration under the requirements of **SEPP 55 before determining the proponent's development** application for consent to carry out development on the land.

The EPA is not aware of any records of contaminated land notices issued for the site however the proponent needs to demonstrate that land potential land or groundwater contamination issues have been addressed.

Supporting information included with the application indicates that restoration and remediation activities have not commenced after many years of extractive activities taking place at the site. Dredged ponds at the site will be retained for use as part of the marina proposal and will ultimately connect with the Georges River. Water and sediment in these ponds should be assessed accordingly before connection.

Underground Petroleum Storage Systems (UPSS)

The proposal includes installation of a 60,000 litre petrol tank and a 30,000 litre diesel tank, along with fuel pumping facilities. The *Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2014* may apply depending on whether the tanks are installed underground and any applicable exemptions to the provisions of the regulation.

Acid Sulphate Soils

The potential impacts identified for the project on acid sulphate soils must be assessed and managed in accordance with the relevant guidelines in the *Acid Sulphate Soils Manual* (Stone et al. 1998) and the *Acid Sulphate Soils Laboratory Methods Guidelines* (Ahern et al. 2004). If acid sulphate soils are identified on the premises the proponent must prepare an Acid Sulphate Soil Management Plan in accordance with the *Acid Soil Planning Guidelines*.

Noise impacts

This project has the potential to impact a number of sensitive receivers and recreational users of the land and water surrounding the project. A Noise Impact Assessment should be undertaken which considers construction and operational noise across the project, and must include the following:

- Operational noise from stationary aspects of the project should be assessed using the *NSW Industrial Noise Policy* (EPA, 2000). http://www.epa.nsw.gov.au/resources/noise/ind_noise.pdf
- Construction noise associated with the project should be assessed using the *Interim Construction Noise Guideline (*EPA, 2009). http://www.environment.nsw.gov.au/noise/constructnoise.htm
- Vibration from any construction activities to be undertaken on the premises should be assessed using the guidelines contained in the *Assessing Vibration: a technical guideline* (EPA, 2006). http://www.environment.nsw.gov.au/noise/vibrationguide.htm

Waste treatment, discharge and management

The EIS should provide details of liquid waste and non-liquid waste management, including:

- the transportation, assessment and handling of waste generated at the site
- any stockpiling of wastes materials at the site
- any waste processing related to the project including on-site treatment
- the method for disposing of all waste materials,
- and proposed controls for managing the environmental impacts of these activities.

Chemicals

The EIS should provide details of:

- the type and quantity of any chemical substances to be used or stored and describe arrangements for their safe use and storage, and
- procedures for the assessment, handling, storage, transport and disposal of all hazardous and dangerous materials used, stored, processed or disposed of, in addition to the requirements for liquid and non-liquid wastes.

Incident Management

The EIS should include a comprehensive assessment of the potential for incidents to occur at any stage of the project, the measures to be used to minimise the risk of incidents and the procedures to be employed in the event of an incident. In addition, information is required about contingency actions in the event that planned incident mitigation measures are inadequate.

Community liaison

The EPA is not aware of community engagement activities for planning processes associated with the project to date. It is recommended that the proponent embark on a program of ongoing consultation throughout the project, from commencement until completion, and this should be detailed in the EIS.

NSW GOVERNMENT | Department of Primary Industries

Our ref: C15/112

Mr Matthew Meyerson
Student Planner, Industry Projects, Industry Assessments
NSW Planning & Environment
GPO Box 39
SYDNEY NSW 2001

Dear My Meyerson,

Request for input into Secretary's Environmental Assessment Requirements for a Marina at Liverpool (EARs ID No. 912)

Thank you for your email to NSW Department of Primary Industries dated 25 March 2015 requesting input into the draft Environmental Assessment Requirements (EARs) for the project stated above. This response incorporates comment from the Fisheries NSW Division of NSW DPI.

Fisheries NSW is responsible for ensuring that fish stocks are conserved and that there is no net loss of key fish habitats upon which they depend. To achieve this, Fisheries NSW ensures that developments comply with the requirements of the *Fisheries Management (FM) Act 1994* (namely the aquatic habitat protection and threatened species provisions in Parts 7 and 7A of the Act, respectively), and the associated *Policy and Guidelines for Fish Habitat Conservation and Management (2013).* In addition, Fisheries NSW is responsible for ensuring the sustainable management of commercial and recreational fishing in NSW.

The Georges River is important key fish habitat within South West Sydney. Considering the provisions of the FM Act and the above mentioned policy, aspects of this proposal of concern to Fisheries NSW include potential:

- Erosion and sedimentation impacts to aquatic habitats during construction,
- Sedimentation of the Georges River from the marina cove during construction,
- Harm to marine and riparian vegetation during construction of the seawall,
- Harm to marine vegetation and increased erosion and sedimentation that may result from any associated increased boat usage in the area,
- Reclamation of the Georges Rive associated with the seawall,
- Removal of snags along the Georges River,
- Acid Sulphate Soil impacts from dredging, reclamation and spoil management, and
- Impacts on water quality during construction and from the ongoing use of the marina.

Fisheries NSW notes that a significant area of seawall is proposed to be constructed along the Georges River. Foreshore protection works in this area are to be designed so that harm of marine vegetation in the river is avoided where possible and any snags in this area are re-instated. There is to be no reclamation activities associated with this seawall. It is highly recommended that foreshore protection works along the river are constructed to enhance riparian and aquatic habitats of the river. Where foreshore protection using natural riparian vegetation and soft engineering techniques is not considered to be suitable, Fisheries NSW recommends that an environmentally friendly seawall design be used. Details of such designs are available from:
http://sydney.cma.nsw.gov.au/component/option,com_remository/Itemid,116/func,select/id,51/

NSW Department of Primary Industries
Locked Bag 1, Nelson Bay NSW 2315
Tel: 02 4254 5527 Fax: 02 4224 9056
www.dpi.nsw.gov.au

Any excavated material is to be treated and deposited appropriately on land according to its contamination and acid sulphate soil characteristics.

Information requirements that may be of assistance in the preparation of an EA for this proposal are listed in Attachment 1. It is important that the extent of the potential impacts on aquatic and riparian habitats above is addressed in the EA and proposed measures to minimise, mitigate, rehabilitate or compensate such impacts are detailed.

Please note that under s.205 of the FM Act, a permit to harm marine vegetation may be required for these works. Also, under s.201 or s.199 of the FM Act, a permit or formal notification will be required for the dredging and reclamation aspects of this proposal. These authorisations are only issued after development consent has been granted.

Should you require any further information concerning this proposal, please contact Carla Ganassin on 4222 8342 or carla.ganassin@industry.nsw.gov.au.

Yours sincerely,



Carla Ganassin
Resource Assessment Officer (Metro), Aquatic Ecosystems Unit

2 April 2015

Environmental Assessment Requirements for proposed Marina at Liverpool

Note: Fisheries NSW recommends that development proposals comply with the *Policy and Guidelines for Fish Habitat Conservation and Management (2013)* (referred to hereafter as P&GLs). A list of general information requirements for developments and standard precautions and mitigation measures are outlined in Section 3.1 of this document. See http://www.dpi.nsw.gov.au/fisheries/habitat/publications/policies,-guidelines-and-manuals/fish-habitat-conservation

A: General Requirements

- site address and contact details.
- property description (e.g. Lot and DP numbers).
- a clear description of the proposal including details of construction methods and materials.
- map(s) of the development area and adjacent areas - this should include nearby waterways, adjacent infrastructure (such as jetties) and land use.
- clear photographs of the site (at low and high tide in estuaries), including photographs of any riparian and aquatic vegetation present (including pest species such as *Caulerpa taxifolia*).
- a clear description of the physical and hydrological features of the development area (which may extend upstream and downstream of the development site in the case of flowing rivers or tidal waterways).
- approximate depth contours within 20 metres of the proposal.
- a clear description of aquatic environments including:
    - threatened and protected species, populations, ecological communities, pest species or presence of 'critical habitat' under the FM Act or EPBC Act,
    - an aquatic and riparian vegetation survey map of the area which shows the location and/or coverage of saltmarsh, mangrove, seagrass, macroalgae, macrophytes, riparian vegetation and snags,
    - description of aquatic habitat TYPE on site (see Table 1 in the P&GLs),
    - description of the waterway CLASS (see Table 2 in the P&GLs).
- details of the nature, timing, magnitude and duration of the proposed disturbance to the aquatic environment.
- assessments of predicted impacts upon any threatened species (fish and marine vegetation) (i.e. completion of a 7 part test and/or species impact statement(s)) and other aquatic flora and fauna.
- details of any mitigation measures to limit environmental impacts.
- details of the general regional context, any protected areas, other developments in the area, and/or cumulative impacts.
- In defining the proposal area, discussion must be provided in regard to possible indirect effects of the proposal on species/habitats in the area surrounding the subject site: for example, through altered hydrological regimes, soil erosion or pollution.
- notification of any other matters relevant to the particular proposal and of interest to NSW DPI.

Dredging and reclamation activities

- purpose of works
- type(s) and distribution of marine vegetation in the vicinity of the proposed works
- method of dredging to be used
- timing and duration of works
- dimension of area of works including levels and volume of material to be extracted or placed as fill
- nature of sediment to be dredged, including Acid Sulphate Soil, contaminated soils etc
- method of marking area subject to works
- environmental safeguards to be used during and after works
- measures for minimising harm to fish habitat under the proposal
- spoil type and source location for reclamation activities
- method of disposal of dredge material
- location and duration of spoil stockpiling, if planned

Activities that damage marine vegetation

- type of marine vegetation to be harmed
- map and density distribution of marine vegetation
- reasons for harming marine vegetation
- methods of harming marine vegetation
- construction details
- duration of works/activities
- measures for minimising harm to marine vegetation under the proposal and details of compensatory habitat development to replace lost vegetation.
- method and location of transplanting activities or disposal or marine vegetation.

B. Aquatic habitat assessment

The aim of the aquatic assessment should be to define the presence of 'key fish habitat' within the study site, adjacent areas (upstream and downstream), and the broader regional area. There may be a range of potential fish habitats that could be impacted by a particular activity. Some points to consider include:

- geomorphic characteristics of the waterway (i.e. what characteristics of a CLASS 1-4 waterway does it have (see Table 2 in P&GLs)? Is it a gully, intermittent stream or major river? Does it have deep pools or in-stream gravel beds? Is it a wetland? Does the watercourse connect with other watercourses upstream or downstream? What is the slope/gradient?),
- is it mapped as key fish habitat? (see www.dpi.nsw.gov.au/fisheries/habitat/protecting-habitats#KFH for maps of key fish habitat per Local Government Area),
- description of the water quality (e.g. discolouration, sedimentation, turbidity, pH, dissolved oxygen, nutrients),
- types of surrounding land use (e.g. agricultural, urban, aquaculture),
- condition of riparian vegetation (i.e. present or absent. Are the species native or exotic? Is the density of vegetation thick or sparse?),
- condition of freshwater aquatic vegetation (i.e. present or absent. Are the species native or exotic? Is the density of vegetation thick or sparse? Is it continuous or sparse in coverage? What is the aerial extent of major vegetation types? Is the vegetation healthy or degraded?),
- condition of marine vegetation (i.e. information on type, species, shoot density and/or percentage cover. Is the vegetation continuous or sparse in coverage? What is the aerial extent? Is the vegetation healthy or degraded? Is wrack (dead seagrass or macroalgae) present?),
- presence of wetlands nearby (including freshwater wetlands and saltmarsh) (i.e. are wetlands protected under any legislation (e.g. SEPP 14 coastal wetlands, Ramsar wetlands)? Are the wetlands in a healthy or degraded condition?)
- substrate type (e.g. rock, sand, gravel, silt),
- presence of refuge areas (e.g. adjacent wetlands, upstream pools),
- types of migratory fish or other aquatic species likely to inhabit the areas (based on known distribution range within the scientific literature),
- timing of construction in relation to any fish migration seasons,
- presence of any listed threatened or protected aquatic species or 'critical habitat' under the FM Act and EPBC Act.

C. Assessment of likely impacts

- indicate the location, nature and extent of habitat removal or modification (both direct and indirect) which may result from the proposed action;
- discuss the potential impact of the modification or removal of habitat (potential direct and indirect sources of impact are stated in the letter with this attachment).

Note: In defining the proposal area, discussion must be provided in regard to possible indirect effects of the proposal on species/habitats in the area surrounding the subject site: for example, through altered hydrological regimes, soil erosion or pollution.

D. Ameliorative measures

The environmental assessment should consider and provide detail on how the proposal has been or may be modified and managed to minimise impacts and conserve aquatic habitat on the subject site and in the study area.

Department of Primary Industries
Office of Water

to Matthew Meyerson
Industry Assessments
Department of Planning & Environment

from Mohammed Ismail
Water Regulation Officer
NSW Office of Water
Mohammed.ismail@dpi.nsw.gov.au

date 15/04/2015

Request for Secretary's Environmental Assessment Requirements for the Construction of a Marina and relative Facilities adjoin Georges River, EARs ID No. 912, (our Ref: ERM2011/304)

I refer to your e-mail dated 25/3/2015 requesting the Secretary's Environmental Assessment Requirements (SEARs) from NSW Office of Water and provide the following comments below, and further detail in **Attachment A**.

It is recommended that the EIS be required to include:

- Details of water proposed to be taken (including through inflow and seepage) from each surface and groundwater source as defined by the relevant water sharing plan.
- Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).
- The identification of an adequate and secure water supply for the life of the project. Confirmation that water can be sourced from an appropriately authorised and reliable supply. This is to include an assessment of the current market depth where water entitlement is required to be purchased.
- A detailed and consolidated site water balance.
- Assessment of impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.
- Full technical details and data of all surface and groundwater modelling.
- Proposed surface and groundwater monitoring activities and methodologies.
- Assessment of any potential cumulative impacts on water resources, and any proposed options to manage the cumulative impacts.
- Consideration of relevant policies and guidelines.
- A statement of where each element of the SEARs is addressed in the EIS (i.e. in the form of a table).

Should you require further information please contact Mohammed Ismail, Water Regulation officer on 0288387535.

Office of Water contact details:

Mohammed Ismail| Water Regulation Officer
NSW Department of Primary Industries | Office of Water
T: 02 8838 7535 | F: 02 8838 7554 | E: mohammed.ismail@dpi.nsw.gov.au
W: www.dpi.nsw.gov.au | www.water.nsw.gov.au

ATTACHMENT A

NSW Office of Water Comments on Secretary's Environmental Assessment Requirements
Marina, Liverpool EARs ID No. 912

The following detailed assessment requirements are provided to assist in adequately addressing the assessment requirements for this proposal.

For further information visit the NSW Office of Water website, www.water.nsw.gov.au

Key Relevant Legislative Instruments

This section provides a basic summary to aid proponents in the development of an Environmental Impact Statement (EIS), and should not be considered a complete list or comprehensive summary of relevant legislative instruments that may apply to the regulation of water resources for a project.

The EIS should take into account the objects and regulatory requirements of the *Water Act 1912* (WA 1912) and *Water Management Act 2000* (*WMA 2000*), and associated regulations and instruments, as applicable.

Water Management Act 2000 (WMA 2000)
Key points:

- Volumetric licensing in areas covered by water sharing plans
- Works within 40m of waterfront land
- SSD & SSI projects are exempt from requiring water supply work approvals and controlled activity approvals as a result of the *Environmental Planning & Assessment Act 1979 (EP&A Act)*.
- No exemptions for volumetric licensing apply as a result of the *EP&A Act*.
- Basic landholder rights, including harvestable rights dams
- Aquifer interference activity approval and flood management work approval provisions have not yet commenced and are regulated by the *Water Act 1912*
- Maximum penalties of $2.2 million plus $264,000 for each day an offence continues apply under the *WMA 2000*

Water Act 1912 (WA 1912)
Key points:

- Volumetric licensing in areas where no water sharing plan applies
- Monitoring bores
- Aquifer interference activities that are not regulated as a water supply work under the *WMA 2000*.
- Flood management works
- No exemptions apply to licences or permits under the *WA 1912* as a result of the *EP&A Act*.
- Regulation of water bore driller licensing.

Water Management (General) Regulation 2011
Key points:

- Provides various exemptions for volumetric licensing and activity approvals
- Provides further detail on requirements for dealings and applications.

Water Sharing Plans – these are considered regulations under the *WMA 2000*

Access Licence Dealing Principles Order 2004

Harvestable Rights Orders

Water Sharing Plans

The proposal is located within the area covered by the Water Sharing Plan for Greater Metropolitan Region. The EIS is required to:

- Demonstrate how the proposal is consistent with the relevant rules of the Water Sharing Plan including rules for access licences, distance restrictions for water supply works and rules for the management of local impacts in respect of surface water and groundwater sources, ecosystem protection (including groundwater dependent ecosystems), water quality and surface-groundwater connectivity.
- Provide a description of any site water use (amount of water to be taken from each water source) and management including all sediment dams, clear water diversion structures with detail on the location, design specifications and storage capacities for all the existing and proposed water management structures.
- Provide an analysis of the proposed water supply arrangements against the rules for access licences and other applicable requirements of any relevant WSP, including:
    - Sufficient market depth to acquire the necessary entitlements for each water source.
    - Ability to carry out a "dealing" to transfer the water to relevant location under the rules of the WSP.
    - Daily and long-term access rules.
    - Account management and carryover provisions.
- Provide a detailed and consolidated site water balance.
- Further detail on licensing requirements is provided below.

Relevant Policies and Guidelines

The EIS should take into account the following policies (as applicable):

- NSW Guidelines for Controlled Activities on Waterfront Land (NOW, 2012)
- NSW Aquifer Interference Policy (NOW, 2012)
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW, 2012)
- Australian Groundwater Modelling Guidelines (NWC, 2012)
- NSW State Rivers and Estuary Policy (1993)
- NSW State Groundwater Policy Framework Document (1997)
- NSW State Groundwater Quality Protection Policy (1998)
- NSW State Groundwater Dependent Ecosystems Policy (2002)
- NSW Water Extraction Monitoring Policy (2007)

Office of Water policies can be accessed at the following links:
http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/default.aspx
http://www.water.nsw.gov.au/Water-licensing/Approvals/Controlled-activities/default.aspx

An assessment framework for the NSW Aquifer Interference Policy can be found online at: http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/Aquifer-interference.

Licensing Considerations

The EIS is required to provide:

- Identification of water requirements for the life of the project in terms of both volume and timing (including predictions of potential ongoing groundwater take following the cessation of operations at the site – such as evaporative loss from open voids or inflows).
- Details of the water supply source(s) for the proposal including any proposed surface water and groundwater extraction from each water source as defined in the relevant Water Sharing Plan/s and all water supply works to take water.
- Explanation of how the required water entitlements will be obtained (i.e. through a new or existing licence/s, trading on the water market, controlled allocations etc.).
- Information on the purpose, location, construction and expected annual extraction volumes including details on all existing and proposed water supply works which take surface water, (pumps, dams, diversions, etc).
- Details on all bores and excavations for the purpose of investigation, extraction, dewatering, testing and monitoring. All predicted groundwater take must be accounted for through adequate licensing.
- Details on existing dams/storages (including the date of construction, location, purpose, size and capacity) and any proposal to change the purpose of existing dams/storages
- Details on the location, purpose, size and capacity of any new proposed dams/storages.
- Applicability of any exemptions under the *Water Management (General) Regulation 2011* to the project.

Water allocation account management rules, total daily extraction limits and rules governing environmental protection and access licence dealings also need to be considered.

The Harvestable Right gives landholders the right to capture and use for any purpose 10% of the average annual runoff from their property. The Harvestable Right has been defined in terms of an equivalent dam capacity called the Maximum Harvestable Right Dam Capacity (MHRDC). The MHRDC is determined by the area of the property (in hectares) and a site-specific run-off factor. The MHRDC includes the capacity of all existing dams on the property that do not have a current water licence. Storages capturing up to the harvestable right capacity are not required to be licensed but any capacity of the total of all storages/dams on the property greater than the MHRDC may require a licence.

For more information on Harvestable Right dams, including a calculator, visit:
http://www.water.nsw.gov.au/Water-licensing/Basic-water-rights/Harvesting-runoff/Harvesting-runoff

Dam Safety

Where new or modified dams are proposed, or where new development will occur below an existing dam, the NSW Dams Safety Committee should be consulted in relation to any safety issues that may arise. Conditions of approval may be recommended to ensure safety in relation to any new or existing dams.

See www.damsafety.nsw.gov.au for further information.

Surface Water Assessment

The predictive assessment of the impact of the proposed project on surface water sources should include the following:

- Identification of all surface water features including watercourses, wetlands and floodplains transected by or adjacent to the proposed project.
- Identification of all surface water sources as described by the relevant water sharing plan.
- Detailed description of dependent ecosystems and existing surface water users within the area, including basic landholder rights to water and adjacent/downstream licensed water users.
- Description of all works and surface infrastructure that will intercept, store, convey, or otherwise interact with surface water resources.
- Assessment of predicted impacts on the following:
    - flow of surface water, sediment movement, channel stability, and hydraulic regime,
    - water quality,
    - flood regime,
    - dependent ecosystems,
    - existing surface water users, and
    - planned environmental water and water sharing arrangements prescribed in the relevant water sharing plans.

Groundwater Assessment

To ensure the sustainable and integrated management of groundwater sources, the EIS needs to include adequate details to assess the impact of the project on all groundwater sources.

Where it is considered unlikely that groundwater will be intercepted or impacted (for example by infiltration), a brief site assessment and justification for the minimal impacts may be sufficient, accompanied by suitable contingency measures in place in the event that groundwater is intercepted, and appropriate measures to ensure that groundwater is not contaminated.

Where groundwater is expected to be intercepted or impacted, the following requirements should be used to assist the groundwater assessment for the proposal.

- Works likely to intercept, connect with or infiltrate the groundwater sources.
- Any proposed groundwater extraction, including purpose, location and construction details of all proposed bores and expected annual extraction volumes.
- Bore construction information is to be supplied to the Office of Water by submitting a "Form A" template. The Office of Water will supply "GW" registration numbers (and licence/approval numbers if required) which must be used as consistent and unique bore identifiers for all future reporting.
- A description of the watertable and groundwater pressure configuration, flow directions and rates and physical and chemical characteristics of the groundwater source (including connectivity with other groundwater and surface water sources).
- Sufficient baseline monitoring for groundwater quantity and quality for all aquifers and GDEs to establish a baseline incorporating typical temporal and spatial variations.

- The predicted impacts of any final landform on the groundwater regime.
- The existing groundwater users within the area (including the environment), any potential impacts on these users and safeguard measures to mitigate impacts.
- An assessment of groundwater quality, its beneficial use classification and prediction of any impacts on groundwater quality.
- An assessment of the potential for groundwater contamination (considering both the impacts of the proposal on groundwater contamination and the impacts of contamination on the proposal).
- Measures proposed to protect groundwater quality, both in the short and long term.
- Measures for preventing groundwater pollution so that remediation is not required.
- Protective measures for any groundwater dependent ecosystems (GDEs).
- Proposed methods of the disposal of waste water and approval from the relevant authority.
- The results of any models or predictive tools used.

Where potential impact/s are identified the assessment will need to identify limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts to the existing groundwater resource and any dependent groundwater environment or water users, including information on:

- Any proposed monitoring programs, including water levels and quality data.
- Reporting procedures for any monitoring program including mechanism for transfer of information.
- An assessment of any groundwater source/aquifer that may be sterilised from future use as a water supply as a consequence of the proposal.
- Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category).
- Description of the remedial measures or contingency plans proposed.
- Any funding assurances covering the anticipated post development maintenance cost, for example on-going groundwater monitoring for the nominated period.

Groundwater Dependent Ecosystems

The EIS must consider the potential impacts on any Groundwater Dependent Ecosystems (GDEs) at the site and in the vicinity of the site and:

- Identify any potential impacts on GDEs as a result of the proposal including:
  - the effect of the proposal on the recharge to groundwater systems;
  - the potential to adversely affect the water quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and
  - the effect on the function of GDEs (habitat, groundwater levels, connectivity).
- Provide safeguard measures for any GDEs.

Watercourses, Wetlands and Riparian Land

The EIS should address the potential impacts of the project on all watercourses likely to be affected by the project, existing riparian vegetation and the rehabilitation of riparian land. It is

recommended the EIS provides details on all watercourses potentially affected by the proposal, including:

- Scaled plans showing the location of:
  - wetlands/swamps, watercourses and top of bank;
  - riparian corridor widths to be established along the creeks;
  - existing riparian vegetation surrounding the watercourses (identify any areas to be protected and any riparian vegetation proposed to be removed);
  - the site boundary, the footprint of the proposal in relation to the watercourses and riparian areas; and
  - proposed location of any asset protection zones.
- Photographs of the watercourses/wetlands and a map showing the point from which the photos were taken.
- A detailed description of all potential impacts on the watercourses/riparian land.
- A detailed description of all potential impacts on the wetlands, including potential impacts to the wetlands hydrologic regime; groundwater recharge; habitat and any species that depend on the wetlands.
- A description of the design features and measures to be incorporated to mitigate potential impacts.
- Geomorphic and hydrological assessment of water courses including details of stream order (Strahler System), river style and energy regimes both in channel and on adjacent floodplains.

Landform rehabilitation

The Environmental Impact Statement report should include:

- Justification of the proposed final landform with regard to its impact on local and regional surface and groundwater systems;
- A detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape;
- Outline of proposed construction and restoration of topography and surface drainage features if affected by the project; and
- An outline of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation.

End Attachment A

Transport
Roads & Maritime
Services

7 April 2015

Director – Industry Assessments
DEPARTMENT OF PLANNING AND ENVIRONMENT
GPO Box 39
SYDNEY NSW 2000

Attention: Matthew Meyerson

Dear Sir/Madam,

Requirements for the preparation of an Environmental Impact Statement (EIS) for the proposed Georges Cove Marina, 146 Newbridge Road, Moorebank - ID No.912

I write in response to your email to Roads and Maritime Services (Development Sydney) dated 25 March 2015 requesting requirements for the above proposal. As the proposal is located adjacent to a navigable waterway, Development Sydney forwarded the referral to Maritime Division to review and provide comment.

The size of the proposed marina will generate a significant increase in vessel movements within the adjacent waterway (Georges River). To assess any impact that this will have on navigation and safety within the waterway, a *Navigational Assessment* should be undertaken. This assessment should consider the impacts of additional vessel movements within the waterway and incorporate safety/mitigation measures to ensure that all users of the waterway are not adversely impacted upon by the development.

Please note that these requirements only relate to maritime issues and that the Roads Division of Roads and Maritime Services will provide separate requirements.

If you have any further questions, please do not hesitate to contact the undersigned on 8588 4581 or at scott.schimanski@rms.nsw.gov.au.

Yours sincerely

Scott Schimanski
Senior Planner
Property, Strategy and Planning

Transport
Roads & Maritime
Services

2 April 2015

RMS Ref: SYD15/00381 (A8903906)
Your Ref: SEAR 912

Manager – Industry Assessment
Department of Planning and Environment
GPO Box 39
Sydney NSW 2001

Attention: Matthew Meyerson

REQUEST FOR SEARS FOR GEORGES COVE MARINA
146 NEWBRIDGE ROAD, MOOREBANK (DGR 563)

Dear Sir/Madam,

Reference is made to your email dated 25 March 2015 requesting Roads and Maritime to provide details of key issues and assessment requirements regarding the abovementioned development for inclusion in the Secretary's Environment Assessment Requirements (SEAR's).

Roads and Maritime require the following issues to be included in the transport and traffic impact assessment of the proposed development:

1. Daily and peak traffic movements likely to be generated by the proposed development including the impact on nearby intersections and the need/associated funding for upgrading or road improvement works (if required).

2. Details of the proposed accesses and the parking provisions associated with the proposed development including compliance with the requirements of the relevant Australian Standards (ie: turn paths, sight distance requirements, aisle widths, etc).

3. Roads and Maritime will require in due course the provision of a traffic management plan for all demolition/construction activities, detailing vehicle routes, number of trucks, hours of operation, access arrangements and traffic control measures.

Any inquiries in relation to this development application can be directed to Jana Jegathesan on 8849-2313.

Yours sincerely

Pahee Rathan
Senior Land Use Planner
Network and Safety Management

Matthew Meyerson

From:	Andrew Docking <andrew.docking@dpi.nsw.gov.au>
Sent:	Tuesday, 31 March 2015 11:17 AM
To:	Matthew Meyerson
Cc:	Landuse Enquiries
Subject:	Fwd: FW: Request for EARs - Marina, Liverpool LGA
Attachments:	Untitled attachment 00385.txt; Form A - SEAR 912.pdf
Categories:	Submission

Matthew

Agriculture NSW

Weed management during construction and operation accord with existing State, regional or local weed management plans or strategies. Destruction or removal of Noxious Weeds may require a permit from Department of Primary Industries
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0015/170232/Application-for-noxious-weed-permit.pdf

Thanks

Regards

Andrew Docking | Resource Management Officer | Agriculture NSW
Postal: NSW Department of Primary Industries | Locked Bag 21 | ORANGE | NSW 2800 or
landuse.ag@dpi.nsw.gov.au
T: 02 9842 8607| M: 0437 896 305
E: andrew.docking@dpi.nsw.gov.au | W: www.industry.nsw.gov.au

Land use planning information and guidelines are available at:
http://www.dpi.nsw.gov.au/agriculture/resources/lup
http://www.dpi.nsw.gov.au/agriculture/resources/lup/analysis-census-data

Building thriving, sustainable Agriculture for tomorrow's communities

---------- Forwarded message ----------
From: **Landuse Ag** <landuse.ag@dpi.nsw.gov.au>
Date: 30 March 2015 at 17:35
Subject: Fwd: FW: Request for EARs - Marina, Liverpool LGA
To: Andrew Docking <andrew.docking@dpi.nsw.gov.au>

FYI

Landuse Planning, Education and Regional Services, Agriculture NSW
E: landuse.ag@dpi.nsw.gov.au

Primary Contact:
Robert Williamson
161 Kite Street | Locked Bag 21 | ORANGE NSW 2800
T: 02 6391 3166 F: 02 6391 3551| E: robert.williamson@dpi.nsw.gov.au

---------- Forwarded message ----------
From: <landuse.enquiries@dpi.nsw.gov.au>
Date: Wed, Mar 25, 2015 at 11:51 AM
Subject: FW: Request for EARs - Marina, Liverpool LGA
To: Water Referrals <water.referrals@dpi.nsw.gov.au>, landuse.ag@dpi.nsw.gov.au, landuse.minerals@industry.nsw.gov.au, ahp.central@dpi.nsw.gov.au

Hi all

TRIM Ref: V15/416#55

Please find below correspondence for the above Local Designated Development application for your direct response to Planning, if relevant (**due date 10/04/15**). It would be appreciated if you could cc me a copy of the response or advise me when completed for my records.

If unable to respond by the due date address your response directly to the proponent with a copy to Planning.

Many thanks Lisa

From: Matthew Meyerson [mailto:matthew.meyerson@planning.nsw.gov.au]
Sent: Wednesday, 25 March 2015 10:41 AM
To: planning.matters@environment.nsw.gov.au; development.Sydney@rms.nsw.gov.au; water.referrals@dpi.nsw.gov.au; landuse.enquiries@dpi.nsw.gov.au
Subject: Request for EARs - Marina, Liverpool LGA

Proposal – Marina, Liverpool EARs ID No. 912

Good Morning,

EMGA Mitchell McLennan (the Applicant) has requested the requirements of the Secretary of the Department of Planning and Environment for the preparation of an Environmental Impact Statement (EIS) for the above local designated development located in the Liverpool LGA.

Under Schedule 2 of the *Environmental Planning and Assessment Regulation 2000,* the Secretary is requesting your requirements for the EIS.

It would be greatly appreciated if we could receive your advice by **10 April 2015**, otherwise the Secretary (or Delegate) will advise the Applicant to consult you directly for your requirements. If this occurs, it would be appreciated if you would forward a copy of any requirements to us for our records.

I have attached a copy of the applicants request for your reference.

If you have any enquiries please contact me on 9228 6378.

Kind Regards,

Matthew Meyerson

Matthew Meyerson

Student Planner

Industry Assessments

Department of Planning & Environment

Level 3 Room 305 | 23-33 Bridge Street | GPO Box 39 SYDNEY NSW 2001

T 02 9228 6378 E matthew.meyerson@planning.nsw.gov.au

NSW GOVERNMENT | Planning & Environment

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Appendix A2

SEAR 912 (DPE 2018)

1

Industry Assessments
Contact: Patrick Copas
Phone: (02) 9274 6273
Email: patrick.copas@planning.nsw.gov.au

Mr Philip Towler
Associate Director
EMM Consulting
PO Box 21
ST LEONARDS NSW 1590

OBJ15/05521
SEAR 912 – Updated

Dear Mr Towler

Georges Cove Marina – 146 Newbridge Road, Moorebank (Lot 7 DP 1065574)
Updated Planning Secretary's Environmental Assessment Requirements (SEAR) 912

Thank you for your request for updated Planning Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an Environmental Impact Statement (EIS) for the above development proposal. I have attached a copy of these updated requirements.

In support of your original application, you indicated that your proposal is both designated and integrated development under Part 4 of the *Environmental Planning and Assessment Act 1979*, and requires an approval under the *Protection of the Environment Operations Act 1997* and the *Water Management Act 2000*.

In preparing the updated SEARs, the Department of Planning and Environment (the Department) has re-consulted with the Department of Industry – Lands and Water Division and the Department of Primary Industries. Their additional comments/requirements for the EIS have been included in **Attachment 1**.

The Department has also re-consulted with the Environment Protection Authority and the Roads and Maritime Services. Unfortunately, these authorities did not respond in time, and you are required to consult with them directly regarding their additional comments/requirements for the EIS.

A copy of the authorities' original responses has been included in **Attachment 2**. You must ensure you address both their original and updated comments/requirements as part of your EIS.

If any other integrated approvals are identified before the Development Application (DA) is lodged, you must undertake direct consultation with the relevant agencies, and address their requirements in the EIS.

If your proposal contains any actions that could have a significant impact on matters of National Environmental Significance, then it will require an additional approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This approval is in addition to any approvals required under NSW legislation. If you have any questions about the application of the EPBC Act to your proposal, you should contact the Commonwealth Department of the Environment and Energy on (02) 6274 1111.

Should you have any further enquiries, please contact Patrick Copas, Planning Services, at the Department on the details above.

Yours sincerely

9/10/18.

Chris Ritchie
Director
Industry Assessments
as delegate of the Planning Secretary

Planning Secretary's Environmental Assessment Requirements

Section 4.12(8) of the *Environmental Planning and Assessment Act 1979*. Schedule 3 of the *Environmental Planning and Assessment Regulation 2000.*

Designated Development

SEAR Number	912 – Updated
Proposal	Construction and operation of a marina comprising the following main elements: • a dry berth facility providing 250 berths for small craft • a wet berth facility for 186 small craft berths • three carparks providing approximately 489 car spaces • private marina club house • associated support infrastructure.
Location	146 Newbridge Road, Moorebank (Lot 7 DP 1065574), in the Liverpool local government area.
Applicant	Benedict Industries Pty Ltd
Date of Issue	9 October 2018
General Requirements	The Environmental Impact Statement (EIS) must meet the minimum form and content requirements in clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.*
Key Issues	The EIS must include an assessment of all potential impacts of the proposed development on the existing environment (including cumulative impacts if necessary) and develop appropriate measures to avoid, minimise, mitigate and/or manage these potential impacts. As part of the EIS assessment, the following matters must also be addressed: • **strategic context** – including: – a detailed justification for the proposal and suitability of the site for the development – a demonstration that the proposal is consistent with all relevant planning strategies, environmental planning instruments, development control plans (DCPs), or justification for any inconsistencies – a list of any approvals that must be obtained under any other Act or law before the development may lawfully be carried out. • **air quality** – including: – a description of all potential sources of air and odour emissions – an air quality impact assessment in accordance with relevant Environment Protection Authority guidelines – a description and appraisal of air quality impact mitigation and monitoring measures. • **noise and vibration** – including: – a description of all potential noise and vibration sources during construction and operation, including road traffic noise – a noise and vibration assessment in accordance with the relevant Environment Protection Authority guidelines – a description and appraisal of noise and vibration mitigation and monitoring measures. • **soil and water** – including: – a description of local soils, topography, drainage and landscapes – details of water usage for the proposal including existing and proposed water licencing requirements in accordance with the *Water Act 1912* and/or

	the *Water Management Act 2000* – details of sediment and erosion controls – a detailed site water balance – an assessment of impacts associated with dredging, reclamation and seawall construction and operation – an assessment in accordance with ASSMAC Guidelines for the presence and extent of acid sulfate soils (ASS) and potential acid sulfate soils (PASS) on the site and, where relevant, appropriate mitigation measures – an assessment of potential impacts on the quality and quantity of surface and groundwater resources – details of the proposed stormwater and wastewater management systems (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts – a description and appraisal of impact mitigation and monitoring measures. • **contamination** – including: – a detailed assessment of the extent and nature of any contamination of the soil, groundwater and marine sediments – conceptual site model detailing the potential risks to human health and the environmental receptors in the vicinity of the site – the preparation of a Remedial Action Plan (RAP) for the site, in accordance with the relevant guidelines produced or approved under the *Contaminated Land Management Act 1997*. • **traffic and transport** – including: – details of road transport routes and access to the site – road traffic predictions for the development during construction and operation – an assessment of impacts to the safety and function of the road network and the details of any road upgrades required for the development. • **marine safety and navigation** – including an assessment of the impacts on water-based traffic and the existing users of the Georges River in the vicinity of the marina. • **biodiversity** – including: – accurate predictions of any vegetation clearing on site or for any road upgrades – a detailed assessment of the potential impacts on any threatened species, populations, endangered ecological communities or their habitats, groundwater dependent ecosystems and any potential for offset requirements in accordance with the current Office of Environment and Heritage legislation and guidelines – a detailed assessment of potential impacts to fish stocks and fish habitat – details of weed management during construction and operation in accordance with existing State, regional or local weed management plans or strategies – a detailed description of the measures to avoid, minimise, mitigate and offset biodiversity impacts. • **waste management** – including: – details of waste handling including, transport, identification, receipt, stockpiling and quality control including off-site reuse and disposal – the measures that would be implemented to ensure that the proposed development is consistent with the aims, objectives and guidelines in the *NSW Waste Avoidance and Resource Recovery Strategy 2014-21.* • **visual** – including an impact assessment at private receptors and public vantage points. • **heritage** – including Aboriginal and non-Aboriginal cultural heritage.

Environmental Planning Instruments and other policies	The EIS must assess the proposal against the relevant environmental planning instruments, including but not limited to: • *State Environmental Planning Policy (Infrastructure) 2007* • *State Environmental Planning Policy (Coastal Management) 2018* • *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development* • *State Environmental Planning Policy No. 55 – Remediation of Land* • *Greater Metropolitan Regional Environment Plan No. 2 – Georges River Catchment* • *Liverpool Local Environmental Plan 2008* • *Greater Sydney Region Plan – A Metropolis of Three Cities* • *Western City District Plan* • relevant development control plans and section 94 plans.
Guidelines	During the preparation of the EIS you should consult the Department's Register of Development Assessment Guidelines which is available on the Department's website at planning.nsw.gov.au under Development Proposals/Register of Development Assessment Guidelines. Whilst not exhaustive, this Register contains some of the guidelines, policies, and plans that must be taken into account in the environmental assessment of the proposed development.
Consultation	During the preparation of the EIS, you must consult the relevant local, State and Commonwealth government authorities, service providers and community groups, and address any issues they may raise in the EIS. In particular, you should consult with the: • Environment Protection Authority • Office of Environment and Heritage • Department of Industry – Lands and Water • Department of Primary Industries • Roads and Maritime Services • Greater Sydney Commission • Liverpool City Council • the surrounding landowners and occupiers that are likely to be impacted by the proposal. Details of the consultation carried out and issues raised must be included in the EIS.
Further consultation after 2 years	If you do not lodge an application under Section 4.12(8) of the *Environmental Planning and Assessment Act 1979* within 2 years of the issue date of these SEARs, you must consult with the Planning Secretary in relation to any further requirements for lodgement.

ATTACHMENT 1
2018 Responses – Public Authorities

Department of Industry

OUT18/14453

Patrick Copas
Planning Officer
Industry Assessments
NSW Department of Planning and Environment

patrick.copas@planning.nsw.gov.au

Dear Mr Copas

Georges Cove Marine SEAR 912
Comment on the Secretary's Environmental Assessment Requirements (SEARs)

I refer to your email of 12 September 2018 to the Department of Industry (DoI) in respect to the above matter.

Comment has been sought from relevant branches of Lands & Water and Department of Primary Industries (DPI), and all advice in the original SEARs is still applicable.

Any further referrals to Department of Industry can be sent by email to landuse.enquiries@dpi.nsw.gov.au.

Yours sincerely

Alison Collaros
A/Manager, Assessment Advice
28 September 2018

ATTACHMENT 2
Original Requirements – Public Authorities

Our reference: DOC15/111855
Contact: Alex Bowlay 02 9995 5257

Mr Matthew Meyerson
Industry Assessments
Department of Planning & Environment
GPO Box 39
SYDNEY NSW 2001

Dear Matthew,

Proposal - Georges Cove Marina, Liverpool SEARs ID No. 912

The Environment Protection Authority (EPA) refers to your email dated 25 March 2015 requesting input to the Secretary's Environmental Assessment Requirements (SEARs) for the Georges Cove Marina project based on information provided by EMGA Mitchell McLennan (the Applicant) on behalf of Benedict Industries Pty Ltd (the Proponent).

The EPA has identified a range of environmental issues from supporting information provided in the email that require consideration in the Environmental Impact Statement (EIS). These are outlined in Attachment A.

The EPA also notes that the types of work to be undertaken for the project and their proximity to a number of sensitive receivers and to commercial and recreational vessels operations on the Georges River will present certain challenges. Accordingly, the EPA recommends that the EIS includes comprehensive consideration of the following issues:

- odour and other air emission controls (e.g. dust) throughout land restoration processes and operation of the marina
- noise from both mobile and stationary sources used in any aspect of the development
- sediment controls during the excavation of any material at the site during the construction phase
- the discharge of treated wastewater and stormwater from the site to the Georges River
- contaminated soil and water issues relating to prolonged historical use of the site for extractive activities, and proposed connection of dredged ponds with the Georges River
- incident risks and contingencies in the event that the planned mitigation measures are insufficient
- marine foreshore construction and the need to use uncontaminated material

Should you wish to discuss any of the above information please contact Operations Officer Alex Bowlay on 9995 5257.

Yours sincerely



7 April 2015

JAMES GOODWIN
Unit Head, High Risk Facilities Unit
Environment Protection Authority

PO Box 668 Parramatta NSW 2124
Level 13, 10 Valentine Avenue, Parramatta NSW 2150
Tel: (02) 9995 5000 Fax: (02) 9995 6900
ABN 43 692 285 758
www.epa.nsw.gov.au

Attachment A

Request for Secretary's Environmental Assessment Requirements – SEAR 912 – Liverpool LGA - Georges Cove Marina Project, Moorebank

Environment Protection Licence and Appropriate Regulatory Authority role

The EPA has identified likely requirements for licensing under the *Protection of the Environment Operations Act* (POEO Act) and the need to identify the agency that will be the Appropriate Regulatory Authority for any non-licensed activities. The EPA has determined that at least some aspects of the project will likely require an Environment Protection Licence (EPL). The EPA will work with Liverpool City Council and the proponent to determine the most appropriate regulatory arrangement for administering the POEO Act requirements as they relate to the project.

It is possible that the project will involve undertaking scheduled development works requiring a scheduled development work licence under the POEO Act. The proposed provision of dry and wet berthing facilities for the number of small water craft indicated in the supporting information indicates that an environment protection licence (premises-based) may be required if the activity qualifies as a 'Marinas and boat repairs' scheduled activity under Schedule 1 of the POEO Act.

Under Schedule 1, a licence is required if the facility has the capacity to handle more than 80 vessels (excluding rowing boats, dinghies and other small craft) at any time as per the 'boat moorings and storage' activity threshold. Supporting information (Figure 8 Marina layout – parking and berth details) is unclear on the detail in this regard as the layout plan contains blurred details on proposed craft type, length and numbers however overall the number of proposed berths is known to exceed 430. It is not known whether maintenance of water craft will occur at the site, which has further implications for licencing depending on the nature of the craft.

The supporting information also makes reference to sewage pump out facilities and provision of support infrastructure that may require authorisation under an EPL.

Odour/ Air quality

Dust management from transportation of materials including untreated stockpiles, must be taken into specific consideration given the proximity to a range of sensitive receivers and commercial and recreational vessels on the George River. Any odour and/or dust suppressants being considered for use in operations must be detailed in the EIS and include investigation of low toxicity options.

An Air Quality Impact Assessment ("AQIA") should be undertaken for the project with the level of assessment being proportionate to the likely level of odour impacts and should consider the requirements of the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (2005)*.

The AQIA should also make appropriate reference to the *Assessment and Management of Odour from Stationary Sources in NSW: Technical Framework (2006)* and *Management of Odour from Stationary Sources in NSW: Technical Notes (2006)*.

The AQIA should also consider the requirements of the *Protection of the Environment Operations (Clean Air) Regulation 2010* if applicable.

Remediation/Contamination

The proposal is known to have received prior development consent from Liverpool City Council on 22 August 2014 however an adjoining landowner successfully challenged the consent on the grounds of clause 7 of State Environment Planning Policy 55 – Remediation of Land (SEPP 55).

A finding of the Land and Environment Court was that neither the preliminary investigation of the land nor the report of the preliminary investigation was carried out, and was not in compliance with relevant clauses of SEPP 55. The consent was declared invalid on 18 March 2015. The proponent is to carry out a preliminary investigation of the land and submit a report to the JRRP, and the JRRP is to undertake consideration under the requirements of SEPP 55 before determining the proponent's development application for consent to carry out development on the land.

The EPA is not aware of any records of contaminated land notices issued for the site however the proponent needs to demonstrate that land potential land or groundwater contamination issues have been addressed.

Supporting information included with the application indicates that restoration and remediation activities have not commenced after many years of extractive activities taking place at the site. Dredged ponds at the site will be retained for use as part of the marina proposal and will ultimately connect with the Georges River. Water and sediment in these ponds should be assessed accordingly before connection.

Underground Petroleum Storage Systems (UPSS)

The proposal includes installation of a 60,000 litre petrol tank and a 30,000 litre diesel tank, along with fuel pumping facilities. The *Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2014* may apply depending on whether the tanks are installed underground and any applicable exemptions to the provisions of the regulation.

Acid Sulphate Soils

The potential impacts identified for the project on acid sulphate soils must be assessed and managed in accordance with the relevant guidelines in the *Acid Sulphate Soils Manual* (Stone et al. 1998) and the *Acid Sulphate Soils Laboratory Methods Guidelines* (Ahern et al. 2004). If acid sulphate soils are identified on the premises the proponent must prepare an Acid Sulphate Soil Management Plan in accordance with the *Acid Soil Planning Guidelines*.

Noise impacts

This project has the potential to impact a number of sensitive receivers and recreational users of the land and water surrounding the project. A Noise Impact Assessment should be undertaken which considers construction and operational noise across the project, and must include the following:

- Operational noise from stationary aspects of the project should be assessed using the *NSW Industrial Noise Policy* (EPA, 2000). http://www.epa.nsw.gov.au/resources/noise/ind_noise.pdf

- Construction noise associated with the project should be assessed using the *Interim Construction Noise Guideline (*EPA, 2009). http://www.environment.nsw.gov.au/noise/constructnoise.htm

- Vibration from any construction activities to be undertaken on the premises should be assessed using the guidelines contained in the *Assessing Vibration: a technical guideline* (EPA, 2006). http://www.environment.nsw.gov.au/noise/vibrationguide.htm

Waste treatment, discharge and management

The EIS should provide details of liquid waste and non-liquid waste management, including:

- the transportation, assessment and handling of waste generated at the site
- any stockpiling of wastes materials at the site
- any waste processing related to the project including on-site treatment
- the method for disposing of all waste materials,
- and proposed controls for managing the environmental impacts of these activities.

Chemicals

The EIS should provide details of:

- the type and quantity of any chemical substances to be used or stored and describe arrangements for their safe use and storage, and
- procedures for the assessment, handling, storage, transport and disposal of all hazardous and dangerous materials used, stored, processed or disposed of, in addition to the requirements for liquid and non-liquid wastes.

Incident Management

The EIS should include a comprehensive assessment of the potential for incidents to occur at any stage of the project, the measures to be used to minimise the risk of incidents and the procedures to be employed in the event of an incident. In addition, information is required about contingency actions in the event that planned incident mitigation measures are inadequate.

Community liaison

The EPA is not aware of community engagement activities for planning processes associated with the project to date. It is recommended that the proponent embark on a program of ongoing consultation throughout the project, from commencement until completion, and this should be detailed in the EIS.

2 April 2015

RMS Ref: SYD15/00381 (A8903906)
Your Ref: SEAR 912

Manager – Industry Assessment
Department of Planning and Environment
GPO Box 39
Sydney NSW 2001

Attention: Matthew Meyerson

REQUEST FOR SEARS FOR GEORGES COVE MARINA
146 NEWBRIDGE ROAD, MOOREBANK (DGR 563)

Dear Sir/Madam,

Reference is made to your email dated 25 March 2015 requesting Roads and Maritime to provide details of key issues and assessment requirements regarding the abovementioned development for inclusion in the Secretary's Environment Assessment Requirements (SEAR's).

Roads and Maritime require the following issues to be included in the transport and traffic impact assessment of the proposed development:

1. Daily and peak traffic movements likely to be generated by the proposed development including the impact on nearby intersections and the need/associated funding for upgrading or road improvement works (if required).

2. Details of the proposed accesses and the parking provisions associated with the proposed development including compliance with the requirements of the relevant Australian Standards (ie: turn paths, sight distance requirements, aisle widths, etc).

3. Roads and Maritime will require in due course the provision of a traffic management plan for all demolition/construction activities, detailing vehicle routes, number of trucks, hours of operation, access arrangements and traffic control measures.

Any inquiries in relation to this development application can be directed to Jana Jegathesan on 8849-2313.

Yours sincerely

Pahee Rathan
Senior Land Use Planner
Network and Safety Management

Transport
Roads & Maritime
Services

7 April 2015

Director – Industry Assessments
DEPARTMENT OF PLANNING AND ENVIRONMENT
GPO Box 39
SYDNEY NSW 2000

Attention: Matthew Meyerson

Dear Sir/Madam,

Requirements for the preparation of an Environmental Impact Statement (EIS) for the proposed Georges Cove Marina, 146 Newbridge Road, Moorebank - ID No.912

I write in response to your email to Roads and Maritime Services (Development Sydney) dated 25 March 2015 requesting requirements for the above proposal. As the proposal is located adjacent to a navigable waterway, Development Sydney forwarded the referral to Maritime Division to review and provide comment.

The size of the proposed marina will generate a significant increase in vessel movements within the adjacent waterway (Georges River). To assess any impact that this will have on navigation and safety within the waterway, a *Navigational Assessment* should be undertaken. This assessment should consider the impacts of additional vessel movements within the waterway and incorporate safety/mitigation measures to ensure that all users of the waterway are not adversely impacted upon by the development.

Please note that these requirements only relate to maritime issues and that the Roads Division of Roads and Maritime Services will provide separate requirements.

If you have any further questions, please do not hesitate to contact the undersigned on 8588 4581 or at scott.schimanski@rms.nsw.gov.au.

Yours sincerely

Scott Schimanski
Senior Planner
Property, Strategy and Planning

Department of Primary Industries
Office of Water

to Matthew Meyerson
Industry Assessments
Department of Planning & Environment

from Mohammed Ismail
Water Regulation Officer
NSW Office of Water
Mohammed.ismail@dpi.nsw.gov.au

date 15/04/2015

Request for Secretary's Environmental Assessment Requirements for the Construction of a Marina and relative Facilities adjoin Georges River, EARs ID No. 912, (our Ref: ERM2011/304)

I refer to your e-mail dated 25/3/2015 requesting the Secretary's Environmental Assessment Requirements (SEARs) from NSW Office of Water and provide the following comments below, and further detail in **Attachment A**.

It is recommended that the EIS be required to include:

- Details of water proposed to be taken (including through inflow and seepage) from each surface and groundwater source as defined by the relevant water sharing plan.
- Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).
- The identification of an adequate and secure water supply for the life of the project. Confirmation that water can be sourced from an appropriately authorised and reliable supply. This is to include an assessment of the current market depth where water entitlement is required to be purchased.
- A detailed and consolidated site water balance.
- Assessment of impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.
- Full technical details and data of all surface and groundwater modelling.
- Proposed surface and groundwater monitoring activities and methodologies.
- Assessment of any potential cumulative impacts on water resources, and any proposed options to manage the cumulative impacts.
- Consideration of relevant policies and guidelines.
- A statement of where each element of the SEARs is addressed in the EIS (i.e. in the form of a table).

Should you require further information please contact Mohammed Ismail, Water Regulation officer on 0288387535.

Office of Water contact details:

Mohammed Ismail| Water Regulation Officer
NSW Department of Primary Industries | Office of Water
T: 02 8838 7535 | F: 02 8838 7554 | E: mohammed.ismail@dpi.nsw.gov.au
W: www.dpi.nsw.gov.au | www.water.nsw.gov.au

ATTACHMENT A

NSW Office of Water Comments on Secretary's Environmental Assessment Requirements
Marina, Liverpool EARs ID No. 912

The following detailed assessment requirements are provided to assist in adequately addressing the assessment requirements for this proposal.

For further information visit the NSW Office of Water website, www.water.nsw.gov.au

Key Relevant Legislative Instruments

This section provides a basic summary to aid proponents in the development of an Environmental Impact Statement (EIS), and should not be considered a complete list or comprehensive summary of relevant legislative instruments that may apply to the regulation of water resources for a project.

The EIS should take into account the objects and regulatory requirements of the *Water Act 1912* (WA 1912) and *Water Management Act 2000* (*WMA 2000*), and associated regulations and instruments, as applicable.

Water Management Act 2000 (WMA 2000)
Key points:

- Volumetric licensing in areas covered by water sharing plans
- Works within 40m of waterfront land
- SSD & SSI projects are exempt from requiring water supply work approvals and controlled activity approvals as a result of the *Environmental Planning & Assessment Act 1979 (EP&A Act)*.
- No exemptions for volumetric licensing apply as a result of the *EP&A Act*.
- Basic landholder rights, including harvestable rights dams
- Aquifer interference activity approval and flood management work approval provisions have not yet commenced and are regulated by the *Water Act 1912*
- Maximum penalties of $2.2 million plus $264,000 for each day an offence continues apply under the *WMA 2000*

Water Act 1912 (WA 1912)
Key points:

- Volumetric licensing in areas where no water sharing plan applies
- Monitoring bores
- Aquifer interference activities that are not regulated as a water supply work under the *WMA 2000*.
- Flood management works
- No exemptions apply to licences or permits under the *WA 1912* as a result of the *EP&A Act*.
- Regulation of water bore driller licensing.

Water Management (General) Regulation 2011
Key points:

- Provides various exemptions for volumetric licensing and activity approvals
- Provides further detail on requirements for dealings and applications.

Water Sharing Plans – these are considered regulations under the *WMA 2000*

Access Licence Dealing Principles Order 2004

Harvestable Rights Orders

Water Sharing Plans

The proposal is located within the area covered by the Water Sharing Plan for Greater Metropolitan Region. The EIS is required to:

- Demonstrate how the proposal is consistent with the relevant rules of the Water Sharing Plan including rules for access licences, distance restrictions for water supply works and rules for the management of local impacts in respect of surface water and groundwater sources, ecosystem protection (including groundwater dependent ecosystems), water quality and surface-groundwater connectivity.
- Provide a description of any site water use (amount of water to be taken from each water source) and management including all sediment dams, clear water diversion structures with detail on the location, design specifications and storage capacities for all the existing and proposed water management structures.
- Provide an analysis of the proposed water supply arrangements against the rules for access licences and other applicable requirements of any relevant WSP, including:
    - Sufficient market depth to acquire the necessary entitlements for each water source.
    - Ability to carry out a "dealing" to transfer the water to relevant location under the rules of the WSP.
    - Daily and long-term access rules.
    - Account management and carryover provisions.
- Provide a detailed and consolidated site water balance.
- Further detail on licensing requirements is provided below.

Relevant Policies and Guidelines

The EIS should take into account the following policies (as applicable):

- NSW Guidelines for Controlled Activities on Waterfront Land (NOW, 2012)
- NSW Aquifer Interference Policy (NOW, 2012)
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW, 2012)
- Australian Groundwater Modelling Guidelines (NWC, 2012)
- NSW State Rivers and Estuary Policy (1993)
- NSW State Groundwater Policy Framework Document (1997)
- NSW State Groundwater Quality Protection Policy (1998)
- NSW State Groundwater Dependent Ecosystems Policy (2002)
- NSW Water Extraction Monitoring Policy (2007)

Office of Water policies can be accessed at the following links:
http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/default.aspx
http://www.water.nsw.gov.au/Water-licensing/Approvals/Controlled-activities/default.aspx

An assessment framework for the NSW Aquifer Interference Policy can be found online at: http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/Aquifer-interference.

Licensing Considerations

The EIS is required to provide:

- Identification of water requirements for the life of the project in terms of both volume and timing (including predictions of potential ongoing groundwater take following the cessation of operations at the site – such as evaporative loss from open voids or inflows).
- Details of the water supply source(s) for the proposal including any proposed surface water and groundwater extraction from each water source as defined in the relevant Water Sharing Plan/s and all water supply works to take water.
- Explanation of how the required water entitlements will be obtained (i.e. through a new or existing licence/s, trading on the water market, controlled allocations etc.).
- Information on the purpose, location, construction and expected annual extraction volumes including details on all existing and proposed water supply works which take surface water, (pumps, dams, diversions, etc).
- Details on all bores and excavations for the purpose of investigation, extraction, dewatering, testing and monitoring. All predicted groundwater take must be accounted for through adequate licensing.
- Details on existing dams/storages (including the date of construction, location, purpose, size and capacity) and any proposal to change the purpose of existing dams/storages
- Details on the location, purpose, size and capacity of any new proposed dams/storages.
- Applicability of any exemptions under the *Water Management (General) Regulation 2011* to the project.

Water allocation account management rules, total daily extraction limits and rules governing environmental protection and access licence dealings also need to be considered.

The Harvestable Right gives landholders the right to capture and use for any purpose 10% of the average annual runoff from their property. The Harvestable Right has been defined in terms of an equivalent dam capacity called the Maximum Harvestable Right Dam Capacity (MHRDC). The MHRDC is determined by the area of the property (in hectares) and a site-specific run-off factor. The MHRDC includes the capacity of all existing dams on the property that do not have a current water licence. Storages capturing up to the harvestable right capacity are not required to be licensed but any capacity of the total of all storages/dams on the property greater than the MHRDC may require a licence.

For more information on Harvestable Right dams, including a calculator, visit:
http://www.water.nsw.gov.au/Water-licensing/Basic-water-rights/Harvesting-runoff/Harvesting-runoff

Dam Safety

Where new or modified dams are proposed, or where new development will occur below an existing dam, the NSW Dams Safety Committee should be consulted in relation to any safety issues that may arise. Conditions of approval may be recommended to ensure safety in relation to any new or existing dams.

See www.damsafety.nsw.gov.au for further information.

Surface Water Assessment

The predictive assessment of the impact of the proposed project on surface water sources should include the following:

- Identification of all surface water features including watercourses, wetlands and floodplains transected by or adjacent to the proposed project.
- Identification of all surface water sources as described by the relevant water sharing plan.
- Detailed description of dependent ecosystems and existing surface water users within the area, including basic landholder rights to water and adjacent/downstream licensed water users.
- Description of all works and surface infrastructure that will intercept, store, convey, or otherwise interact with surface water resources.
- Assessment of predicted impacts on the following:
    - flow of surface water, sediment movement, channel stability, and hydraulic regime,
    - water quality,
    - flood regime,
    - dependent ecosystems,
    - existing surface water users, and
    - planned environmental water and water sharing arrangements prescribed in the relevant water sharing plans.

Groundwater Assessment

To ensure the sustainable and integrated management of groundwater sources, the EIS needs to include adequate details to assess the impact of the project on all groundwater sources.

Where it is considered unlikely that groundwater will be intercepted or impacted (for example by infiltration), a brief site assessment and justification for the minimal impacts may be sufficient, accompanied by suitable contingency measures in place in the event that groundwater is intercepted, and appropriate measures to ensure that groundwater is not contaminated.

Where groundwater is expected to be intercepted or impacted, the following requirements should be used to assist the groundwater assessment for the proposal.

- Works likely to intercept, connect with or infiltrate the groundwater sources.
- Any proposed groundwater extraction, including purpose, location and construction details of all proposed bores and expected annual extraction volumes.
- Bore construction information is to be supplied to the Office of Water by submitting a “Form A” template. The Office of Water will supply “GW” registration numbers (and licence/approval numbers if required) which must be used as consistent and unique bore identifiers for all future reporting.
- A description of the watertable and groundwater pressure configuration, flow directions and rates and physical and chemical characteristics of the groundwater source (including connectivity with other groundwater and surface water sources).
- Sufficient baseline monitoring for groundwater quantity and quality for all aquifers and GDEs to establish a baseline incorporating typical temporal and spatial variations.

- The predicted impacts of any final landform on the groundwater regime.
- The existing groundwater users within the area (including the environment), any potential impacts on these users and safeguard measures to mitigate impacts.
- An assessment of groundwater quality, its beneficial use classification and prediction of any impacts on groundwater quality.
- An assessment of the potential for groundwater contamination (considering both the impacts of the proposal on groundwater contamination and the impacts of contamination on the proposal).
- Measures proposed to protect groundwater quality, both in the short and long term.
- Measures for preventing groundwater pollution so that remediation is not required.
- Protective measures for any groundwater dependent ecosystems (GDEs).
- Proposed methods of the disposal of waste water and approval from the relevant authority.
- The results of any models or predictive tools used.

Where potential impact/s are identified the assessment will need to identify limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts to the existing groundwater resource and any dependent groundwater environment or water users, including information on:

- Any proposed monitoring programs, including water levels and quality data.
- Reporting procedures for any monitoring program including mechanism for transfer of information.
- An assessment of any groundwater source/aquifer that may be sterilised from future use as a water supply as a consequence of the proposal.
- Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category).
- Description of the remedial measures or contingency plans proposed.
- Any funding assurances covering the anticipated post development maintenance cost, for example on-going groundwater monitoring for the nominated period.

Groundwater Dependent Ecosystems

The EIS must consider the potential impacts on any Groundwater Dependent Ecosystems (GDEs) at the site and in the vicinity of the site and:

- Identify any potential impacts on GDEs as a result of the proposal including:
  - the effect of the proposal on the recharge to groundwater systems;
  - the potential to adversely affect the water quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and
  - the effect on the function of GDEs (habitat, groundwater levels, connectivity).
- Provide safeguard measures for any GDEs.

Watercourses, Wetlands and Riparian Land

The EIS should address the potential impacts of the project on all watercourses likely to be affected by the project, existing riparian vegetation and the rehabilitation of riparian land. It is

recommended the EIS provides details on all watercourses potentially affected by the proposal, including:

- Scaled plans showing the location of:
  - wetlands/swamps, watercourses and top of bank;
  - riparian corridor widths to be established along the creeks;
  - existing riparian vegetation surrounding the watercourses (identify any areas to be protected and any riparian vegetation proposed to be removed);
  - the site boundary, the footprint of the proposal in relation to the watercourses and riparian areas; and
  - proposed location of any asset protection zones.
- Photographs of the watercourses/wetlands and a map showing the point from which the photos were taken.
- A detailed description of all potential impacts on the watercourses/riparian land.
- A detailed description of all potential impacts on the wetlands, including potential impacts to the wetlands hydrologic regime; groundwater recharge; habitat and any species that depend on the wetlands.
- A description of the design features and measures to be incorporated to mitigate potential impacts.
- Geomorphic and hydrological assessment of water courses including details of stream order (Strahler System), river style and energy regimes both in channel and on adjacent floodplains.

Landform rehabilitation

The Environmental Impact Statement report should include:

- Justification of the proposed final landform with regard to its impact on local and regional surface and groundwater systems;
- A detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape;
- Outline of proposed construction and restoration of topography and surface drainage features if affected by the project; and
- An outline of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation.

End Attachment A

Department of Primary Industries

Our ref: C15/112

Mr Matthew Meyerson
Student Planner, Industry Projects, Industry Assessments
NSW Planning & Environment
GPO Box 39
SYDNEY NSW 2001

Dear My Meyerson,

Request for input into Secretary's Environmental Assessment Requirements for a Marina at Liverpool (EARs ID No. 912)

Thank you for your email to NSW Department of Primary Industries dated 25 March 2015 requesting input into the draft Environmental Assessment Requirements (EARs) for the project stated above. This response incorporates comment from the Fisheries NSW Division of NSW DPI.

Fisheries NSW is responsible for ensuring that fish stocks are conserved and that there is no net loss of key fish habitats upon which they depend. To achieve this, Fisheries NSW ensures that developments comply with the requirements of the *Fisheries Management (FM) Act 1994* (namely the aquatic habitat protection and threatened species provisions in Parts 7 and 7A of the Act, respectively), and the associated *Policy and Guidelines for Fish Habitat Conservation and Management (2013).* In addition, Fisheries NSW is responsible for ensuring the sustainable management of commercial and recreational fishing in NSW.

The Georges River is important key fish habitat within South West Sydney. Considering the provisions of the FM Act and the above mentioned policy, aspects of this proposal of concern to Fisheries NSW include potential:

- Erosion and sedimentation impacts to aquatic habitats during construction,
- Sedimentation of the Georges River from the marina cove during construction,
- Harm to marine and riparian vegetation during construction of the seawall,
- Harm to marine vegetation and increased erosion and sedimentation that may result from any associated increased boat usage in the area,
- Reclamation of the Georges Rive associated with the seawall,
- Removal of snags along the Georges River,
- Acid Sulphate Soil impacts from dredging, reclamation and spoil management, and
- Impacts on water quality during construction and from the ongoing use of the marina.

Fisheries NSW notes that a significant area of seawall is proposed to be constructed along the Georges River. Foreshore protection works in this area are to be designed so that harm of marine vegetation in the river is avoided where possible and any snags in this area are re-instated. There is to be no reclamation activities associated with this seawall. It is highly recommended that foreshore protection works along the river are constructed to enhance riparian and aquatic habitats of the river. Where foreshore protection using natural riparian vegetation and soft engineering techniques is not considered to be suitable, Fisheries NSW recommends that an environmentally friendly seawall design be used. Details of such designs are available from:
http://sydney.cma.nsw.gov.au/component/option,com_remository/Itemid,116/func,select/id,51/

NSW Department of Primary Industries
Locked Bag 1, Nelson Bay NSW 2315
Tel: 02 4254 5527 Fax: 02 4224 9056
www.dpi.nsw.gov.au

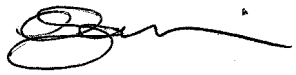
Any excavated material is to be treated and deposited appropriately on land according to its contamination and acid sulphate soil characteristics.

Information requirements that may be of assistance in the preparation of an EA for this proposal are listed in Attachment 1. It is important that the extent of the potential impacts on aquatic and riparian habitats above is addressed in the EA and proposed measures to minimise, mitigate, rehabilitate or compensate such impacts are detailed.

Please note that under s.205 of the FM Act, a permit to harm marine vegetation may be required for these works. Also, under s.201 or s.199 of the FM Act, a permit or formal notification will be required for the dredging and reclamation aspects of this proposal. These authorisations are only issued after development consent has been granted.

Should you require any further information concerning this proposal, please contact Carla Ganassin on 4222 8342 or carla.ganassin@industry.nsw.gov.au.

Yours sincerely,



Carla Ganassin
Resource Assessment Officer (Metro), Aquatic Ecosystems Unit

2 April 2015

Environmental Assessment Requirements for proposed Marina at Liverpool

Note: Fisheries NSW recommends that development proposals comply with the *Policy and Guidelines for Fish Habitat Conservation and Management (2013)* (referred to hereafter as P&GLs). A list of general information requirements for developments and standard precautions and mitigation measures are outlined in Section 3.1 of this document. See http://www.dpi.nsw.gov.au/fisheries/habitat/publications/policies,-guidelines-and-manuals/fish-habitat-conservation

A: General Requirements

- site address and contact details.
- property description (e.g. Lot and DP numbers).
- a clear description of the proposal including details of construction methods and materials.
- map(s) of the development area and adjacent areas - this should include nearby waterways, adjacent infrastructure (such as jetties) and land use.
- clear photographs of the site (at low and high tide in estuaries), including photographs of any riparian and aquatic vegetation present (including pest species such as *Caulerpa taxifolia*).
- a clear description of the physical and hydrological features of the development area (which may extend upstream and downstream of the development site in the case of flowing rivers or tidal waterways).
- approximate depth contours within 20 metres of the proposal.
- a clear description of aquatic environments including:
    - threatened and protected species, populations, ecological communities, pest species or presence of 'critical habitat' under the FM Act or EPBC Act,
    - an aquatic and riparian vegetation survey map of the area which shows the location and/or coverage of saltmarsh, mangrove, seagrass, macroalgae, macrophytes, riparian vegetation and snags,
    - description of aquatic habitat TYPE on site (see Table 1 in the P&GLs),
    - description of the waterway CLASS (see Table 2 in the P&GLs).
- details of the nature, timing, magnitude and duration of the proposed disturbance to the aquatic environment.
- assessments of predicted impacts upon any threatened species (fish and marine vegetation) (i.e. completion of a 7 part test and/or species impact statement(s)) and other aquatic flora and fauna.
- details of any mitigation measures to limit environmental impacts.
- details of the general regional context, any protected areas, other developments in the area, and/or cumulative impacts.
- In defining the proposal area, discussion must be provided in regard to possible indirect effects of the proposal on species/habitats in the area surrounding the subject site: for example, through altered hydrological regimes, soil erosion or pollution.
- notification of any other matters relevant to the particular proposal and of interest to NSW DPI.

Dredging and reclamation activities

- purpose of works
- type(s) and distribution of marine vegetation in the vicinity of the proposed works
- method of dredging to be used
- timing and duration of works
- dimension of area of works including levels and volume of material to be extracted or placed as fill
- nature of sediment to be dredged, including Acid Sulphate Soil, contaminated soils etc
- method of marking area subject to works
- environmental safeguards to be used during and after works
- measures for minimising harm to fish habitat under the proposal
- spoil type and source location for reclamation activities
- method of disposal of dredge material
- location and duration of spoil stockpiling, if planned

Activities that damage marine vegetation

- type of marine vegetation to be harmed
- map and density distribution of marine vegetation
- reasons for harming marine vegetation
- methods of harming marine vegetation
- construction details
- duration of works/activities
- measures for minimising harm to marine vegetation under the proposal and details of compensatory habitat development to replace lost vegetation.
- method and location of transplanting activities or disposal or marine vegetation.

B. Aquatic habitat assessment

The aim of the aquatic assessment should be to define the presence of 'key fish habitat' within the study site, adjacent areas (upstream and downstream), and the broader regional area. There may be a range of potential fish habitats that could be impacted by a particular activity. Some points to consider include:

- geomorphic characteristics of the waterway (i.e. what characteristics of a CLASS 1-4 waterway does it have (see Table 2 in P&GLs)? Is it a gully, intermittent stream or major river? Does it have deep pools or in-stream gravel beds? Is it a wetland? Does the watercourse connect with other watercourses upstream or downstream? What is the slope/gradient?),
- is it mapped as key fish habitat? (see www.dpi.nsw.gov.au/fisheries/habitat/protecting-habitats#KFH for maps of key fish habitat per Local Government Area),
- description of the water quality (e.g. discolouration, sedimentation, turbidity, pH, dissolved oxygen, nutrients),
- types of surrounding land use (e.g. agricultural, urban, aquaculture),
- condition of riparian vegetation (i.e. present or absent. Are the species native or exotic? Is the density of vegetation thick or sparse?),
- condition of freshwater aquatic vegetation (i.e. present or absent. Are the species native or exotic? Is the density of vegetation thick or sparse? Is it continuous or sparse in coverage? What is the aerial extent of major vegetation types? Is the vegetation healthy or degraded?),
- condition of marine vegetation (i.e. information on type, species, shoot density and/or percentage cover. Is the vegetation continuous or sparse in coverage? What is the aerial extent? Is the vegetation healthy or degraded? Is wrack (dead seagrass or macroalgae) present?),
- presence of wetlands nearby (including freshwater wetlands and saltmarsh) (i.e. are wetlands protected under any legislation (e.g. SEPP 14 coastal wetlands, Ramsar wetlands)? Are the wetlands in a healthy or degraded condition?)
- substrate type (e.g. rock, sand, gravel, silt),
- presence of refuge areas (e.g. adjacent wetlands, upstream pools),
- types of migratory fish or other aquatic species likely to inhabit the areas (based on known distribution range within the scientific literature),
- timing of construction in relation to any fish migration seasons,
- presence of any listed threatened or protected aquatic species or 'critical habitat' under the FM Act and EPBC Act.

C. Assessment of likely impacts

- indicate the location, nature and extent of habitat removal or modification (both direct and indirect) which may result from the proposed action;
- discuss the potential impact of the modification or removal of habitat (potential direct and indirect sources of impact are stated in the letter with this attachment).

Note: In defining the proposal area, discussion must be provided in regard to possible indirect effects of the proposal on species/habitats in the area surrounding the subject site: for example, through altered hydrological regimes, soil erosion or pollution.

D. Ameliorative measures

The environmental assessment should consider and provide detail on how the proposal has been or may be modified and managed to minimise impacts and conserve aquatic habitat on the subject site and in the study area.

From:	Andrew Docking
To:	Matthew Meyerson
Cc:	Landuse Enquiries
Subject:	Fwd: FW: Request for EARs - Marina, Liverpool LGA
Date:	Tuesday, 31 March 2015 11:17:40 AM
Attachments:	image001.png Untitled attachment 00385.txt Form A - SEAR 912.pdf

---

Matthew

Agriculture NSW

Weed management during construction and operation accord with existing State, regional or local weed management plans or strategies. Destruction or removal of Noxious Weeds may require a permit from Department of Primary Industries
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0015/170232/Application-for-noxious-weed-permit.pdf

Thanks

Regards

Andrew Docking | Resource Management Officer | Agriculture NSW
Postal: NSW Department of Primary Industries | Locked Bag 21 | ORANGE | NSW 2800
or landuse.ag@dpi.nsw.gov.au
T: 02 9842 8607| M: 0437 896 305
E: andrew.docking@dpi.nsw.gov.au | W: www.industry.nsw.gov.au

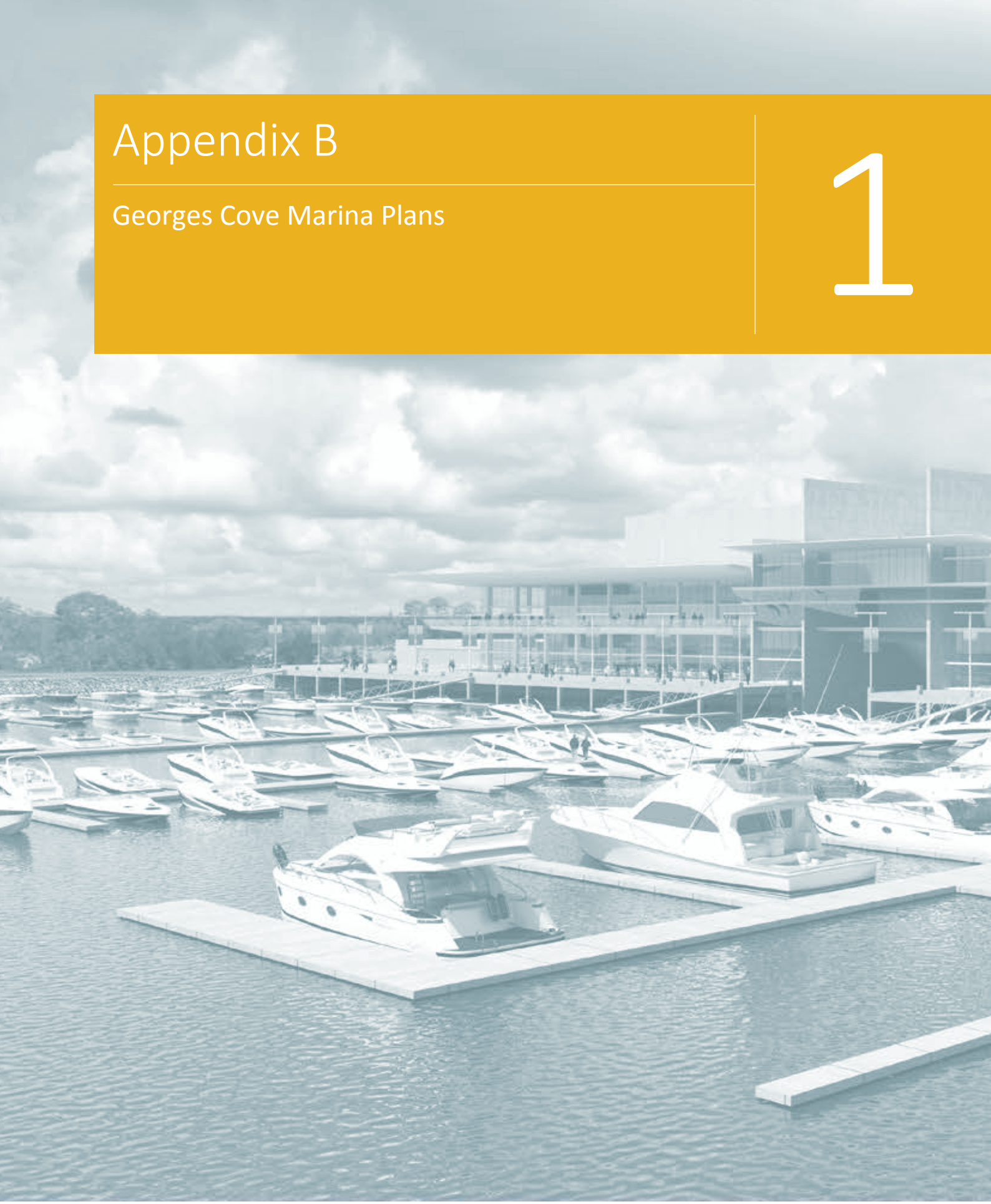
Land use planning information and guidelines are available at:
http://www.dpi.nsw.gov.au/agriculture/resources/lup
http://www.dpi.nsw.gov.au/agriculture/resources/lup/analysis-census-data

Building thriving, sustainable Agriculture for tomorrow's communities

Appendix B

Georges Cove Marina Plans

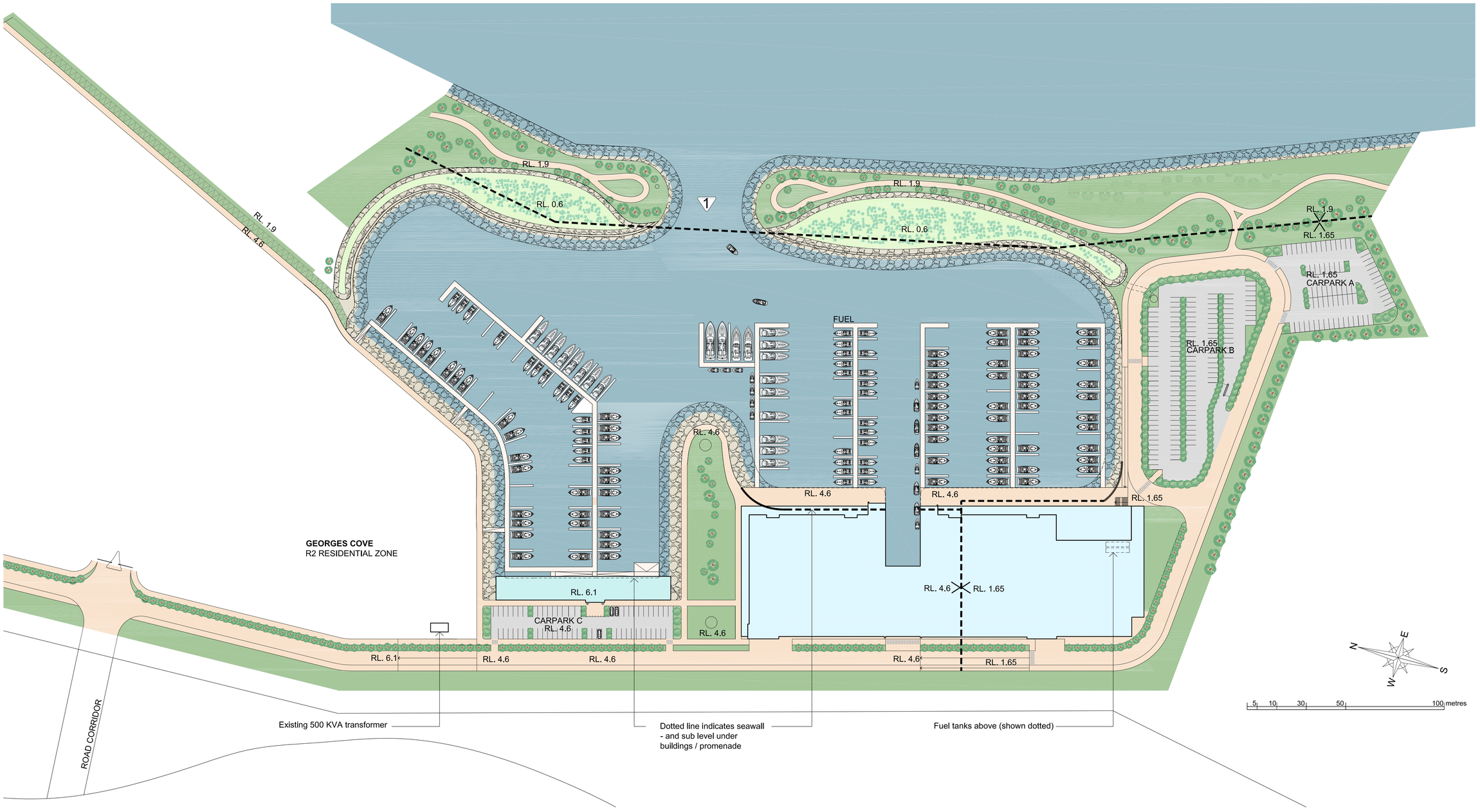
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Appendix B1

Georges River Marina plans (MFA 2015)

1



01 Site - Plan
1: 1000

Legend

- Water
- Seawall
- Wetlands
- Landscape
- Circulation
- Carparking
- Private Marina Clubhouse
- Maritime Building

amendment:

Mar. 2015	Level modification - Level change between RL 4.6 & RL 1.65 - moved North so extending the RL 1.65 an additional 24 metres into the area RL 4.6 providing an additional 4780m3 of flood storage - as requested by Liverpool City Council.

MFA
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2/ 5 NARABANG WAY BELROSE NSW 2085
TEL (02) 9450 2070 FAX (02) 94502757

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ISSUE	REV	AMENDMENTS	DATE
A		Issue for Development Application	16.11.10
B		Amendments following Liverpool Council design review panel meeting	29.06.12
C		Issue for Development Application	26.10.12
D		Re-issue for Development Application	26.03.15
E		Re-issue for Development Application	01.04.15
	1	Bridge deleted	
F		Re-Issue for Development Application	06.05.19

ISSUE	REV	AMENDMENTS	DATE

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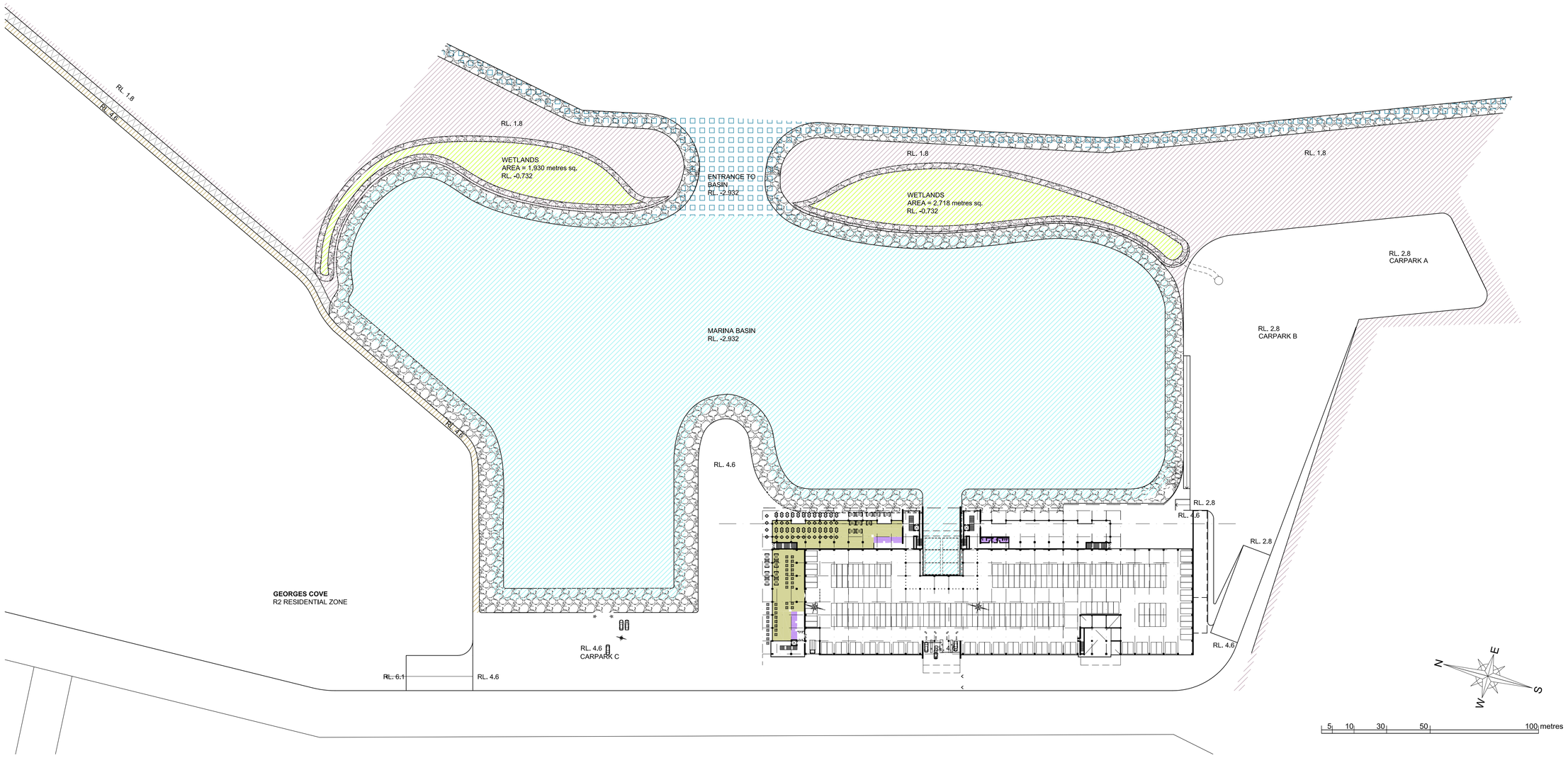
PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

PRINTED: May 07, 2019 - 9:39am
P:\MOOREBANK MARINA\Cadwork\Drawings\DA-001- Site Plan.dwg

DRAWING
Site - Plan
General Layout

DRAWN	CHKD	APPROVED
MF		
SCALE 1 : 1000 @ A1 1: 2000 @ A3	DATE 01/04/15	CAD FILE No
JOB NO 0914	DRAWING NO DA- 001	ISSUE F

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01 Site - Plan
1: 2000

Legend

	Level	Area
Northern Carpark & Surrounds	RL. 4.6	3,737 m sq
Maritime Building & Surrounds	RL. 4.6	20,157 m sq
Southern Carpark & Roads	RL. 2.8	11,398 m sq
Wetlands	RL. -0.732	4,648 m sq
Marina Basin	RL. -2.932	48,955 m sq
Entrance to Basin	RL. -2.932	4,550 m sq
Pedestrian/ Cycle Path & Open Space	RL. 1.8	15,616 m sq

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ISSUE	REV	AMENDMENTS	DATE
A		Issue for Development Application	16.11.10
B		Re-issue for Development Application	01.04.15
C		Re-issue for Development Application	26.03.15
D		Re-issue for Development Application	07.05.19

ISSUE	REV	AMENDMENTS	DATE

CLIENT
Benedict Industries Pty. Ltd.

PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

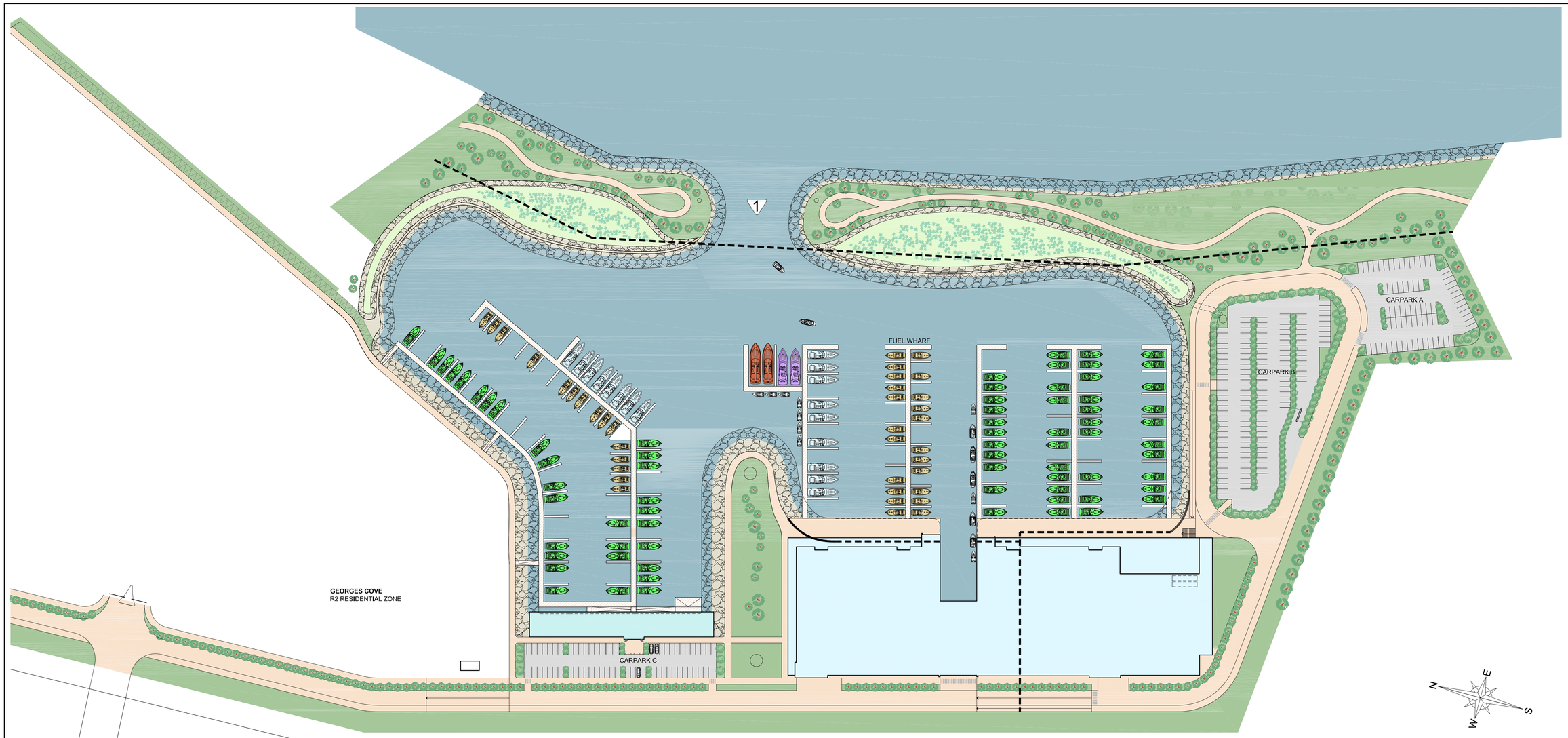
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DRAWING
Site - Plan
Diagram - Levels & Contours

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MF		
SCALE	DATE	CAD FILE No
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JOB NO	DRAWING NO	ISSUE
0914	DA- 002	D

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01 Site - Plan
1: 1000

Numbers

Carparking	Number
Carpark A	73 on-grade car spaces
Carpark B	134 on-grade car spaces
Carpark C	60 on-grade car spaces
Carpark - Dry Store - Level 1	251 under-cover car spaces
Carpark - Dry Store - Sub Level	119 under-cover car spaces
Total Car Spaces	**637**

Marina	Length	Number
Small Craft (<15m)	≥ 8m < 10m	52 Marina Berths
Small Craft (<15m)	≥ 10m < 12m	110 Marina Berths
Small Craft (<15m)	≥ 12m < 15m	20 Marina Berths
Vessels	≥ 15m < 18m	2 Marina Berths
Vessels less than	20m	2 Marina Berths
Vessels	20m or more	0 Marina Berths
Total Marina Berths		**186**

Dry Store	Length	Number
Small Craft (<15m)	≥ 4m < 6m	125 Dry Berths
Small Craft (<15m)	≥ 6m < 8m	125 Dry Berths
Vessels	≥ 15m	0 Dry Berths
Total Dry Berths		**250**

Note Berths & fairways have been designed in accordance with AS. 3962-2001

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ISSUE	REV	AMENDMENTS	DATE
A		Issue for Development Application	16.11.10
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C		Issue for Development Application	26.10.12
D		Re-issue for Development Application	26.03.15
E		Re-issue for Development Application	01.04.15
F		Re-issue for Development Application	10.04.15
G		Re-issue for Development Application	22.04.15
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H		Re-Issue for Development Application	06.05.19

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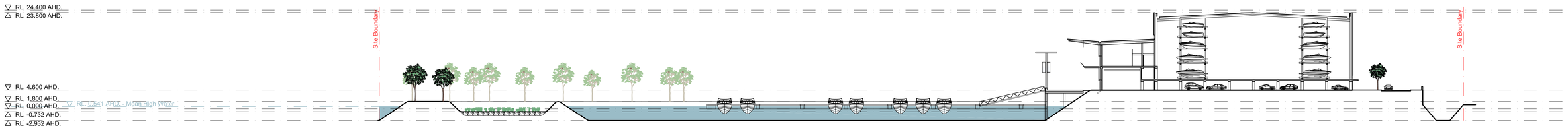
PROJECT: Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

PRINTED: May 07, 2019 - 9:38am
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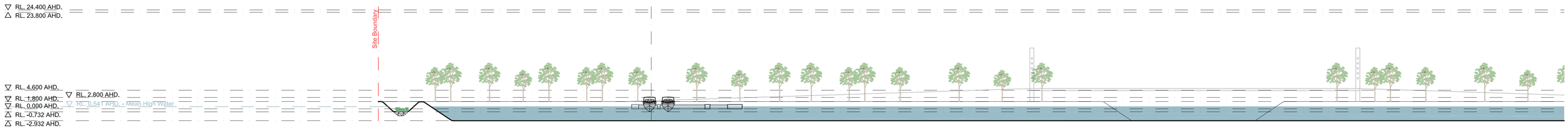
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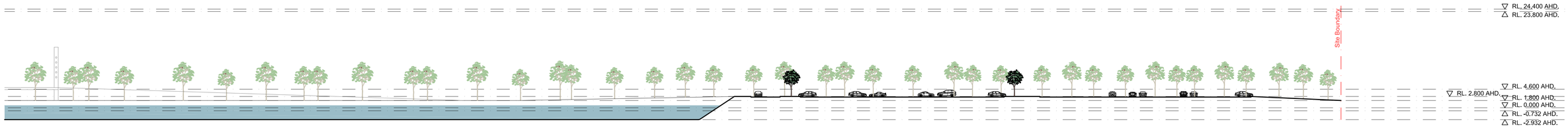
MFA
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01 Section AA
1: 500



02 Section BB - North
1: 500



03 Section BB - South
1: 500

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ISSUE	REV	AMENDMENTS	DATE
A		Issue for Development Application	23.07.10
B		Re-issue for Development Application	26.03.15

ISSUE	REV	AMENDMENTS	DATE

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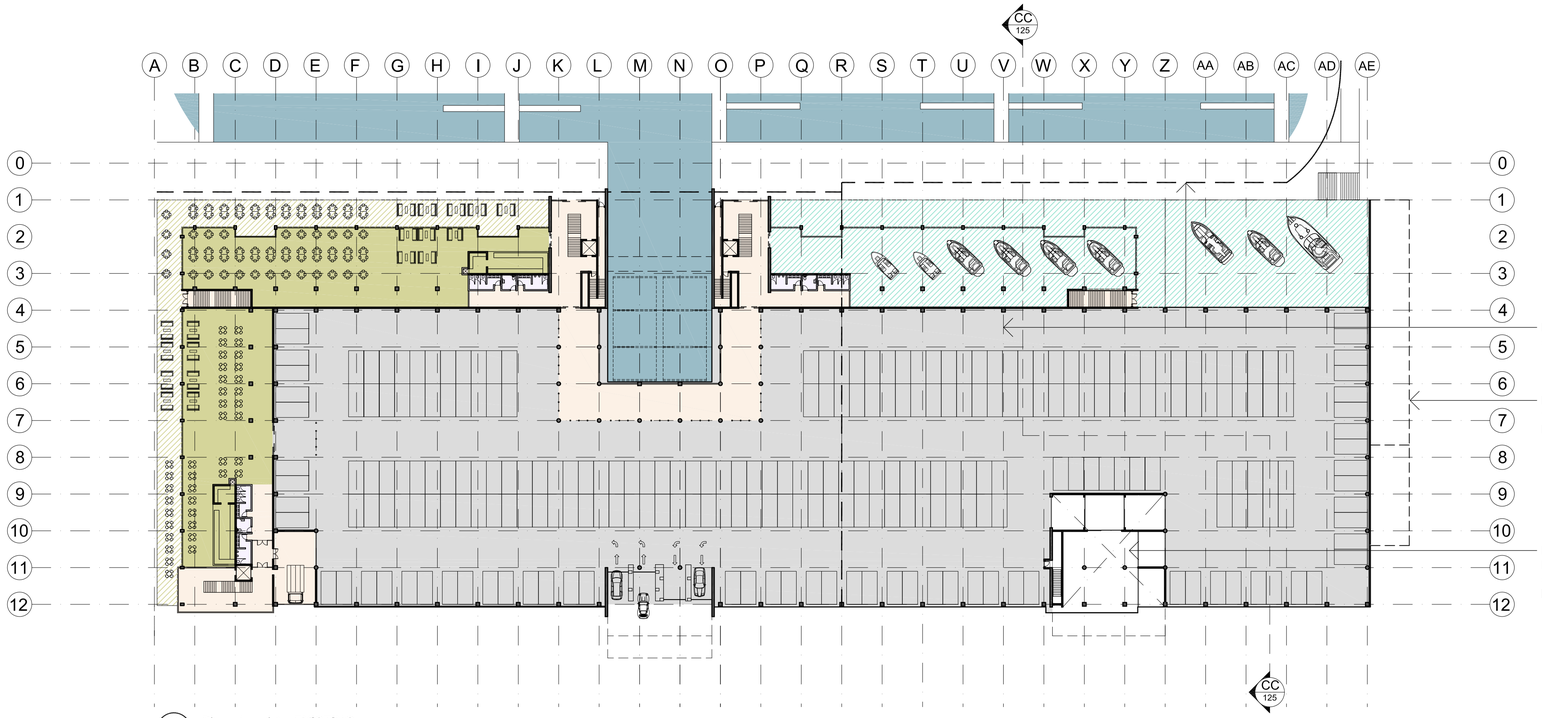
PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

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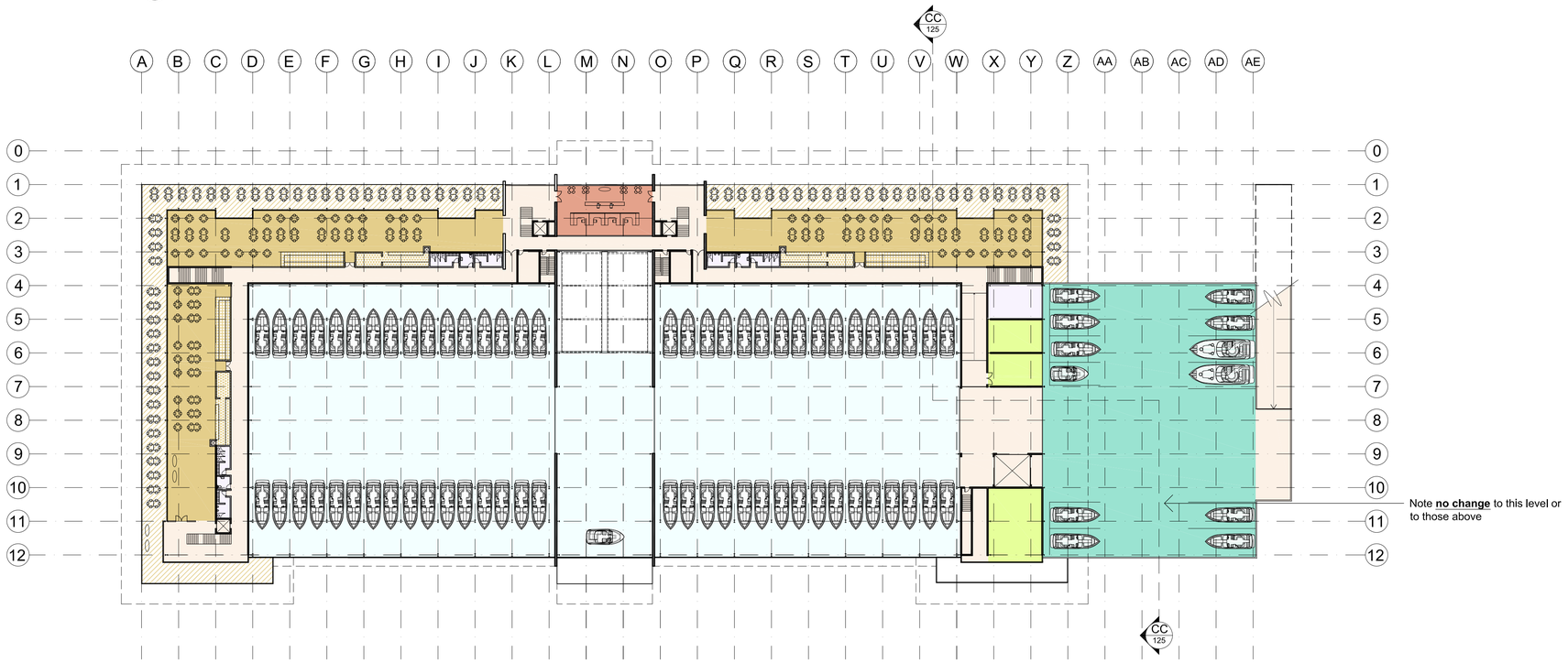
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Site - Sections

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JOB NO 0914	DRAWING NO DA- 020	ISSUE B

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01 Plan - Level 1 - **EXISTING**
1: 500



02 Plan - Level 2 - **EXISTING**
1: 500

Legend

- **Water**
- **Circulation:** 3,119.17m²
- **Carparking:** 11,994.42m²
- **Dry Berth Store:** 5,946.43m²
- **Workshops:** 248.97m²
- **Amenities:** 270.96m²
- **Hardstand Storage:** 1848.20m²
- **Small Craft Display:** 1,605.87m²
- **Kiosks, Commercial, Tourist, Recreational & Club Facilities:** 1,201.87m²
- **Undercroft - Kiosks, Commercial, Tourist, Recreational & Club Facilities:** 543.27m²
- **Function Centre - Kitchen:** 110.28m²
- **Function Centre - Bar/ Servery:** 95.76m²
- **Function Centre - Terrace:** 1,059.19m²
- **Function Centre:** 1,354.99m²
- **Marina Office:** 150.73m²
- **Public Marina Club Lounge:** 449.64m²
- **Public Marina Club Lounge - Terrace:** 127.26m²

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ISSUE	REV	AMENDMENTS	DATE
A		Issue for Development Application	16.11.10
B		Amendments following Liverpool Council design review panel meeting	29.06.12
C		Issue for Development Application	26.10.12
D		Re-issue for Development Application	26.03.15
E		Re-issue for Development Application	22.04.15

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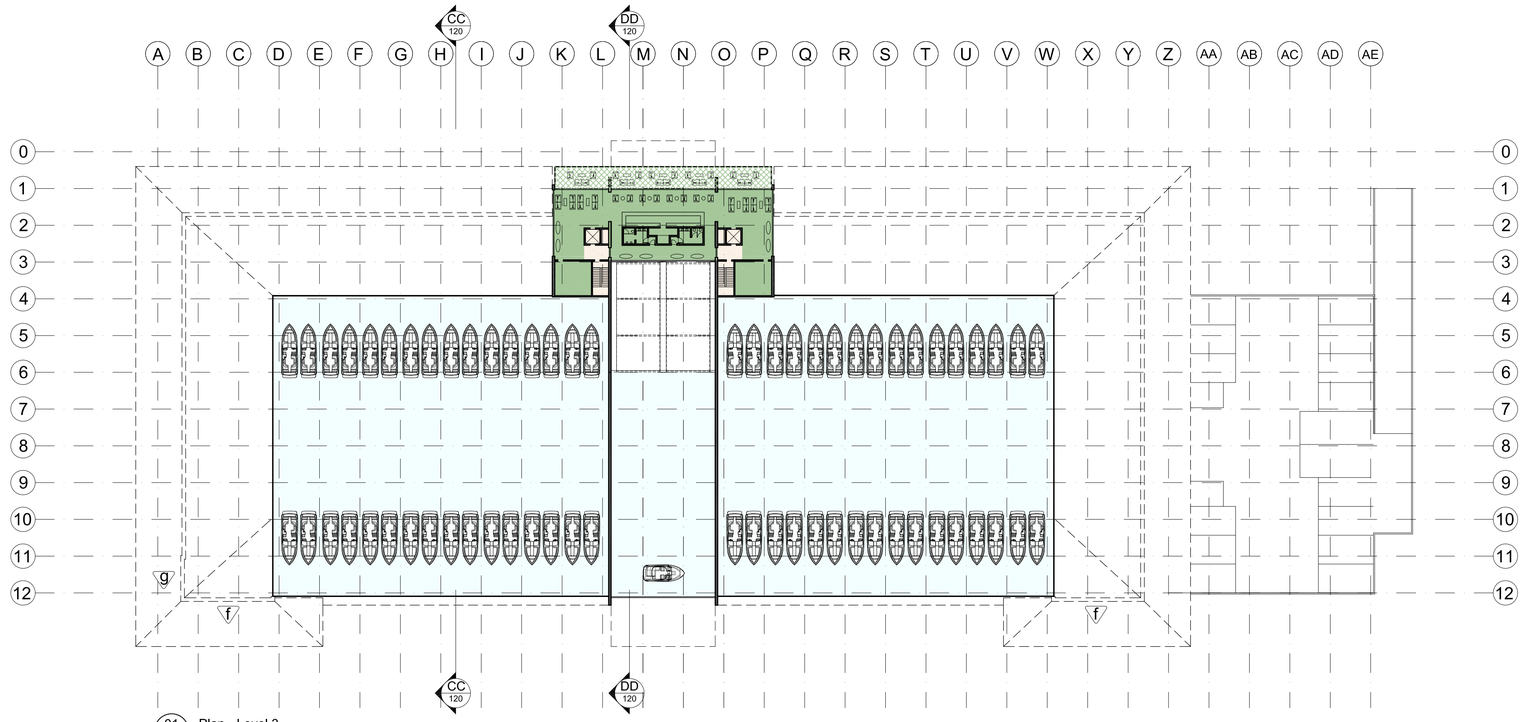
PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

PRINTED: Apr 22, 2015 - 12:48pm
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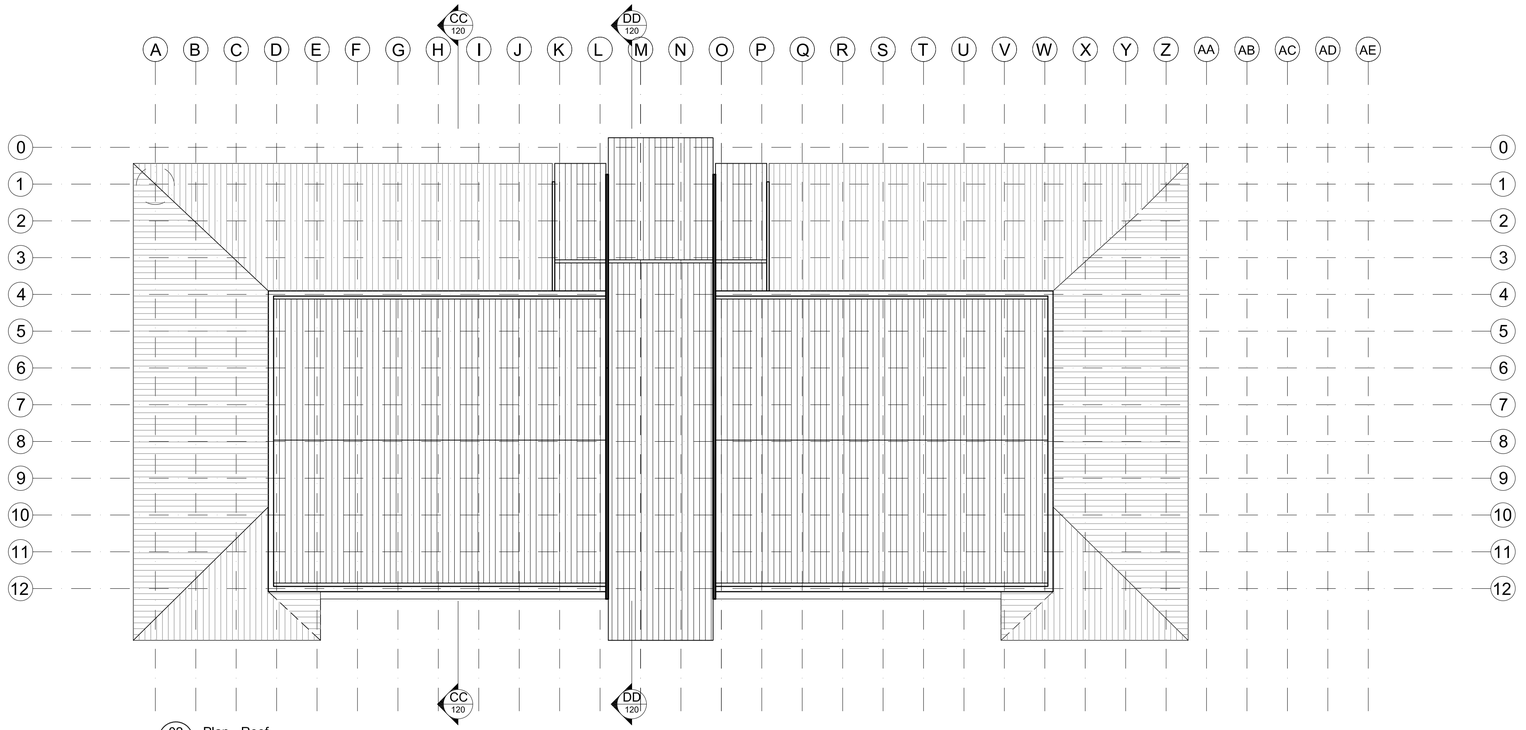
DRAWING
Maritime Building
Plans - Levels 1 & 2

DRAWN	CHKD	APPROVED
MF		
SCALE 1: 1000 @ A3, 1 : 500 @ A1	DATE 26.03.15	CAD FILE No
JOB NO 0914	DRAWING NO DA- 100	ISSUE E

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TEL (02) 9450 2070 FAX (02) 94502757



01 Plan - Level 3
1: 500



02 Plan - Roof
1: 500

Legend

- **Water**
- **Circulation:** 3,119.17m²
- **Carparking:** 11,994.42m²
- **Dry Berth Store:** 5,946.43m²
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- **Public Marina Club Lounge - Terrace:** 127.26m²

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B		Amendments following Liverpool Council design review panel meeting	29.06.12
C		Re-issue for Development Application	26.03.15
D		Re-issue for Development Application	22.04.15

ISSUE	REV	AMENDMENTS	DATE

CLIENT
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PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

PRINTED: Apr 22, 2015 - 12:49pm
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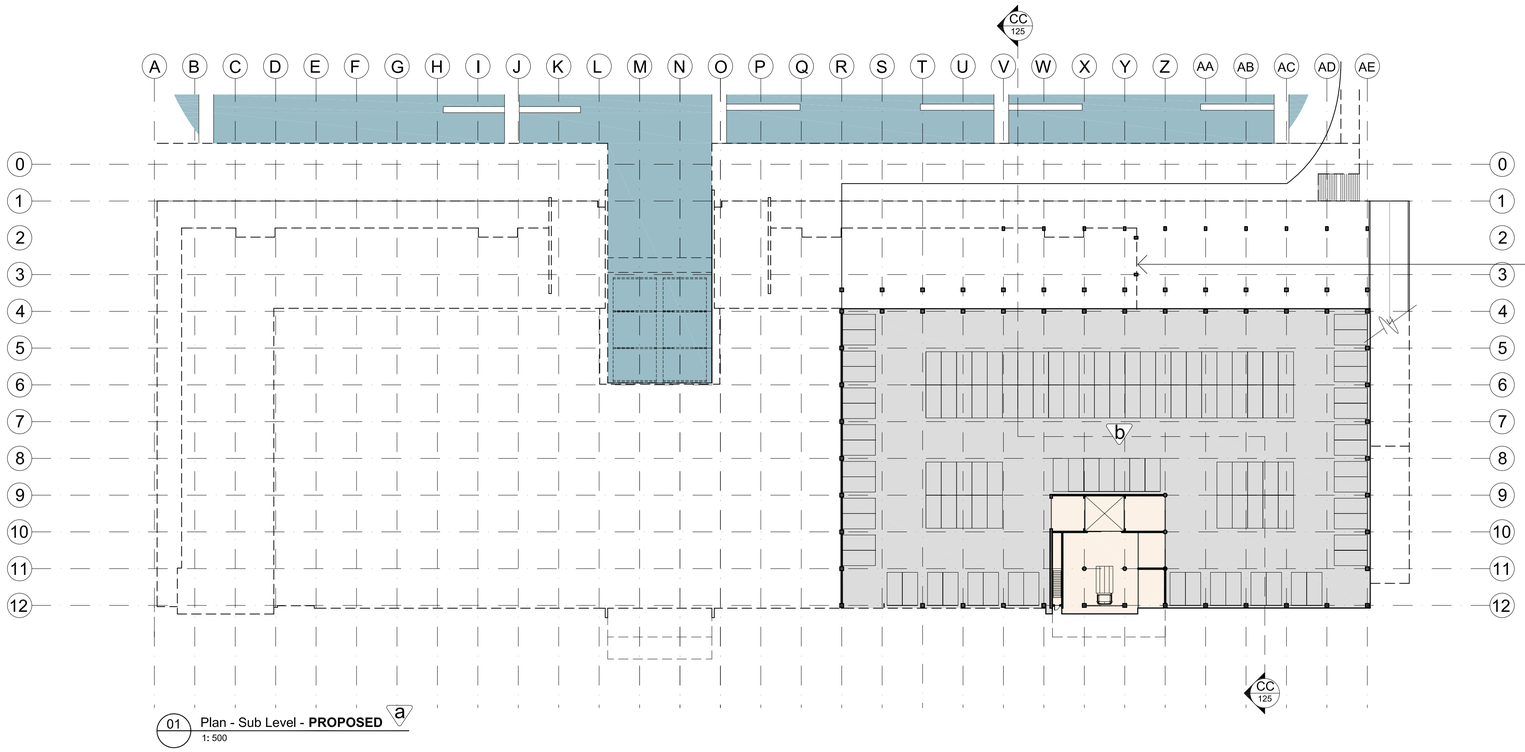
DRAWING
Maritime Building
Plans - Level 3 & Roof

DRAWN	CHKD	APPROVED
MF		

SCALE	DATE	CAD FILE No
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JOB NO	DRAWING NO	ISSUE
0914	DA- 101	D

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01 Plan - Sub Level - **PROPOSED** a
1: 500

Legend

- **Water**
- **Circulation:** 3,119.17m²
- **Carparking:** 11,994.42m²
- **Dry Berth Store:** 5,946.43m²
- **Workshops:** 248.97m²
- **Amenities:** 270.96m²
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- **Public Marina Club Lounge:** 449.64m²
- **Public Marina Club Lounge - Terrace:** 127.26m²

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ISSUE	REV	AMENDMENTS	DATE
C		Issue for Development Application	26.10.12
D		Re-issue for Development Application	26.03.15
E		Re-issue for Development Application	10.04.15
F		Re-issue for Development Application	22.04.15

ISSUE	REV	AMENDMENTS	DATE

CLIENT
Benedict Industries Pty. Ltd.

PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

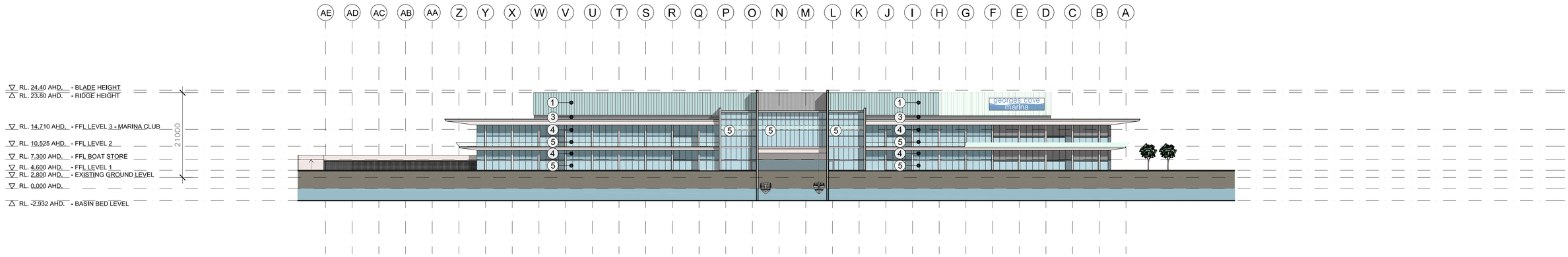
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DRAWING
Maritime Building
Plans - Sub Level - Carpark

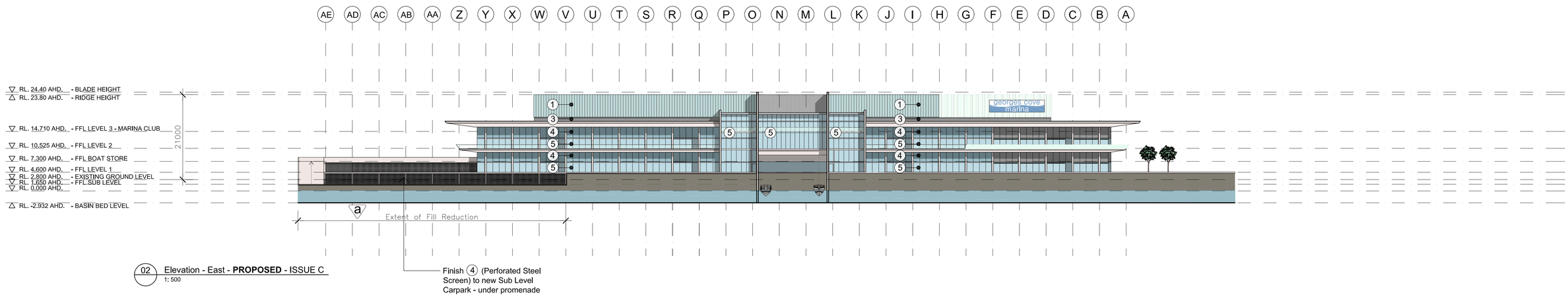
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MF		
SCALE 1: 1000 @ A3 1 : 500 @ A1	DATE 26.03.15	CAD FILE No

JOB NO	DRAWING NO	ISSUE
0914	DA- 102	F

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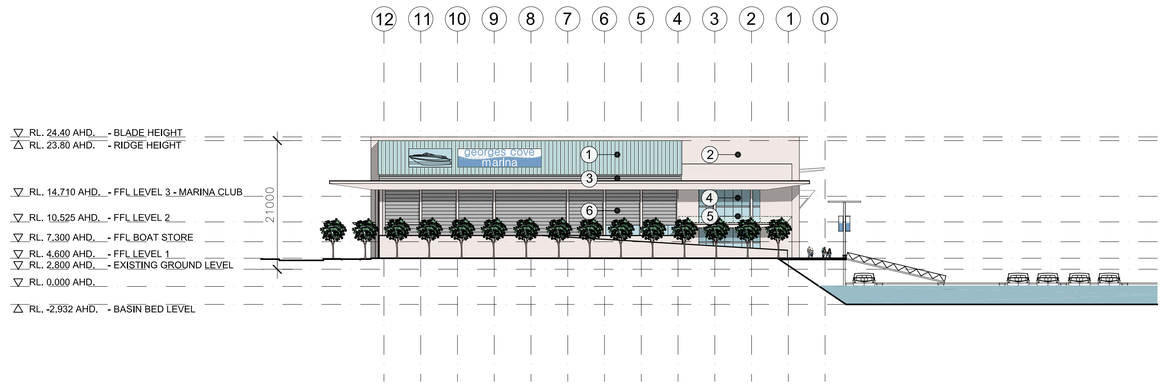


01 Elevation - East - **EXISTING** - ISSUE B
1: 500

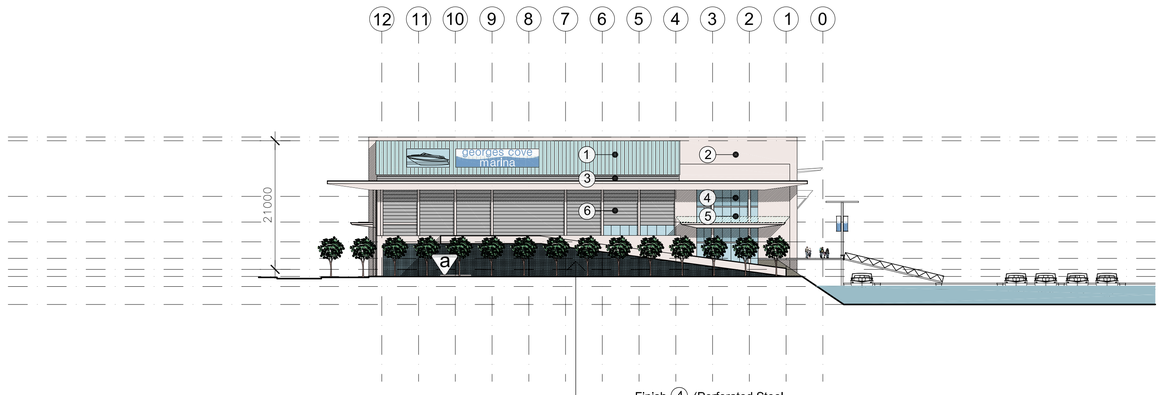


02 Elevation - East - **PROPOSED** - ISSUE C
1: 500

Finish (4) (Perforated Steel Screen) to new Sub Level Carpark - under promenade



03 Elevation - South - **EXISTING** - ISSUE B
1: 500



04 Elevation - South - **PROPOSED** - ISSUE C
1: 500

Finish (4) (Perforated Steel Screen) added under ramp - extended to new ground level

Finishes Schedule

(1) Corrugated translucent fibreglass sheeting	(2) Fibre Cement Sheet	(3) Steel fixed louvres	(4) Perforated Steel Screen	(5) Glass	(6) Roller Door

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ISSUE	REV	AMENDMENTS	DATE
C		Issue for Development Application	26.10.12
D		Re-issue for Development Application	26.03.15

ISSUE	REV	AMENDMENTS	DATE

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Benedict Industries Pty. Ltd.

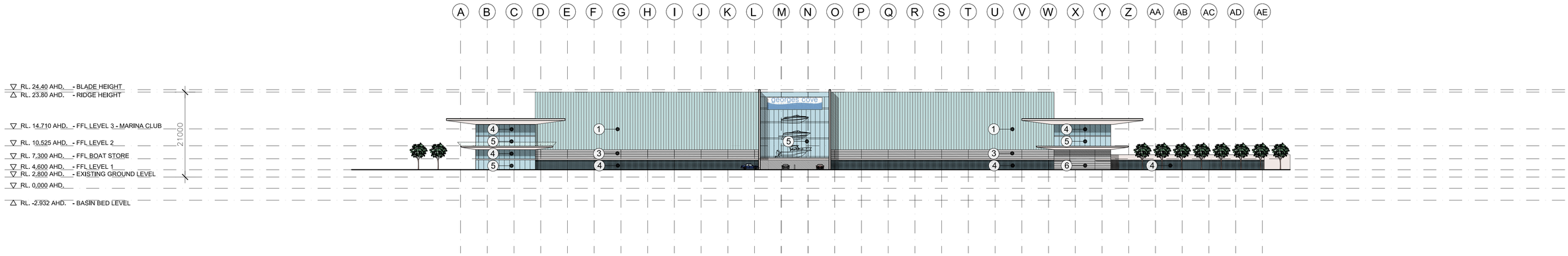
PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

PRINTED: Mar 26, 2015 - 11:47am
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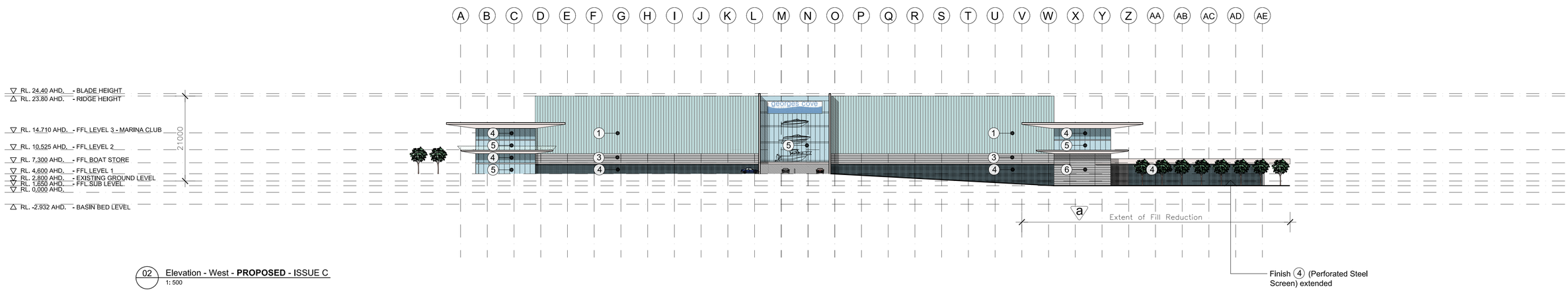
DRAWING
Maritime Building
Elevations - Comparisons

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MF		
SCALE	DATE	CAD FILE No
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JOB NO	DRAWING NO	ISSUE
0914	DA- 115	D

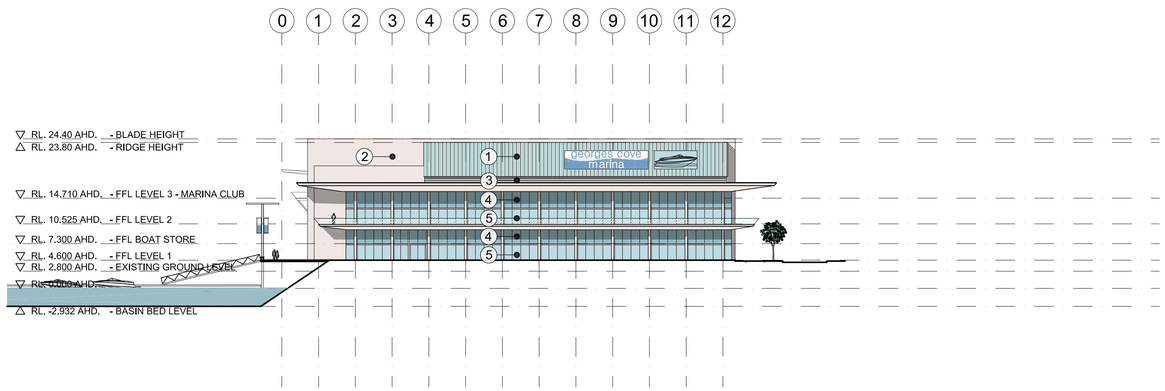
MICHEAL FOUNTAIN ARCHITECTS PTY. LTD.
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TEL (02) 9450 2070 FAX (02) 94502757



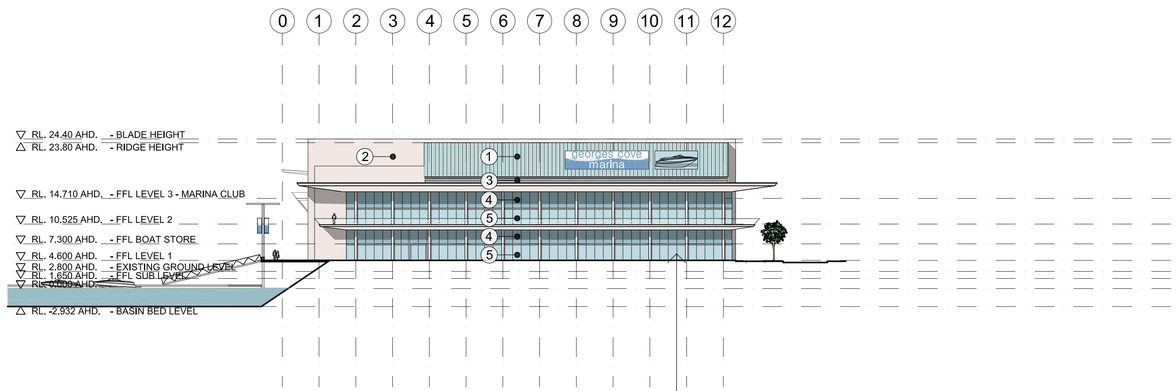
01 Elevation - West - **EXISTING** - ISSUE B
1: 500



02 Elevation - West - **PROPOSED** - ISSUE C
1: 500



03 Elevation - North - **EXISTING** - ISSUE B
1: 500



04 Elevation - North - **PROPOSED** - ISSUE C
1: 500

Finishes Schedule

1. Corrugated translucent fibreglass sheeting
2. Fibre Cement Sheet
3. Steel fixed louvres
4. Perforated Steel Screen
5. Glass
6. Roller Door

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ISSUE	REV	AMENDMENTS	DATE
C		Issue for Development Application	26.10.12
D		Re-issue for Development Application	26.03.15

ISSUE	REV	AMENDMENTS	DATE

CLIENT
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PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

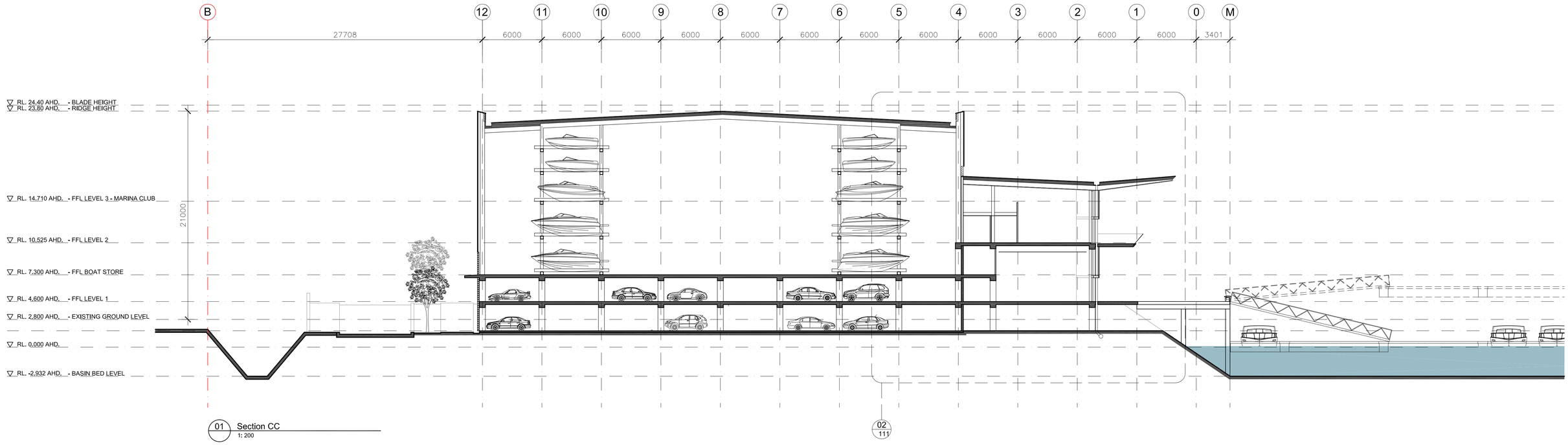
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DRAWING
Maritime Building
Elevations - Comparisons

DRAWN	CHKD	APPROVED
MF		
SCALE	DATE	CAD FILE No
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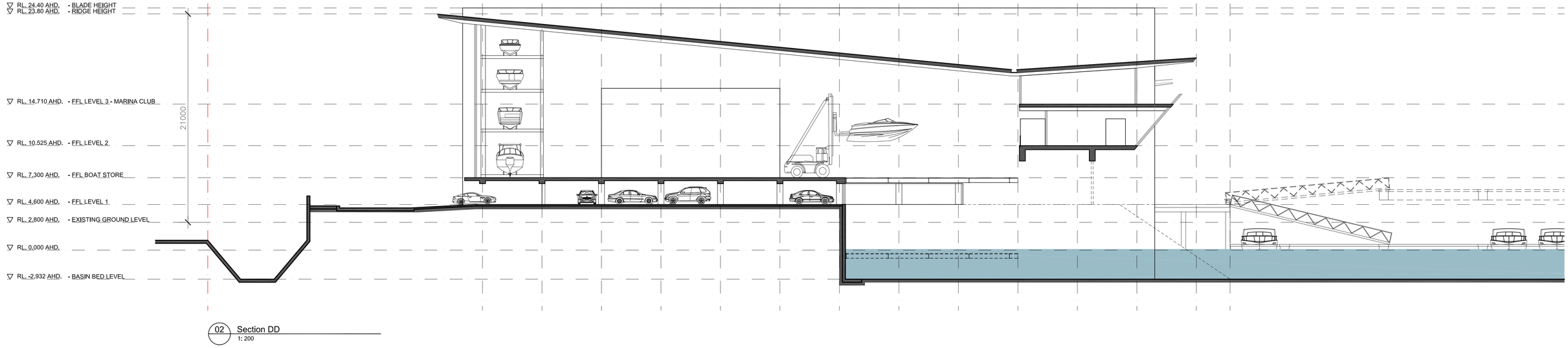
JOB NO	DRAWING NO	ISSUE
0914	DA- 116	D

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01 Section CC
1: 200

02
111



02 Section DD
1: 200

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ISSUE	REV	AMENDMENTS	DATE
A		Issue for Development Application	16.11.10
B		Amendments following Liverpool Council design review panel meeting	29.06.12
C		Re-issue for Development Application	26.03.15

ISSUE	REV	AMENDMENTS	DATE

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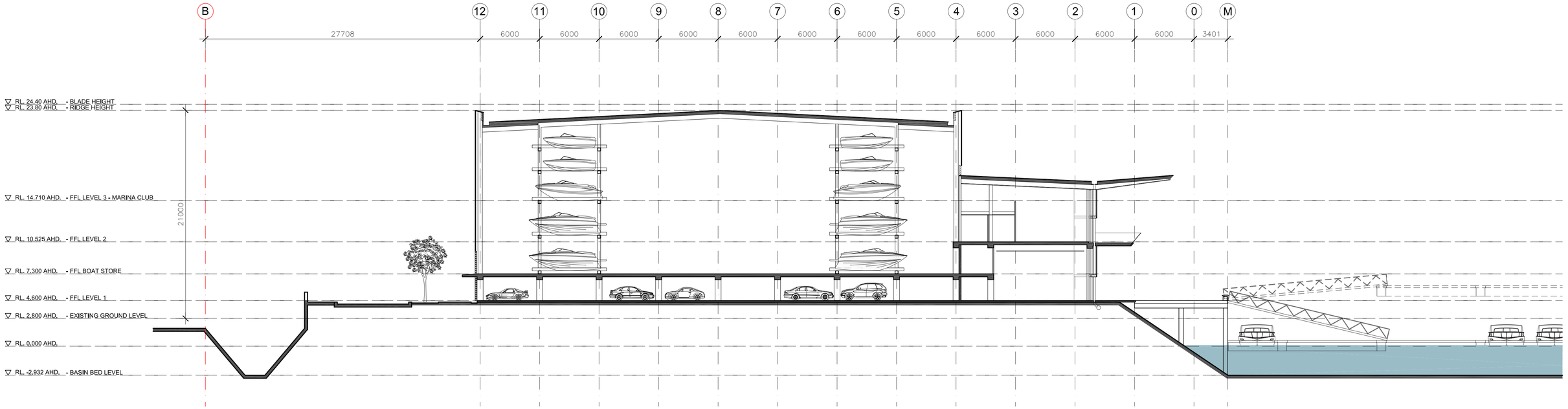
PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

PRINTED: Mar 26, 2015 - 11:34am
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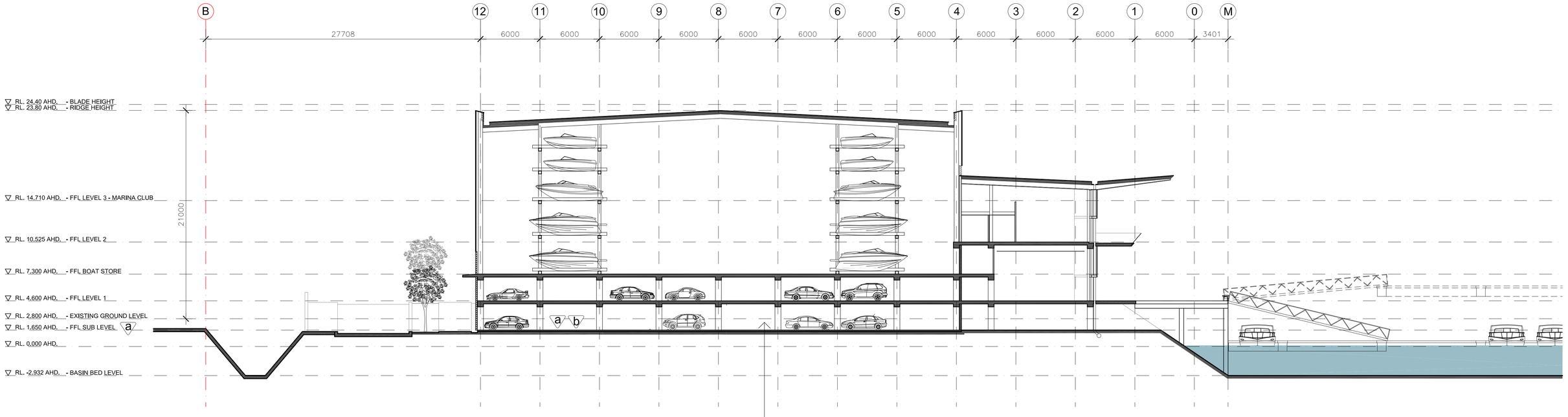
DRAWING
Maritime Building Sections

DRAWN	CHKD	APPROVED
MF		
SCALE	DATE	CAD FILE No
1 : 200 @ A1	27- 11- 09	
JOB NO	DRAWING NO	ISSUE
0914	DA- 120	C

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01 Section CC - **EXISTING** - ISSUE B
1: 200



02 Section CC - **PROPOSED** - ISSUE C
1: 200

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ISSUE	REV	AMENDMENTS	DATE
C		Issue for Development Application	26.10.12
D		Re-issue for Development Application	26.03.15

ISSUE	REV	AMENDMENTS	DATE

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Benedict Industries Pty. Ltd.

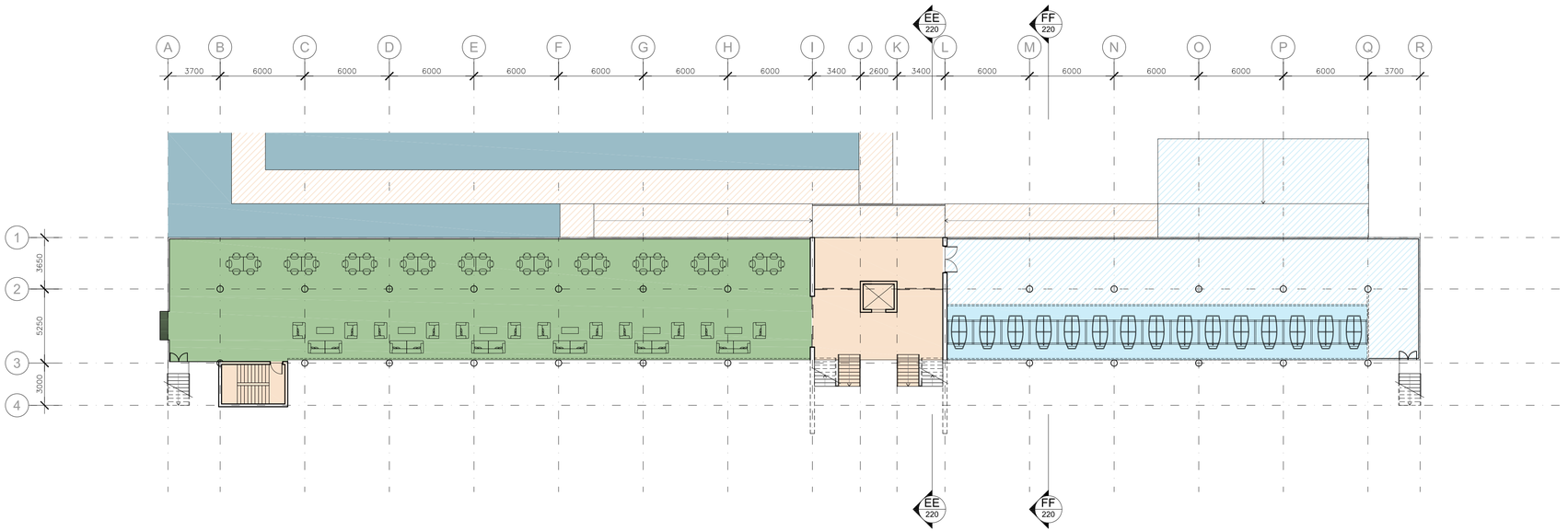
PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

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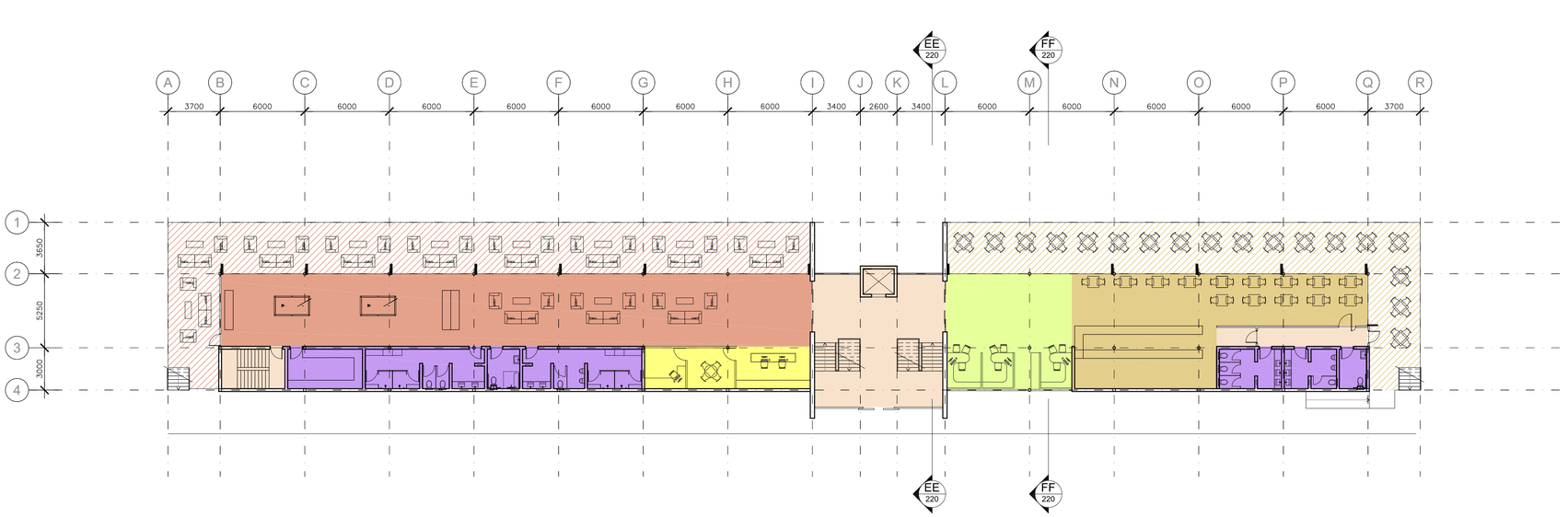
DRAWING
Maritime Building
Sections - Comparisons

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MF		
SCALE	DATE	CAD FILE No
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JOB NO	DRAWING NO	ISSUE
0914	DA- 125	D

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01 Plan - Level 1
1: 200



02 Plan - Level 2
1: 200

Legend

- **Water**
- **Small Craft Store:** 117.30m²
- **Small Craft Circulation (& Ramp):** 278.11m²
- **Circulation:** 215.93m²
- **Circulation on Pontoons:** 221.16m²
- **Barbeque Area:** 392.47m²
- **Barbeque Terrace**
- **Amenities:** 108.32m²
- **Kiosk:** 123.38m²
- **Kiosk - Terrace:** 149.71m²
- **Brokerage:** 72.49m²
- **Marina Office:** 35.55m²
- **Private Marina Clubhouse:** 215.64m²
- **Private Marina Clubhouse - Terrace:** 193.72m²

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ISSUE	REV	AMENDMENTS	DATE
A		Issue for Development Application	16.11.10
B		Re-issue for Development Application	26.03.15
C		Re-issue for Development Application	01.05.15

ISSUE	REV	AMENDMENTS	DATE

CLIENT
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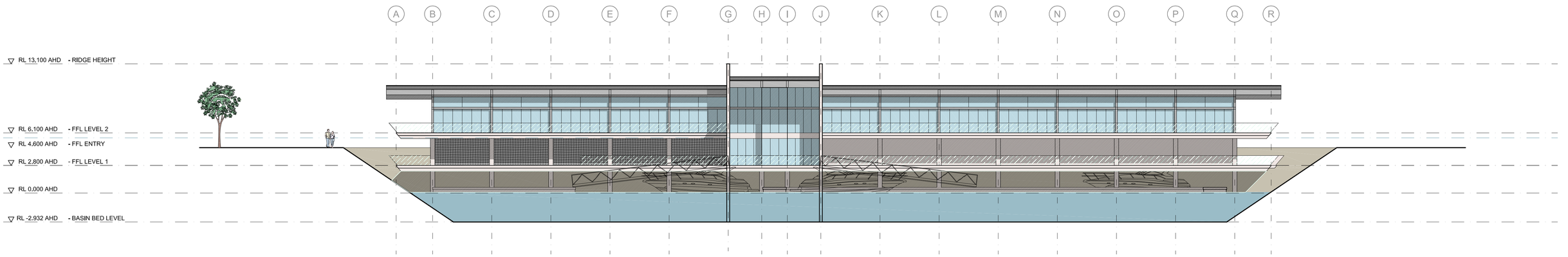
PROJECT
Georges Cove Marina
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Moorebank NSW 2170

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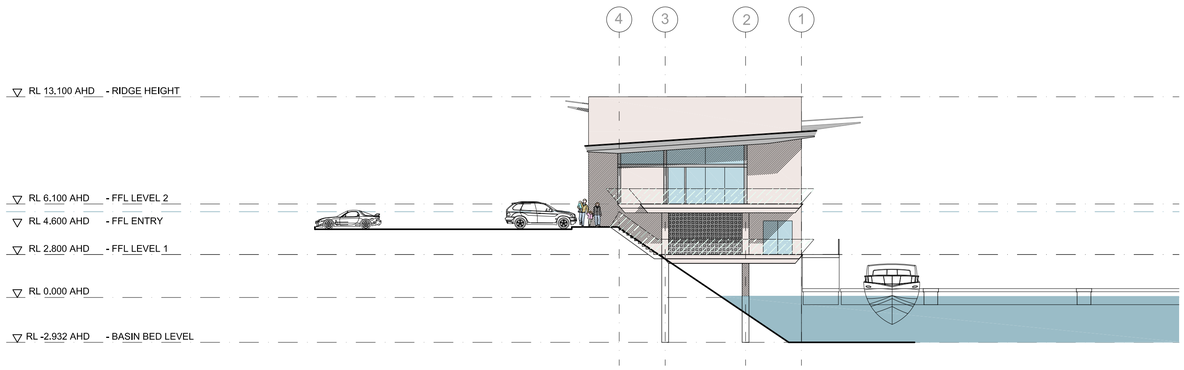
DRAWING
Private Marina Clubhouse
Floor Plans

DRAWN	CHKD	APPROVED
RJC		
SCALE 1: 400 @ A3, 1 : 200 @ A1	DATE 27- 11- 09	CAD FILE No
JOB NO 0914	DRAWING NO DA- 200	ISSUE C

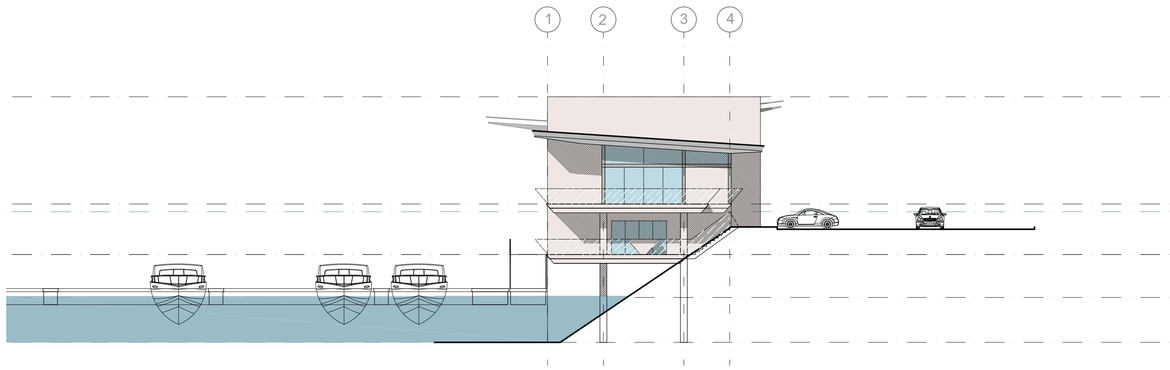
MFA
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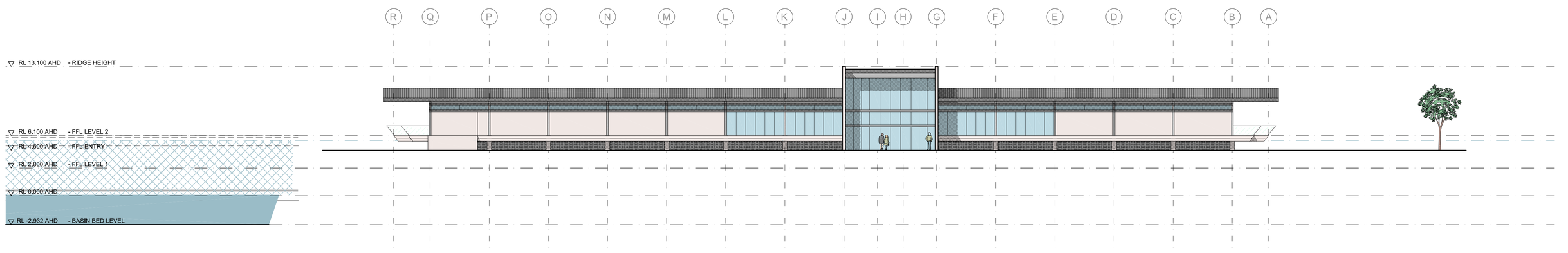
01 Elevation - East
1: 200



02 Elevation - South
1: 200



03 Elevation - North
1: 200



04 Elevation - West
1: 200

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ISSUE	REV	AMENDMENTS	DATE
A		Issue for Development Application	16.11.10
B		Re-issue for Development Application	26.03.15

ISSUE	REV	AMENDMENTS	DATE

CLIENT
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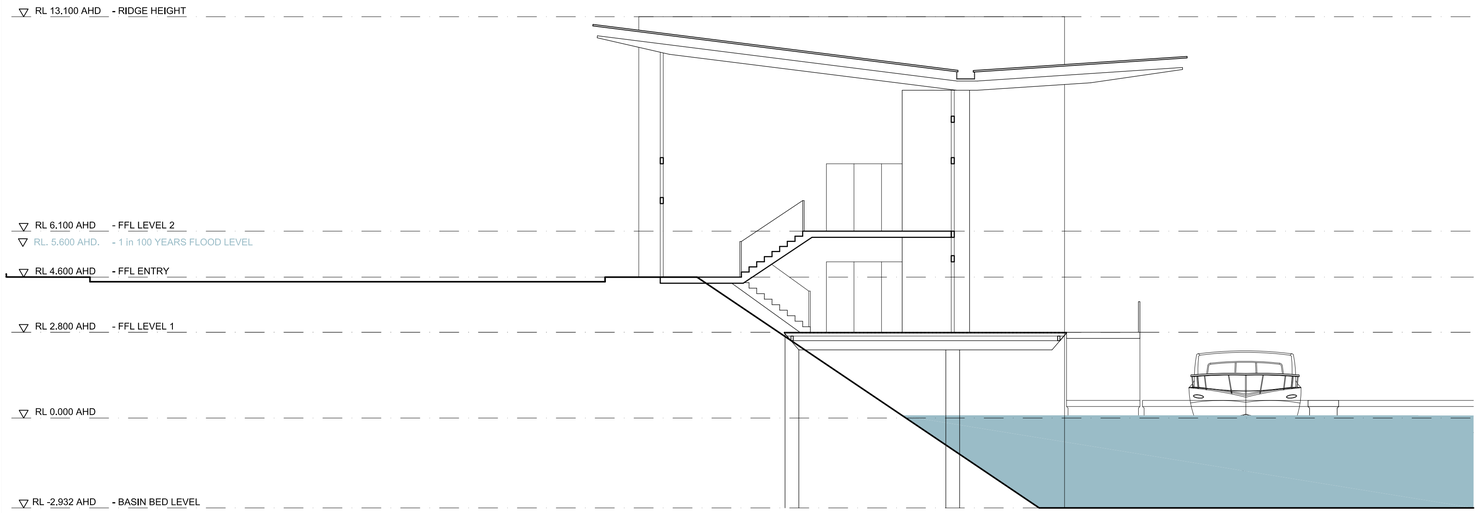
PROJECT
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Newbridge Road
Moorebank NSW 2170

PRINTED: Mar 26, 2015 - 11:42am
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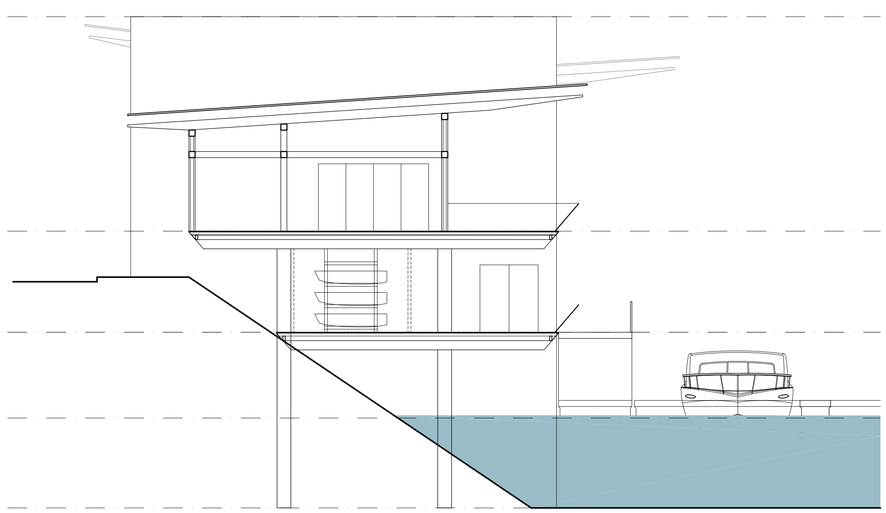
DRAWING
Private Marina Clubhouse Elevations

DRAWN	CHKD	APPROVED
RJC		
SCALE 1: 400 @ A3, 1 : 200 @ A1	DATE 27- 11- 09	CAD FILE No
JOB NO 0914	DRAWING NO DA- 210	ISSUE B

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01 Section EE
1: 100



02 Section FF
1: 100

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ISSUE	REV	AMENDMENTS	DATE
A		Issue for Development Application	16.11.10
B		Re-issue for Development Application	26.03.15

ISSUE	REV	AMENDMENTS	DATE

CLIENT
Benedict Industries Pty. Ltd.

PROJECT
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Newbridge Road
Moorebank NSW 2170

PRINTED: Mar 26, 2015 - 11:44am
\\MFA01\Projects\MOOREBANK MARINA\Cadwork\Drawings\Amended DA_26032015\SK-220-Marina Club Sections.dwg

DRAWING
Private Marina Clubhouse Sections

DRAWN	CHKD	APPROVED
RJC		

SCALE	DATE	CAD FILE No
1: 200 @ A3 1 : 100 @ A1	28.04.10	

JOB NO	DRAWING NO	ISSUE
0914	DA- 220	B

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Appendix B2

Boundary definition (JMD 2018)

1

John M. Daly
and Associates Pty Ltd
ABN 88 051 977 989

JMD Development Consultants

32 Iolanthe Street
Campbelltown NSW 2560
P.O. Box 25
Campbelltown NSW 2560
Ph: (02) 4625 5055
Fax: (02) 4628 2013
Email: admin@jmd.com.au

Our Ref: 14005
Date: 31 May 2018

Benedict Industries
PO Box 10
MOOREBANK NSW 2170

ATTENTION: MR ERNEST DUPERE

Dear Ernest,

Re: Lot 7 in DP1065574 at Moorebank
Georges River Boundary Definition

This letter has been prepared for Benedict Industries Pty Ltd. to document the actual position of the common boundary of the Georges River and Lot 7 in DP1065574.

To determine the position of the abovementioned boundary JMD have made extensive investigations.

A topographical survey of the Georges River bank within Lot 7 in DP1065574 on 15th May 2018 by JMD found that the position of the mean high-water mark is no longer consistent with the boundary identified in the most recent survey plan. The most recent survey plan defining the mean high water mark of the Georges River Boundary in this area is DP189774 (circa 1932).

Clause 48(3) of the Survey Practice Regulation 2017 states:-
"If the change in the position of the mean high-water mark arose otherwise than from natural, gradual and imperceptible accretion or erosion, the position of the mean high-water mark, as defined by a survey plan, survey report or survey record filed or recorded by the Registrar-General or a public authority before the change, is to be adopted".

The Georges River has been subject to a number of significant flood events over time which have resulted in changes to the position of the mean high-water mark within the Georges River. During our investigation, the NSW Land Registry Service acknowledged that changes to the position of the mean high-water mark within the Georges River due to floods are not considered to be part of "*natural, gradual and imperceptible accretion or erosion*".

As such, the most recent survey plan which defines the mean high-water mark of the Georges River adjacent to Lot 7 in DP1065574 is DP189774 (circa 1932) and this has been used to determine the position of the common boundary of the Georges River and Lot 7 in DP1065574.

DP189774 shows surveyed lines west of the alignment of the Georges River boundary (mean high-water mark) and these have been adopted as the design extents of proposed rock armouring works within Lot 7 in DP1065574.

Appended to this letter is a plan showing the mean high-water mark derived from DP189774 and the extent of the proposed rock works overlaid on a current aerial photograph.

It is my assessment that all proposed rock works for bank protection of the Georges River, assuming a standard 60 degree angle of repose, can be carried out completely within Lot 7 in DP1065574.

Yours faithfully
JOHN M DALY & ASSOCIATES PTY LTD

.....
Paul M Daly
Registered Surveyor

Attachments:

MEAN HIGH WATER MARK DP189774

LEGAL PROPERTY BOUNDARY

MGA

LOT 7

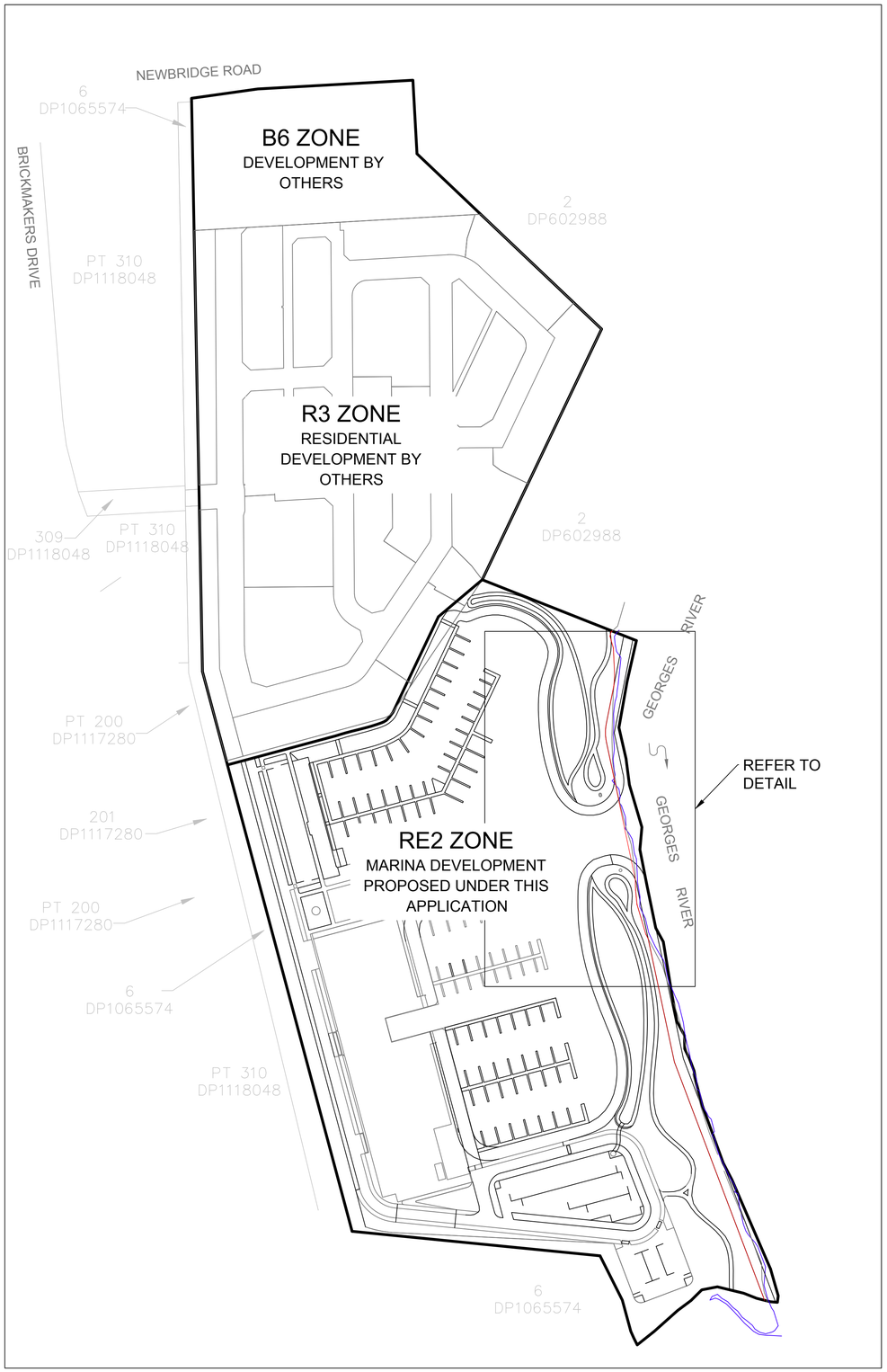
DP 1065574

GEORGES

PROPOSED EDGE OF ROCK WORKS

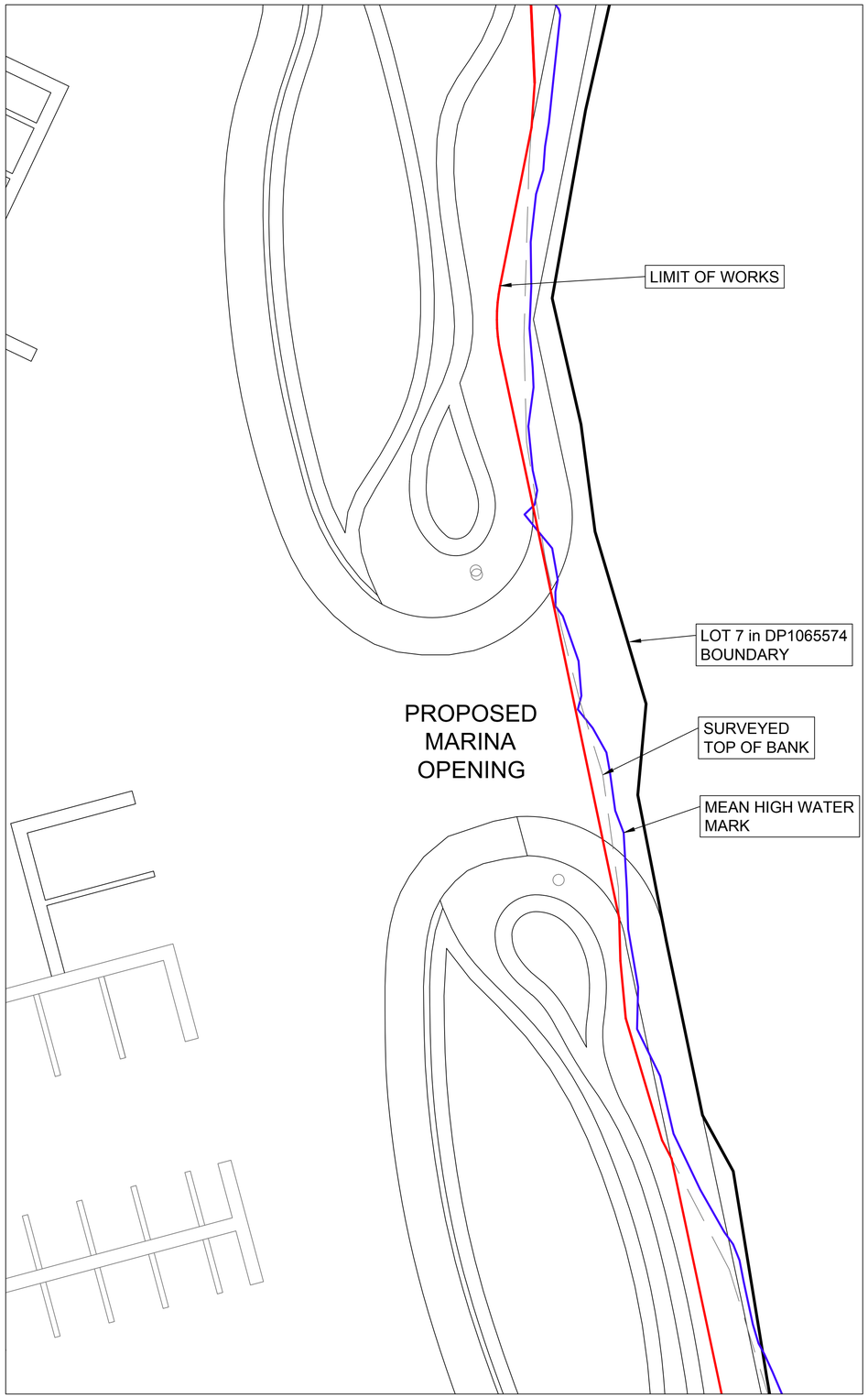
MEAN HIGH WATER MARK DP189774
LEGAL PROPERTY BOUNDARY

RIVER



OVERALL PLAN
RATIO 1:2000

0 10 20 40 60 80 100 200
SCALE :- 1 : 2000 Metres (A1)



DETAIL PLAN OF FUTURE RIVER OPENING
RATIO 1:500

20 30 40 50
SCALE :- 1 : 500

Issue	App	Date	Description
C	S.G.	21-05-2019	LIMIT OF WORKS BOUNDARY SHOWN & ARCHITECT'S PLAN REMOVED
B	S.G.	20-05-2019	OVERLAID ON ARCHITECT'S PLAN
A	S.G.	20-05-2019	ISSUED FOR INFORMATION

Client: BENEDICT INDUSTRIES PTY LTD.
Designed by : S.G.
Date of Drawing : 20-05-2019
Ratio (A1) : 1:2000

Datum : AHD
Origin of Levels : N/A
Date of Survey : N/A

JMD Development Consultants

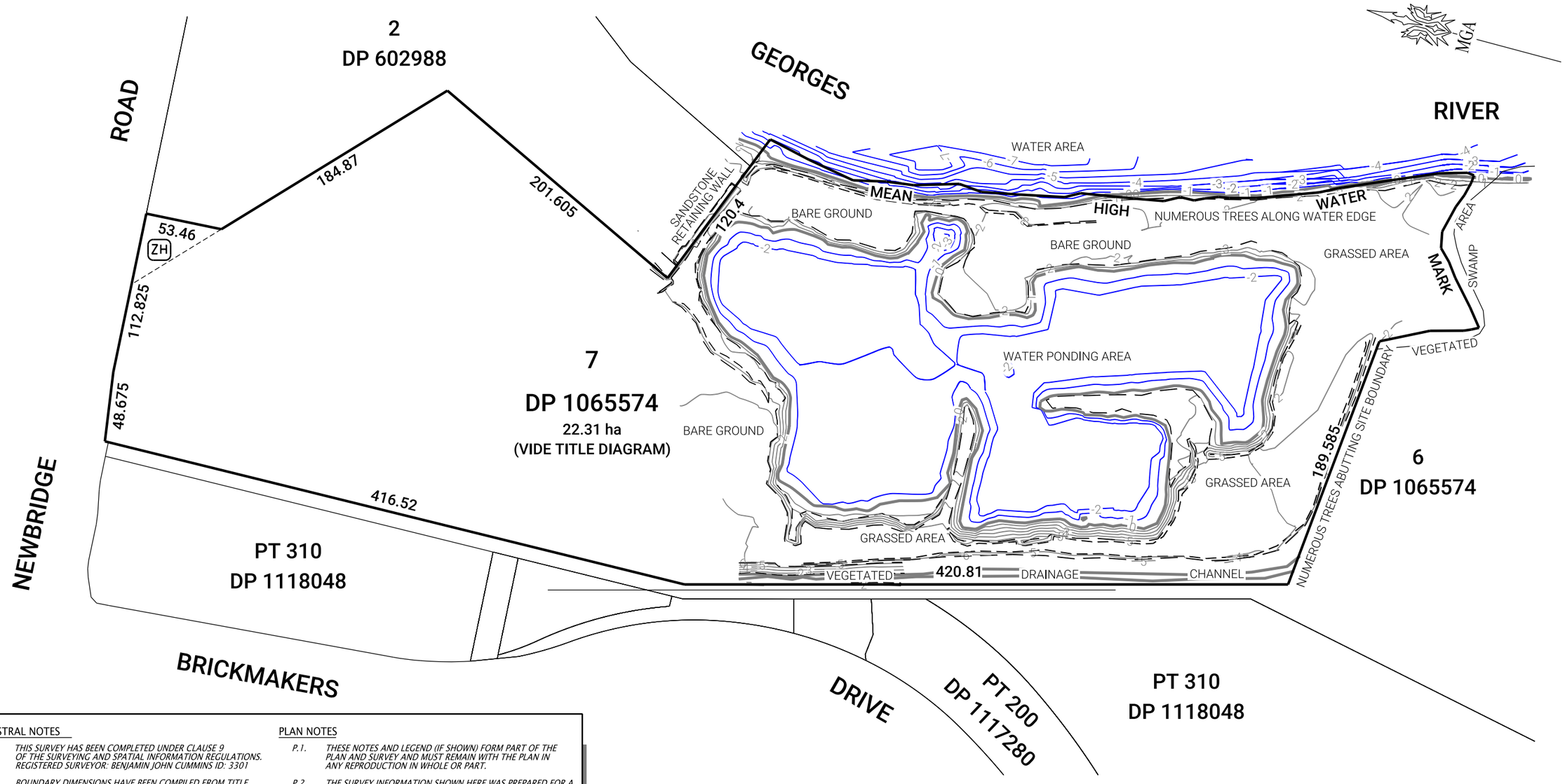
John M. Daly & Associates PTY LTD
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Project : LOT 7 IN DP1065574 - 146 NEWBRIDGE ROAD, MOOREBANK
Sheet 1 of 1 sheets

PLAN SHOWING BOUNDARY, MEAN HIGH WATER MARK & PROPOSED MARINA
Ref: 14005E33

Locality : MOOREBANK
L.G.A. : LIVERPOOL
CAD Ref: S:\JOBS\14\14005\14005 EMW\ENG\CAD\E33 - MARINA INFO\MARINA DA BASE

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C.2. *BOUNDARY DIMENSIONS HAVE BEEN COMPILED FROM TITLE DIAGRAMS AND ADJOINING DEPOSITED PLANS AND ARE SUBJECT TO SURVEY.*

C.3. *THIS SURVEY DOES NOT INCLUDE CADASTRAL DEFINITION OF BOUNDARIES WHICH COULD IMPACT ON THE OVERALL SIZE OF PROPOSED EXTENSIONS OR STRUCTURES.*

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ZH LAND EXCLUDES MINERALS (DP1065574)

LEGEND

Bank

Denotes Contour Interval Beneath Water Surface

Denotes Contour Interval at Water Level and Edge of Water

Denotes Boundary of Lot 7 in DP1065574

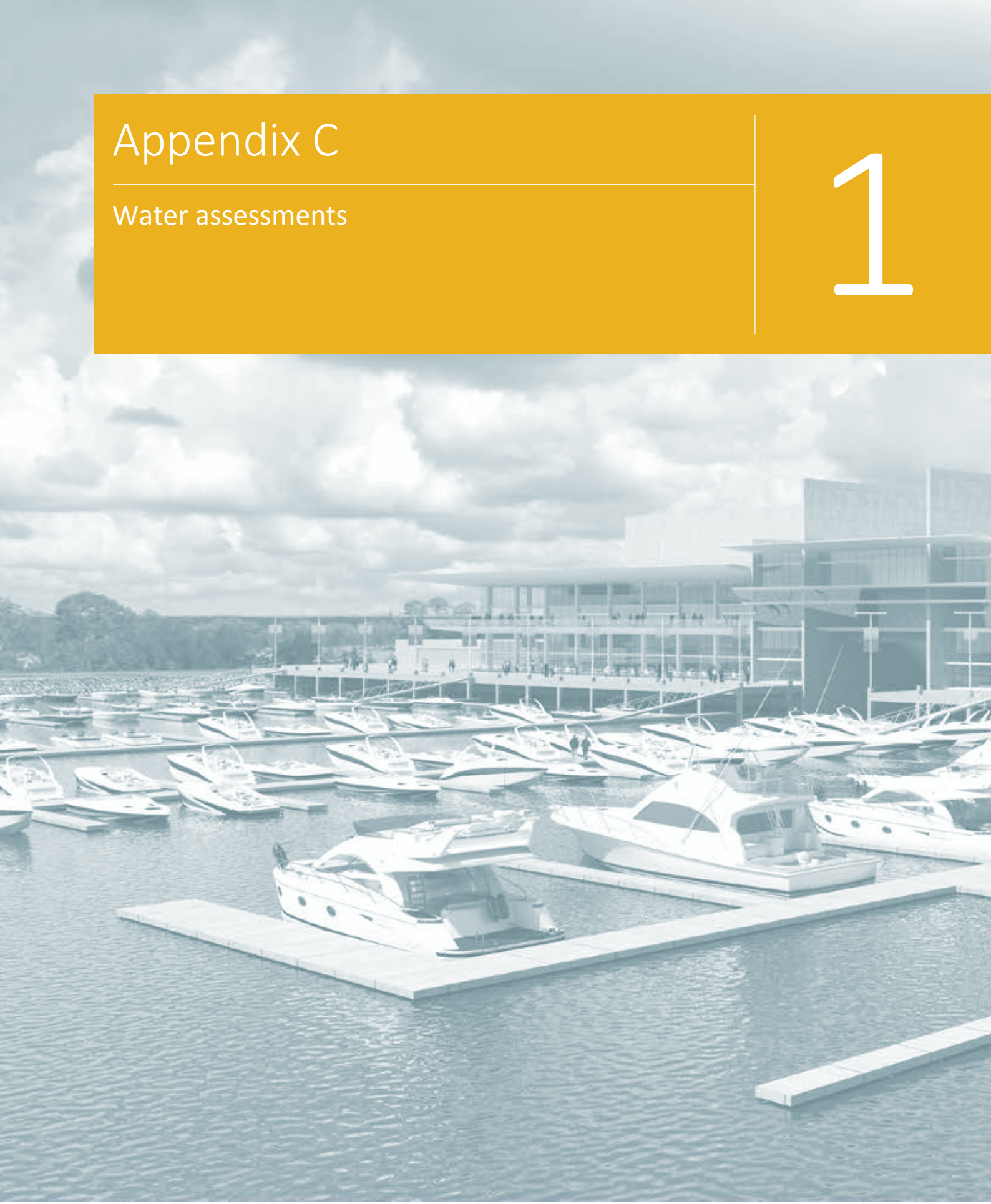
Client: BENEDICT INDUSTRIES PTY LTD	Origin of Levels : SSM 49623 RL 3.310 (VIDE SCIMS)	JMD Development Consultants	John M. Daly & Associates PTY LTD A.B.N. 88051977989 Surveying Engineering Project Management Licensed Water Service Co ordinators 32 Iolanthe Street P.O. BOX 25 CAMPBELLTOWN N.S.W. 2560 PH. (02) 4625 5055 FAX (02) 4628 2013 email: admin@jmd.com.au	Project : LOT 7 IN DP1065574 146 NEWBRIDGE ROAD, MOOREBANK SURVEY PLAN OVER PART OF SITE	Sheet 1 of 1 sheets
Date of Survey : VARIOUS					Ref: 14005(3)SP
Ratio (A3) : 1:3000					
Datum : A.H.D.	Approved : BC 22-05-2019			Locality : MOOREBANK / L.G.A. : LIVERPOOL	CAD Ref: S:\JOBS\14\14005\14005 EMW\SURV\DA Plans\14005(3)SP.dgn

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Appendix C

Water assessments

1



Appendix C1

Preliminary Marina concept design and environmental assessment (Worley Parsons 2010)

1

WorleyParsons
resources & energy

EcoNomics

BENEDICT INDUSTRIES PTY LTD

Georges Cove Marina, Moorebank

Preliminary Marina Concept Design and Environmental Assessment

301015-01167

7-Oct-10

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SYNOPSIS

This report has been prepared to support the development application for the proposed Georges Cove Marina. It addresses the engineering, river and water related aspects of the proposed development.

The proposed marina, with appropriate design and mitigation measures as recommended in this report, would not have a significant adverse impact on the river processes, flooding or water quality and would provide a facility which is in short supply along the Georges River.

Disclaimer

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PROJECT 301015-01167 - GEORGES COVE MARINA, MOOREBANK

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
B	per client comments	FC	MT	N/A	11 Mar 2009	N/A	
C	Revised for new marina concept	FC	MT	N/A	11 June 2010		N/A
D	Added copper discussion	FC	MT	MT	30 July 2010		N/A
E	Minor Edits	FC	MT	MT	7 Oct 2010		

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1. INTRODUCTION

Benedict Sand & Gravel Pty Ltd proposes to redevelop the Moorebank quarry site to incorporate a marina. This report has been prepared to support the development application for the proposed Georges Cove Marina. It addresses the engineering, river and water related aspects of the proposed development.

The site is located south of Newbridge Road at Moorebank and adjacent to the Georges River.

The marina basin would be formed in the location of the current quarry excavation.

The proposed marina site is adjacent to an area where a combination of residential and commercial development is proposed.

The proposed development site location is shown on **Diagram 1–1**.

Diagram 1–1– Site Location Plan



2. DESCRIPTION OF THE EXISTING ENVIRONMENT

2.1 River Processes

River processes relate to sediment transport, tidal flows, flood flows and water quality. Detailed analysis of tidal flows and water quality can be found in **Sections 5 and 6**.

2.1.1 Sediment Transport

The tidal velocities in the river are sufficient to transport sand as bed load along the river. This has been established in the Georges River Database Compilation and Assessment report prepared by PWD in 1991. It also identified that the Chipping Norton Lakes System formed in the early 1980s acts as a large trap for sand transported along the river.

2.1.2 Tidal Flows

Tidal flows in the river represent a significant volume of flow. The basin would create a small additional waterway area with a tidal prism forming a negligible fraction of the tidal volume.

2.1.3 Flooding

The site is located on a floodplain. Typically, a 2-year ARI event would overtop a river bank, in this case the bank has been artificially modified and it is uncertain if this would occur. The basin would provide a small increase in flood conveyance and storage area and would have a beneficial impact by marginally lowering the flood level in the local area.

2.1.4 Water Levels

The Georges River Database Compilation and Assessment prepared in February 1991 by the then Public Works Department provides a review of tidal measurements in the Georges River. The tidal planes determined at Milperra Bridge (closest location to the subject site) are presented in **Table 2–1**.

The predicted Georges River flood levels are presented in the Georges River Flood Study undertaken by Bewsher Consulting in 2000 which established a MIKE 11 model to reproduce the original levels predicted in the PWD physical flood model for Georges River. The predicted flood levels for the site are:

- 20 yr ARI RL 4.6 m AHD
- 100 yr ARI RL 5.6 m AHD
- PMF RL 10.2 m AHD

Table 2–1 – Tidal Water Levels

Plane	Datum (m)	
	ISLW	AHD
Higher High Water Springs	1.913	0.988
Mean High Water	1.466	0.541
Mean Water Level	1.002	0.077
Mean Low Water	0.538	-0.387
ISLW	0.193	-0.732

2.1.5 Water Quality

The major influences on water quality in the river are stormwater discharges, treated and untreated sewage discharges, tidal flushing and flood flows. The proposed development would not influence these major processes in the river.

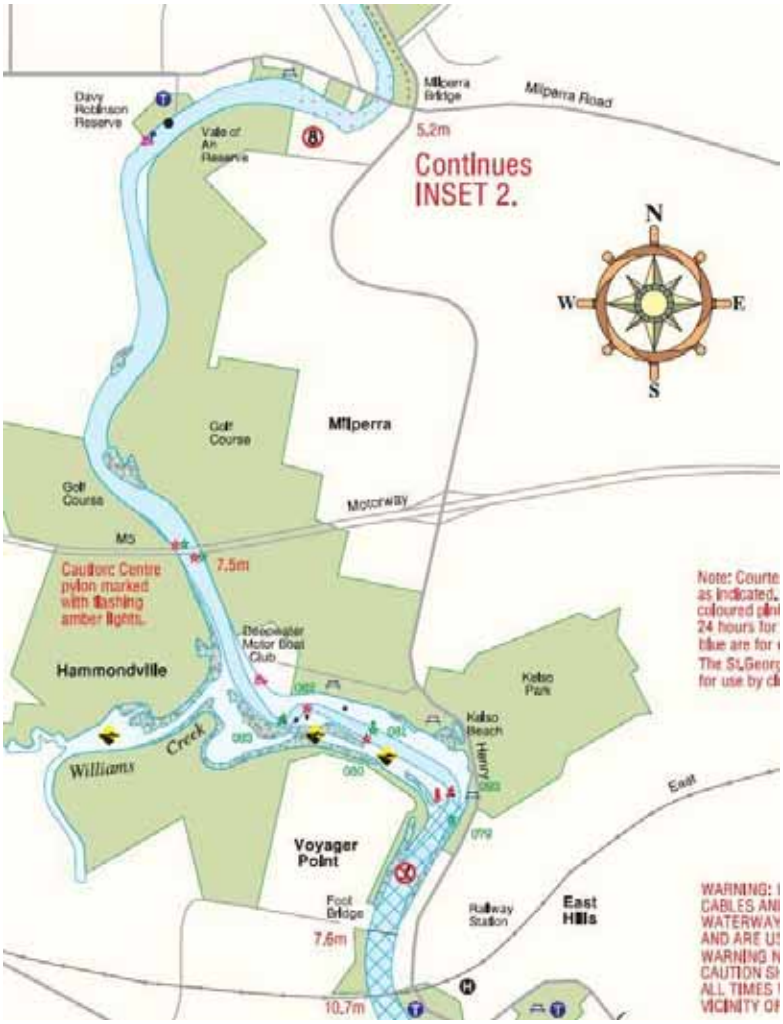
The water quality in the basin would therefore be primarily influenced by the tidal flushing from the river, i.e. the ability to maintain the same water quality in the basin as in the river. The basin has been designed to maximise circulation by maintaining an open connection to the river. The depth of the basin would be above the adjacent river bed level, avoiding poor circulation of water at the bed of the basin.

2.2 Sediment

2.2.1 Recreational Use of the River

There are numerous existing boat ramps along the Georges River supporting use of trailered recreational craft. **Diagram 2–1** shows the NSW Maritime Boating map for the area which indicates the location of existing facilities and any boating restrictions. The proposed marina is located within a length of river that is heavily used for speed boat racing and water skiing (between Davy Robinson boat ramp and the Deep Water Motor Club). This area has no speed restrictions (speed restrictions exist along most of the Georges River) and it is therefore an important amenity area for speed boat activities.

Diagram 2–1 – Local Boating Map (NSW Maritime)



Discussions with NSW Maritime indicate that there are no proposals to limit the speed along this reach of the river, so as to continue its availability for water skiing and other high speed uses.

The only aquatic licences in the area would be for events held by the Deepwater Motor Boat Club, which runs racing events.

3. DESCRIPTION OF THE PROJECT

3.1 Marina Basin

The proposal includes a marina basin of approximate dimensions of 150 m by 350 m. The marina would open to the Georges River with a short entrance channel 40-50 m wide. The layout of the proposed marina development and basin is shown in **Figure 1**.

The proposed approximately rectangular plan shape of the marina basin with dimensions of approximately 150 m by 380 m has been designed to alleviate the potential for the formation of poorly flushed corners and will assist to maintain good water quality and visual appearance.

The marina basin would be located on a relatively straight section of the river. These sections are generally more stable and less prone to the significant variations in flow velocity at bends in the river. These velocity variations typically result in sediment deposition on the inside of the bend and significant erosion on the outside of the bend. The location of the marina on the relatively straight river section will provide more stable bank and bed conditions and less potential for sedimentation in the marina basin or entrance.

The basin would be formed by filling the existing quarry to shape it into the final landform using a dredge and land based earth moving machinery. The dredge would operate as at present in a water filled basin. The excavated sand would be used for forming the Vessel Access Channel and associated land areas required for the marina. This work would commence at the landward end forming the basin and land base prior to breakthrough of the banks to the river. In this way, these works would not impact on the river water quality. The breakthrough to the river would be undertaken as the last activity after the water quality in the basin had stabilised and was suitable to discharge to the river once the banks were excavated. Water quality testing through the quarry pond and the river area adjacent to the site demonstrates that the water in the pond is of a similar quality to that of the Georges River (refer to **Table 6–2** for results of water quality testing).

3.2 Marina Basin Depth

The basin water depth is a function of the craft draught and the water depths available in the adjacent river.

The craft to be catered for in the marina would be power craft up to around 20 m in length. The Australian Standard AS 3962 – 2001, Guidelines for Design of Marinas recommends the draught of these craft of 1.5 m. The standard recommends that the basin water depth be determined by adding a freeboard of 0.3m to the largest vessel draught and half the design wave height as well as an allowance for sedimentation. The recommended basin bed level would be RL 2.2 m below the local Indian Spring Low Water (ISLW) which includes the 1.5 m draught, 0.3 m freeboard, 0.1 m half wave

height and 0.3 m for sedimentation. ISLW is the chart datum or lowest expected tidal water level in the river. The proposed basin bed level would therefore be RL-2.932 m AHD.

The Georges River Flood Study employed a model from which the cross-sectional elevations were used to generate a terrain model of the river.

Survey of the depth of the river was undertaken adjacent to the proposed marina.

3.3 Berths Details

From consultation with NSW Maritime and boat user groups, the proposed marina is within a highly utilised stretch of the river. The existing layout would accommodate a total of 186 wet berths and 250 dry berths as indicated in the following tables. The number of berths is restricted by the site and space available. The marina layout is shown in **Figure 1**.

Table 3–1 – Marina

Length (m)	Beam (m)	Percentage	Draft (m)	Berth Widths (m)	Number Of Berths
Small Craft (<15m) ≥8m <10m	4	28%	1	9	52
Small Craft (<15m) ≥10m <12m	4.4	59%	1	9.8	110
Small Craft (<15m) ≥12m <15m	5	11%	1.2	11	20
Vessels ≥15m <18m	5.4	1%		11.8	2
Vessels <20	5.7	1%	1.5	12.4	2
Vessels >20m					0
Total					186

Table 3–2 – Dry Store

Length (m)	Beam (m)	Percentage	Draft (m)	Berth Widths (m)	Number Of Berths
Small Craft (<15m) ≥4m <6m	2.8	50%		4	125
Small Craft (<15m) ≥6m <8m	3.4	20%	0.9	4.6	125
Vessels ≥15m					0
Total					**250**

3.4 Marina Building

The proposed marina building would include parking on the ground floor, a conference facility, kiosks, function centre/ casual dining, dry storage for boats, marina office, amenities. The details of the dry berths are presented in **Table 3–2** and a cross section through the marina building is shown in **Figure 2**.

3.5 Marina Entrance

The proposed marina is recessed into the riverbank and entrance to the river would be via a short entrance channel (approximately 50 m long). The entrance would be 40 to 50 m wide.

A pedestrian bridge would be provided across the river entrance to the marina to allow pedestrian connectivity along the Georges River foreshore. This bridge would also act to limit the size of vessels entering the marina by precluding vessels above a set height.

3.6 Finished Levels

The foreshore levels for the marina area are influenced by the need for convenient access to craft, adjacent land and proposed development levels and flood levels.

The marina building would consist of parking, a conference facility, function centre, kiosks, waterside casual dining and dry boat sales, repair and storage. The minimum habitable floor level for the conference as designated by Liverpool City Council policy would be the flood planning level (0.5m above the 100yr ARI flood level) which would be RL 6.1 m AHD. The mean tide level in the marina basin would be around RL 0 m AHD and as such, provision of convenient access to craft is an issue which requires careful design consideration.

The northern carpark would be formed at the 20 year ARI flood level of RL 4.6 m AHD. Otherwise, the ground surrounding the marina building would generally be at a level of RL 2.5 m AHD. The entrance roadway, connecting to the residential area to the north, would need to rise to approximately RL 5.7 m AHD, at a relatively low grade (say 8%) to allow ease of transport of boats on trailers.

It will be necessary to incorporate a number of benches into the foreshore fronting the marina berths. The uses at the foreshore level have been selected to minimise flood damages. Given the flood warning time, which would be greater that 12 hours, important equipment or records could be relocated to higher ground to minimise flood damages even further. It would be necessary to work closely with Council to devise controls which were sufficiently practical to warrant a special “merits based” dispensation through Council’s flood policy for development at a level of RL 2.5 m AHD.

A timber boardwalk would be located at a level of RL 1.5 m AHD to provide a better amenity for access to craft and further opportunity for passive recreation close to the river/basin water level. A hinged ramp would provide access from the promenade level (RL 2.5 m AHD) to the floating pontoon

berths. Access would be provided from the promenade level in order that the access ramp would not be damaged in a 100 yr ARI flood as it would be able to rotate up to the flood level of RL 5.6 m AHD.

The sections in **Figure 2** illustrate the proposed levels and their relationship with the surrounding area.

3.7 Bank Edge Treatments

The main function of the basin edge treatments is bank stability with a strong focus on creating environmental enhancement. Two potential edge treatments have been identified for use within the marina. The marina edge treatment locations have been suggested based on an appreciation of their integration with the proposed river bank protection, proposed development layout and the existing ecology.

Two edge treatments have been considered within the basin; **Type 1** is a combination of rock revetments and integrated vegetation zone; and **Type 2** is a concrete wall. Type 1 would be similar to those proposed to stabilise the river banks along the site.

A freshwater wetland is proposed along the inside of the river bank to treat runoff from the adjacent proposed residential area. The wetland would be vegetated with suitable macrophytes and would enhance the riparian zone with more diverse aquatic habitats and diverse vegetation.

Type 1 - Rock Revetment with Integrated Vegetation Zone

For this edge treatment the rock revetment would incorporate a berm of saltmarsh (or other suitable habitat) between the rock revetment and the edge treatment to improve the ecological and aesthetic value of the foreshore. The foreshore would then be backed by littoral vegetation and possibly an access path.

This option stabilises the slope through a rock revetment with the benefit of creating specific habitat environments within it. The revetment would consist of layers of rock armour to comply with the wave climate, over a geotextile fabric.

Further design of this option would be required in consultation with a specialist ecologist to establish the required height for the mid level vegetation and suitable native species.

Type 2 – Rock Revetment with Boardwalk

To enable access to berths, the use of a rock revetment with a timber boardwalk is suggested.

Where the boat moorings are proposed a timber boardwalk and a walkway down to floating pontoons would be constructed over the rock revetment. The boardwalk and pontoon would extend sufficiently

over the revetment so that the required depth would be achieved below the moored boats. Alternatively, the walkway could extend directly from the shore out to floating pontoons.

3.8 Carparking

Carparking has been provided in accordance with the numbers agreed with Council. The carpark layout is shown on **Figure 2**.

3.9 River Bank and Riparian Zone

The existing riverbank over the 500 m of the site foreshore is generally devoid of any vegetation. The river banks are eroding thereby undermining what foreshore vegetation exists at present. Without this development, these processes will continue to remove the riparian vegetation and there will continue to be no public access to the foreshore.

This project proposes to rehabilitate the foreshore and re-establish the riparian corridor vegetation representing a significant improvement to the aquatic and riparian environment. The NSW government does not have the resources to undertake these regionally significant river works which is their responsibility. The residents of the region will benefit greatly from the improved river environment and foreshore access. The loss of a small section (40 to 50 m wide) of the river foreshore for the basin entrance is minor and readily compensated for with the proposed foreshore stabilisation and riparian rehabilitation over the 500m of the remainder of the site foreshore. The marina basin would provide additional river foreshore and riparian vegetation and habitats to compensate for the foreshore loss at the basin entrance.

It should be noted that the existing length of river bank, at the proposed basin entrance, is degraded. The bank is also continuing to erode. The proposed works would improve the river bank in a number of ways:

- reduce ongoing scour/erosion of the river bank;
- provide additional habitats (including wetlands) and improve local biodiversity;
- improve visual quality; and
- improve foreshore amenity.

The basin entrance has been located to avoid any significant existing vegetation. The impact of this entrance on the riparian zone is considered minimal given the overall positive benefits to be derived from the bank stabilisation and re-establishment of the riparian zone vegetation over the entire site.

3.10 Sedimentation of the Basin

Sedimentation of the basin could occur due to inflow of sand size sediments being transported along the bed of the river by tidal and flood processes and with the deposition of fine sediments from floodwaters.

The deposition of fine sediments in the basin during a large flood would occur but at a very slow rate. The velocities in the over bank flood area in which the basin would be located are sufficient to transport fine sediment and to prevent its deposition. The basin is not deep enough to provide sufficiently low velocities during a flood to cause significant deposition of fine sediments. At the conclusion of a flood, there will be the gradual deposition of an insignificant amount of fine sediments remaining in the water column.

The tidal velocities in the river are sufficient to transport sand as bed load along the river. This has been established in the Georges River Database Compilation and Assessment report prepared by PWD in 1991. It also identified that the Chipping Norton Lakes System formed in the early 1980s acts as a large trap for sand transported along the river. As such, the sand transport rate past the proposed marina basin will be low for many decades, until such time as the lakes are full of sediments or the landform is otherwise changed. Hence, the source of sediment from the Georges River would be low.

The reasons the sedimentation rate in the basin of sand size sediments will be low include:

- location of the basin entrance on a straight section of the river channel not exposed to the large depositional episodes on river bends;
- the bed of the basin has been located above the general bed level of the river and hence bed load sand transport will not enter the basin; and
- the bed load sand transport rate past the basin entrance will be low.

The depth of sediment collected in 100 years was estimated using the following parameters:

- an average suspended solids concentration of 30 mg/L,
- an average particle size of 2 micron (clay),
- a fluid density of 1000 kg/m^3,
- a sediment density of 2500 kg/m^3, and
- a fluid viscosity of 0.01 Pa s.

The depth of sediment was thus estimated to be approximately 120 mm.

A 300 mm allowance has been adopted to accommodate minor sedimentation in the basin.

3.11 Construction

It is proposed to construct the marina using conventional land based plant and equipment *(such as excavators and all terrain trucks*), as is currently used to quarry material on the site. This marina basin is substantially already formed by the quarrying activities.

Connection to the river would be delayed for as long as practicable and would be completed during favourable water level conditions (i.e. at or around slack water) to enable management of the breakthrough with the deployment of an appropriate turbidity curtain.

The excavation works would be managed to minimise the total area to be disturbed and the exposure time of any disturbed area.

4. FLOODING

The Georges River Flood Study was completed in 2000 by Bewsher Consulting. The flood study was based on a MIKE11 hydraulic model and has been adopted by the Bankstown, Fairfield and Liverpool Councils. Results from the study have been incorporated into the Georges River Floodplain Risk Management Study and Plan, (Bewsher Consulting, 2004).

The model extends over a distance of some 46km, from above Cambridge Avenue to Botany Bay. There are over 278 cross sections and a number of separate overland flow paths.

The mid section of the model used for the Georges River Flood Study is the section relevant to this project, as it extends from Liverpool to Picnic Point. Prior to the MIKE11 model, this reach was modelled by the Georges River physical model, which had been extensively calibrated to floods that occurred in 1956, 1978, 1986 and 1988. Consequently, there is a high degree of confidence in the results from the physical model. The MIKE-11 model was calibrated to the physical model in the reach between Liverpool and Picnic Point.

4.1 Flood Impact Assessment

As the Georges River Flood Study (2000) is considered to be representative of the state of the current catchment, the flood impact assessment was based on the results of the existing study. The available flood storage is presented in **Table 4–1**. The calculations account for a loss of flood storage caused by the residential development, there is an overall gain in flood storage, which is largely due to the marina basin.

Table 4–1 – Flood Storage

Location	Plan Area (m^2)	Existing Level (m AHD)	Proposed Level (m AHD)	Change in Elevation (m)	Change in Flood Storage (m^3)
Northern Carpark (raised above 20 year ARI level)	7,801	2.7	4.6	-1.9	-14,822
Dry Storage Building	21,807	2.5	4.6	-2.1	-45,795
Southern Carpark	15,120	2.5	2.8	-0.3	-4,536
Riparian Zone	18,973	2	1.8	0.2	3,795
Wetlands	4,648	2	0.541	1.459	6,781
Marina Basin	48,727	2.7	0.541	2.159	105,202
Entrance to Basin	3,656	2	0.541	1.459	5,334
Net change					**55,959**

4.2 Marina Flood Management

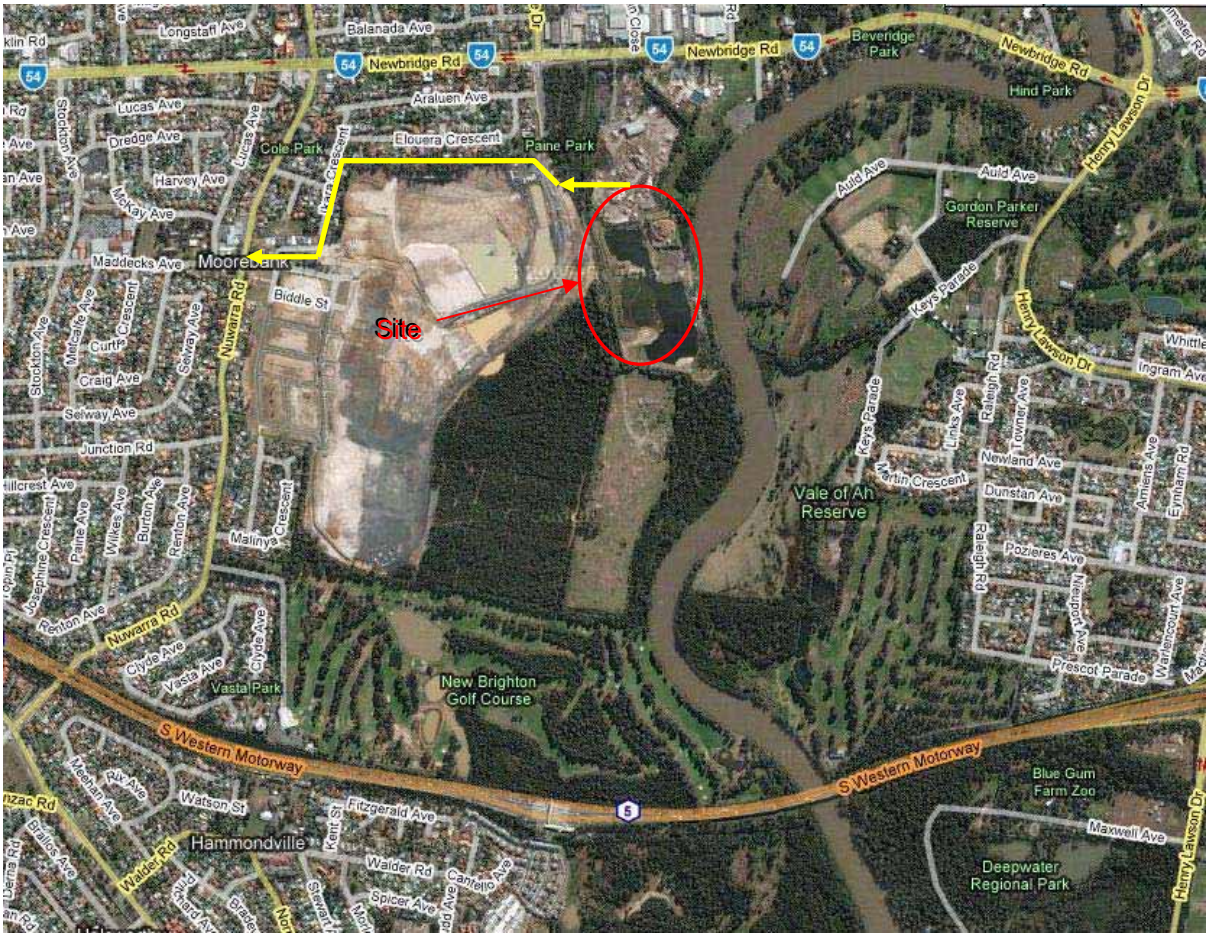
The floating marina pontoons would be designed to cater for the flood levels and flow and debris forces imposed by the 100yr ARI flood flows. This could be achieved with appropriate pile design in combination with consideration of the access connection between the floating pontoons and the foreshore areas. It is typical that the foreshore be gradually stepped down in a series of levels and boardwalks to provide a convenient amenity, access and visual aesthetics to this area.

4.3 Preliminary Flood Emergency Response Plan

The flood emergency response plan (FERP) is required for the marina and building to provide a strategy for dealing with floods more severe than the 100yr ARI event. There would be many hours warning for a severe flood. The key principle in the FERP is to provide an evacuation strategy from the site to a location above the water level in the Probable Maximum Flood (PMF).

The egress route for the marina is initially to the north, through the residential and commercial areas, to Newbridge Road, and then turning left to travel west along Newbridge Road. The route is indicated on **Diagram 4–1**.

Diagram 4–1 – Flood Evacuation Route



A full FERP would be prepared at a later date once the full details of the occupation of the building are known, including nomination of individual staff for emergency roles.

Flood warnings for the Georges River are available from the Bureau of Meteorology. For a fee, these can be sent directly to a site, to the Flood Warden.

Given the nature of the conference facility, the space would not be permanently occupied, reducing the risk of a flood occurring while people are on site. It would also be possible to prevent access to the site when a flood warning had been received.

A backup anchor pile and chain system would hold in place the marina pontoons should the piles fail or the pontoons float free of them.

All craft would also be readily tied to the chain system with quick lock fixtures when a severe flood warning was received.

5. TIDAL HYDRODYNAMICS

A hydraulic model was created using the RMA 2 software which provides results detailing the flow behaviour.

RMA-2 is a two dimensional fluid flow program which allows complicated and detailed flow systems to be designed and modelled. RMA-2 effectively simulates water flow through different networks; however it is essential that the network has been created carefully in order to efficiently model the land topography.

The model network consists of a mesh of variable sized quadrilaterals and triangles, similar in nature to a triangulated irregular network (*TIN*). Each quadrilateral or triangular element represents a portion of the ground surface defined by elevations at the corner and midside nodes. The elements also represent roughness of the surface defined by Manning's n or Chezy C values. The flexible nature of the network permits complex changes in topography, built environment and hydraulic conditions to be modelled with appropriate degrees of accuracy or representation. Elements represent areas of land, therefore the smaller the elements the more effectively the area is modelled, however the associated processing time increases. Due to these factors a compromise is sought to effectively model the network with sufficient detail, yet while not complicating the model unnecessarily.

5.1 Model Extents

In order to capture the full tidal prism, it was necessary to create a model of the Georges River from downstream of the subject site extending upstream to the Chipping Norton lakes system.

The cross-sectional model extents were limited to the area wet under average conditions, i.e. overbank areas were not included. This created a more stable model without losing any necessary information for the water quality modelling.

5.2 Boundary Conditions

The location and model boundary conditions were selected based on a range of criteria, so that the model results were stable and produced an accurate replication at the subject site.

The upstream and downstream boundary condition needed to be located a sufficient distance away from the subject site to ensure that the model stabilises and produces accurate results. The upstream and downstream boundary conditions were adopted from historical data supplied by the Manly Hydraulics Laboratory. The upstream site of Lansvale was adopted as it lies at the upstream boundary of the Chipping Norton lakes system. For the downstream boundary, the next suitable location was at Picnic Point. Despite the closer Kelso Creek station being located closer to the

subject site, yet sufficiently downstream, it was not suitable as it did not capture the full tidal range thereby producing inaccurate results.

5.3 Model Terrain

The model terrain used to construct the RMA model, was adopted using a combination of data. Specifically, the information used included:

- Aerial photography supplied by the NSW Department of Lands;
- A digital terrain model generated from cross-sectional survey data from the Georges River Flood Study; and
- Visual inspections and measurements (which were used to accurately define the Manning's "n" values along the channel and the dimensions of hydraulic features).

5.4 Marina Basin

The marina basin layout was adopted based on the current layout drawing as shown in **Figure 2**. An entrance 40 m wide and 50 m long was adopted. This is represents a worse case for flushing than a 50 m wide entrance.

5.5 Model Calibration

Once the 2D RMA model was built it was checked to ensure that it behaved correctly and represented the terrain. The model cross sections (specifically bridge structures which can have significant localised affects) were compared against the survey data (obtained from the Georges River Flood Study) and site inspection data and adjusted accordingly so that it correctly represented the terrain.

The Manning's "n" values were also checked and adjusted against site inspection and aerial photos to correctly determine and model the river's behaviour.

5.6 Tidal Exchange

The model results indicated that a high degree of exchange would occur between the river and the marina, due to the relatively wide marina entrance. The river is approximately 80 m wide in this location, while the entrance is at least 40 m wide. The water levels in the marina mimic those in the river, indicating that the entrance does not control flows entering and leaving the marina basin.

5.7 Flow Velocities

The model indicated that flow velocities due to tidal flows were low. Velocities in the marina basin were below 0.05 m/s and velocities in the river adjacent to the proposed marina were generally less than 0.3 m/s.

5.8 Bank Stability

Although the tidal flow velocities are low, other factors also affect bank stability. The 1.5 year ARI flow is considered to be the “bank forming” flow, during which velocities would likely be higher than those during tidal flow conditions. Waves generated by boats on the river also affect bank stability. The bank protection would be designed to withstand these forces.

6. WATER QUALITY

6.1 Introduction

The Georges Cove Marina would be connected to the Georges River. The river encompasses a large part of the Sydney urban area catchment and as such, receives significant pollutant loads from urban runoff and sewage overflows/discharges from the sewerage system and sewage treatment works. The proposed marina water quality will reflect the river water quality because the river flows are enormous in comparison to the volume of water in the marina basin. Nonetheless, the aim is for the marina to provide water quality which is better than the river quality so that it will not preclude the longer term improvement in river water quality. Also, it will be important that the marina does not contribute to make one element of water quality worse in the river. This will be achieved by targeting ANZECC water quality guidelines in the marina suitable for estuarine ecology.

The potential pollutant sources in the marina development are runoff from the land, copper from antifouling paints on the craft hulls and indiscriminate discharge of sewage from craft while at the marina berths. The development would incorporate water sensitive urban design measures to treat runoff prior to entering the marina basin and a sewage pumpout facility would be provided to alleviate unlawful discharges of sewage from craft holding tanks.

The proposed marina on the Georges River was assessed for the following purposes:

- To determine the potential impacts on the water quality in the river; and
- To determine the water quality within the waterbody of the marina.

The key consideration is the introduction of copper, used in antifouling paints, to the aquatic system. The introduction of copper would be limited through the management measures listed in **Section 6.1.1**. The other important parameters are suspended solids, nitrogen and phosphorus. These parameters are to be assessed on two bases:

- Comparison with existing water quality in the river; and
- Comparison with water quality guidelines.

The relevant water quality guidelines are the Australian and New Zealand Environment and Conservation Council (*ANZECC*), *Australian and New Zealand Guidelines for Fresh and Marine Water Quality,* 2000.

6.1.1 Environmental Measures

Specific facilities within the development will reduce the environmental impact of the marina. A brief description of the facilities is provided below:

- The dry storage facility reduces the exposure of anti-fouling paint on craft hulls in the marina;

- The sewage and bilge pumpout facility within the marina will alleviate nutrient loads entering the marina through indiscriminate discharge of sewage from craft while at the marina berths; and
- Water sensitive design elements throughout the development will provide treatment of stormwater runoff and a reduction of pollutant load prior to entry into the marina/Georges River.

Management has decided not to sell anti-fouling paint that contains copper through the marina. This measure will decrease the copper load through the berthing facility.

6.1.2 Guidelines

The ANZECC/ARMCANZ 2000 guidelines aim to maintain or improve the environmental value of natural or semi-natural water resources. The guidelines recommend monitoring a range of indicators, collecting biological effect data for the existing ecosystem and the use of reference sites where no site-specific data is available. The guidelines are recommend tailoring for local conditions. Currently the site of the proposed marina is occupied by a sand extraction operation, including water bodies created through the dredging process. The construction of the marina would result from the sand extraction operation. This investigation compares predicted water quality indicators with default guideline values to assess the water quality performance of the proposed design.

6.1.3 Trigger values

'Trigger values' are defined as numerical values of an indicator (*such as concentration of total copper*) at which some management action is triggered.

As the marina does not exist, indicators were used predict the water quality behaviour. The aim of investigations is to ensure, to the extent possible, that the water quality indicators will be below the trigger values for a sufficient proportion of the time.

In line with current guidelines, the predicted stormwater water quality will need to be modelled and assessed in terms of the concentration of total nitrogen (TN), total phosphorus (TP) and total suspended solids (TSS).

Copper loading from stormwater and copper leaching from antifouling has been calculated in terms of total copper (TCu). The TCu concentrations do not always meet the trigger values so, in accordance with the guidelines, copper speciation in the marina has been modelled and the labile (*bioavailable*) concentration (LCu) compared with the trigger values.

Nutrients

The guidelines give a set of default trigger values for physical and chemical stressors, such as nutrients, below which there is considered to be a low risk to the aquatic ecosystem from the physical

and chemical stressors (Table 3.3.2 in ANZECC/ARMCANZ, 2000). The Guidelines are given in terms of the 80th percentile of measurements.

	Total Nitrogen (μg/L)	Total Phosphorus (μg/L)
Estuarine waters	300	30

The estuarine values have been adopted for the marina and the Georges River.

The primary mechanism by which excessive nutrients threaten the aquatic ecosystem is the same as for recreational and aesthetic values - algal blooms. A low risk to the aquatic ecosystem means a low risk of algal blooms and hence low risk also to the recreational and aesthetic values of the water body.

Suspended Solids

Estuaries typically experience a wide range of TSS concentrations. No absolute trigger values for TSS are given in the guidelines in relation to secondary contact recreational use, aesthetic value or risk to aquatic ecosystems. Effects of TSS loading on the aquatic ecosystem and aesthetic value can be discussed in terms of change from pre-development conditions. TSS loads to the marina are also relevant to the fate of copper in the marina.

Copper

The initial indicator for assessing the toxic effect of copper is concentration of total copper. However not all forms of copper are equally toxic. The decision tree for metal speciation given in the guidelines (Figure 3.4.2 in ANZECC/ARMCANZ, 2000) describes how if the total copper concentration fails to meet the trigger value then copper speciation and bonding with sediment can be considered to establish a bioavailable or 'labile' concentration that can be compared to the trigger value.

For protection of aquatic ecosystems the trigger values for concentration of labile copper are given in the guidelines (Table 3.4.1 in ANZECC/ARMCANZ, 2000) and presented in Table 6–1. The values for marine water are applicable to the site. The values for freshwater are shown for comparison purposes.

Table 6–1 – ANZECC Trigger Values for Copper

	Level of Protection (Percent of Species)			
	99%	95%	90%	80%
Trigger values for marine water (μg/L)	**0.3**	**1.3**	**3.0**	**8.0**
Trigger values for freshwater (μg/L)	1.0	1.4	1.8	2.5

For recreational use, the guidelines give a trigger value for copper concentration of 1000μg/L (Table 5.2.3 in ANZECC/ARMCANZ, 2000).

The guidelines do not give specific advice on copper concentrations for protection of human consumers of aquatic food. For the protection of aquaculture species a default trigger value of 5μg/L is given (Table 4.4.3 in ANZECC/ARMCANZ, 2000).

The marina's primary purpose is to provide a facility for recreational boats and the marina is not intended to extend the existing aquatic habitats available in the Georges River. Hence, the 90% or even 80% species protection value (**3.0** *or* **8.0 μg/L**) may be appropriate trigger values for the in-marina water quality. This should allow colonisation of the marina by copper tolerant species.

6.1.4 Water Quality Monitoring

Water quality monitoring of the existing waterbodies has been undertaken, primarily by Marine Pollution Research in 2006. **Table 6–2** lists the results of monitoring by Marine Pollution Research as reported in 2010.

Table 6–2 – Water Quality Test Results by Marine Pollution Research

Analyte**	Units	DetLim	Site	N	Min	Max	Mean	SE
pH	pH units		Bank	48	3.2	6.3	5.0	0.14
pH			Pond	12	6.8	8.7	7.9	0.16
pH			River	24	6.5	7.6	7.3	0.06
Cond	μS/cm		Bank	16	5400	14600	10038	695
Cond			Pond	4	7200	14800	11250	1571
Cond			River	8	8700	21000	16488	1771
TDS	mg/L		Bank	16	4700	10000	7438	441.10
TDS			Pond	4	7300	9600	8450	608.96
TDS			River	8	9600	14000	11950	562.84
Alkalinity	mg/L	< 0.1	Bank	16	0.05	150	32.6	11.86
Alkalinity			Pond	4	110	140	122.5	7.50
Alkalinity			River	8	65	95	75.1	3.41
TOC	mg/L		Bank	16	4	29	13.1	1.42
TOC			Pond	4	16	30	24.3	2.95
TOC			River	8	2	7	3.8	0.56
NH4-N	mg/L	<0.1	Bank	16	0.64	3.8	1.5	0.23
NH4-N			Pond	4	0.042	0.2	0.1	0.04
NH4-N			River	8	0.044	0.05	0.0	0.00

Analyte**	Units	DetLim	Site	N	Min	Max	Mean	SE
NOx	mg/L	<0.005	Bank	22	0.0025	0.22	0.1	0.01
NOx			Pond	4	0.0025	0.43	0.1	0.10
NOx			River	8	0.031	0.62	0.2	0.07
Al	mg/L	< 0.1	Bank	8	0.05	65	17.7	9.84
Al			Pond	2	0.05	0.2	0.1	0.08
Al			River	4	0.05	0.05	0.1	0.00
Cu	mg/L	<0.01	Bank	12	0.005	0.1	0.023	0.01
Cu			Pond	3	0.005	0.005	0.005	0.00
Cu			River	6	0.005	0.005	0.005	0.00
Fe	mg/L	<0.02	Bank	8	22	230	87.4	26.22
Fe			Pond	2	0.05	0.22	0.1	0.09
Fe			River	4	0.01	0.36	0.1	0.08
Mn	mg/L		Bank	16	0.7	4.4	1.8	0.25
Mn			Pond	4	0.04	0.15	0.1	0.02
Mn			River	8	0.02	0.06	0.0	0.01
Pb	mg/L	<0.01	Bank	12	0.005	0.07	0.0	0.00
Pb			Pond	3	0.005	0.015	0.0	0.00
Pb			River	6	0.005	0.015	0.0	0.00
Zn	mg/L	<0.02	Bank	10	0.03	0.3	0.1	0.03
Zn			Pond	0	0	0	0.0	0.00
Zn			River	2	0.01	0.01	0.0	0.00

* Bank = 4 bore sites on riverbank, pond is single dredge pond site and river = two river edge sites

**All other analytes (As, Ba, Cd, Cr, Hg, Se, OC pesticides, PAH & Phenols) were below detection or non-significant.

Additional monitoring was undertaken by quarry staff in 2008 for testing of the various copper components and associated suspended sediment levels in the river adjacent to the site. The samples were tested by the CSIRO laboratory at Lucas Heights. Sampling was undertaken on both spring and neap tides and at both high and low tides to gather the widest possible range of information on water quality at the site. Wet weather sampling was also undertaken for a rain event during which 27.2 mm of rain fell at Liverpool and 32 mm of rain fell at Bankstown. The results of this monitoring are shown in **Table 6–3**. It can be seen from the test results that the water has a dry weather labile copper concentration of 1.5 ± 0.40 µg/L, while combining the dry and wet weather results gives a concentration of 1.4 ± 0.41 µg/L. Thus, the water in the Georges River in the vicinity of the site generally only complies with the copper trigger value for protection of 90% of species.

Table 6–3 – Water Quality Test Results by Benedict / CSIRO

Laboratory I.D.	Sample I.D.	Date Sampled	Time Sampled	Conditions	Total Copper (µg/L)	Dissolved Copper (µg/L)	Labile Copper (µg/L)	Total Suspended Solids (mg/L)
CE5-1	MBK001	16/01/2008	10.10	Low neap tide	3.0	2.4	1.3	8
CE5-2	MBK002	16/01/2008	16.15	High neap tide	2.6	2.0	1.3	8
CE5-3	MBK003	22/01/2008	10.05	High spring tide	3.3	2.2	2.1	15
CE5-4	MBK004	22/01/2008	16.50	Low spring tide	3.0	2.2	1.3	15
CE5-5	MBK005	1/02/2008	12.00	Wet weather	3.0	2.3	1.0	21

6.2 Pollutant Inputs

6.2.1 Stormwater

Runoff from urban areas in the marina's catchment is not the primary source of pollutants entering the marina, but this source has been taken into account in the modelling for nutrients (*nitrogen and phosphorous*), suspended solids and copper.

A MUSIC water quality model was created to determine the pollutant inputs from stormwater in the catchment.

Rainfall data was collected from the *Bureau of Meteorology* (*BoM*) to be used in the MUSIC model. Pluvial rainfall data from Liverpool rainfall station (*station number 67035*) was used as it is the closest rainfall station to the marina and provided all years of data (*excluding 1994 where a complete year was not recorded*) between 1963 and 2000. The average annual rainfall depth for this period was 866 mm.

For this study the pluviograph record from 1st January 1972 through until 31st December 1975 was utilised for the MUSIC modelling because this relatively recent period contained both a dry, average and wet year, and has an annual average rainfall of 885 mm which is close to the long term average for the region.

The default soil parameter values in the MUSIC program were calibrated to reflect the runoff characteristics of the site. The soil parameters used for marina model were adopted from a previous study, where the soil parameters were calibrated to reflect the flood plain characteristics of a nearby site also located on the Georges River. The soil parameters adopted are shown in **Table 6–4**.

Table 6–4 – Adopted Soil Parameters

Parameters	Value
Soil Storage Capacity	120 mm
Initial Storage	30 %
Field Capacity	30 mm
Daily Deep Seepage Rate	30 %

The total rainfall catchment flowing into the marina is enclosed by the site boundaries with a total area of 16.5 ha. The site does not receive any water from any external catchments. The site comprises of 7.5 ha of residential development, 1.53 ha of commercial development and 9.94 ha of open space for the marina.

The development was modelled with general urban pollutant characteristics within the MUSIC model. Based on descriptions of the site, geographical maps and architectural drawings, the proposed development was modelled with impervious percentage of 70%.

The volumetric runoff coefficient (Cv) was assessed to check whether the adopted impervious percentage was acceptable. Calculations showed that an impervious percentage of 70% and the adopted soil parameters yielded a Cv value of 0.65 and a runoff volume of 94 ML/year. This Cv value typically reflects the characteristics of an urbanised site, and concludes that the adopted values in the MUSIC model will produce reliable indicative results. MUSIC results of pollutant discharge are shown in **Table 6–5**. Site runoff will be treated to attain best practice standards of 80% reduction in suspended solids and 45% reduction in nitrogen and phosphorus. It is assumed that copper concentrations would also be reduced through treatment. A reduction rate of 45% was conservatively adopted.

Table 6–5 – Music Results

Pollutant	Load Before Treatment (kg/year)	Minimum Reductions	Maximum Resultant Load (kg/year)
TSS	9,320	80 %	1,864
TP	22.5	45 %	12.4
TN	187	45 %	103
TCu	7.44	45 %	4.1

6.2.2 Discharges from Moored craft

General

The marina is being designed to accommodate 182 small craft and 4 larger vessels as per **Table 3–1**. Of these it is predicted that 176 will be private recreational craft and 10 will be commercial craft. Pumpout facilities as well as associated management practices will be incorporated within the marina to cater for the disposal of bilge water and sewage from craft while at berths. Notwithstanding these precautions the modelling has incorporated allowance for some illegal discharges of sewage and bilge water from craft.

All vessels berthed within the marina are expected to be painted with antifouling paint to slow the growth of marine organisms on the hull. Antifouling paint typically incorporates a biocide that is slowly leached from the paint into the surrounding water. By far the most common biocide currently used on recreational craft and small commercial vessels is copper. Copper leaching from antifouling paint represents a pollution load into the marina, as referred to in Section 6.1.1, anti-fouling paint which contains copper will not be sold at the marina.

Illegal or Accidental Discharge of Sewage and Bilge Water

With the pump-out facilities and management controls, accidental or illegal discharges of bilge water and sewage are expected to be minor. The pollution loadings for these discharges from vessels have been included in the marina water quality modelling.

Vessel usage will vary over the year, with a predicted maximum usage of 40% of craft moored at berths in peak summer periods. If it is assumed that the peak usage rate is extended over the entire year, the estimated weekly pollutant load from accidental sewage would conservatively be:

- Number of craft in the development = 186
- Usage rate of craft in any one week = 40%
- Average number of people on craft = 4
- Number of craft which cause discharges of sewage to the waterway = 20%

- All discharges occur within the marina waterway and not in the river
- Previous studies indicate the following loading factors for the use of toilets:
    - Suspended Solids 50 g/person/day
    - Total Nitrogen 8 g/person/day
    - Total Phosphorus 2 g/person/day

The total number of people who are assumed to contribute to unauthorised sewage discharge during a week can be calculated as follows:

186 craft x 40% occupancy x 4 people x 20% causing discharge = 60 persons

Hence, the pollution loading from accidental sewage discharge weekly by 60 persons would be approximately:

- Suspended Solids 21.0 kg/wk
- Total Nitrogen 3.36 kg/wk
- Total Phosphorous 0.84 kg/wk

The estimated potential quantity of accidental bilge water which may be discharged to the marina has been based on the craft usage noted above and the following conservative assumptions:

- Average craft bilge water pumpout volume per annum is 400 L (i.e. about 8L per week);
- Usage rate of craft in any one week = 40%;
- Number of craft which cause accidental discharge of bilge water = 20%;
- All discharge occurs within the marina waterway;
- Number of craft causing discharge per week = 15;
- Volume of bilge water discharged per week = 120 L.

Typical concentrations in bilge water, based on data collected in an earlier study by Dames and Moore, are as follows (rates for steel-hulled vessels have been conservatively adopted):

- Suspended Solids 355 mg/L
- Total Nitrogen 14 mg/L
- Total Phosphorous 1380 mg/L
- Copper 0.8 mg/L

The conservatively estimated pollutant loads entering the marina waterway in a week due to accidental bilge water discharge are presented below:

- Suspended Solids 42.6 g/wk
- Total Nitrogen 1.68 g/wk
- Total Phosphorous 166 g/wk
- Copper 0.096 g/wk

6.2.3 Copper Leaching from Antifouling Paint

The copper loading from antifouling is a function of the number and size of craft, the usage patterns of the craft, and the copper leaching rate from the antifouling paint.

Vessel Type and Size Distributions

The marina is being designed to accommodate 182 small craft and 4 larger vessels as per **Table 3–1**, with an assumed average wetted surface area of 24.6 m^2.

The distribution of berths in the marina is based on the predicted craft size distribution, taking into account the river location. The adopted craft size distribution is given in **Table 3–1**.

A craft-type distribution was estimated considering that typically most private marinas are dominated by power boats and, due to its location on the Georges River, this marina would have a particular bias towards power boats.

Curves are shown in **Figure W** relating hull length to wetted surface area for traditional long-keeled sailing boats, modern fin-keeled sailing boats, and a high and low curve for power boats which can vary greatly in shape and underwater appendages.

Vessel Usage Patterns

The usage patterns of vessels can have a significant effect on the copper leaching rate from the antifouling paint. Prior studies indicate that:

- most vessels are antifouled once per year;
- in water hull cleaning is either banned or discouraged on environmental grounds;
- most private marinas are dominated by power cruisers;
- on a busy weekend typically 10%-40% of boats may depart the marina;

- marinas surrounded by good cruising grounds, sheltered waterways with plenty of destinations within easy reach tend to have a higher rate of departures;
- up to 60% of vessels leave their berth very rarely or never.

Commercial vessels are predicted to be limited at the marina, due to its location on a river, distant from more popular coastal destinations.

Occupancy rates of 95% and 80% were adopted for private vessels and commercial vessels, respectively. These values are considered conservative.

Copper Leaching Rates

Copper leaching rates from antifouling paint may vary with many factors including the amount of copper in the paint, type of paint, water flow past the paint surface, temperature, salinity and pH of the water, presence of a bio-film on the paint surface, time since application and mechanical cleaning.

An emerging alternative to copper based antifouling systems are silicone based coatings which aim to make the surface so slippery that fouling organisms are washed off as the vessel moves through the water. These systems are considered to be superior from an environmental point of view as the do not include any biocide that is released into the water. However, at the current time and for the foreseeable future, copper based paints are considerably cheaper and more effective and are much more commonly used on both recreational and commercial vessels.

Valkirs et al 2003 conducted an extensive set of experiments to quantify leaching rates under a range of exposure conditions in San Diego Bay. Seven different self-polishing paints and one ablative antifouling paint were tested. Based on this study and other available information, a leaching rate of 7 µg/cm^2/day was adopted.

Copper Loading from Antifouling

The copper loading from antifouling is calculated from the number of vessels, vessel size distribution, the wetted surface area curves, the proportion of time the vessels are expected to be in the marina and the adopted leaching rates. The predicted copper loading is 123 kg/yr.

6.2.4 Summary of Pollutant Inputs

A summary of the pollutant loadings adopted for modelling of the marina water quality is presented in **Table 6–6**.

Table 6–6 Summary of Pollutant Inputs to the Marina, ultimate developed scenario (kg/yr)

Pollutant	Load

From Stormwater	
Total Nitrogen	103
Total Phosphorus	12.4
Total Suspended Solids	1,864
Total Copper	4.1
Discharges from Craft	
Total Nitrogen	1094
Total Phosphorus	175
Suspended Solids	52.3
Copper	0.005
Copper from Antifouling	123
Total Copper from Stormwater, Craft Discharges and Antifouling	127

6.3 Flushing

6.3.1 General

Flushing is the exchange of water between the marina and the river, and it is an important mechanism for removal of pollutants from the marina. Natural flushing is driven by tidal flows, wind, density currents, stormwater inflows and diffusion. Tidal and stormwater flows would be the most important processes for the proposed marina.

6.3.2 Tidal Flushing

The proposed marina is situated on the Georges River, connected by a 40 m wide, 50 m long entrance channel. The tidal flushing of the marina is predominant because water will move all the way out of the channel and well beyond in one tidal cycle. There is the potential for up to 40 to 60% of the marina water to be exchanged between each peak and trough of a tidal cycle, varying with the tidal range.

6.3.3 Stormwater Flushing

Stormwater flushing is not considered to be the dominant flushing mechanism for the marina, as tidal flushing would occur daily and thus be more significant to the typical water quality in the marina.

Due to the relatively small catchment size, only 94 ML/year of runoff passes through the marina. This equates to approximately half the volume of the marina. Hence the tidal flushing of 40 to 60% per tidal cycle is of greater significance than 50% per year due to stormwater flushing.

6.4 Water Quality Modelling

Using the results from the hydraulic RMA-2 model, a water quality model describing the transportation and dispersion of pollutants could then be developed using the RMA-11 software.

RMA-11 is a two dimensional water quality and environmental transport software package, which can be used to model the advection-diffusion process in the aquatic environment along with basic algal, nitrogen, phosphorus and oxygen processes. RMA-11 operates on a physical hydrodynamic environment provided by the results of the RMA-2 modelling, that is, it is designed to accept velocity and depth data generated from the two-dimensional hydrodynamic model (*i.e., RMA-2*).

The RMA-11 model indicated that, under the tidal conditions modelled, approximately 53% of a conservative pollutant would be washed out of the marina in a day. This indicates that the marina basin layout and entrance configuration are not constraining tidal flushing.

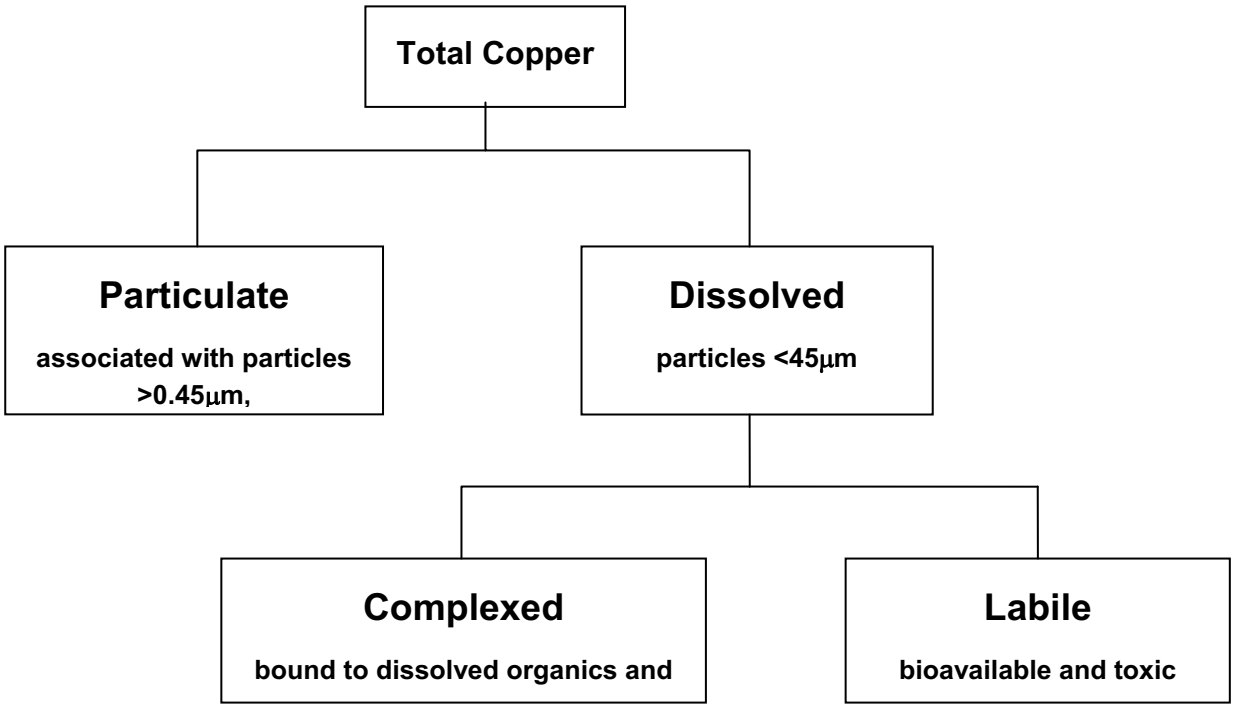
6.5 Copper

6.5.1 Copper Loading

Inputs to the model are average copper loadings from stormwater and vessel antifouling paint as described in **Section 6.1.4**.

6.5.2 Copper Partitioning

The terminology used to describe the copper partitioning is illustrated below.



Following the method of Chadwick et al (2004), the total copper within the water of the marina is divided into dissolved and particulate phases so that:

$$c_t = c_d + c_p$$

where: c_t = concentration of total copper

c_d = concentration of dissolved copper

c_p = concentration of particulate copper

'Particulate copper' is copper associated with particles greater than 0.45 µm diameter and is less toxic. 'Dissolved copper' is everything less than 0.45 µm diameter. A suspended solid dependant equilibrium between the particulate and dissolved copper is assumed such that:

$$c_p = K_d c_d \text{ TSS}$$

where: K_d = partitioning coefficient (L/mg)

TSS = total suspended solids (mg/L)

The dissolved phase is further divided into complexed and labile phases:

$$c_d = c_c + c_l$$

where: c_c = concentration of complexed copper

c_l = concentration of labile copper

'Labile copper' is the bioavailable and therefore more toxic phase. 'Complexed copper' is bound to dissolved organics or colloids and is not bioavailable. The partitioning coefficient for the complexed and labile phases varies with the amount of available complexing material in the water. Based on advice from Dr Graeme Batley of CSIRO for coastal/estuarine waters, the complexed copper concentration has been determined as (refer **Appendix**):

$c_c = 0.65\ c_d$, up to a maximum of 4.0 μg/L

6.5.3 Flushing

Flushing exchanges a portion of the water of the marina with water from the river every day, as described in **Section 6.3.2**, so the flux of copper out of the marina due to flushing is:

$$F = f\ V\ (c_t - c_{t,\ background}) \quad (g/day)$$

where: f = flushing rate (% per day)

V = volume of marina

$c_{t,\ background}$ = Georges River background total copper concentration

Flux to Sediments

Chadwick et al (2004) investigated a uniform first order loss to sediments as well as a simple partial settling model. They found that the particle settling model better predicted the copper concentration in San Diego Bay and this model has been adopted for the marina, so the flux to sediments over the marina is:

$$L = w V c_p / h \qquad \text{(g/day)}$$

where: w = effective fall velocity (m/day)

h = depth of marina

Chadwick et al acknowledge that this particle settling model is a simplification of the actual sediment-water exchange of copper which results from a number of processes including particle settling and re-suspension, as well as pore water advection and diffusion. Even in existing systems where data can be collected it is difficult to characterise all of these processes so an 'effective' fall velocity which integrates all of the processes is used.

6.5.4 Mass Balance Model of Copper in the Marina Basin

Copper from antifouling paint enters the water as copper ions, a large portion of which quickly binds to suspended solids or forms complexes with dissolved organics and colloids. This leaves only a fraction of the total copper in a bioavailable or 'labile' form. A mass balance model of copper in the marina has been constructed based on the work of Chadwick et al (2004) who modelled the mass balance and fate of copper in San Diego Bay and earlier studies.

The mass balance model considers the marina as a single, well mixed element in steady-state. The model considers the attachment of copper to sediments and settling to the bed, the complexing of dissolved copper and the removal of copper from the marina by tidal flushing.

EVALUATION OF PARAMETERS IN COPPER MASS BALANCE MODEL

The particulate-dissolved partitioning coefficient, K_d, can be calculated from physical measurements in an existing system of interest but the effective fall velocity, w, is to a large extent a calibration parameter. Calibration of the model was based on the results of calibration in other projects.

The particulate-dissolved partitioning coefficient, K_d for the Georges River averaged 0.033 for dry weather events.

San Diego Bay

Chadwick et al (2004) calibrated their model of San Diego Bay to 4 sets of measured data. Their best-fit parameters are given below in **Table 6–7**:

Table 6–7 Best-fit parameters for San Diego Bay (from Chadwick et al 2004)

	Combined	Aug 2000	Jan 2001	May 2001	Sept 2001
K_d (L/mg)	0.1	0.22	0.06	0.05	0.08
w (m/day)	1.4	0.85	4.8	3.3	1.3

It was noted that the two parameters were not independent, with high partitioning coefficients occurring with low effective fall velocities and vice versa. It is thought that the sediment in the bay in May 2001 was coarser and less reactive than the sediment in August 2000. The difference may be explained by the variation in river and stormwater flows entering the bay. Coarse sediments have proportionally less surface area by weight and therefore less affinity for copper (*smaller K_d*) and higher fall velocities than fine sediment. Organic sediment tends to have a higher affinity for copper than inorganic sediment.

Other Systems

Chadwick et al. (2004) also give some values for dissolved-particulate copper partitioning coefficients determined from other studies:

Location	K_d (L/mg)
Melbourne	0.076
Southern coast of England	0.0003-0.12
San Francisco Bay	0.07
Galverston Bay, Texas	0.03

Proposed Marina

The sources of sediment to the marina will be the river, treated local catchment stormwater, resuspension of sediments on the bed stirred up by craft movement, wave action and discharges from vessels. Much of the stormwater will have passed through a treatment train consisting of devices such as wetlands, swales and gross pollutant traps. Furthermore, the stormwater flushing is low relative to tidal flushing. It is therefore expected that the river will be the primary source of the suspended solids entering the marina.

The concentration of suspended solids (TSS) in the marina is an important parameter for prediction of copper partitioning. TSS in the marina has been established by measurements taken in the Georges River and taken as the average of dry weather conditions. The concentration as well as the characteristics of the suspended solids varies with the antecedent rainfall conditions. From the available data on TSS in the Georges River a value of 12 mg/L was chosen to represent average conditions. This value is conservative for modelling purposes, as a higher TSS concentration would lead to a greater loss of copper from the water column through sedimentation.

Table 6–8 Copper Mass Balance Parameters

Conditions	K_d (L/mg)	w (m/d)	TSS (mg/L)
average	0.033	1.4	12

The Georges River background total copper concentration as averaged from **Table 6–3** was 3 μg/L.

PREDICTED COPPER CONCENTRATIONS IN THE MARINA

The predicted copper concentrations are presented in **Table 6–9**. The labile copper concentration with TSS varies significantly and is most sensitive to the concentration of suspended solids during dry weather conditions. For average conditions, the labile copper concentration is predicted to meet the target for 90% of species (3 μg/L), just failing to meet the 95% target of 1.3 μg/L.

Table 6–9 Predicted Copper Concentrations

Case	Total (μg/L)	Particulate (μg/L)	Dissolved (μg/L)	Complexed (μg/L)	Labile (μg/L)
Average	5.82	1.65	4.17	2.71	1.46

6.5.5 Sensitivity Analysis

Sensitivity analyses were carried out as presented below.

TIDAL FLUX

The hydrodynamic model predicted a tidal exchange rate between the marina and the river of 53% of the marina water per day. The following table indicates that an extreme variation in the tidal flux value would be required in order to have a significant impact on the predicted labile copper concentration, in consideration of the monitored range of labile copper in the river (1.4 ± 0.41 µg/L).

Table 6–10 – Tidal Flux Sensitivity Analysis

Tidal Flux (%)	Predicted Labile Copper Concentration (µg/L)
30	1.79
40	1.59
50 (adopted value from hydrodynamic model)	1.46
60	1.36
70	1.29

MARINA OCCUPANCY

Occupancy rates of 95% for recreational vessels and 80% for commercial vessels were adopted for modelling. If a boat leaves the marina for two of the seven days of the week, it would occupy the marina 71% of the time. If a boat leaves the marina for a long day out (say 12 hours), it would occupy the marina 93% of the time. Model runs were carried out as below to represent both higher and lower occupancy rates than those adopted in the modelling.

Table 6–11 – Marina Occupancy Sensitivity Analysis

	Low Occupancy	Adopted Value	High Occupancy
Recreational Vessel Occupancy %	71	95	100
Commercial Vessel Occupancy %	50	80	93

Total Copper from Antifouling (kg/year)	89.7	123	131
Total Copper from Stormwater (kg/year)	4.1	4.1	4.1
Total Copper Discharges from Craft (kg/year)	0.005	0.005	0.005
Total Copper from Stormwater, Craft Discharges and Antifouling (kg/year)	93.8	127	135
Predicted Labile Copper Concentration in Marina (µg/L)	1.23	1.46	1.52

The occupancy sensitivity analysis indicates that modelling increased values for occupancy would not have a significant effect on the percentage of species protected as the predicted labile copper concentration lies within the existing monitored range in the river.

BOAT NUMBERS

A sensitivity analysis for the number of boats was undertaken as presented in the following table

Table 6–12 Boat Number Sensitivity Analysis

	Low	Adopted	High
Number of Recreational Craft	164	176	200
Number of Commercial Craft	9	10	11
Total Copper from Antifouling (kg/year)	114	123	139
Total Copper from Stormwater (kg/year)	4.1	4.1	4.1

Total Copper Discharges from Craft (kg/year)	0.005	0.005	0.005
Total Copper from Stormwater, Craft Discharges and Antifouling (kg/year)	118	127	143
Predicted Labile Copper Concentration in Marina (µg/L)	1.40	1.46	1.57

The results indicate that the predicted labile copper concentration is not highly sensitive to the number of boats in the marina, as the predicted high and low concentrations still lie within the current monitored range of copper in the river (1.4 ± 0.41 µg/L).

6.5.6 Summary of Copper in the Marina

The toxicity of copper varies as copper is present in different chemical states. Of most concern to the aquatic environment is labile copper, which is a bioavailable form of copper, The ANZECC guidelines state trigger values for the concentration of labile copper in an aquatic environment, which correlate to a percentage of aquatic species that will be protected at this value.

As the marina's primary function is to provide a facility for recreational boats and not to extend the existing aquatic habitats which are available in the Georges River, 90-95% of species protection (which equates to a labile copper concentration of 1.3 – 3 µg/L) would be appropriate for in-marina water quality. Labile copper in the Georges River has been measured at 1.0 - 2.1 µg/L.

To calculate the quantity of copper entering the marina for comparison to the ANZECC trigger levels the following information was utilised and incorporated into a mass balance assessment:

- Sources of copper into the marina are stormwater runoff (this is treated by water sensitive urban design measures), illegal bilge discharge from moored craft and leaching from copper-based anti-fouling paint on craft hulls;
- The leaching from anti-fouling paint varies as a function of the number of boats in the marina and their size, usage patterns of craft and the leaching rate of paint;
- Tidal flushing provides an exchange of 40-60% of the water in the marina;
- The river is expected to be the main source of TSS in the proposed marina. TSS in the marina is important for the prediction of copper partitioning. The value of 12 mg/L was adopted as an average river value, based on water quality measurements. On average, the background level of total copper in the Georges River is 2.98 ±0.25 µg/L.

Using the above information in Chadwick's model, the quantity of labile copper in the marina is predicted to be 1.46 µg/L. Based on the ANZECC guidelines, a concentration of 1.46 µg/L of labile copper correlates to the protection of 90-95% of aquatic species, and also indicates no change from the monitored range of copper concentrations in the river (1.4 ± 0.41 µg/L).

6.5.7 Conclusion

This analysis demonstrates that development of the marina would not have a significant impact on the existing copper concentrations in the Georges River and the predicted concentrations would allow 90 to 95% of species to inhabit the marina in accordance with the ANZECC/ARMCANZ (2000) guidelines for the protection of aquatic ecosystems.

6.6 Acid Sulfate Soils

Management of Acid Sulfate Soil is an important aspect of the construction and operation processes. A geotechnical investigation would be required to identify the presence of Acid Sulphate Soils on the site, and within the area where works would occur. If Acid Sulfate Soil is present on-site, an Acid Sulfate Soil Management Plan would be required.

Acid Sulfate Soil is the common name given to sediment and soil containing iron sulfide. The exposure of iron sulfides to air will result in oxidation and the generation of sulfuric acid. Acid leachate can strip metals such as aluminium and iron from the soil matrix and release them into water bodies. Toxic concentrations of these metals will affect water quality and adversely affect aquatic organisms (disease or death) that inhabit the water body.

When saturated mud, gravel or sand containing iron sulfides is disturbed by excavation, dredging or dewatering and exposed to air, the generated acid leaches from the soil (Acid Sulfate Soils Planning Guidelines, 1998). Acid leachate can cause severe environmental degradation and/or contamination. In discussion of acid sulfate soils the following definitions are important (ASSMAC, 1998):

Acid Sulfate Soils (ASS) include actual acid sulfate soils and potential acid sulfate soils. Actual and potential acid sulfate soils are often found in the same soil profile, with actual acid sulfate soils generally overlying potential acid sulfate soil horizons.

Actual Acid Sulfate Soils are soils containing highly acidic (pH ≤ 4) soil horizons or layers resulting from the aeration of soil materials that are rich in sulfides, primarily iron sulfide. This oxidation produces hydrogen ions in excess of the sediments capacity to neutralise the acidity of the soil. These soils can usually be identified by the presence of pale yellow mottles and coatings of jarosite.

Potential Acid Sulfate Soils are soils which contain iron sulfide material which have not been exposed to air and oxidised. However they pose a considerable environmental risk when disturbed, as they will become severely acidic when exposed to air and oxidised. Exposure of acid sulfate soils to the atmosphere (lowering of the watertable or disturbance through dredging/excavation) has the potential to produce acid generating conditions that may adversely affect the local environment.

The Acid Sulfate Soils Planning Guidelines (1998) have a hierarchy of management techniques for dealing with ASS. These are listed as follows:

1. **Avoid land where acid sulfate soils occur**

   If the preliminary soil survey indicates that the site contains high levels of acid sulfate soils, the most environmentally responsible action may be to investigate alternative feasible sites that meet the operational needs of the applicant.

   This principle applies equally when selecting routes for drains, roads or pipelines or for individual sites for residential developments, infrastructure projects, agricultural enterprises or quarries. In the case of quarries, dredging or other operations which have the potential to result in moving acid sulfate soils problems on to another site, the onsite mitigation measures prior to transport plus the cost of quality assurances programs will need to be factored into the project along with the costs associated with the liability for damages if acid is generated at the other site.

2. **Avoid disturbing ASS if present on land**

   To develop effective avoidance strategies, a more detailed investigation is required to understand the soils, surface and sub-surface water characteristics on the site and the sensitivity of the surrounding environment. In many cases, the site should be mapped indicating the depth to sulfide material and groundwater and the variation in the soil characteristics including the concentration of the sulfidic material. The advantage of an "avoidance" approach is that there is no ongoing mitigation required. Possible avoidance mitigation options include the following options.

   a. Undertake shallow soil disturbance so as not to disturb acid sulfate soils;
   b. Redesign existing drains so they are shallow and do not disturb acid sulfate soils
   c. Avoid activities which result in the fluctuation of groundwater, in particular the lowering of groundwater
   d. Cover acid sulfate soils with clean fill material so as not to disturb them
   e. Set aside acid sulfate soil areas and not disturb them
   f. Set aside highest sulfide areas and disturb only the lowest

3. **Prevent the oxidation of sulfide**

   Mitigation strategies to prevent oxidation depend on maintaining the sulfidic material in an anaerobic environment. However, soils or soil layers with existing acidity from previous oxidation of sulfide (indicated by field $pH_F < 4.5$) are more difficult to prevent further oxidation by denial of oxygen alone, as oxidation may proceed by electron transfer between compounds at different oxidation states. Usually some addition of a neutralising agent will also be necessary when acidity has already been produced.

a. Stage projects to prevent oxidation

b. Place any excavated sulfidic material immediately under water

c. Raise the watertable to maintain potential acid sulfate soils in a saturated state

d. Cap the acid sulfate soil material

4. Oxidation of sulfide and neutralising acid as it is produced

The most common acid sulfate soils mitigation methods relies on providing sufficient neutralising agent to neutralise acid as it is produced over time due to the gradual oxidation of acid sulfate soils. Most mitigation strategies will result in a certain amount of oxidation of acid sulfate soils either deliberately or inadvertently. In most cases, the natural buffering capacity of the system will initially contribute to the neutralisation of acid produced. However, depending on the sulfide content, substantially more neutralising material usually needs to be added.

a. Oxidation of sulfide and neutralising using lime or similar agents

b. Neutralisation using the buffering capacity of estuarine water

c. Vertical mixing and neutralisation using the buffering capacity of soil

5. Separate out and treat the sulfidic component

With some types of sediments extracted by dredging, it may be possible to partially or fully separate the acid sulfate fines from the sand resource by mechanical methods such as sluicing or hydrocycloning techniques. The method is a particularly attractive mitigation option when full separation can be easily achieved, as the resource can be considered to be “clean” and require the addition of little or no neutralising agent prior to use.

7. NAVIGATION

7.1 Marina Entrance

The proposed marina is recessed into the riverbank and entrance to the river would be via a short entrance channel (approximately 50 m long). Navigation through the entrance would be available at all states of tide as sufficient water depth would be provided at low water for the types and size of vessels likely to use this facility.

Due to the location of the marina entrance, within the speed boat area, measures are proposed to maintain safety and minimise the impact on existing river users. Navigation markers could be positioned near the marina entrance to denote a specific entry channel and keep passing boats away from the entrance side of the river. The design and location of the navigation markers would be undertaken in close consultation with NSW Maritime.

Signs would also be used to alert those leaving the marina to proceed with caution at a maximum of 4 knots onto the river. River users could also be alerted to the marina entrance by appropriate signage.

7.2 Impact on Bank Stability

The marina would result in additional craft using the adjacent stretch of water in the Georges River compared to current conditions, however this would not necessarily impact the river banks, as the reach is already currently heavily used at high speeds.

The marina design incorporates bank stabilisation works, which would be an improvement on the existing scenario, where the river bank is eroding. The bank stabilisation works would be undertaken in consideration of the boat generated waves in the river, hence resulting in a more stable stretch of foreshore.

8. SUMMARY AND CONCLUSION

The proposed design of the Georges Cove Marina has incorporated a number of measures to address flooding, tidal hydrodynamics, water quality and navigation issues. These are summarised below:

- Floor levels of the building and marina facilities have been determined utilising the 100-year ARI flood levels produced in the Georges River Flood Study (adopted by Liverpool Council) and incorporate the appropriate amount of freeboard;
- Tidal hydrodynamics have been assessed through hydraulic modelling. There is a high degree of tidal exchange between the marina and the river, this is not significantly affected by varying the entrance channel between 40 and 50 metres in width.
- Based on water quality testing, the water quality in the quarry is of a similar quality to that in the Georges River. Breakthrough of the bank from the marina to the Georges River would not significantly affect the water quality of either bodies;
- Pollutants sources for the marina are stormwater runoff, illegal discharges of sewage and bilge water, copper leaching from anti-fouling paint on boat hulls and sediment from the Georges River.
    - The incorporation of water sensitive urban design elements provides stormwater treatment to reduce nitrogen, phosphorus, TSS and heavy metals;
    - Bilge and sewage pump-out facilities would be provided in the proposed marina. It is expected that there will still be a small amount of illegal discharge. This pollutant load was modelled and due to the high flushing rate of the marina through the tidal cycle, nutrients will not accumulate in the basin; and
    - Modelling of copper concentrations indicates that the development of the marina would not have a significant impact on the existing copper concentrations in the Georges River and the predicted concentrations would allow 90 to 95% of species to inhabit the marina per the ANZECC/ARMCANZ (2000) guidelines for the protection of aquatic ecosystems.
- Navigation through the channel to enter the marina would be available through all states of the tide. Measures are proposed to maintain safety in the area as the entrance of the marina is within a speed boat area;

The marina design incorporates bank stabilisation works; currently there is no bank protection and erosion is occurring.

The proposed marina basin, with appropriate design and mitigation measures as recommended in this report would provide a facility which would meet the community environmental standards and would provide a recreational asset, which is in short supply along the Georges River.

9. REFERENCES

1. Australian Standard AS 3962 – 2001, Guidelines for Design of Marinas
2. ANZECC/ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*
3. Public Works Department (June 1990) *The East Hills Bank Erosion Study, Georges River*
4. Public Works Department (February 1991) *The Georges River Database Compilation and Assessment*
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6. Chadwick D, Zirino A, Rivera-Duarte I, Katz C and Blake A (2004) *Modelling the mass balance and fate of copper in San Diego Bay*, Limnology and Oceanography, vol.49(2), 355-366
7. Marine Pollution Research (2010) *Georges River Marina, Moorebank Aquatic Ecology Aspects & Environmental Assessment Of Marina Concept Design Report Prepared For Benedict Industries Pty Ltd*
8. Valkirs A, Seligman P, Haslbeck E and Caso J (2003) *Measurements of copper release rates from antifouling paint under laboratory and in situ conditions: implications for loading estimation to marine water bodies* Marine Pollution Bulletin 46

Figures

FIGURE 1

LEGEND

EXISTING CONTOURS

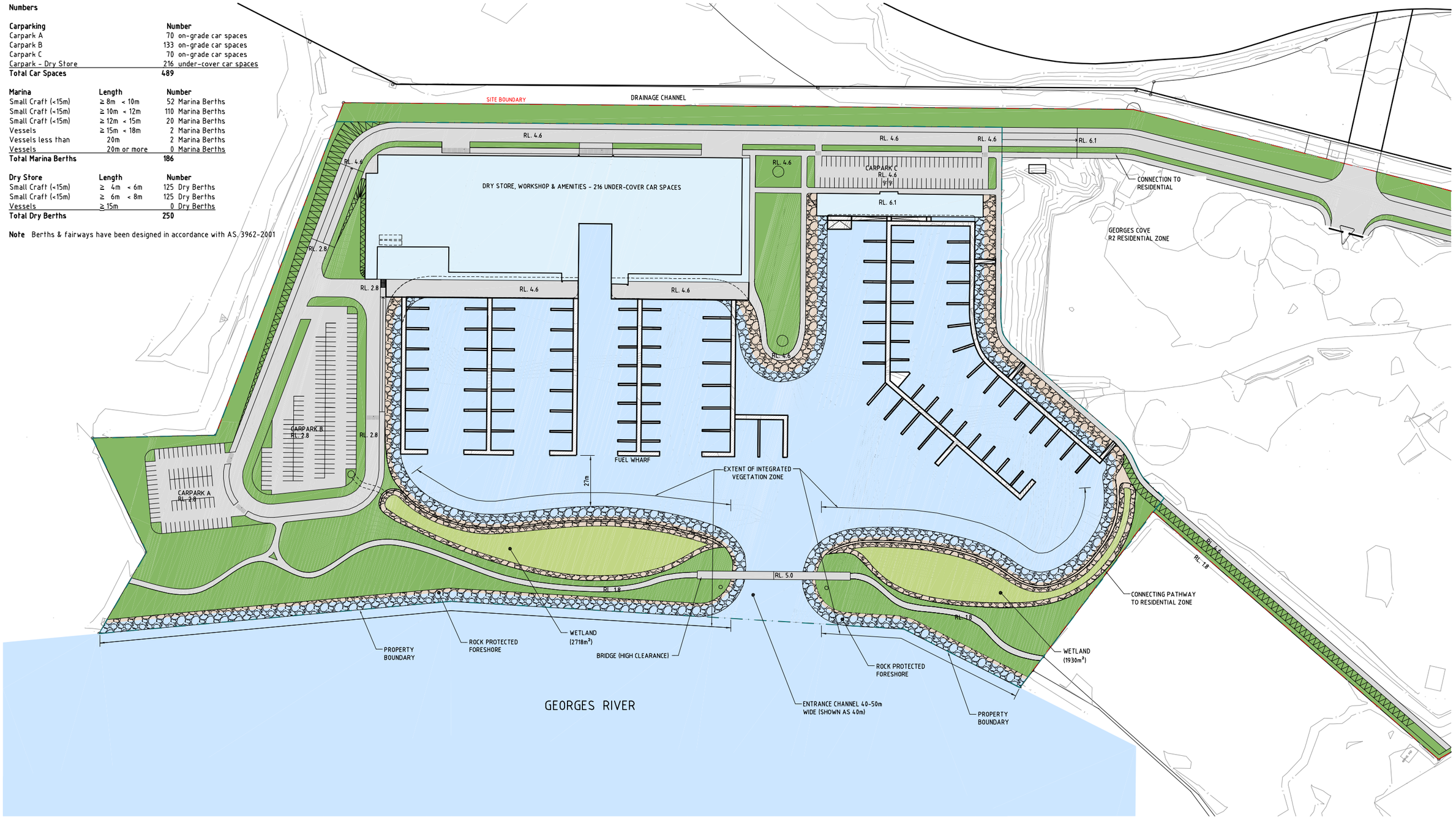
Numbers

Carparking	**Number**	
Carpark A	70	on-grade car spaces
Carpark B	133	on-grade car spaces
Carpark C	70	on-grade car spaces
Carpark - Dry Store	216	under-cover car spaces
Total Car Spaces	**489**	

Marina	**Length**	**Number**	
Small Craft (<15m)	≥ 8m < 10m	52	Marina Berths
Small Craft (<15m)	≥ 10m < 12m	110	Marina Berths
Small Craft (<15m)	≥ 12m < 15m	20	Marina Berths
Vessels	≥ 15m < 18m	2	Marina Berths
Vessels less than	20m	2	Marina Berths
Vessels	20m or more	0	Marina Berths
Total Marina Berths		**186**	

Dry Store	**Length**	**Number**	
Small Craft (<15m)	≥ 4m < 6m	125	Dry Berths
Small Craft (<15m)	≥ 6m < 8m	125	Dry Berths
Vessels	≥ 15m	0	Dry Berths
Total Dry Berths		**250**	

Note Berths & fairways have been designed in accordance with AS 3962-2001



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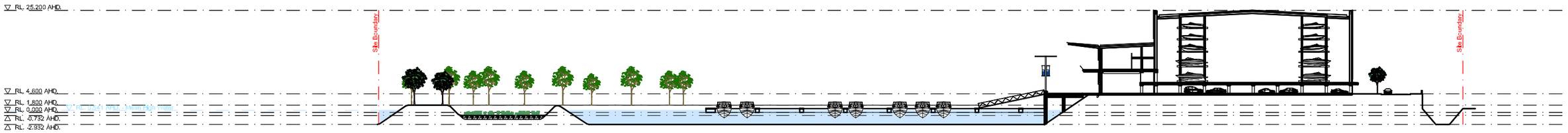
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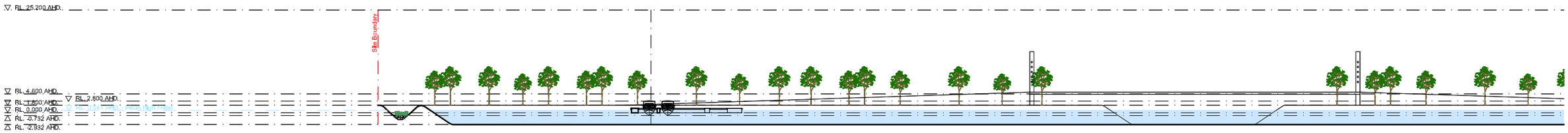
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MARINA BASIN LAYOUT

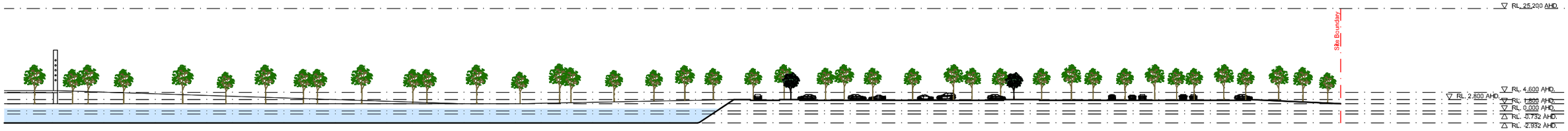
FIGURE 2



01 Section AA
1:500



02 Section BB - North
1:500



03 Section BB - South
1:500

0 10 20 30 40 50m

1:500(A1) 1:1000(A3)

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ISSUE	DATE	ISSUE DESCRIPTION
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LOCATION: W:_Infrastructure\Projects\301015\01167 - BS&G Marina\Drawings\SKETCHES\01167 FIGURE 1.dwg DATE & TIME: 15-Jul-10, 11:23:05 AM

SITE SECTIONS

Appendix C2

Flood reports (NPC 2015)

1

management consultants &
project managers

27 March 2015

Liverpool City Council
Locked Bag 7064
Liverpool BC, NSW 1871

Attention: Rajendra Autar

Dear Sir,

Re Georges Cove Marina – New development application

Benedict Industries proposes to submit a new development application for the Georges Cove Marina. The proposal is exactly identical, in flooding terms, to the one considered and approved by the JRPP in August 2014.

The flood modelling work undertaken for the original approved marina proposal therefore remains contemporary and applicable to this new application for the marina.

The attached flood reports to support the new application for the marina therefore comprise the following:-

- Attachment 1: Assessment of the Flood Impact of the Proposed Bridge on Flooding in the Vicinity of the Georges Cove Marina (Cardno, May 2014)
- Attachment 2: Flood Risk Management Report (npc, November 2013)
- Attachment 3: Flood Impact Assessment for the Proposed Georges Cove Marina, Moorebank (Cardno, January 2013).

The flood impacts are unchanged from the approved marina and will remain negligible.

Yours faithfully,

Mark Tooker

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ATTACHMENT 1

Assessment of the Impact of the Proposed Bridge on Flooding in the Vicinity of the Georges Cove Marina, Moorebank (Cardno, May 2014)

Our Ref: NA49913037:BCP/bcp
Contact: Dr Brett C. Phillips

23rd May 2014

Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035

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203 Pacific Highway
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Web: www.cardno.com.au

The Manager
npc
PO Box 1060
CROWS NEST NSW 1585

Attention: Mr Mark Tooker

Dear Mark,

ASSESSMENT OF THE IMPACT OF THE PROPOSED BRIDGE ON FLOODING IN THE VICINITY OF THE GEORGES COVE MARINA, MOOREBANK

In 2012 Cardno was commissioned by npc to prepare a flood model to undertake a flood impact assessment of the proposed Georges Cove Marina development in Moorebank, within the Liverpool City Council Local Government Area (LGA).

Cardno has been requested to present the flood impact detailed for the proposed road bridge crossing located to the north of the Georges Cove Marina site. The bridge is proposed to connect Brickmakers Drive to the Benedict site and crossing over the access road to the Moorebank Recyclers site.

A previous concept design of the bridge with four 18m spans (total span of 72m) was approved by Council. The updated design modelled within this assessment is a clear 32m span covering the access road reserve and adjacent open channel.

1. ASSESSMENT SCENARIOS

The proposed location and design layout of the road bridge is shown in **Figure 1**.

The bridge crossing has been modelled in accordance with the concept design (Drawing no. 101015-00561-ci-fig3, Worley Parsons). The following details were adopted for the purpose of the hydraulic modelling assessment:

- The bridge has a clear span with the underside of the bridge higher than the 100 yr ARI flood level (5.52m AHD) so that the waterway opening is not pressurised during a 100 yr ARI flood and the bridge deck can be omitted from the hydraulic model. Consequently the hydraulic roughness of the bridge waterway remained unchanged from existing conditions; and
- The footprint of the proposed embankment for the bridge extends as in the above design plans and as shown schematically in **Figure 1**.

The following scenarios were assessed under developed conditions without and with the bridge crossing:

- A 100 yr ARI flood in the Georges River;
- The 100yr ARI local storm event in combination with two Georges River flooding scenarios:
  - a 20 yr ARI Georges River flood; and,
  - a Georges River base flow of 200 m^3/s.

No blockage has been adopted within the hydraulic modelling for the bridge as the clear span is 32m, which is significantly greater than the 18m spans within the previous bridge design. This approach is in accordance with blockage assessment techniques set-out in AR&R Project 11 Stage 2 Report (Engineers Australia, 2013).

2. FLOOD IMPACT ASSESSMENT

The peak flows under each scenario are summarised in Table 1 while Table 2 summarises the flood level and peak flow velocity at two reference locations. These are located just upstream of the proposed bridge crossing (Location 1) and downstream of the stormwater outfall south of Newbridge Road (Location 2).

Table 1 Peak Flows (m^3/s)

Scenario	Georges River	Local Catchment
1	2,081	0*
2	1,567	35.8
3	200	35.8

* In a 36 hour 100 yr ARI storm the estimated peak runoff from the local catchment was only around 5 m^3/s consequently this local inflow was not included in Scenario 1

Under Scenario 2 the runoff from the local catchment in a 100 yr ARI storm equates to 2.3% of the 20 yr ARI peak flow in the Georges River while under Scenario 3 the runoff from the local catchment in a 100 yr ARI storm equates to 18% of the 200 m^3/s base flow in the Georges River.

Table 2 Peak Water Level (m AHD)

Scenario	Location 1			Location 2		
	Without Bridge	With Bridge	Difference	Without Bridge	With Bridge	Difference
Peak Water Level (m AHD)						
1	5.52	5.52	0.00	5.52	5.52	0.00
2	4.60	4.60	0.00	4.60	4.60	0.00
3	3.33	3.39	0.06	3.56	3.59	0.03

It is noted that under Scenario 3 the peak water level is 1.9 m to 2.2 m lower than the 100 yr ARI flood level.

2.1 Flood Impacts during a 100 yr ARI Georges River Flood

The peak water level differences during a 100 yr ARI flood in the Georges River (Scenario 1) resulting from the proposed bridge are shown in **Figure 2**. It can be seen from Figure 2 and Table 2 that the impact of the proposed bridge crossing on the 100 yr ARI flood level is negligible (ie. <0.01 m). This is because the 100 yr ARI flood level is governed by backwater flooding from the Georges River.

The peak flow velocity differences during a 100 yr ARI flood in the Georges River resulting from the proposed bridge are shown in **Figure 3**. There are minor peak velocity increases (<0.04 m/s) in the vicinity of the bridge span, with minor decreases in velocity (0.04 m/s) for an area south of the bridge.

2.2 Flood Impacts during a Local Catchment 100 yr ARI Storm

In response to preliminary comments received from Liverpool City Council dated 13 May 2014, local catchment flooding has been assessed in accordance with the methodology outlined in the Moorebank Recyclers Flood Impact Assessment (WMA Water, 2013).

A hydrological model of the local catchment was prepared using **xprafts** based on the details given in Section 4.2 of the Moorebank Recyclers Flood Impact Assessment report (WMA Water, 2013). The hydrological model was run and the 100yr ARI flows from the catchment were found to match the peak flow of 35.8 m^3/s reported in the 2013 study.

The flow hydrograph for the local catchment was input in the hydraulic model at the stormwater outfall location identified in **Figure 4** (immediately south of Newbridge Road).

The 100yr ARI local storm event was assessed in combination with two Georges River flooding scenarios, namely in combination with:

- a 20yr ARI Georges River flood (where the peak flows from the local catchment was delayed so that it coincided with the peak flow in the Georges River) (Scenario 2); and,
- a constant Georges River base flow of 200 m^3/s (Scenario 3)

Under Scenario 2 the peak water level differences are shown in **Figure 4** while the peak velocity differences are shown in **Figure 5**.

These results show negligible water level impacts (<0.01m) resulting from the bridge structure as the runoff in a local 100 yr ARI storm has negligible impact on the floodplain compared to the flooding caused by the 20 year ARI flood in the Georges River. It was also found that there are minor peak velocity increases (<0.04 m/s) in the vicinity of the bridge span, with significant decreases in velocity (0.15 m/s) occurring in an area south of the bridge embankment.

Under Scenario 3 the peak water level differences are shown in **Figure 6** while the peak velocity differences are shown in **Figure 7**.

It is noted that the water level increases locally upstream of the bridge by up to 0.1 m in the floodplain, with minor increases (<0.02 metres) further upstream within the Newbridge Road reserve to the north. There are minor peak velocity increases (<0.05 m/s) in the vicinity of the bridge crossing with significant decreases in velocity (0.8 m/s) for an area south of the bridge embankment.

It is noted that under Scenario 3 the peak water level is 1.9 m to 2.2 m lower than the 100 yr ARI flood level.

The water level increases of 0.1 metres for local catchment flooding are considered minor as:

- They do not represent a significant alteration of flow regime when considering the negligible velocity impacts for the area; and,

- They do not have any impact on compliance with Council's development controls because the 100 yr ARI is governed by flooding from the Georges River and the bridge crossing has negligible impacts in this event.

2.3 Flood Storage

The estimated loss of flood storage in a 100 yr ARI Georges River flood due to the construction of the road embankment is estimated to be around 4,780 m3 (in comparison with an indicative flood volume of 12.8 million m3) ie. the loss of flood storage equates to 0.0037% of the 100 yr ARI flood volume.

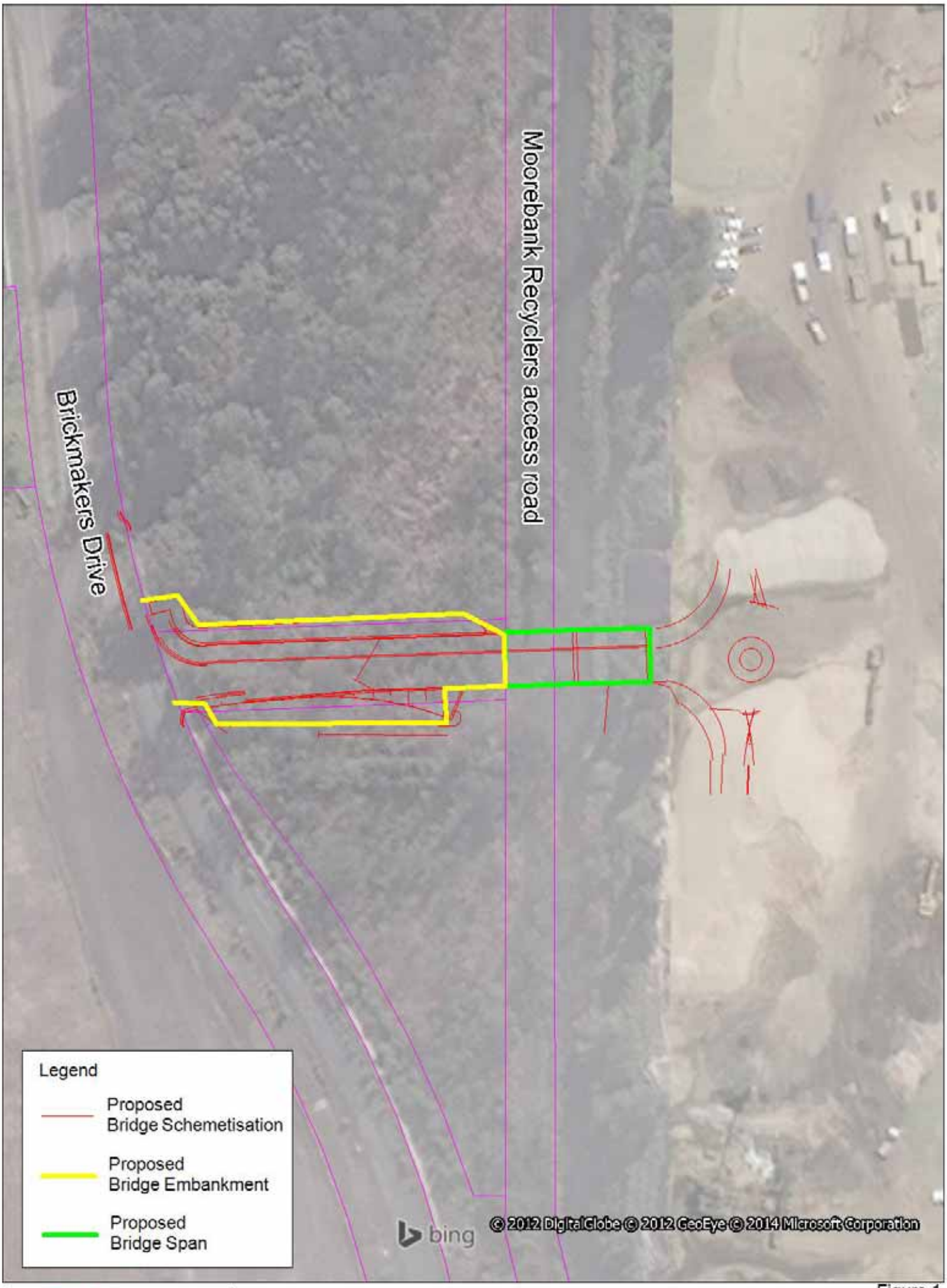
Note that the previously approved bridge design resulted in a flood storage loss of approximately 1,960m3, therefore the updated bridge design results in an increase in flood storage loss of approximately 2,820m3 over the previous approved design. i.e. the impact of the new design is 0022% of the 100 yr ARI flood volume.

We note from previous correspondence that Council's default position in relation to applications which have some impact on flood storage but do not carry out a detailed Flood Impact Assessment is to require compensatory earthworks or the like to compensate for any loss of storage. The point of undertaking a Flood Impact Assessment is to determine if any loss in floodplain storage has any impact. In this instance, the Flood Impact assessment has clearly shown that the impact of the loss of such a small amount of flood storage has no impact and in our view there is no justification to require works to balance these storage losses.

Yours faithfully



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Dr Brett C. Phillips
Director, Water Engineering
for **Cardno**

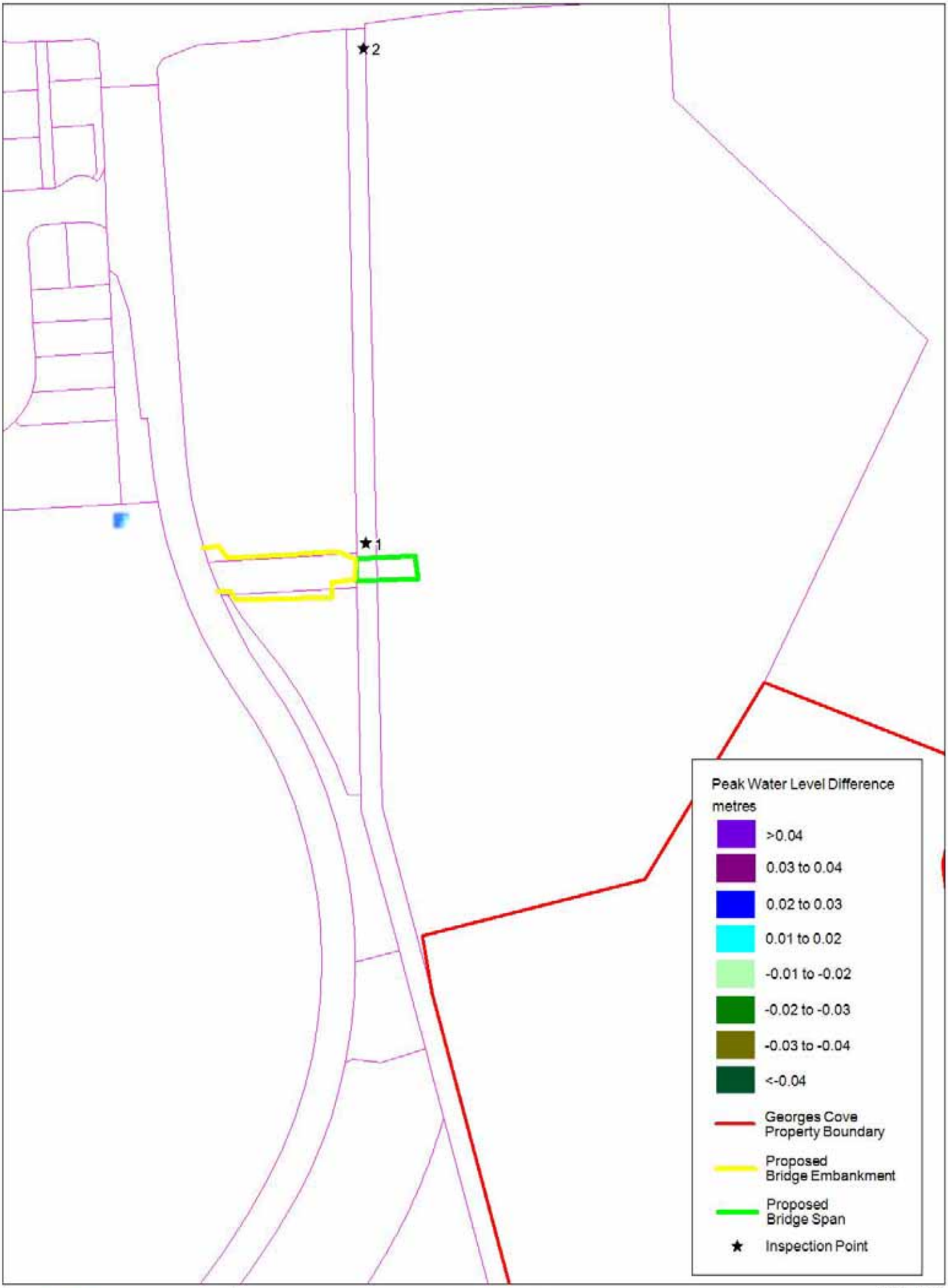


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Georges Cove
Flood Impact Assessment

Figure 1
Proposed Road Bridge

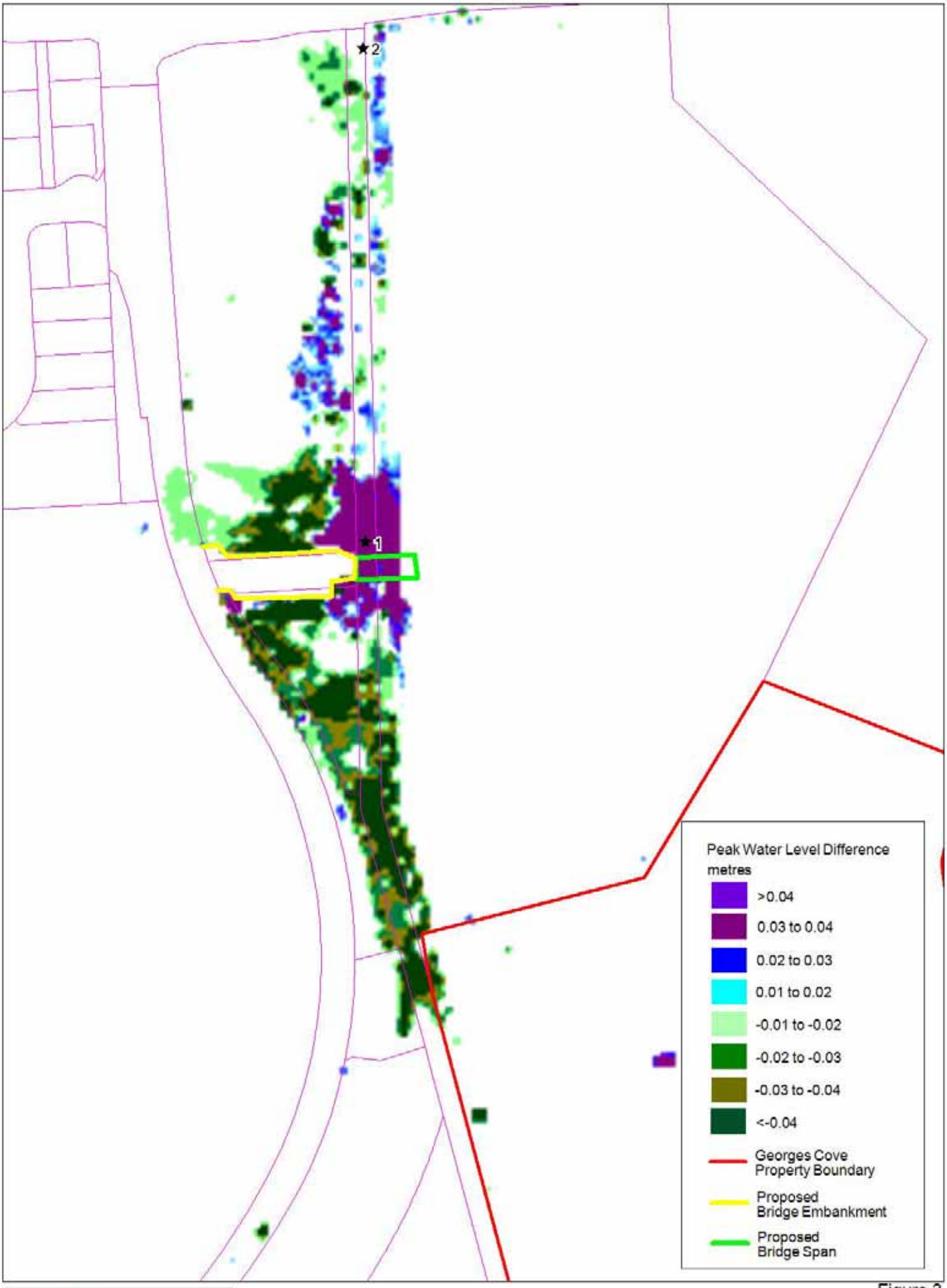


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Flood Impact Assessment

Figure 2
100 year ARI Georges River Flooding
Peak Water Level Differences
Post-Development - Road Bridge

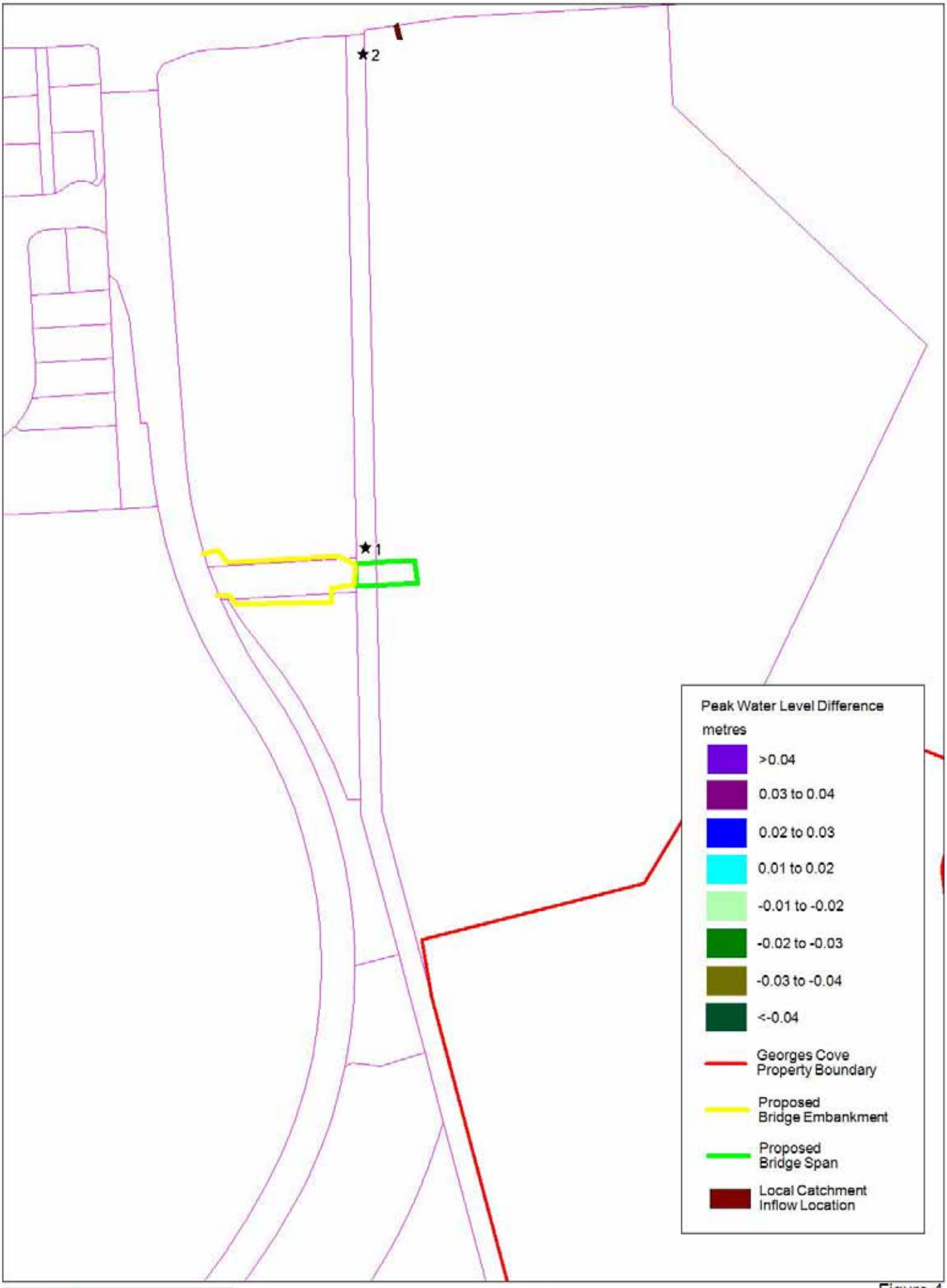


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Georges Cove
Flood Impact Assessment

Figure 3
100 year ARI
Peak Velocity Differences
Post-Development - Road Bridge

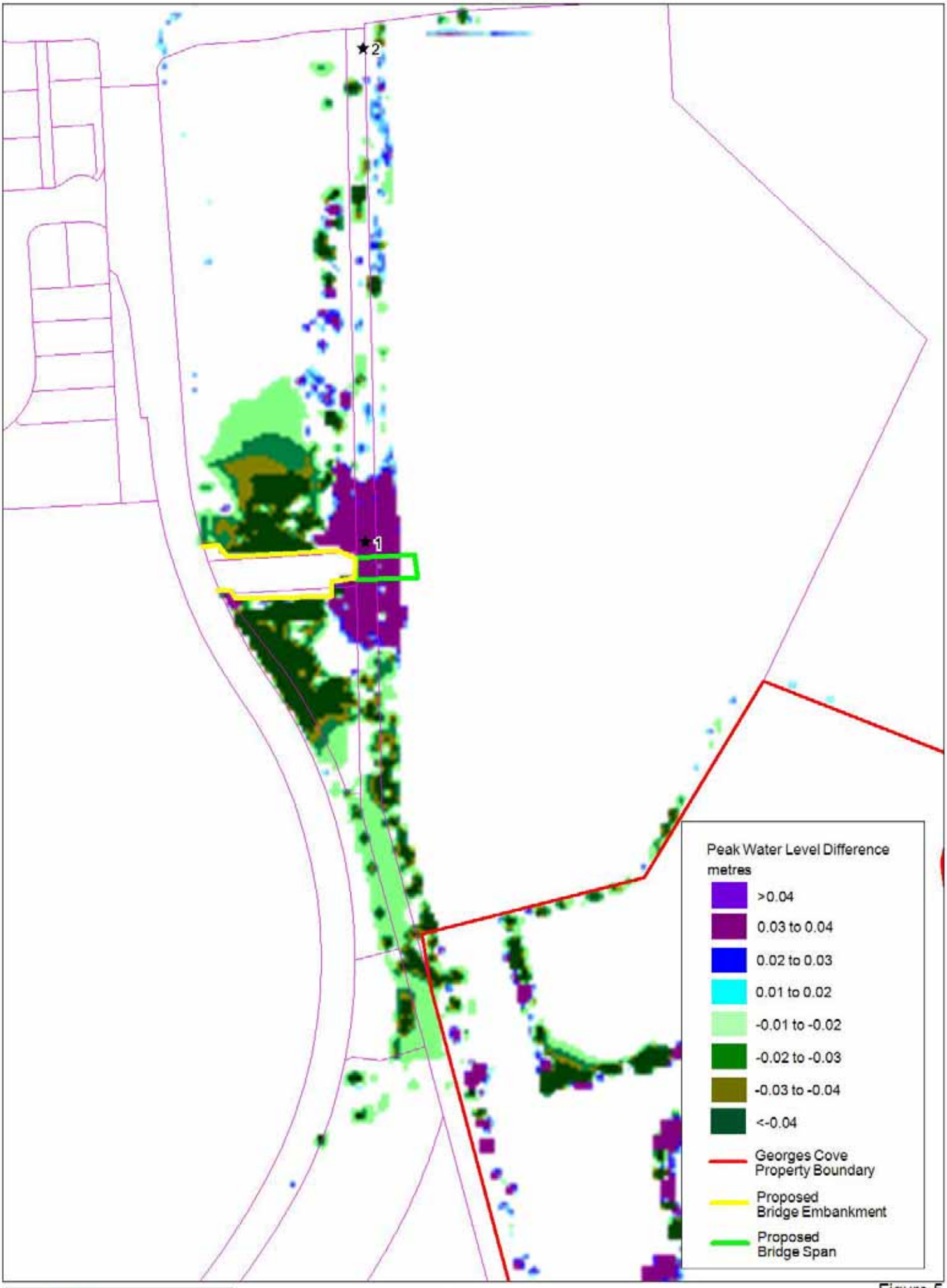


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Georges Cove
Flood Impact Assessment

Figure 4
20 year ARI Georges River Flooding
100 year ARI Local Flooding
Peak Water Level Differences
Post-Development - Road Bridge

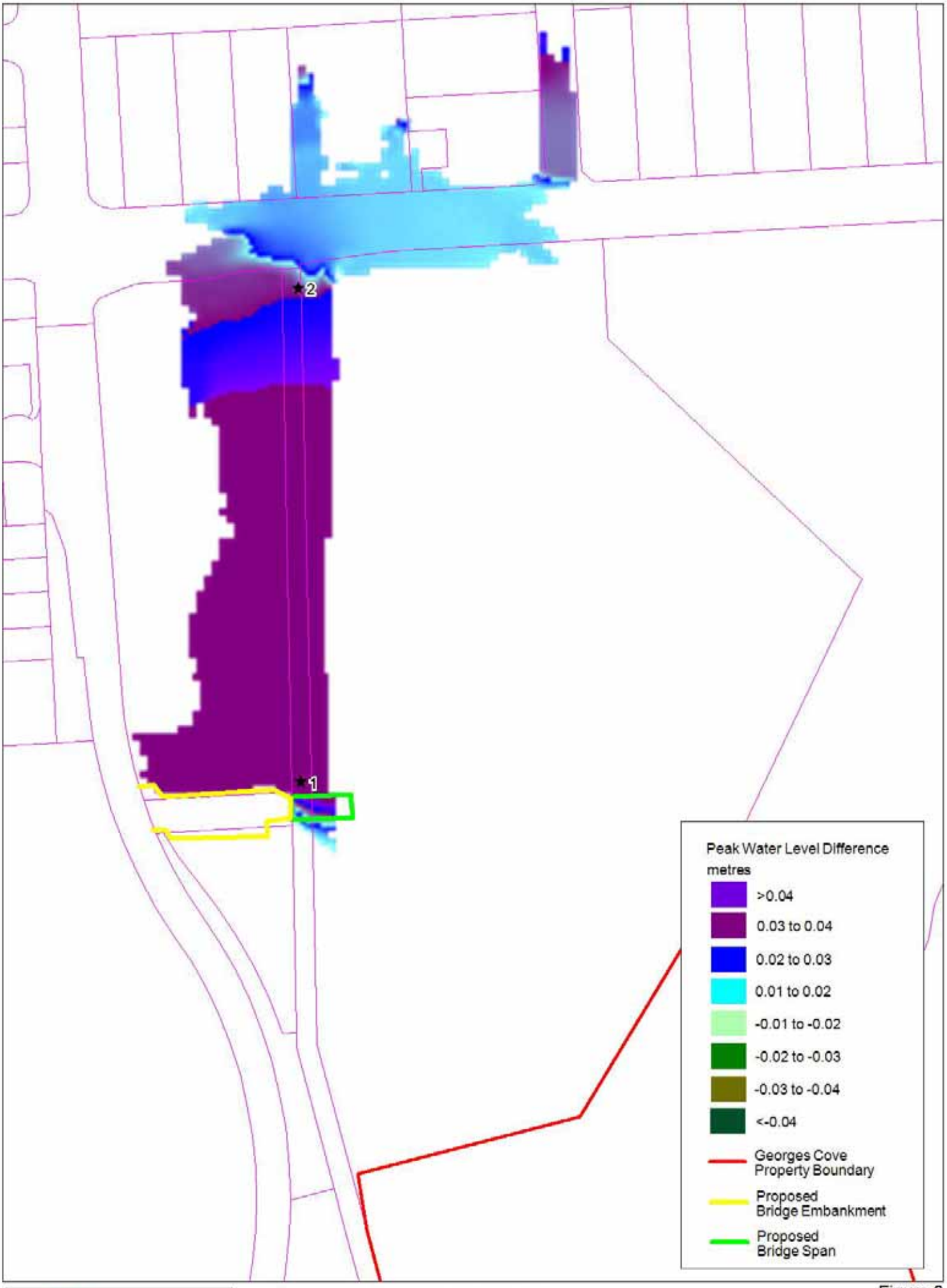


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May 2014

Georges Cove
Flood Impact Assessment

Figure 5
20 year ARI Georges River Flooding
100 year ARI Local Flooding
Peak Velocity Differences
Post-Development - Road Bridge

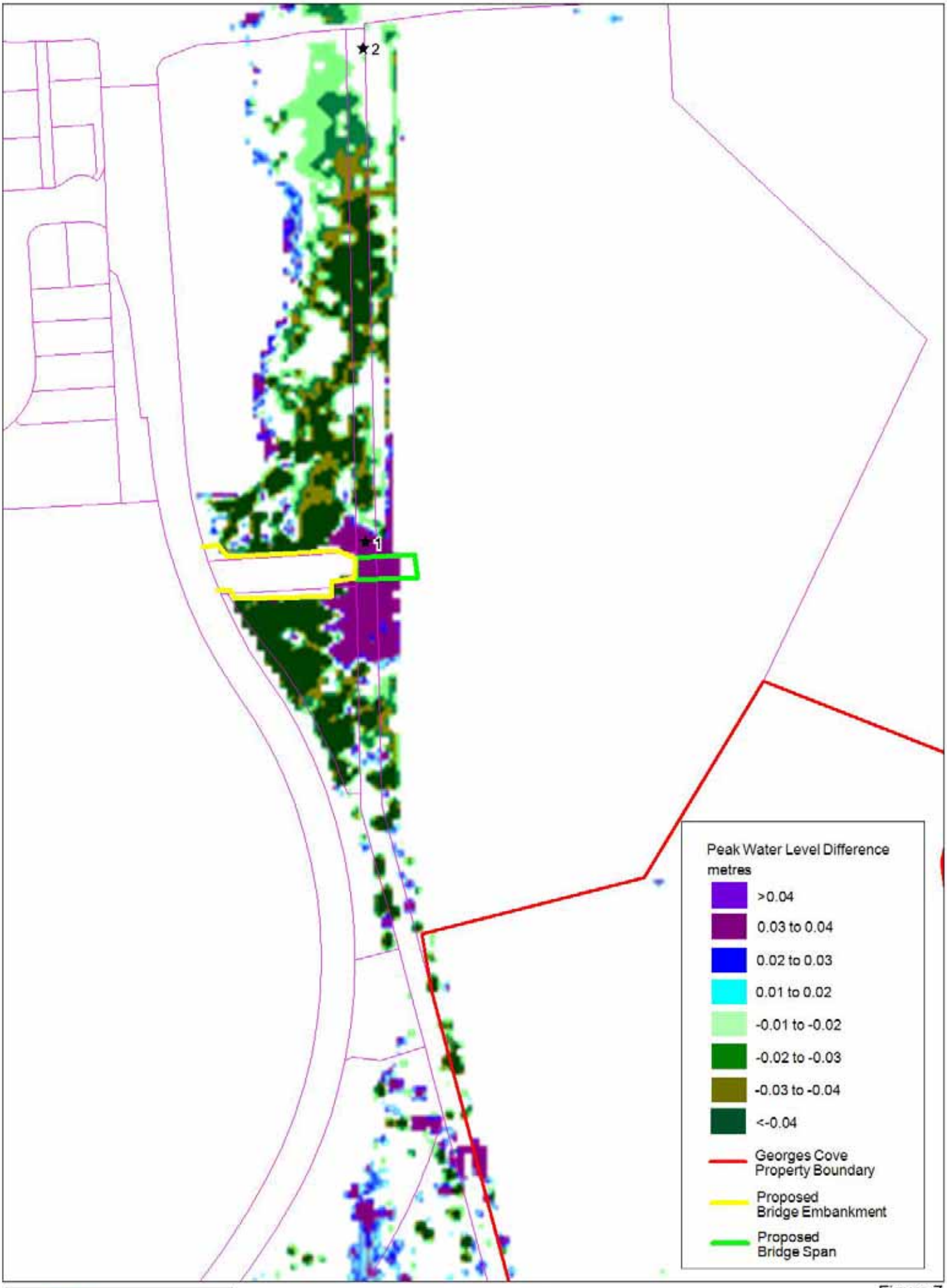


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Georges Cove
Flood Impact Assessment

Figure 6
100 year ARI Local Flooding
Peak Water Level Differences
Post-Development - Road Bridge



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Georges Cove
Flood Impact Assessment

Figure 7
100 year ARI Local Flooding
Peak Velocity Differences
Post-Development - Road Bridge

ATTACHMENT 2

Flood Risk Management Report (npc, November 2013)

Georges Cove Marina
Flood Risk Management

November 2013

1. Flood Levels

The predicted flood levels for the marina site are:-

20 yr ARI	– RL 4.6 to 4.7m AHD
100 yr ARI	– RL 5.6m AHD
Probable Maximum Flood (PMF)	– RL 10.2m AHD

The flood planning level (FPL) is RL 6.1m AHD (100 yr ARI + 0.5m freeboard).

2. Proposed Marina Development

The marina buildings have been designed to minimize their impact on flood behavior and the impact of flooding on the buildings. The main buildings housing the boat storage and amenities has the amenity facilities located above the PMF flood level at a minimum level of RL 10.525m AHD. The upper floor of the amenity facilities will be at RL 14.71m AHD. The first level of boat storage in this building will be at RL 7.3m AHD at least 1.7m above the 100 yr ARI flood level. The building below RL 7.3m AHD will be an open structure to allow flow through during floods. Parking under this main building will be at RL 4.6m AHD which is the 20 yr ARI flood level.

The small building will be the Private Marina Club house with a minimum floor level at the flood planning level of RL 6.1m AHD.

The southern carpark will be at a level of RL 1.65m AHD. This is equivalent to a 5 yr ARI flood level.

The marina development has been designed to ensure there is no loss of flood storage to minimize the impact on flood behavior.

3. Flood Behaviour

The proposed marina is located westwards of the main river flood flow paths and protected from these flows by the high lands immediately north and south of the site. The detailed 2D flood modeling of the proposed development by Cardno reaffirmed this behavior with low peak flow velocities in the 100 yr ARI flood of mainly 0 to 0.3 m/s with some isolated areas of higher velocity up to 0.5m/s. The floodway was located in the main river with velocities around 0.5 to 2 m/s (refer to Figure 3-18 in Cardno report).

The proposed marina and the area to the south west is a flood storage area which also plays an important part in the flood behavior. The proposed marina was designed to minimize any loss of flood storage.

The Cardno report demonstrated that the proposed marina would not have a significant adverse impact on flood levels and velocities. This is shown in the plot of water level and velocity differences between the post and before development scenarios presented in Figures 4-1 to 4-8 in the Cardno Report.

The Cardno flood study established that the preliminary hydraulic hazard in the marina would be rated as high in the 100 yr ARI flood.

4. Government Flood Risk Management Policy

The NSW Government's Flood Prone Land Policy and Floodplain Development Manual support the wise and rational development of flood prone land, the area inundated by the probable maximum flood (PMF). The policy acknowledges that flood prone land is a valuable resource that should not be sterilised by unnecessarily precluding its development and that development should be treated on its merits rather than through the application of rigid and prescriptive criteria.

The Manual specifies a process for appropriate risk management which requires Councils to under a flood study followed by a flood management study which should lead to the formulation of a floodplain management plan.

Liverpool City Council has prepared such a plan and integrated it into its Local Environmental Plan 2008 (Section 7.8) and the Liverpool Development Control Plan 2008 (Section 9 Flooding Risk).

The DCP specifies an industry best practice approach based on a matrix system which provides guidance on allowable development depending on flood risk category, land use risk category and planning controls. Table 4 for Georges River from Section 9 of the DCP applies to the proposed marina development. A copy of Table 4 is contained at Attachment A.

The flood risk category is high and the land use risk category is recreation and non-urban. Development of the marina is permissible subject to the controls listed in Table 4.

In terms of floor level, Table 4 requires non-habitable floor levels to be no lower than the 5 yr ARI level and habitable floors at the FPL. The proposed marina complies with these requirements (refer to Section 2).

For building components, Table 4 requires that all structures have flood compatible building components below the FPL. This can be complied with and is a proposed consent condition (Condition 27).

With structural soundness, Table 4 requires that an Engineer's report be provided to confirm the structure can withstand forces of floodwater, debris and buoyancy up to the FPL. The buildings will be open structures up to the FPL thereby limiting the force on the structures in a flood. The low velocities within the marina will also assist to alleviate the forces on the structures.

The building design would incorporate piles and columns capable of resisting the flood forces. The height of the building to the 100yr ARI flood level from the RL 4.5m and RL 1.65m ground levels would be 1m and 3.95m respectively. This is equivalent to just over a one store building. Also, the buildings will be open structures up to a minimum level of 0.5m above the 100yr ARI flood level.

For the PMF flood, the height to this flood level would be 5.6m and 8.55m respectively. This would represent a 2 to 3 storey building. A well designed building would be able to resist the hydraulic loads from a flood in the proposed conditions. A report from a certified engineer would be obtained to provide this evidence at the construction certificate stage. There is a proposed consent condition requiring this design and report from a certified engineer (Condition 28).

For flood effects, Table 4 requires conformance to three requirements. The first is to provide a report demonstrating no significant impacts on flood behaviour. The Cardno report demonstrates conformance to this requirement.

The second requirement deals with a floodway or major flood conveyance area and the likely adverse impact of structures in this area on flood behaviour. As noted in Section 3, the building structures are not located in a floodway and as such, this is why the Cardno flood study can demonstrate no significant adverse impact on flood behavior.

The third requirement deals with the need for a balanced cut and fill to avoid adverse impacts on flood behavior. This was an important consideration in the formulation of the marina proposal and involved considerable discussions with Council. The proposed marina complies with this requirement. There is a consent condition requiring the balanced cut and fill (Condition 29).

For car parking and driveway access, Table 4 requires conformance to four conditions. The first condition is that open car parking shall be as high as possible. The northern carpark is at the 20 yr ARI flood level at RL 4.6m AHD. The southern carpark is at the lowest level required in floor level conditions in order to balance the cut and fill. As such, this part of the parking conforms to the minimum requirement while being at the maximum level to conform to the balanced cut and fill requirement.

The second condition requires the driveway to be as high as practical and be generally rising. The driveway connects to the two parking areas which are as high as possible. It also generally rises from the southern carpark at RL 1.65m AHD to the northern carpark at RL 4.6m AHD and then to the proposed residential area to the north at RL 6.1m AHD. The driveway therefore conforms to this condition.

The third condition requires parking areas below the 20 yr ARI flood level shall have warning systems, signage and exits. The southern carpark would be fitted with these requirements as part of the Site Emergency Response Flood Plan to be formulated during the detailed design phase. The Site Emergency Response Flood Plan is discussed in Section 7. There is a condition proposed by Council to require a Flood Emergency Response Plan (Condition 115).

The fourth condition requires barriers to be provided in under building carparks to prevent floating vehicles from leaving the site. This condition will be complied with and this condition is proposed by Council (Condition 31).

For evacuation, Table 4 requires conformance with two conditions. The first condition requires that the development is consistent with any relevant flood evacuation strategy or similar plan. The existing strategy is to proceed to higher ground above the PMF level. The proposed evacuation strategy is outlined in Section 7.

The second condition requires that evacuation requirements be considered and an engineer's report would be required where evacuation might not be achieved within the effective warning time. The evacuation requirements have been considered in the provision of a rising route to land above the PMF level. This is discussed more fully in Section 7 along with the 12 hour warning time available which would be readily adequate to evacuate the proposed marina development.

For management and design, Table 4 requires conformance to three conditions. The first condition requires a safe Emergency Response Flood Plan where floor levels are below the design floor level. The Response Plan is outlined in Section 7 and Council has included a Condition requiring such a plan (Condition 115).

The second condition requires that there are areas above the PMF level to store goods. There are areas available in the main building which are above the PMF level which could be used to store goods during a severe flood.

The third condition requires that no materials are to be stored below the FPL which may cause pollution or be potentially hazardous during a flood. This can be readily achieved in the boat storage area which has a minimum storage level of RL 7.3m AHD. This is 1.2m above the FPL. There is a consent condition addressing this issue (Condition 144).

For fencing, Table 4 requires three conditions. These conditions relate to the fences not having an adverse impact on flood behavior by being permeable, allowed to collapse if necessary or not being unsafe during floods. This will be complied with and Council has incorporated a consent condition to address this issue (Condition 25).

The proposed marina development therefore complies with all the flood related requirements in the Liverpool DCP 2008 such that the flood risk management is appropriate and meets the requirements of NSW Government policy and legislation. Confirmation of this is required by the consent conditions throughout the project approval and development phases.

5. Liverpool Local Environmental Plan 2008

Section 7.8 (3) in the Liverpool LEP 2008 specifies the Flood Planning requirements for the proposed marina development. These requirements are addressed below.

5.1 Flood Behaviour and Adjacent Property

a) will not adversely affect flood behaviour and increase the potential for flooding to detrimentally affect other development or properties

The detailed flood impact assessment undertaken by Cardno established that the proposed development would not adversely impact flood behavior and would not adversely impact on the flood behaviour on adjacent properties (refer to Figures 4-1 to 4-8 in Cardno report).

5.2 Flow Distributions and Velocities

b) will not significantly alter flow distributions and velocities to the detriment of other properties or the environment

The proposed marina structures are located outside the main flood flow areas and is located in a flood storage area with low velocities. As such, there is no adverse impact on flood flow distributions and velocities (refer to Figures 3-8 and 3-18 in the Cardno report and in the responses in Section 5.1).

5.3 Safe Occupation and Evacuation

c) will enable the safe occupation and evacuation of the land

The proposed marina will have an approved safe emergency response flood plan as described in Section 7. It meets all the Government requirements for floor and car parking levels, rising evacuation routes, more than adequate warning times, dedicated and trained staff to manage the evacuation plan and a fallback option of vertical evacuation in the main building to levels significantly above the PMF level. The proposed development meets all the requirements of the NSW Government's Floodplain Development Manual and the Council's LEP and DCP for flooding. As such it is considered to enable safe occupation and evacuation.

5.4 Adverse Environmental Impacts

d) Will not have a significant detrimental effect on the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of any riverbank or watercourse

The proposed marina development will incorporate rock walls around the marina basin perimeter and on the outer walls along the river. This will stabilise the banks and prevent erosion. As the flood velocities are low, any erosion potential would be low.

As the development does not cause any significant change to the flow distribution and velocities as discussed in Sections 5.1 and 5.2, the development would not induce any new instability in the riverbank.

There will be a low rate of siltation in the marina basin due to sediment ladened flood flow. This is addressed in Section 3.10 of the Worley Parsons report supporting the application. The estimated rate of siltation in the marina basin is approximately 120mm over 100yrs. This will not cause any significant problems as a siltation allowance of 300mm has been incorporated into the selection of the design depth of the basin.

The existing riparian vegetation along the river foreshore at the marina site is limited and will be maintained.

5.5 Sustainable Flood Related Social and Economic Costs

e) will not be likely to result in unsustainable social and economic costs to the flood affected community or general community as a consequence of flooding

The proposed marina has been designed to minimize the potential flood related damages in terms of the building form, materials selection and adopted floor levels. Also, flood safety has been an important design principle. The proposed development is in accord with the NSW Government Floodplain Development Manual and thus, along with the above design approach, ensures that the development offers a sustainable approach to the social and economic costs of the local and general community. Importantly, it does not require significant additional flood related infrastructure or resources to support the proposed development.

5.6 Compatible with Flood Flow and Hazard

f) if located in the floodway, will be compatible with the flow of flood waters and with any flood hazard on that floodway

The development is not located within a floodway however it still is compatible with the flood flow and hazard. The buildings have been specifically located west of the main flood flows and designed to comply with its flood hazard and the associated requirements of Council's LEP and DCP as discussed in Section 4.

6. NSW Government Flood Related Legislation

The NSW Government's Floodplain Development Manual 2005 sets out the Government's Flood Prone Land Policy. Section 117 of the Environmental Planning and Assessment Act 1979 (EPA Act) allows the Minister for Planning to give directions to Councils regarding principles, aims, objectives or policies to be achieved in the preparation of draft local environmental plans (LEP).

The Minister released new directions on 1 July 2009 under Section 117(2) of the EPA Act. For directions related to Flood Prone Land, they were the same as Direction 15 issued on 31 January 2007.

The Directions for Flood Prone Land relate to the preparation of a Planning Proposal or draft LEP and as such are not relevant to the Georges Cove Marina DA.

Also, these Directions permit inconsistency with the Directions if the inconsistency was in accordance with the principles and guidelines of the Floodplain Development Manual 2005. Liverpool City Council has conformed with the Floodplain Development Manual 2005 in the undertaking and preparation of the Georges River flood study, floodplain management study and plan, the Liverpool LEP and DCP. In this way, the Section 117(2) Directions relating the Flood Prone Land are not applicable to the subject development as the development complies with the Liverpool LEP and DCP.

7. Site Emergency Response Flood Plan

The site emergency response flood plan would be formulated in detail as required in Council's consent conditions (Conditions 115-119). The approach and structure of this plan is discussed in the following sections.

The plan would be managed on site by the manager of the marina development. The leases for the onsite activities would identify the manager of the plan and provide the manager with the authority to order various activities under the plan such as training drills and evacuations.

Flooding in the Georges River has a 12 hour warning time issued by the Bureau of Meteorology for severe flooding. This warning can be issued electronically direct to the marina manager and other dedicated staff in the marina facility. In addition to this warning, there would be water level readers located at the waters edge which issue an electronic warning and sound an audible alarm when the river level reaches RL 1.3m AHD. The marina manager would then assess the flood risk and decide on the appropriate actions.

In considering the appropriate actions, the manager would review whether advice had been received from SES.

The first action would be to clear any cars parked in the southern carpark to areas offsite above the PMF level.

If the flooding was considered to be severe then the manager would instigate an orderly evacuation of the site. The evacuation would involve:-

- locking down the moored boats;
- storing any hazardous materials into designated areas above the FPL;
- requiring all persons to evacuate by the designated route and remove cars from the northern carpark.

The marina pontoons and pile supports would be designed to cater for flood levels, flood flows and debris imposed by the 100 yr ARI flood. A back up anchor pile and chain system would hold in place the marina pontoons. All craft could be readily tied to the chain system with quick lock fixtures when a severe flood warning was received.

The marina manager would act as the flood warden and he would have a number of designated assistant flood wardens. It would be the responsibility of the assistant flood wardens to ensure all people and cars in the facility have been evacuated.

The designated evacuation route would be east along the rising marina access road to the proposed bridge to Governor Macquarie Drive and up to Nuwarra Road. Nuwarra Road is above the PMF flood level and provides opportunities for refuge.

Flood warning signs would be provided in the carparks indicating that evacuation may be required and providing directions as to the evacuation route.

Each lease provided in the marina would include a flood management package alerting lessees of the potential flood risk, the evacuation plan and the need to follow the directions of the flood warden.

The flood warden would be responsible for providing flood training at the beginning of each new lease and organizing flood evacuation training for all employees on site at least once a year.

The flood risk management onsite is relatively straight forward as the people on site will be either employees or visitors to the site all under the control and management of the marina manager. There is also considerable flood warning time allowing for an orderly evacuation. Importantly, there is a fail safe back up evacuation plan which should not need to be used but if for some reason, a person does not evacuate the site in time, there is refuge available in the upper floors of the main building in areas above the PMF flood level.

8. JRPP Flood Related Issues

Liverpool City Council has conformed to the requirements of the NSW Government Flood Prone Land Policy and Floodplain Development Manual for the Georges River floodplain by undertaking a flood study, floodplain management study and floodplain management plan. Council has devised an appropriate means of achieving an acceptable flood risk management in the development of the floodplain in the formulation of a flood risk management matrix in its Liverpool DCP 2008 and the flood planning requirements in its LEP 2008.

The proposed marina conforms with the flood risk management guidelines thereby balancing the issues of risk management with the social and economic benefits of development. The specific aspects raised by the JRPP and the compliance of the marina development is summarised in the following sections.

8.1 Compliance with LEP

The compliance with Section 7.8 (3) of the Liverpool LEP 2008 is discussed in Section 5. This compliance is supported by the detailed flood impact assessment by Cardno and the discussion in Section 4 of the marina compliance with the flood risk management matrix in the Liverpool DCP 2008.

8.2 Compliance with NSW Legislation and Floodplain Development Manual

NSW Government policy requires a merit based approach to flood risk management based on a specified process of defining the flood behavior (flood study) and formulating a strategy for how best to deal with the flood risks (flood management plan, LEP and DCP requirements). This process has been followed by Council and the discussion in Sections 4, 5, 6 and 7 demonstrates how the proposed marina conforms to the requirements.

8.3 Building Adequacy

The proposed buildings are not located within the floodway. The Cardno detailed flood study demonstrates that the flow velocities are low in the area of the proposed buildings and the buildings are located in a flood storage area. Nonertheless, the building has been designed as an open structure below the FPL to minimize the flood loads. The low flow velocities will assist to minimize the flood forces on the building.

The structural adequacy issue is discussed in Section 4 and would be verified by a report from a certified engineer.

8.4 Site Evacuation

A site emergency response flood plan is discussed in Section 7 and outlines how this plan would provide a “trigger point” for critical flood events and an evacuation strategy for practical and safe passage of vehicles and patrons from the site.

ATTACHMENT A

Table 4

Section 9 Liverpool DCP 2008

Flooding Risk

Table 4 Georges River Floodplain (Includes Harris Ck and Williams Ck, lower parts of Anzac Ck, but not Cabramatta Creek)

Flood Risk Category	Land Use Risk Category	Planning Controls							
		Floor Level	Building Components	Structural Soundness	Flood Effects	Car Parking & Driveway Access	Evacuation	Management & Design	Fencing
Low Flood Risk	Critical Uses & Facilities								
	Sensitive Uses & Facilities	13	4	4	2, 4, 5	2, 3, 6, 7, 8	6, 8, 9	2, 4	
	Subdivision				2, 4, 5			1	
	Residential (++)	2, 6	2	3	2, 4, 5	2, 3, 6, 7, 8	6, 9		
	Commercial & Industrial	4, 8, 15	2	3	2, 4, 5	2, 3, 6, 7, 8	(4 or 9), 6	2, 3, 5	
	Tourist Related Development	2, 6, 15	2	3	2, 4, 5	2, 3, 6, 7, 8	6, 9	2, 3, 5	
	Recreation & Non-Urban	2, 7	2	3	2, 4, 5	1, 5, 7, 8	6, 8	2, 3, 5	
	Concessional Development	14, 15	2	3	2, 4, 5	1, 7, 8, 9	6, 9	2, 3, 5	
Medium Flood Risk	Critical Uses & Facilities								
	Sensitive Uses & Facilities								
	Subdivision				1, 4, 5			1	1, 2, 3
	Residential	2, 6, 15	2	2	2, 4, 5	2, 3, 6, 7, 8	6, 9		1, 2, 3
	Commercial & Industrial	8, 4, 15	2	2	2, 4, 5	2, 3, 6, 7, 8	4, 6	2, 3, 5	1, 2, 3
	Tourist Related Development	2, 6, 15	2	2	2, 4, 5	2, 3, 6, 7, 8	6, 9	2, 3, 5	1, 2, 3
	Recreation & Non-Urban	2, 7	2	2	2, 4, 5	1, 5, 7, 8	6, 8	2, 3, 5	1, 2, 3
	Concessional Development	14, 15	2	2	2, 4, 5	1, 7, 8, 9	8, 9	2, 3, 5	1, 2, 3
High Flood Risk	Critical Uses & Facilities								
	Sensitive Uses & Facilities								
	Subdivision								
	Residential								
	Commercial & Industrial								
	Tourist Related Development								
	Recreation & Non-Urban	2, 7	2	2	1, 4, 5	1, 5, 7, 8	6, 8	2, 3, 5	1, 2, 3
	Concessional Development	14, 15	2	2	1, 4, 5	1, 7, 8, 9	6, 9	2, 3, 5	1, 2, 3

Key:

	Not Relevant
	Unsuitable Land Use
1, 2, 3	Control reference number relevant to the particular planning consideration. (see Table 6)
(++)	Attached dwellings, Dwelling houses, dual occupancies, multi unit dwelling housing, residential flat buildings (not including development for the purpose of group homes or seniors housing), Secondary dwellings and Semi-detached dwellings are exempt from these controls.

Table 5 Local Overland Flooding

Flood Risk Category	Land Use Risk Category	Planning Controls							
		Floor Level	Building Components	Structural Soundness	Flood Effects	Car Parking & Driveway Access	Evacuation	Management & Design	Fencing
Local Overland Flood Risk	Critical Uses & Facilities	13	4	5	3	4, 7, 8	7	3, 5	2, 4
	Sensitive Uses & Facilities	13	4	5	3	4, 7, 8	7	3, 5	2, 4
	Subdivision				3		5	1	2, 4
	Residential	3, 5	1	6	3	4, 7, 8	5		2, 4
	Commercial & Industrial	10	1	6	3	4, 7, 8	5	3, 5	2, 4
	Tourist Related Development	3, 5	1	6	3	4, 7, 8	5	3, 5	2, 4
	Recreation & Non-Urban	3, 5	1	6	3	4, 7, 8	5	3, 5	2, 4
	Concessional Development	14	1	6	3	4, 7, 8	5	3, 5	2, 4

Key:

	Not Relevant
1, 2, 3	Control reference number relevant to the particular planning consideration.

Table 6 Explanation of Development Controls

Ref No	Controls
Floor level	
1	All floor levels to be as high as practical but not less that the 20% AEP flood level.
2	Non habitable floor levels to be as high as practical but no less than the 5% AEP flood level.
3	Non-habitable floor levels to be not less than the 1% AEP flood.
4	The level of Non-habitable and general Industrial floor areas to be as high as practical but not less that the 2% AEP flood. Where this is impractical for single lot developments within an existing developed area, the floor shall be as high as practical but no less than the 5% AEP flood.
5	Habitable floor levels to be equal to or greater than the 1% AEP flood level plus 300mm freeboard.
6	Habitable floor levels to be equal to or greater than the 1% AEP flood level plus 500mm freeboard.
7	Habitable floor levels to be no lower than the 1% AEP flood plus 500mm freeboard unless justified by site specific assessment.
8	Habitable and general commercial floor levels to be as high as practical but no lower than the 1% AEP flood plus 500mm freeboard unless justified by site specific assessment.
9	The level of habitable floor areas to be equal to or greater than the 1% AEP flood level plus 500mm freeboard. If this level is impractical a lower floor level may be considered provided the floor level is as high as possible but no less than the 5% AEP flood level.
10	All floor levels to be equal to or greater than the 1% AEP flood level plus 300mm freeboard. Freeboard may be reduced if justified by site specific assessment.
11	All floor levels to be no lower than the 1% AEP flood plus 500mm freeboard. Freeboard may be reduced if justified by site specific assessment.
12	All floor levels to be equal to or greater than the PMF level. If this level is impractical a lower floor level may be considered provided the floor level is as high as possible but no less than the 1% AEP flood level plus 500mm freeboard.

Ref No	Controls
13	Floor levels to be no lower than the PMF level unless justified by a site specific assessment.
14	Floor levels to be equal to or greater than the minimum requirements normally applicable to this type of development. Where this is not practical due to compatibility with the height of adjacent buildings, or compatibility with the floor level of existing buildings, or the need for access for persons with disabilities, a lower floor level may be considered. In these circumstances, the floor level is to be as high as practical, and, when undertaking alterations or additions no lower than the existing floor level.
15	A restriction is to be placed on the title of the land, pursuant to S.88B of the *Conveyancing Act*, where the lowest habitable floor area is elevated more than 1.5m above finished ground level, confirming that the undercroft area is not to be enclosed.
Building Components & Method	
1	All structures to have flood compatible building components below the 1% AEP flood level plus 300mm freeboard.
2	All structures to have flood compatible building components below the 1% AEP flood level plus 500mm freeboard.
3	All structures to have flood compatible building components below the 1% AEP flood level plus 500mm freeboard or a PMF if required to satisfy evacuation criteria (see below).
4	All structures to have flood compatible building components below the PMF level.
Structural Soundness	
1	Applicant to demonstrate that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus 500mm freeboard or a PMF if required to satisfy evacuation criteria (see below). An engineers report may be required.
2	Engineer's report to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus 500mm freeboard.
3	Applicant to demonstrate that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus 500mm freeboard.
4	Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a PMF. An engineers report may be required.
5	Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a PMF.
6	Applicant to demonstrate that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus 300mm freeboard.
Flood Effects	
1	Engineers report required to certify that the development will not increase flood effects elsewhere, having regard to: (I) loss of flood storage; (ii) changes in flood levels, flows and velocities caused by alterations to flood flows; and (iii) the cumulative impact of multiple similar developments in the floodplain.
2	The flood impact of the development to be considered to ensure that the development will not increase flood effects elsewhere, having regard to: (i) loss of flood storage; (ii) changes in flood levels and velocities caused by alterations to the flood conveyance; and (iii) the cumulative impact of multiple potential developments in the floodplain. An engineer's report may be required.
3	The flood impact of the development to be considered to ensure that the development will not increase flood affectation elsewhere having regard to changes in flood levels and velocities caused by

Ref No	Controls
	alteration of conveyance of flood waters. An engineers report may be required if Council considers a significant affectation is likely. The unmitigated obstruction, concentration or diversion of overland flow paths to adjacent property shall not be permitted.
4	A floodway or boundary of significant flow may have been identified in this catchment. This area is the major conveyance area for floodwaters through the floodplain and any structures placed within it are likely to have a significant impact on flood behaviour. Within this area no structures other than concessional development, open type structures or small non habitable structures (not more than 30sqm) to support agricultural uses will normally be permitted. Development outside the Boundary of Significant flow may still increase flood effects elsewhere and therefore be unacceptable
5	Any filling within the 1% AEP flood will normally be considered unacceptable unless compensatory excavation is provided to ensure that there is no net loss of floodplain storage volume below the 1% AEP flood.
Car Parking and Driveway Access	
1	The minimum surface level of open car parking spaces, carports or garages, shall be as high as practical.
2	The minimum surface level of a car parking space, which is not enclosed (e.g. open car parking space or carport) shall be as high as practical, but no lower than the 5% AEP flood level or the level of the crest of the road at the highest point were the site can be accessed. In the case of garages, the minimum surface level shall be as high as practical, but no lower than the 5% AEP flood.
3	Garages capable of accommodating more than 3 vehicles on land zoned for urban purposes, or basement car parking, must be protected from inundation by floods equal to or greater than the 1% AEP flood plus 0.1m freeboard.
4	Basement car parking shall be protected from inundation by the 1% AEP flood.
5	The driveway providing access between the road and car parking space shall be as high as practical and generally rising in the egress direction.
6	The level of the driveway providing access between the road and car parking space shall be no lower than 0.3mbelow the 1% AEP flood or such that depth of inundation during a 1% AEP flood is not greater than either the depth at the road or the depth at the car parking space. A lesser standard may be accepted for single detached dwelling houses where it can be demonstrated that risk to human life would not be compromised.
7	Basement car parking or car parking areas accommodating more than 3 vehicles (other than on Rural zoned land) with a floor level below the 5% AEP flood or more than 0.8m below the 1% AEP flood level; shall have adequate warning systems, signage and exits.
8	Barriers to be provided to prevent floating vehicles leaving a site during a 1% AEP flood.
9	Driveway and car parking space levels shall be no lower than the minimum requirements normally applicable to this type of development. 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 or additions no lower than the existing level.
Evacuation	
1	Reliable access for pedestrians required during a 1% AEP flood.
2	Reliable access for pedestrians or vehicles is required from the building, commencing at a minimum level equal to the lowest habitable floor level to an area of refuge above the PMF level, or a minimum of 20% of the habitable floor area is above the PMF.
3	Reliable access for pedestrians or vehicles is required from the building to an area of refuge above the PMF level, or a minimum of 20% of the habitable floor area is above the PMF

Ref No	Controls
4	Reliable access for pedestrians or vehicles required during a 1% AEP flood to a publicly accessible location above the PMF.
5	The evacuation requirements of the development during flooding shall be considered.
6	The development is to be consistent with any relevant flood evacuation strategy or similar plan.
7	The evacuation requirements of the development are to be considered up to the PMF level.
8	The evacuation requirements of the development are to be considered. An engineers report will be required if circumstances are possible where the evacuation of persons might not be achieved within the effective warning time.
9	Adequate flood warning is available to allow safe and orderly evacuation without increased reliance upon the SES or other authorised emergency services personnel.
Management and Design	
1	Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accordance with this DCP.
2	Site Emergency Response Flood Plan required where floor levels are below the design floor level, (except for single dwelling-houses).
3	Applicant to demonstrate that area is available to store goods above the 1% AEP flood level plus 500mmfreeboard.
4	Applicant to demonstrate that area is available to store goods above the PMF level.
5	No storage of materials below the design floor level which may cause pollution or be potentially hazardous during any flood.
6	Finished land levels in new release areas shall be not less than the 1% AEP flood unless justified by site specific assessment. A surveyor's certificate will be required upon completion certifying that the final levels are not less that the required level.
Fencing	
1	Fencing within a High Flood Risk area, Boundary of Significant Flow or floodway will not be permitted except for permeable open type fences.
2	Fencing is to be constructed in a manner that does not obstruct the flow of floodwaters so as to have an adverse impact on flooding.
3	Fencing shall be constructed to withstand the forces of floodwaters or collapse in a controlled manner so as not to obstruct the flow of water, become unsafe during times of flood or become moving debris.
4	Fencing shall be constructed to withstand the forces of floodwaters.

ATTACHMENT 3

Flood Impact Assessment for the Proposed Georges Cove Marina, Moorebank (Cardno, January 2013)

Our Ref: NA49913037-L02:BCP/bcp
Contact: Dr Brett C. Phillips

29th January 2013

The Manager
npc
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CROWS NEST NSW 1585

Attention: Mr Mark Tooker

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Dear Mark,

FLOOD IMPACT ASSESSMENT FOR THE PROPOSED GEORGES COVE MARINA, MOOREBANK

Cardno was commissioned by npc to conduct a Flood Impact Assessment for the proposed Georges Cove Marina development in Moorebank, within the Liverpool City Council Local Government Area (LGA).

The objective of the study was to determine the flooding behaviour for the proposed Georges Cove Marina site during major flood events and to assess the impact if any of proposed development on flooding of adjacent properties.

At the request of Liverpool City Council flooding in the 20 year and 100 year Average Recurrence Interval (ARI) events has been assessed. Council was particularly concerned about the proposed marina impacting on flows during the 20 yr ARI flood into the flood storage area immediately southwest of the site and the potential increase in flood levels on adjacent properties.

1. BACKGROUND

1.1 Study Area

The Georges Cove Marina site is located on the western bank of the Georges River between Newbridge Road and the M5 motorway in the suburb of Moorebank, in south-west Sydney. The site location is shown in **Figure 1-1**.

The site covers an area of approximately 12.3 ha and is part of the Benedict Sand & Gravel (BS&G) landholding. Sand extraction activities are undertaken on the site. There are large expanses of undeveloped vegetated floodplain south of the site.

1.2 Flooding in the Georges River at Moorebank

The 2004 Georges River Floodplain Risk Management Study by Bewsher Consulting modelled the flooding behaviour for the Georges River from the upper Georges River upstream of Liverpool to Botany Bay downstream. The Study used the 1D hydraulic modelling program MIKE-11 as the basis for its flood analysis.

The following overview has been extracted from the Georges River Floodplain Risk Management Study (Bewsher Consulting, 2004) detailing various flood studies that had occurred prior to 2004:

> *Design flood levels on the Georges River are available from the Georges River Flood Study [PWD, 1991]. This study used a physical scale model of the Georges River to simulate flood conditions between Picnic Point and Liverpool.*
>
> *A number of other studies have also been undertaken to define flood conditions upstream of Liverpool and for the main tributary creeks of the Georges River. These studies include:*
>
> - *Upper Georges River Flood Study [DLWC, 1999];*
> - *Draft Cabramatta Creek Floodplain Management Study [Bewsher Consulting,1999];*
> - *Lower Prospect Creek Floodplain Management Study [Willing & Partners, 1990];*
> - *Milperra Industrial Area Hydraulic Study [Willing & Partners, 1990];*
> - *Little Salt Pan Creek Flood Study [Manly Hydraulics Laboratory, 1995];*
> - *Salt Pan Creek Flood Study [PWD, 1991];*
> - *Deadmans Creek Flood Study [DLWC, 1997].*
>
> *A single computer model of the Georges River study area was developed by Bewsher Consulting for Liverpool Council. This model has been used as part of further flood investigations for the 2004 floodplain management study.*
>
> *The Georges River MIKE-11 model was developed from various sources. The origin of the model was a MIKE-11 in-bank tidal model, which was first developed by the Public Works Department to study tidal behaviour between Liverpool and Botany Bay [PWD, 1992]. The tidal model was subsequently extended by Bewsher Consulting to incorporate the floodplain, by extending model cross sections and inserting additional overbank flow paths. A separate MIKE-11 model, developed as part of the Upper Georges River Flood Study [DLWC, 1998], was also added to the main model to extend it upstream of Liverpool (Bewsher, 2004)*

Council requested that a flood impact assessment be undertaken of the proposed development using a 2D floodplain model of the site and adjoin lands upstream and downstream of the site. Council provided a copy of the MIKE-11 model to assist in the assembly of the 2D floodplain model.

1.3 Proposed Development

The proposed development has been described in the following terms.

The proposed development of a marina is located on land zoned private and public recreation located on the western bank of the Georges River and is around 600 m due south of Newbridge Road.

The site is presently a sand extraction area located immediately south of a proposed residential area (ground level above the 100yr ARI), immediately east of the residential development in the former Boral quarry site and immediately north of a large elevated former landfill site (levels near and above the 100yr ARI). The Flower Power site also immediately to the north has been recently approved for development by Council. The residential area immediately to the north includes a high level bridge connection to the former Boral quarry site residential development which provides access to high ground above the PMF level. The marina development will have access to this bridge.

The flood levels at the site estimated from the 2004 Georges River Floodplain Risk Management Study are as follows:

20 yr ARI	RL 4.6 m AHD
100 yr ARI	RL 5.6m AHD
PMF	RL 10.2m AHD

The flood planning level is RL 6.1m AHD (100 yr ARI plus 0.5m).

The proposed marina development consists of floating berths, a dry storage facility incorporating amenities at the upper levels and a private marina club house. Importantly the buildings are located on the western edge of the site and are open structures below the flood planning level. The formation of the marina basin creates additional flood storage.

The lowest level of boat storage is above the FPL at RL 7.3 m AHD. The lowest amenities area in the boat storage building is at a level above the PMF level at RL 10.525 m AHD. The private marina club level is at the FPL of RL 6.1 m AHD. It is stated that these buildings provide minimum disruption to any flood conveyance because:

1. They are open structures below the FPL;
2. They do not extend eastwards of the major flood flow controllers either upstream or downstream of the site which are the residential area (and Flower Power) to the north and the former landfill site to the south.

A key issue is that stated presence of high ground immediately north of the proposed development (higher than the 100 yr ARI flood level) and a large elevated former landfill site (levels near and above the 100yr ARI) located immediately south of the proposed development. If this is the case then it would be expected that flooding of the proposed development in events up to the 100 yr ARI event would be primarily by the lateral discharge of floodwaters from the river into the site rather than longitudinal flood flows spilling into the site across its northern boundary and discharging through the southern boundary of the site. The lateral interchange of flow with the river would be then primarily controlled by the ground levels on the bank of the river (eastern side of the site) and the waterway opening through the river bank.

It is expected that in a PMF the site would be subject initially to lateral flows which would then become longitudinal flood flows as the flood level continues to rise above the 100 yr ARI flood level.

The development site is located between high ground upstream and downstream and it is expected that in events less than a 100 yr ARI event that the proposed development would have only local impacts on design flood levels and it is likely that these impacts would be minimal and would not have any significant impacts upstream of the site.

The proposed development has been detailed on an architectural plan view, included as **Figure 1-2**, and section views of the proposed site included as **Figure 1-3**, prepared by Michael Fountain Architects on 11th November 2010.

2. HYDRAULICS

Hydrological modelling was not required to support this assessment (with the exception of the Newbridge culverts, refer to **Section 2.2.1**) due to the availability of routed hydrographs that were obtained from Council's existing MIKE-11 models which were prepared as part of the 2004 Georges River Flood Risk Management Study.

In order to assess the spatial impact of the proposed development on flooding it was proposed to assemble a local 2D floodplain model of the development and a reach upstream and downstream of the site. The hydraulic study area is identified in **Figure 2-1**.

2.1 2D Floodplain Model

The TUFLOW 2D hydraulic model covers an area of about 744 ha. The model extends from upstream of Newbridge Road in the north to just downstream of the M5 Motorway to the south.

Digital Elevation Model

The Digital Elevation Model (DEM), which assigns elevation values to the 2D grid cells, has been mostly based on Aerial Laser Survey (ALS) data provided by Liverpool City Council on the 14th September 2012.

Generally, the accuracy of the ALS data is +/- 0.15m for vertical elevations on hard surfaces, but provides less reliable records in densely vegetated areas. ALS is unable to penetrate surface of water bodies and therefore provides no data on the bed geometry of the Georges River. Hence the Georges River bed geometry was represented in the DEM based on the 1D cross sections extracted from Council's existing MIKE-11 model. The bed and bank geometry were interpolated between cross sections to create a 2D DEM of the river bed and banks.

The base DEM is shown in **Figure 2-2**.

For assessment purposes a 2m x 2 m grid size was adopted in the TUFLOW 2D floodplain model.

Surface Roughness

Hydraulic surface roughness have been modelled in the 2D TUFLOW model using spatially distributed Manning roughness ("n") values based on aerial photography (NearMap, recorded 23/10/11). Areas of the floodplain were assigned a land-use category, with an associated roughness value as shown in **Table 2-1**.

The land-use breakdown for the study area is shown in **Figure 2-3**.

Boundary Conditions

Inflows to the local 2D floodplain model were based on routed hydrographs that were obtained from Council's existing MIKE-11 models which were prepared as part of the 2004 Georges River Flood Risk Management Study.

Table 2-1 Roughness Values for Different Landuse Categories

Land-Use Type	Manning Roughness Value
Water Body	0.040 – 0.045
Open Space	0.04
Floodplain	0.09
Environmental / Special Use	0.09
Road	0.02
Residential	0.12
Commercial	0.20
Industrial	0.20
Rockwall	0.10

There were three main inflows considered in this study:

- *Georges River:* The critical duration storm for the Georges River catchment is the 36 hour storm for both the 20 year and 100 year ARI events and is estimated to generate peak flows of approximately 1,570 m^3/s and 2,080 m^3/s respectively in the vicinity opposite Bankstown Airport (refer MIKE-11 Cross Section Chainage 10121 m).

- *Milperra Drain:* The Milperra Drain collects runoff from the suburbs of Georges Hall and Milperra and from Bankstown Airport. It flows in a westerly direction along the northern boundary of Bankstown Golf Course before turning south and flowing along the western boundary of the Bankstown Golf Course before then turning west and flowing under Henry Lawson Drive and eventually discharging into the Georges River. The peak flow for the 20 year and 100 year ARI 36 hour duration storms was calculated to be approximately 54 m^3/s and 66 m^3/s respectively (refer MIKE-11 Cross Section MD8470 m). The inflows from Milperra Drain were input in the 2D floodplain model in the vicinity of the northwestern corner of the Bankstown Golf Course.

- *Newbridge Road Drain:* There is a major stormwater outfall located on the southern side of Newbridge Road to the west of the BS&G site. The outfall comprises 4 x 0.65 m (H) x 1.75 m (W) box culverts. This is the outfall of a drainage network with unknown extents in the suburb of Chipping Norton to the north of the site. The potential peak discharge of the culverts in a 36 hour storm was estimated by assembling a broadscale DRAINS model for the estimated local catchment area. The peak discharges at the outfall in the 20 year and 100 year ARI 36 hour storms were estimated to be approximately 4 m^3/s and 5 m^3/s respectively. These minor inflows were considered negligible in comparison with the flows in the Georges River and Milperra Drain and therefore the discharge from the Newbridge Road outfall was not included in the TUFLOW hydraulic model.

The hydrograph inflow locations are shown in **Figure 2-2**.

The adopted downstream boundary conditions were the 20 and 100 year ARI water level time series obtained from Council's existing MIKE-11 model at a cross section located immediately downstream of the M5 Motorway (Chainage 14180 m).

2.1 Model Calibration

The calibration of the TUFLOW floodplain model was conducted iteratively by comparing the 100 yr ARI and 20 yr ARI flood levels predicted by the TUFLOW and 2004 MIKE-11 models by progressively adjusting the roughness values within acceptable ranges to achieve an acceptable fit to the design flood levels estimated in 2004.

A comparison of the design flood levels predicted by the 2004 MIKE-11 model and TUFLOW floodplain model is given in **Table 2-2**. Approximate locations of the MIKE-11 cross section locations are shown in **Figure 2-2**. Cross sections from chainages 11960 m to 12890 m are within the vicinity of the Georges Cove site with cross sections chainages 12330 m, 12500 m, and 12620 m are adjacent to the Georges Cove site.

It is concluded that the TUFLOW base model gives an acceptable representation of the MIKE-11 design flood with the level of agreement for the predicted 100 yr ARI flood levels being between – 0.02 m to +0.15 m and for the 20 yr ARI flood levels being between – 0.02 m to +0.15 m. In the vicinity of the proposed development the level of agreement for the predicted 100 yr ARI flood levels being between – 0.02 m to +0.02 m and for the 20 yr ARI flood levels being between – 0.01 m to +0.03 m.

Table 2-2 Comparison of Predicted Design Flood Levels (m AHD)

Cross Section Chainage (m)	MIKE-11 Peak WL Results (m AHD)		TUFLOW Peak WL Results (m AHD)		WL Difference (m) (TUFLOW Less MIKE-11)	
	20 year ARI	100 year ARI	20 year ARI	100 year ARI	20 year ARI	100 year ARI
10120	5.15	5.94	5.18	6.01	0.03	0.06
10290	5.05	5.85	5.11	5.94	0.06	0.09
10410	5.01	5.81	5.08	5.91	0.07	0.10
10590	4.96	5.78	5.05	5.89	0.09	0.11
10740	4.91	5.74	5.02	5.87	0.11	0.13
10890	4.86	5.70	4.99	5.85	0.13	0.15
10930	4.84	5.68	4.97	5.83	0.13	0.15
10970	4.78	5.65	4.93	5.80	0.15	0.15
11050	4.78	5.66	4.93	5.79	0.15	0.13
11140	4.79	5.67	4.94	5.80	0.15	0.14
11350	4.76	5.65	4.83	5.73	0.07	0.08
11650	4.76	5.65	4.79	5.69	0.04	0.05
11780	4.75	5.65	4.77	5.66	0.02	0.02
11960	4.74	5.64	4.74	5.63	-0.01	-0.01
12140	4.72	5.63	4.71	5.61	-0.01	-0.02
12330	4.70	5.60	4.70	5.59	0.00	-0.01
12500	4.64	5.54	4.67	5.57	0.03	0.02
12620	4.65	5.56	4.64	5.54	-0.01	-0.02
12890	4.59	5.50	4.58	5.49	-0.01	-0.01
13030	4.56	5.47	4.56	5.46	0.00	-0.01
13200	4.54	5.44	4.53	5.44	0.00	-0.01
13520	4.48	5.37	4.49	5.39	0.02	0.02
13820	4.39	5.29	4.39	5.30	-0.01	0.01
13960	4.35	5.25	4.33	5.24	-0.02	-0.01
14150	4.28	5.19	4.29	5.19	0.00	0.00
14180	4.28	5.18	4.28	5.18	0.00	0.00

The main differences between the predicted flood levels are attributed to the differences in floodplain storage associated with a 1D representation of the floodplain in comparison with a 2D representation of the floodplain at a far finer scale than the 1D model. It is expected that the 2D model provides a better definition of the floodplain topography and floodplain storage.

2.6 Benchmark (Pre-Development) Scenario

The calibrated benchmark pre-development model was adjusted to represent approved levels on a number of sites located within the study area as follows:

- There are a number of current developments near the Georges Cove site which have the potential to impact on the hydraulics of the study area. Liverpool City Council advised npc that the future finished levels of the Flower Power site, and northern portion of the BS&G site would be 6.3 m AHD. These two sites were raised to these levels in the benchmark scenario.

- There is also a residential development proposed to the west of the Georges Cove site which was flood affected in the initial TUFLOW model (refer to **Figure 2-4**). It was assumed that the landform would be modified such that there will be is no inundation on the development in either the 20 year or the 100 year ARI events.

- Following discussion with Liverpool City Council it was agreed that the levels of the Georges Cove site in the benchmark model should represent the likely rehabilitated site topography following works to remove the existing lakes and material stockpiles from the site.

  The pre-development site includes an environmental protection zone on the eastern side of the site incorporated within a 40 m riparian zone along the bank of the Georges River. The pre-development level of this area is around 1.9 m AHD and was assumed to be represented by a hydraulic roughness of 0.04. The remainder of the site is subject to a rehabilitation consent condition that requires finished levels of between 1.6 m AHD – 1.7m AHD. This area was treated as cleared land with a hydraulic roughness of 0.04.

The changes to the pre-development study area are summarised in **Figure 2-4**, the pre-development DEM is shown in **Figure 2-5**, and the pre-development land-use / roughness map is shown in **Figure 2-6**.

2.7 Post-Development Scenario

The benchmark floodplain model was subsequently modified to represent planned development site as detailed on an architectural plan view, included as **Figure 1-2**, and section views of the proposed site included as **Figure 1-3**, prepared by Michael Fountain Architects on 11th November 2010.

The main features of the proposed development are as follows:

- A marina basin located in the middle of the site with an assumed an invert level of -3.5m AHD for the marina and a hydraulic roughness of 0.04;
- A series of wetlands with a finished level of 0.6m AHD, and vegetated areas with a finished level of 1.9 m AHD located along the eastern side of the site located within the 40 m wide riparian zone of the Georges River, with an adopted hydraulic roughness of 0.09;
- A car park in the north-west corner of the site raised to 4.7 m AHD with an adopted hydraulic roughness of 0.02;

- A proposed 6 storey building on the western side of the site with car parking on the ground floor at 4.7 m AHD which is suspended above a 1.65 m AHD finished ground level at the southern end of the building, with a hydraulic roughness of 0.12; and
- A lower car park located on the southern side of the site with a ground level of at 1.65 m AHD and a hydraulic roughness of 0.02.

The post-development DEM is shown in **Figure 2-7**, the post-development land-use / roughness map included as **Figure 2-8**, and a comparison of the levels adopted in the pre-development and post-development DEMs has been included in **Figure 2-9**.

A post-development building blockage sensitivity analysis was also assessed. The sensitivity analysis was based on the assumption that the area under the southern side of the building will be 50% blocked during a rainfall event by debris and other objects. The blockage scenario sensitivity analysis DEM is shown in **Figure 2-10**. A comparison of the levels adopted in the pre-development and post-development DEMs for this option has been included in **Figure 2-11.**

3. FLOOD IMPACT ASSESSMENT

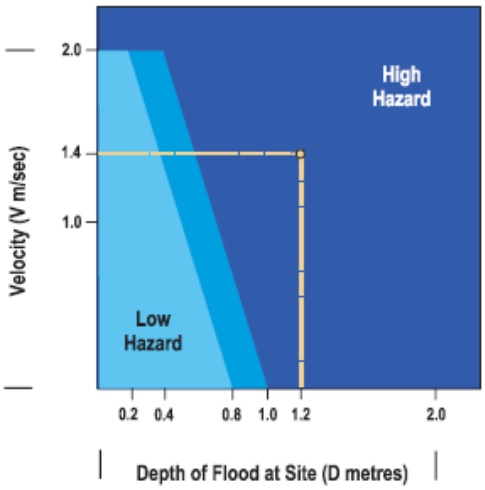
3.1 Pedestrian and Vehicular Stability

When considering pedestrian and vehicular stability, three velocity x depth criteria were identified as follows:

Velocity x Depth	Comment
≤ 0.4 m^2/s	This is typically adopted by Councils as a limit of stability for pedestrians
0.4 – 0.6 m^2/s	Unsafe for pedestrians but safe for vehicles if overland flood depths do not exceed around 0.3 m
> 0.6 m^2/s	This is typically adopted by Councils as a limit of stability for vehicles

3.2 Flood Hazards

Experience from studies of floods throughout NSW and elsewhere has allowed authorities to develop methods of assessing the hazard to life and property on floodplains. This experience has been used in developing the NSW Floodplain Development Manual to provide guidelines for managing this hazard. These guidelines are shown schematically below.



Provisional Hazard Categories
(after Figure L2, NSW Government, 2005)

To use the diagram, it is necessary to know the average depth and velocity of floodwaters at a given location. If the product of depth and velocity exceeds a critical value (as shown below), the flood flow will create a **high hazard** to life and property. There will probably be danger to persons caught in the floodwaters, and possible structural damage. Evacuation of persons would be difficult. By contrast, in **low hazard** areas people and their possessions can be evacuated safely by trucks. Between the two categories a transition zone is defined in which the degree of hazard is dependent on site conditions and the nature of the proposed development. This calculation leads to a provisional hazard rating. The provisional hazard rating may be modified by consideration of effective flood warning times, the rate of rise of floodwaters, duration of flooding and ease or otherwise of evacuation in times of flood.

3.3 Benchmark Conditions

The estimated 20 yr ARI flood levels, depths, velocities, velocity x depth and hazards under benchmark conditions are plotted in **Figures 3-1, 3-2, 3-3, 3-4** and **3-5** respectively.

The estimated 100 yr ARI flood levels, depths, velocities, velocity x depth and hazards under benchmark conditions are plotted in **Figures 3-6, 3-7, 3-8, 3-9** and **3-10** respectively.

It was concluded that:

- Peak flow velocities across the site are low;
- Velocities in the floodplain southwest of the site are even lower; and that
- The floodplain southwest of the site is flood storage in floods up to the 100 yr ARI event.

3.4 Post-Development Conditions

Two development scenarios were assessed as follows:

- Development of the Georges Cove site as given in **Figure 2-7** with no blockage factor applied under Marina building
- Development of the Georges Cove site as given in **Figure 2-10** with a 50% blockage factor applied under Marina building

The estimated 20 yr ARI flood levels, depths, velocities, velocity x depth and hazards under the Post-development conditions are plotted in **Figures 3-11, 3-12, 3-13, 3-14** and **3-15** respectively.

The estimated 100 yr ARI flood levels, depths, velocities, velocity x depth and hazards under the Post-development conditions are plotted in **Figures 3-16, 3-17, 3-18, 3-19** and **3-20** respectively.

The estimated 20 yr ARI flood levels, depths, velocities, velocity x depth and hazards under Post-development – blockage conditions are plotted in **Figures 3-21, 3-22, 3-23, 3-24** and **3-25** respectively.

The estimated 100 yr ARI flood levels, depths, velocities, velocity x depth and hazards under Post-development – blockage conditions are plotted in **Figures 3-26, 3-27, 3-28, 3-29** and **3-30** respectively.

4. FLOOD IMPACT ASSESSMENT

4.1 Post-development Condition

The post-development condition represents the marina as proposed in the applicant's Development Application.

The flood level differences in a 20 Yr ARI and 100 yr ARI events for Post-development Conditions are plotted in **Figures 4-1** and **4-2** respectively. The flood velocity differences in a 20 Yr ARI and 100 yr ARI events for Post-development Conditions are plotted in **Figures 4-5** and **4-6** respectively.

In a 20 yr ARI flood it was assessed that the planned development would locally reduce the 20 yr ARI flood levels west of the site by up to 0.03 m while a small local increase would occur in the entry channel to the marina. This local increase is confined to the waterway and does not impact on any other property. Similarly in the 100 yr ARI flood it was assessed that the planned development would locally reduce the 100 yr ARI flood levels southwest of the site by up to 0.03 m while a small local increase would occur in the entry channel to the marina and within the site. These local increases do not impact on any other property.

In the 20 yr ARI flood the peak velocity within the site of up to around 0.9 m/s occurs locally in the southern car park (Car Park B in Figure 1-2) while in the 100 yr ARI flood the peak velocity in this area increase to around 1.0 m/s.

In the 20 yr ARI flood and the 100 yr ARI flood the planned development reduces peak velocities within the site waterways and adjoining areas by greater than 0.04 m/s while in the south-west corner of the site the peak velocity is increased by up to 0.04 m/s. The peak velocity in the Newbridge Road drainage corridor increases by up to 0.04 m/s in the 20 yr ARI flood and the 100 yr ARI flood. The peak velocity in the majority of the land south-west of the site decreases by up to 0.04 m/s or more in the 20 yr ARI flood and the 100 yr ARI flood.

In a 20 yr ARI flood and the 100 yr ARI flood the impact of the planned development on peak velocity x depth is negligible except where the local raising of the ground levels to 4.7 m AHD eliminates the velocity x depth in comparison with pre-development conditions.

On the landform raised to 4.7 m AHD the velocity x depth under the building and in the elevated car park (Car Park C in Figure 1-2) is around 0.6 m^2/s in the 100 yr ARI flood (ie. the stability limit for vehicles).

In a 20 yr ARI event the impact of the planned development on flood hazard is negligible except where planned raising of the ground level on the western side of the site eliminates the flood hazard while in the 100 yr ARI flood the impact of the planned development on flood hazard is negligible.

It is concluded that the proposed development has negligible impact on the behaviour of flooding in the flood storage area located southwest of the proposed marina and nil or negligible impacts on any other adjacent properties.

4.2 Post-development – Blockage Scenario

This option blocks around 50% of the undercroft under the marina building further to the south. The flood level differences in a 20 yr ARI and 100 yr ARI events for the blockage scenario are plotted in **Figures 4-3** and **4-4** respectively. The flood velocity differences in a 20 Yr ARI and 100 yr ARI events for Post-development Conditions are plotted in **Figures 4-7** and **4-8** respectively

In a 20 yr ARI flood it was assessed that the partial blockage planned development would locally reduce the 20 yr ARI flood levels west of the site by up to 0.02 m while a small local increase would occur in the entry channel to the marina. This local increase is confined to the waterway and does not impact on any other property. Similarly in the 100 yr ARI flood it was assessed that the planned development would locally reduce the 100 yr ARI flood levels southwest of the site by up to 0.03 m while a small local increase would occur in the entry channel to the marina and within the site. While the local impact within the site is greater than under the nil blockage scenario these local increases do not impact adversely on any other property.

In the 20 yr ARI flood and the 100 yr ARI flood the planned development with partial blockage reduces peak velocities within the site waterways and adjoining areas by greater than 0.04 m/s while in the south-west corner of the site the peak velocity is increased by up to 0.04 m/s. The peak velocity in the Newbridge Road drainage corridor increases by up to 0.04 m/s in the 20 yr ARI flood and the 100 yr ARI flood. The peak velocity in the majority of the land south-west of the site decreases by up to 0.04 m/s or more in the 20 yr ARI flood and the 100 yr ARI flood.

In a 20 yr ARI flood the impact of the planned development and partial blockage on peak velocity x depth is negligible except where the local raising of the ground levels to 4.7 m AHD eliminates peak velocity x depth in comparison with pre-development conditions. In the 100 yr ARI flood planned development and partial blockage creates a zone of higher velocity x depth on the northwestern corner of the site.

In a 20 yr ARI event the impact of the planned development and partial blockage on flood hazard is negligible except where planned raising of the ground level on the western side of the site eliminates the flood hazard while in the 100 yr ARI flood the impact of the planned development and partial blockage on flood hazard is negligible.

5. CONCLUSIONS

The main features of the proposed development are as follows:

- A marina basin located in the middle of the site with an assumed an invert level of -3.5m AHD for the marina and a hydraulic roughness of 0.04;
- A series of wetlands with a finished level of 0.6m AHD, and vegetated areas with a finished level of 1.9 m AHD located along the eastern side of the site located within the 40 m wide riparian zone of the Georges River, with an adopted hydraulic roughness of 0.09;
- A car park in the north-west corner of the site raised to 4.7 m AHD with an adopted hydraulic roughness of 0.02;
- A proposed 6 storey building on the western side of the site with car parking on the ground floor at 4.7 m AHD which is suspended above a 1.65 m AHD finished ground level at the southern end of the building, with a hydraulic roughness of 0.12; and
- A lower car park located on the southern side of the site with a ground level of at 1.65 m AHD and a hydraulic roughness of 0.02.

The post-development DEM is shown in **Figure 2-7** while the post-development land-use / roughness map included as **Figure 2-8**. A post-development with 50% blockage of the undercroft was also assessed.

5.1 Post Development

It was concluded from the assessment of Post Development Conditions that:

(i) In a 20 yr ARI flood the planned development would locally reduce the 20 yr ARI flood levels west of the site by up to 0.03 m while a small local increase would occur in the entry channel to the marina.

(ii) Similarly in the 100 yr ARI flood the planned development would locally reduce the 100 yr ARI flood levels southwest of the site by up to 0.03 m while a small local increase would occur in the entry channel to the marina and within the site.

(iii) The local increases in 20 yr ARI and 100 yr ARI are in a very limited area only and do not impact on any other property;

(iv) In the 20 yr ARI flood and the 100 yr ARI flood the planned development reduces peak velocities within the site waterways and adjoining areas by greater than 0.04 m/s while in the south-west corner of the site the peak velocity is increased by up to 0.04 m/s;

(v) The peak velocity in the Newbridge Road drainage corridor increases by up to 0.04 m/s in the 20 yr ARI flood and the 100 yr ARI flood while the peak velocity in the majority of the land south-west of the site decreases by up to 0.04 m/s or more in the 20 yr ARI flood and the 100 yr ARI flood;

(vi) In a 20 yr ARI flood the velocity x depth on land southwest of the site is reduced in some areas while in the 100 yr ARI flood the impact of the planned development on peak velocity x depth is negligible except where the local raising of the ground levels to 4.7 m AHD eliminates the velocity x depth in comparison with pre-development conditions;

(vii) On the landform raised to 4.7 m AHD the velocity x depth under the building and in the elevated car park (Car Park C in Figure 1-2) is around 0.6 m2/s in the 100 yr ARI flood (ie. the stability limit for vehicles).

(viii) In a 20 yr ARI event the impact of the planned development on flood hazard is negligible except where planned raising of the ground level on the western side of the site eliminates the flood hazard while in the 100 yr ARI flood the impact of the planned development on flood hazard is negligible; and

(ix) The proposed development has negligible impact on the behaviour of flooding in the flood storage area located southwest of the proposed marina and nil or negligible impacts on any other adjacent properties.

5.2 Post Development with Blockage

It was concluded from the assessment of Post Development conditions with 50% blockage of the undercroft that:

(i) In a 20 yr ARI flood the planned development would locally reduce the 20 yr ARI flood levels west of the site by up to 0.02 m while a small local increase would occur in the entry channel to the marina.

(ii) Similarly in the 100 yr ARI flood the planned development would locally reduce the 100 yr ARI flood levels southwest of the site by up to 0.03 m while a small local increase would occur in the entry channel to the marina and within the site.

(iii) The local increases in 20 yr ARI and 100 yr ARI are in a very limited area only and do not impact on any other property;

(iv) In the 20 yr ARI flood and the 100 yr ARI flood the planned development with partial blockage reduces peak velocities within the site waterways and adjoining areas by greater than 0.04 m/s while in the south-west corner of the site the peak velocity is increased by up to 0.04 m/s;

(v) The peak velocity in the Newbridge Road drainage corridor increases by up to 0.04 m/s in the 20 yr ARI flood and the 100 yr ARI flood while the peak velocity in the majority of the land south-west of the site decreases by up to 0.04 m/s or more in the 20 yr ARI flood and the 100 yr ARI flood;

(vi) In a 20 yr ARI flood the impact of the planned development with partial blockage on peak velocity x depth is minor except where the local raising of the ground levels to 4.7 m AHD eliminates the peak velocity x depth in comparison with pre-development conditions;

(vii) In the 100 yr ARI flood the impact of the planned development with partial blockage on peak velocity x depth is negligible except where the local raising of the ground levels to 4.7 m AHD reduces significantly the peak velocity x depth in comparison with pre-development conditions;

(viii) In a 20 yr ARI event the impact of the planned development with partial blockage on flood hazard is negligible except where planned raising of the ground level on the western side of the site eliminates the flood hazard while in the 100 yr ARI flood the impact of the planned development on flood hazard is negligible.

(ix) The proposed development with partial blockage has negligible impact on the behaviour of flooding in the flood storage area located southwest of the proposed marina and nil or negligible impacts on any other adjacent properties.

Yours faithfully



……

Dr Brett C. Phillips
Director, Water Engineering
for **Cardno**

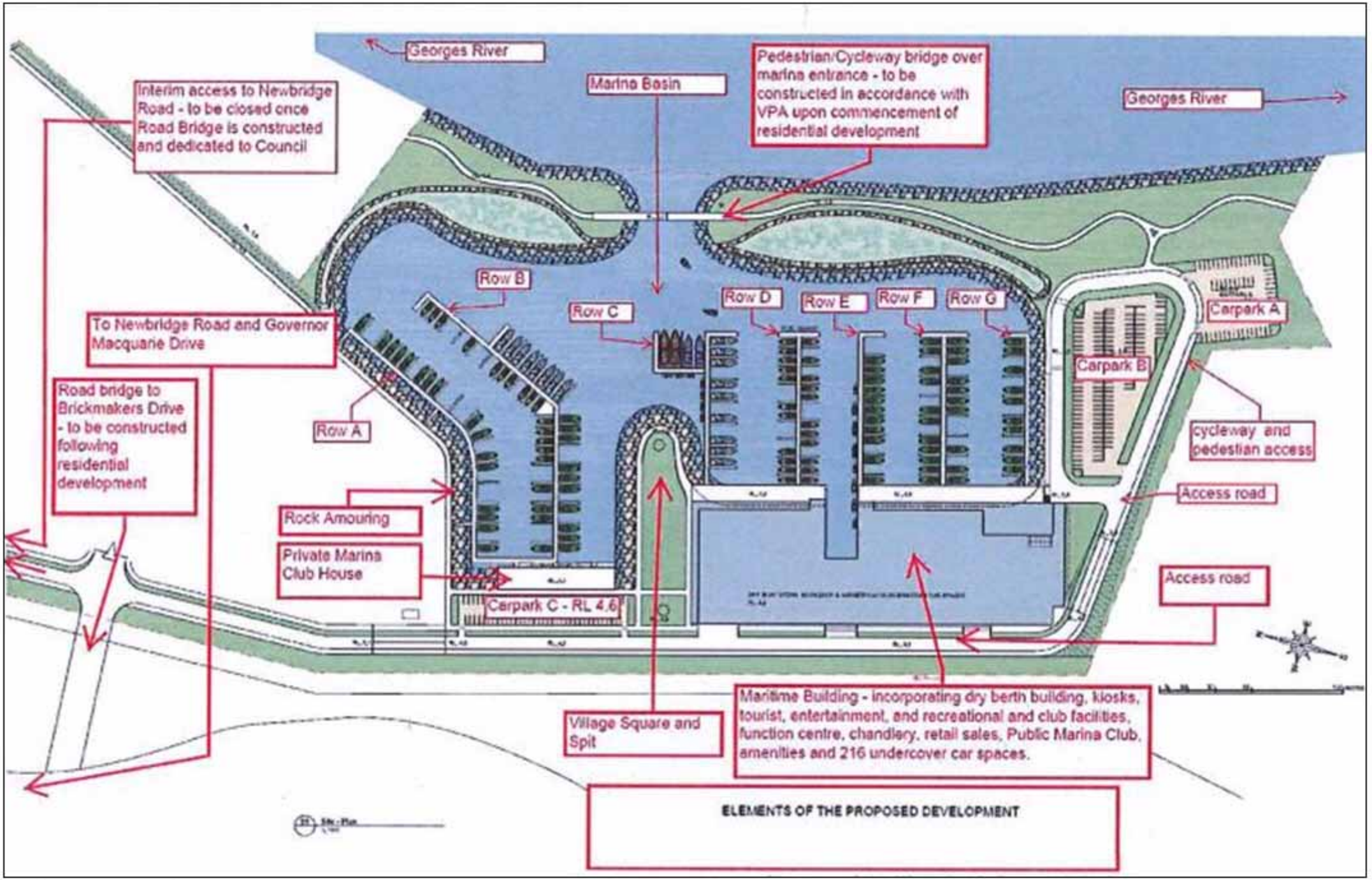


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January 2013

Georges Cove
Flood Impact Assessment

Figure 1-1
Subject Site


Georges River
Marina Basin
Pedestrian/Cycleway bridge over marina entrance - to be constructed in accordance with VPA upon commencement of residential development
Georges River
Interim access to Newbridge Road - to be closed once Road Bridge is constructed and dedicated to Council
Row B
Row C
Row D
Row E
Row F
Row G
Carpark A
Carpark B
To Newbridge Road and Governor Macquarie Drive
Road bridge to Brickmakers Drive - to be constructed following residential development
Row A
cycleway and pedestian access
Access road
Rock Amouring
Private Marina Club House
Carpark C - RL 4.6
Access road
Village Square and Spit
Maritime Building - incorporating dry berth building, kiosks, tourist, entertainment, and recreational and club facilities, function centre, chandlery, retail sales, Public Marina Club, amenities and 216 undercover car spaces.
ELEMENTS OF THE PROPOSED DEVELOPMENT

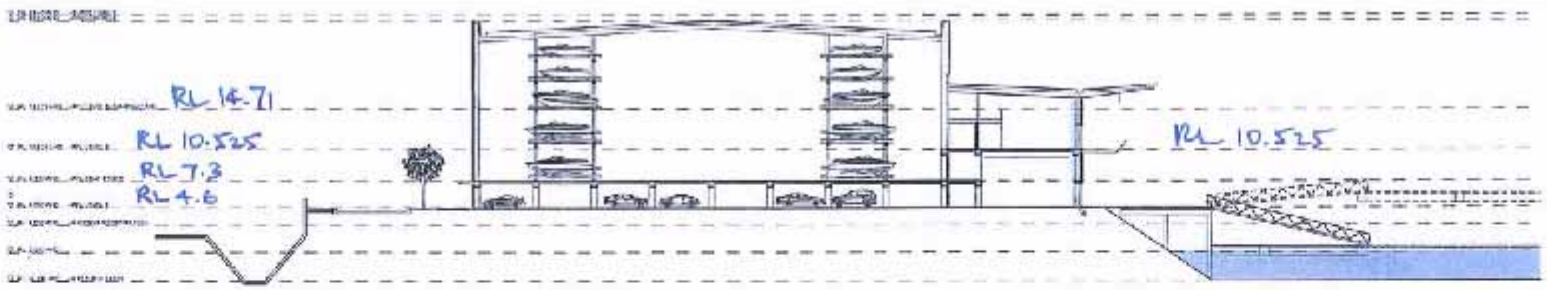
According to Flood Consultant, Worley Parsons:
the 1 in 100 year floor level is 5.6 AHD
the flood planning level is 6.1 AHD.
all habitable development should be at or above this level.

We have therefore assumed the following levels:

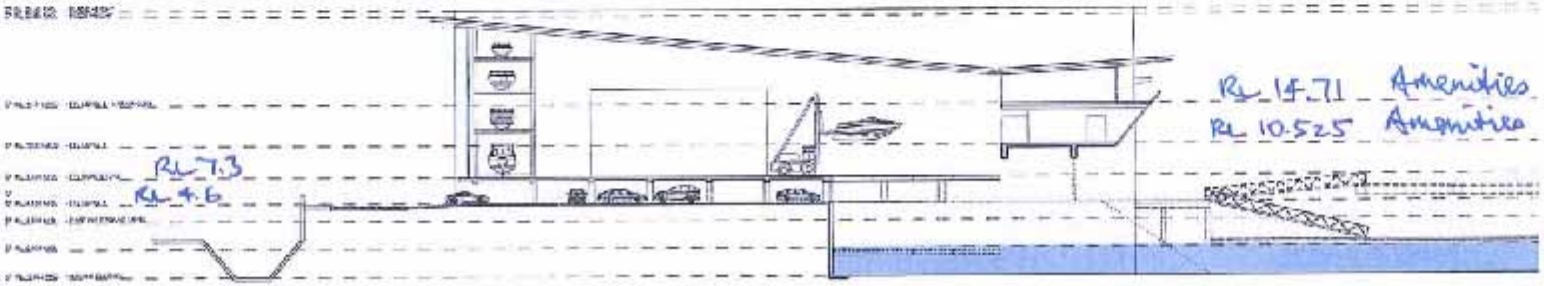
6.10	Commercial spaces, dry berth stores and the hardstand
4.60	Dry store carpark and Northern car park
2.8	Southern car park
0.98	Higher high water springs

(All levels are AHD)

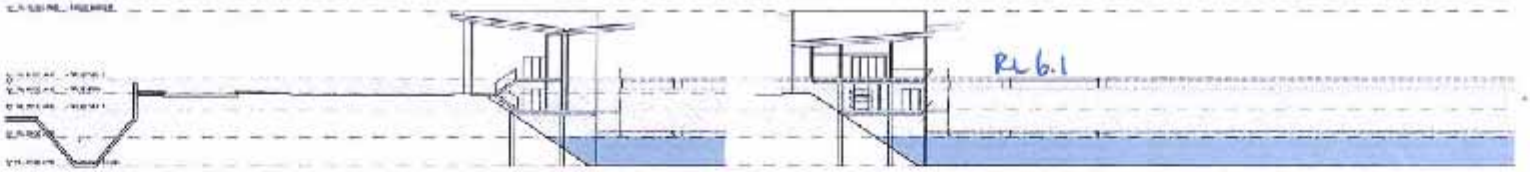




Section - Dry Berth Store



Section - Dry Berth Store



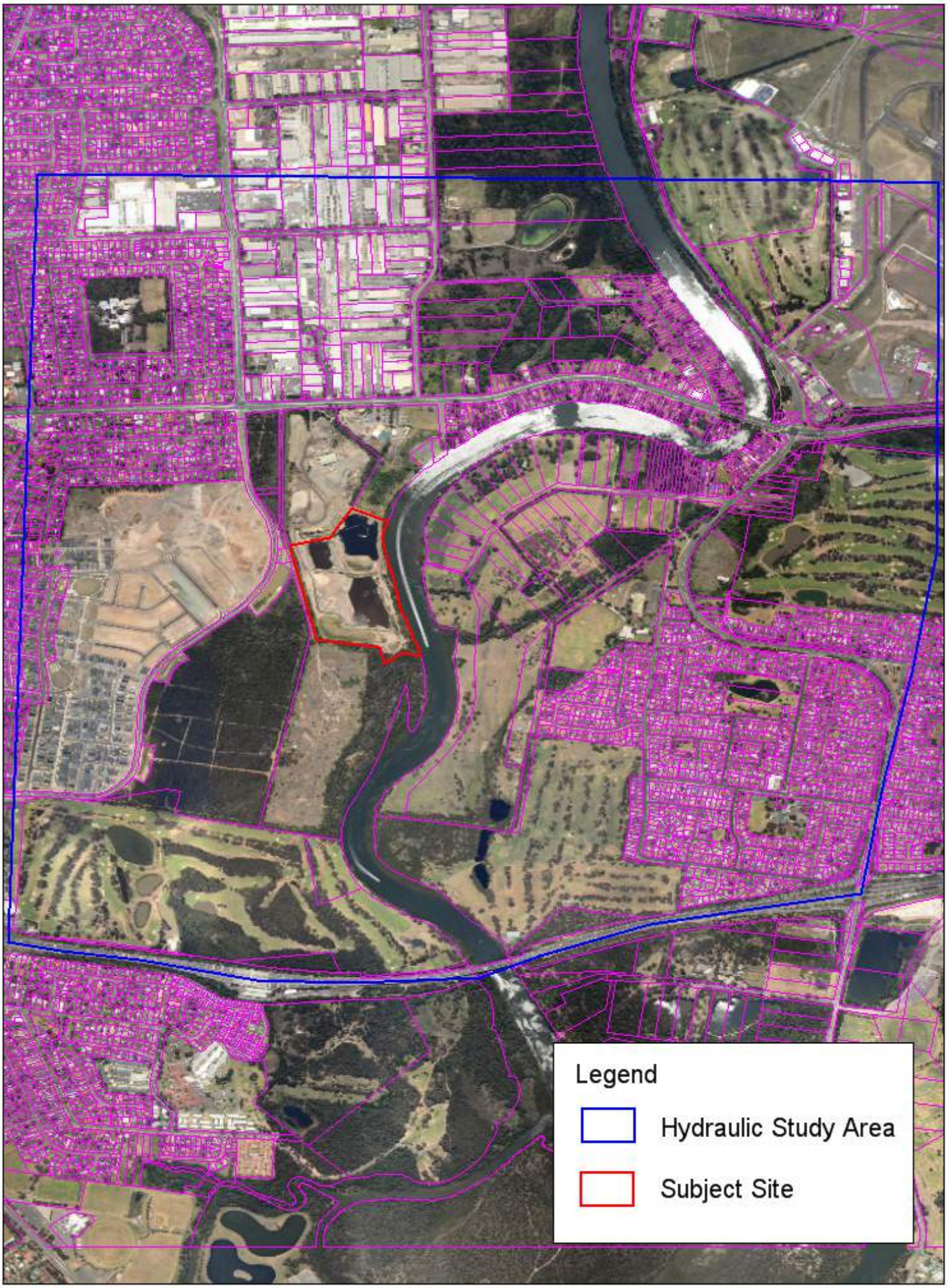
Sections - Private Marina Clubhouse

Prepared by:
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Web: www.mfa.com.au

Issue:
TO CLIENT
Date:
11th November 2010

Project:
GEORGES COVE MARINA
NEWBRIDGE ROAD, MOOREBANK
Client:
BENEDICT INDUSTRIES PTY LTD

georges cove marina

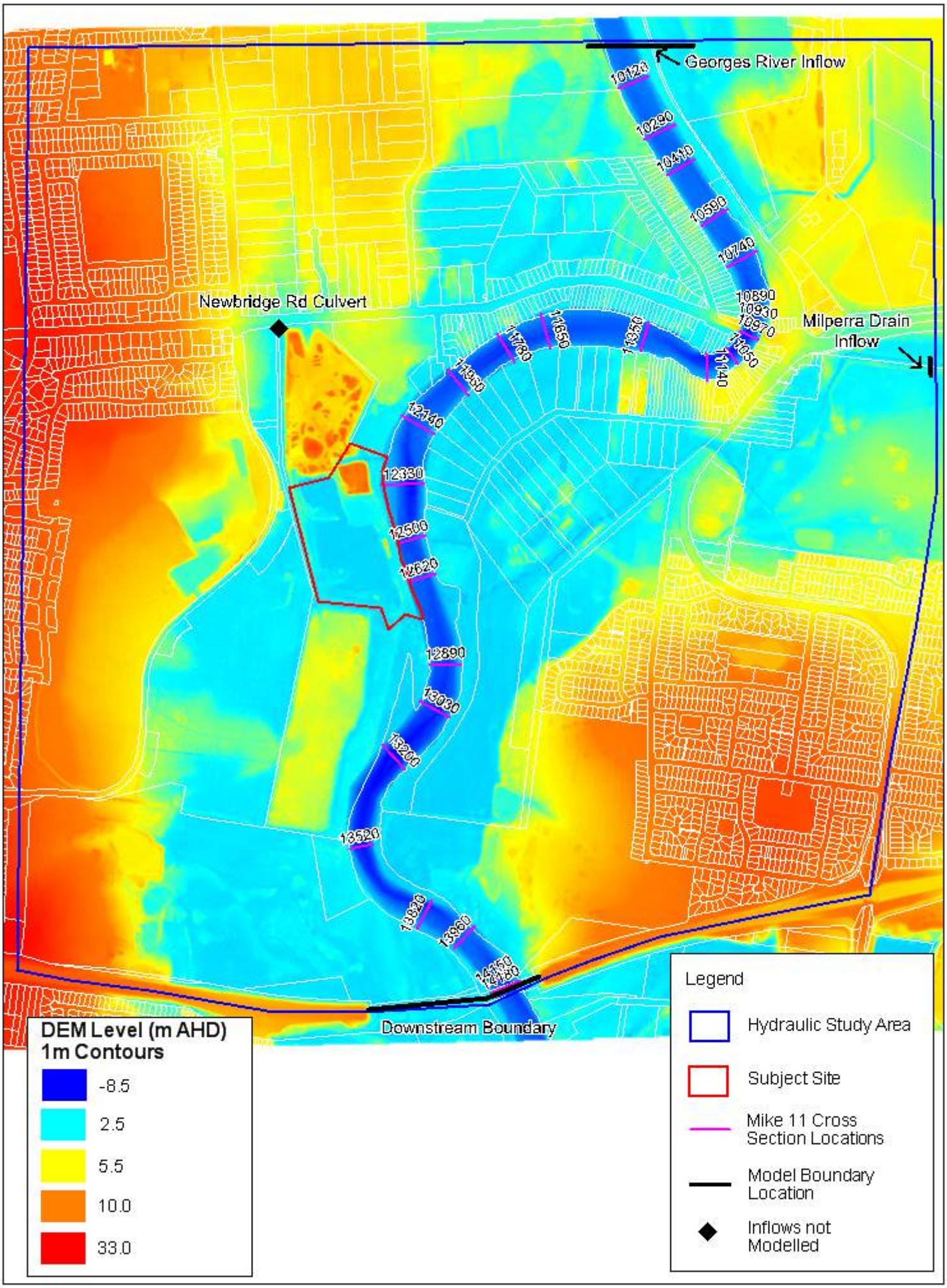


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Georges Cove
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Figure 2-1
Hydraulic Study Area

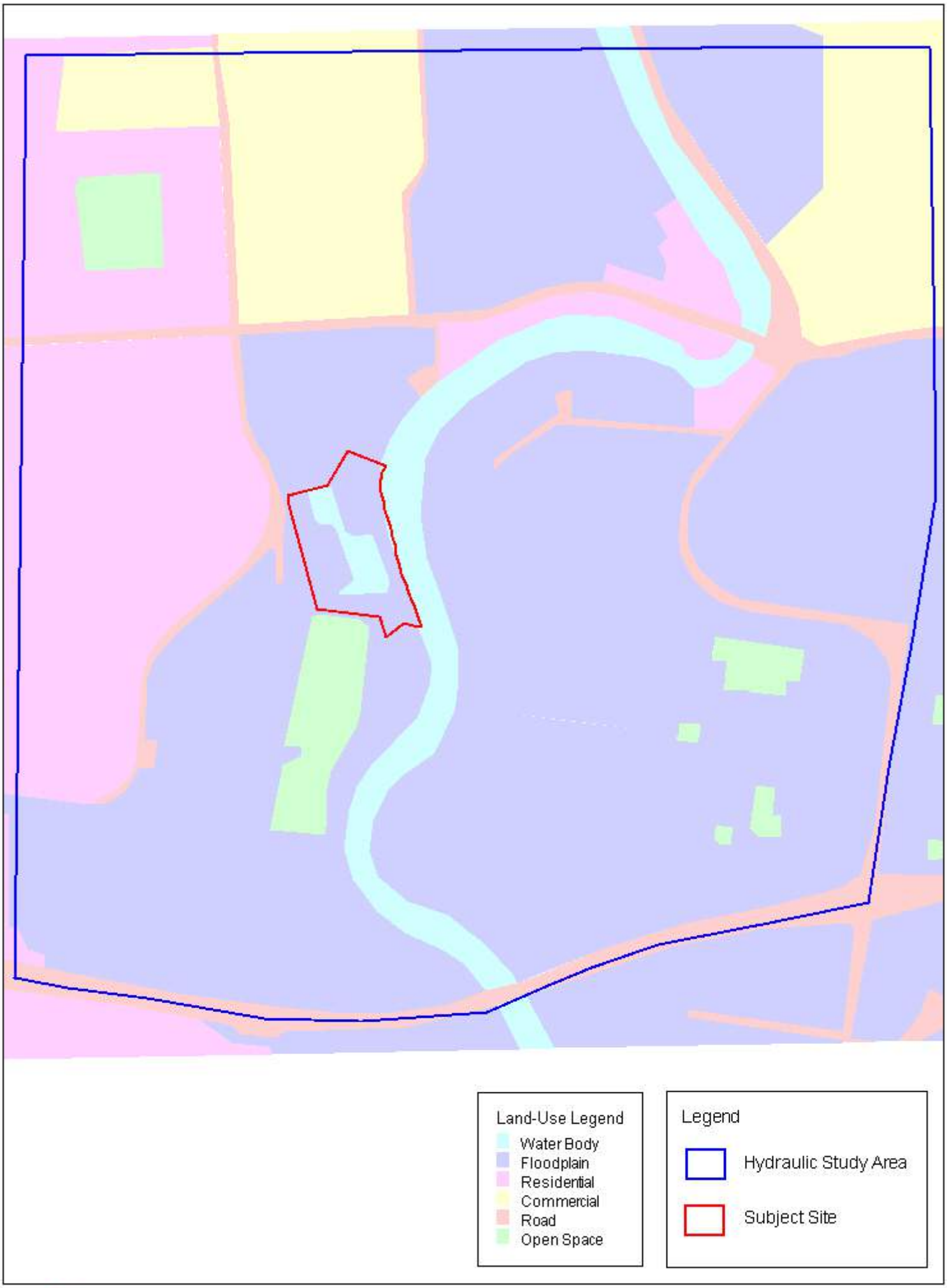


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Figure 2-2
Base Model Set-up

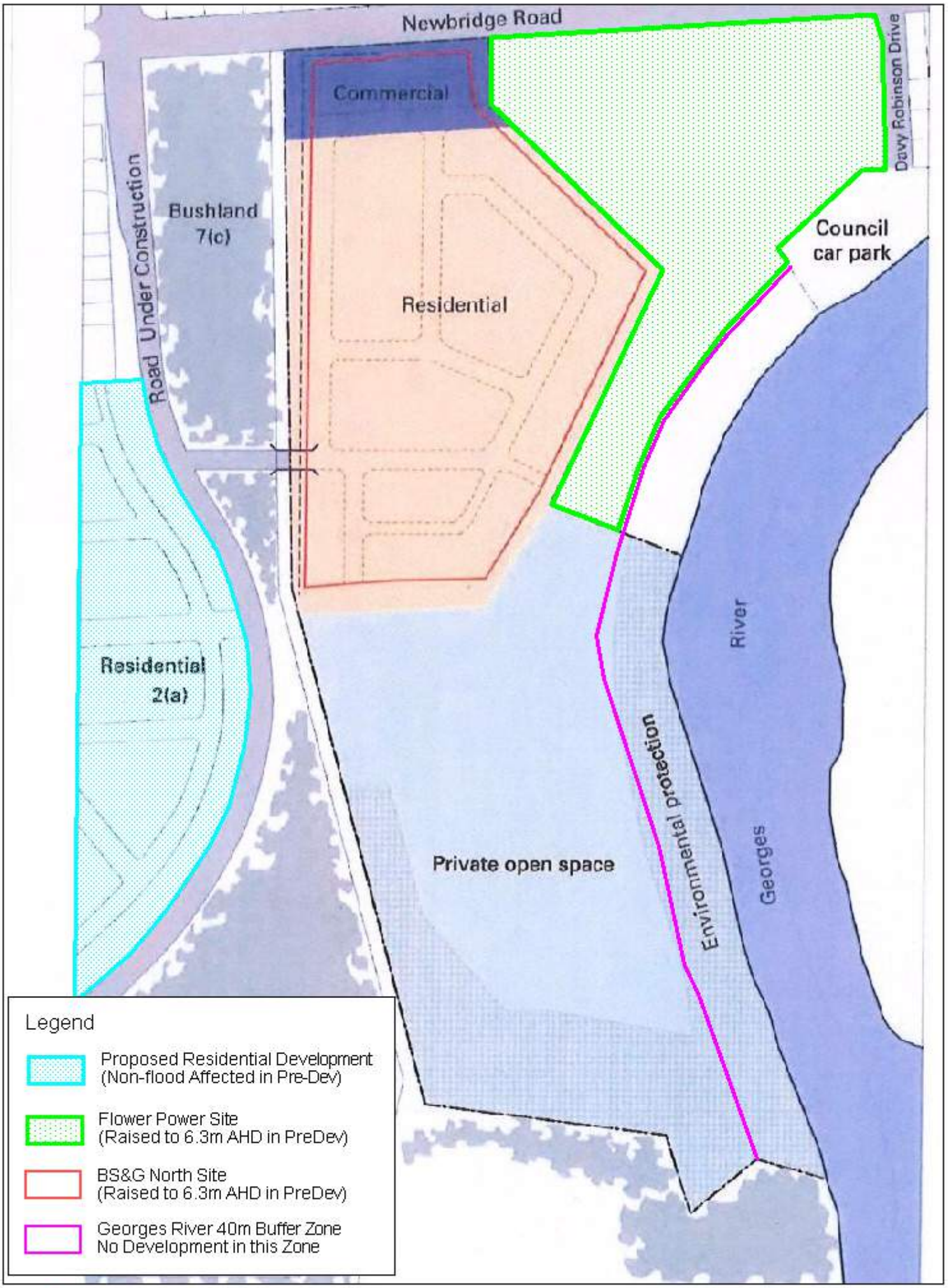


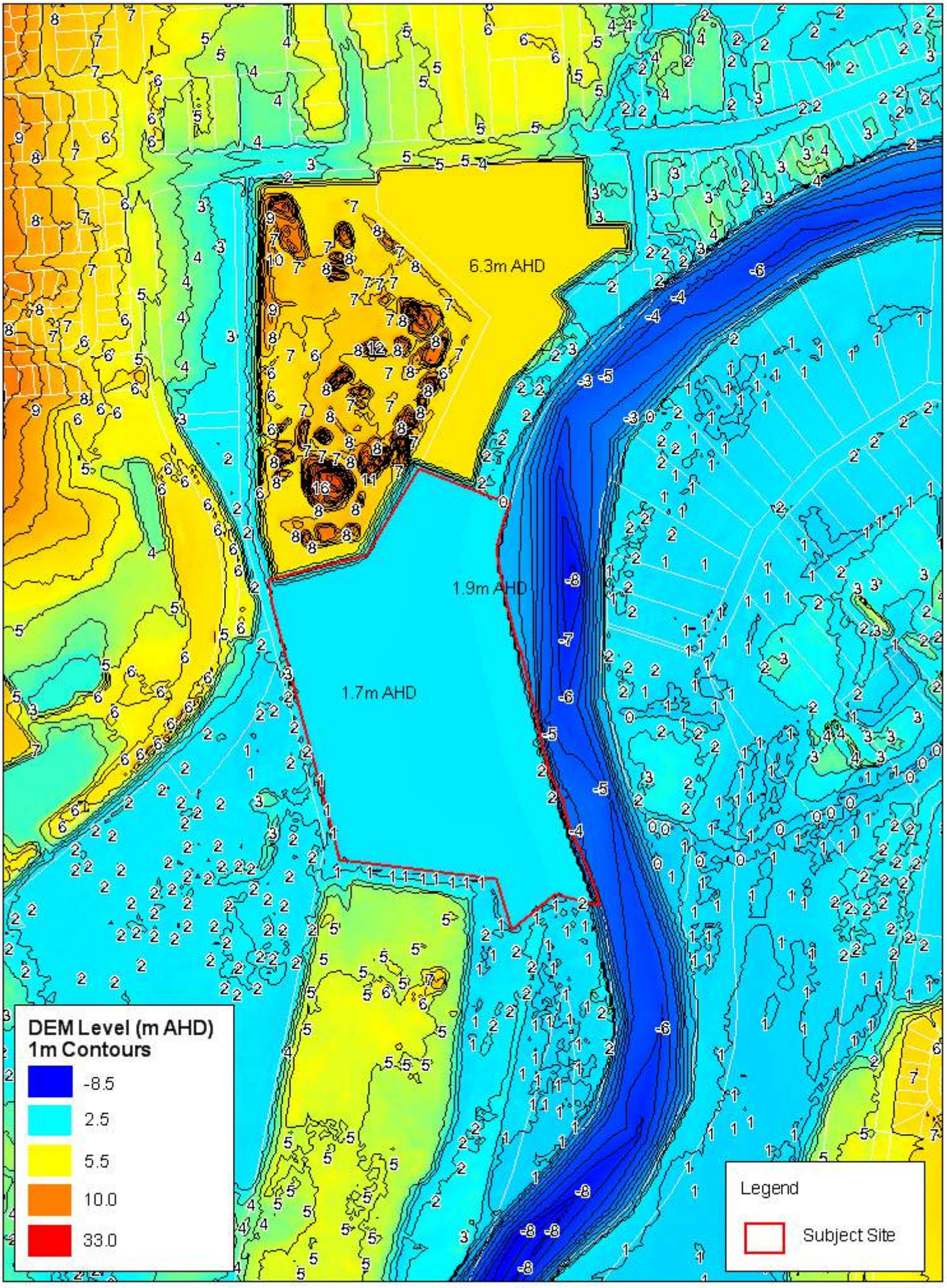
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Georges Cove
Flood Impact Assessment

Figure 2-3
Land-Use


Newbridge Road
Commercial
Davy Robinson Drive
Bushland
7(c)
Road Under Construction
Residential
Council
car park
Residential
2(a)
River
Environmental protection
Georges
Private open space
Legend
Proposed Residential Development
(Non-flood Affected in Pre-Dev)
Flower Power Site
(Raised to 6.3m AHD in PreDev)
BS&G North Site
(Raised to 6.3m AHD in PreDev)
Georges River 40m Buffer Zone
No Development in this Zone

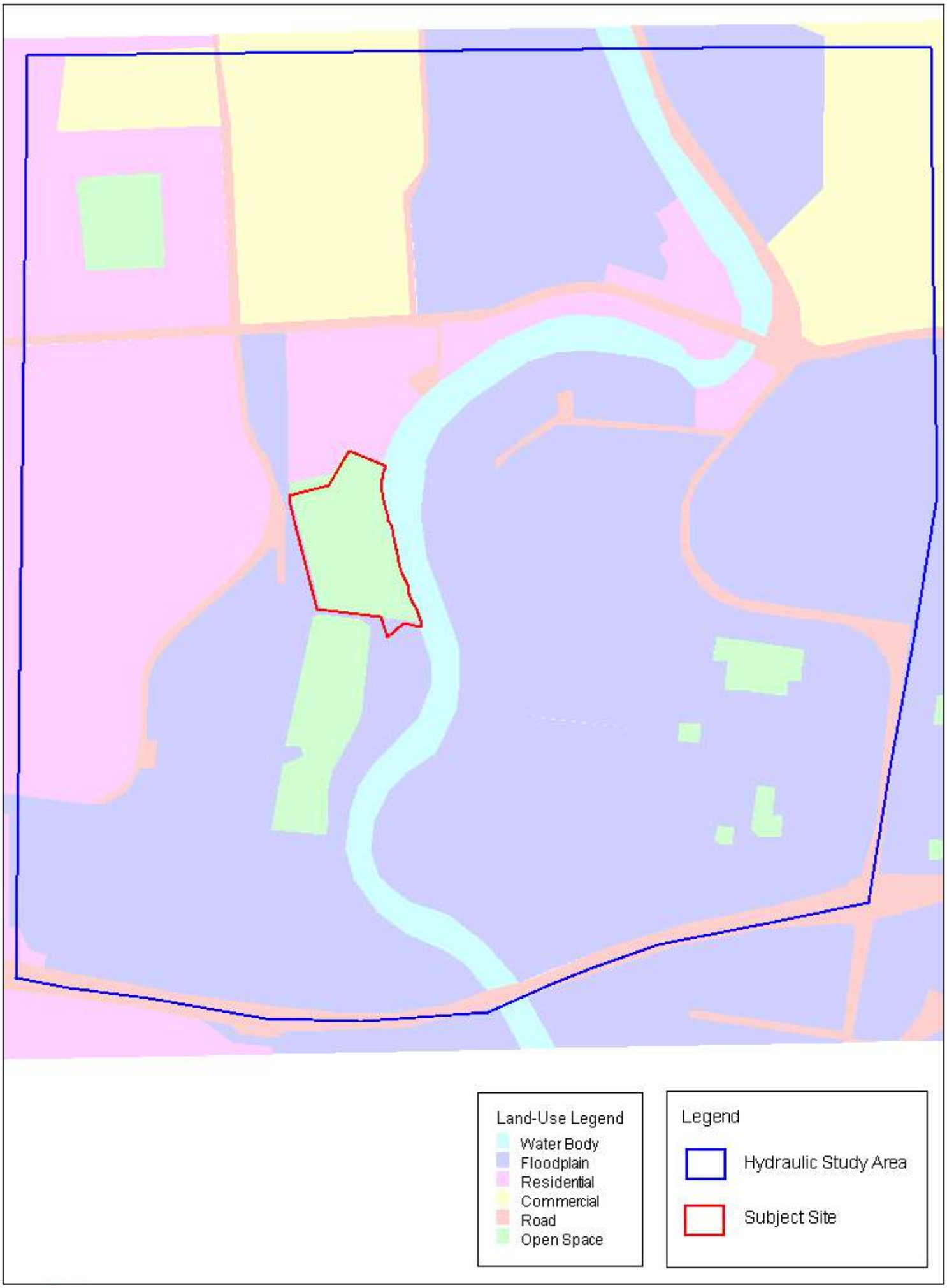


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Georges Cove
Flood Impact Assessment

Figure 2-5
Benchmark (Pre-Development) DEM

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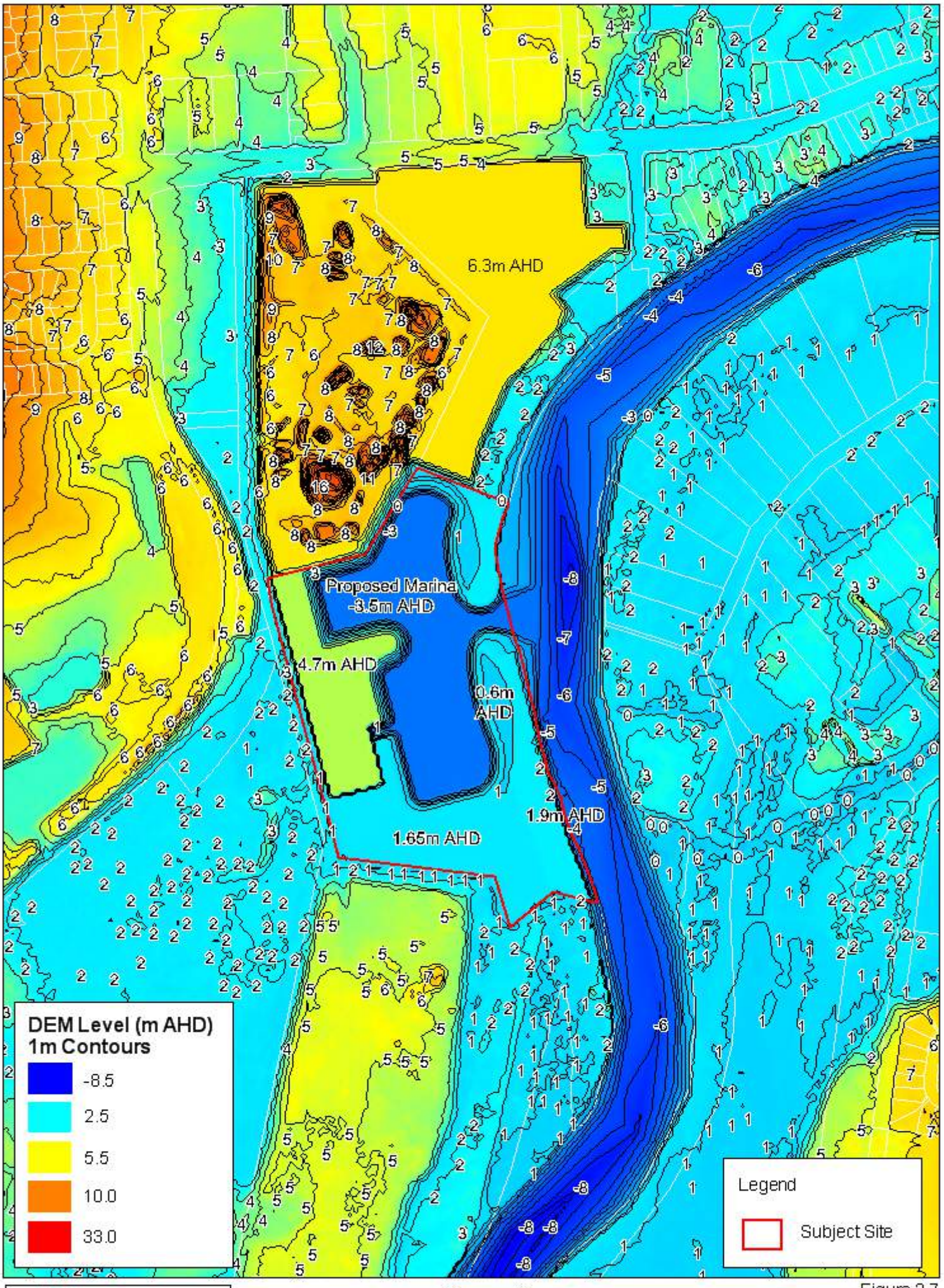


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Georges Cove
Flood Impact Assessment

Figure 2-6
Land-Use
Pre-Development

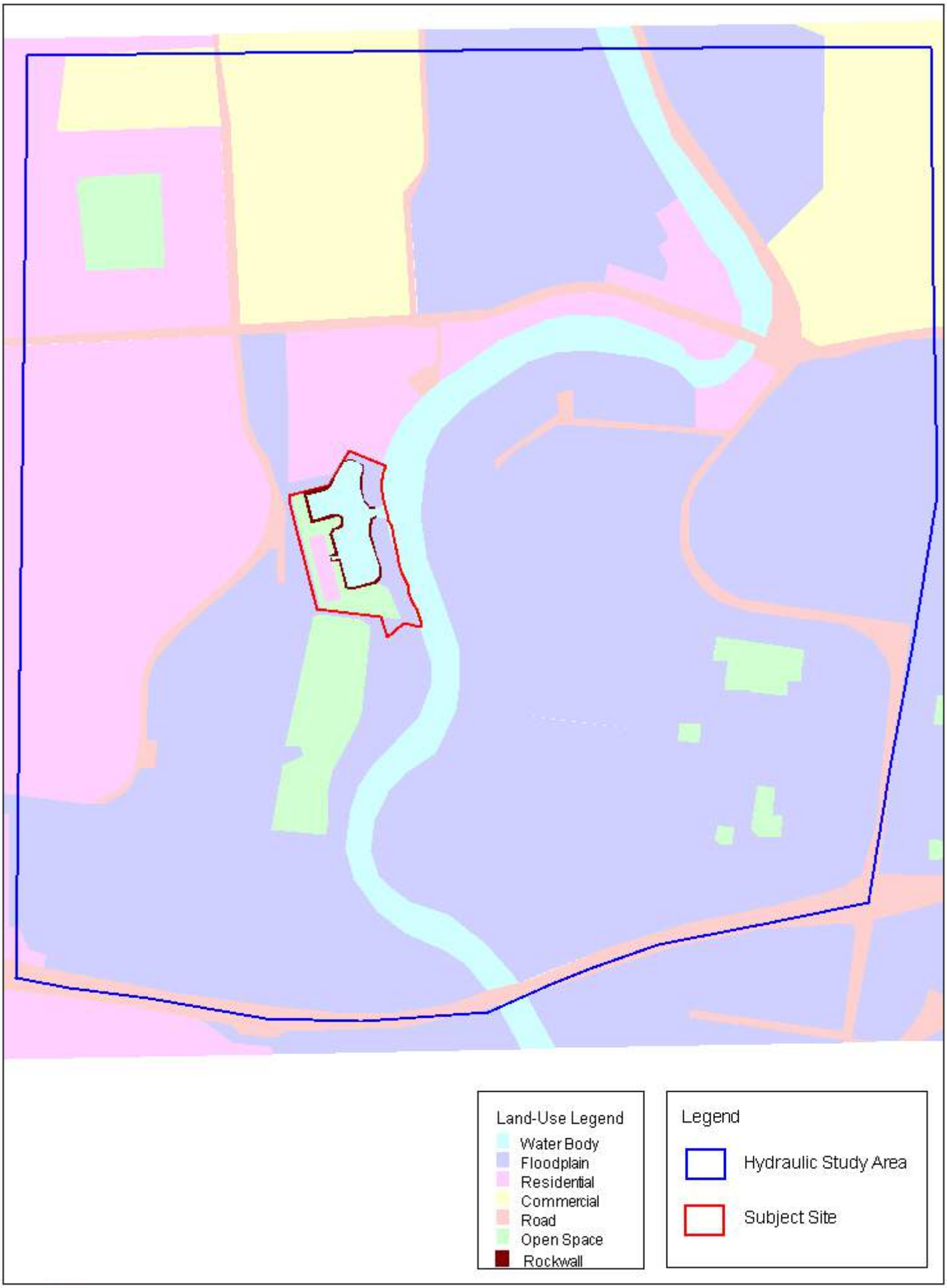


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Georges Cove
Flood Impact Assessment

Figure 2-7
DEM
Post-Development

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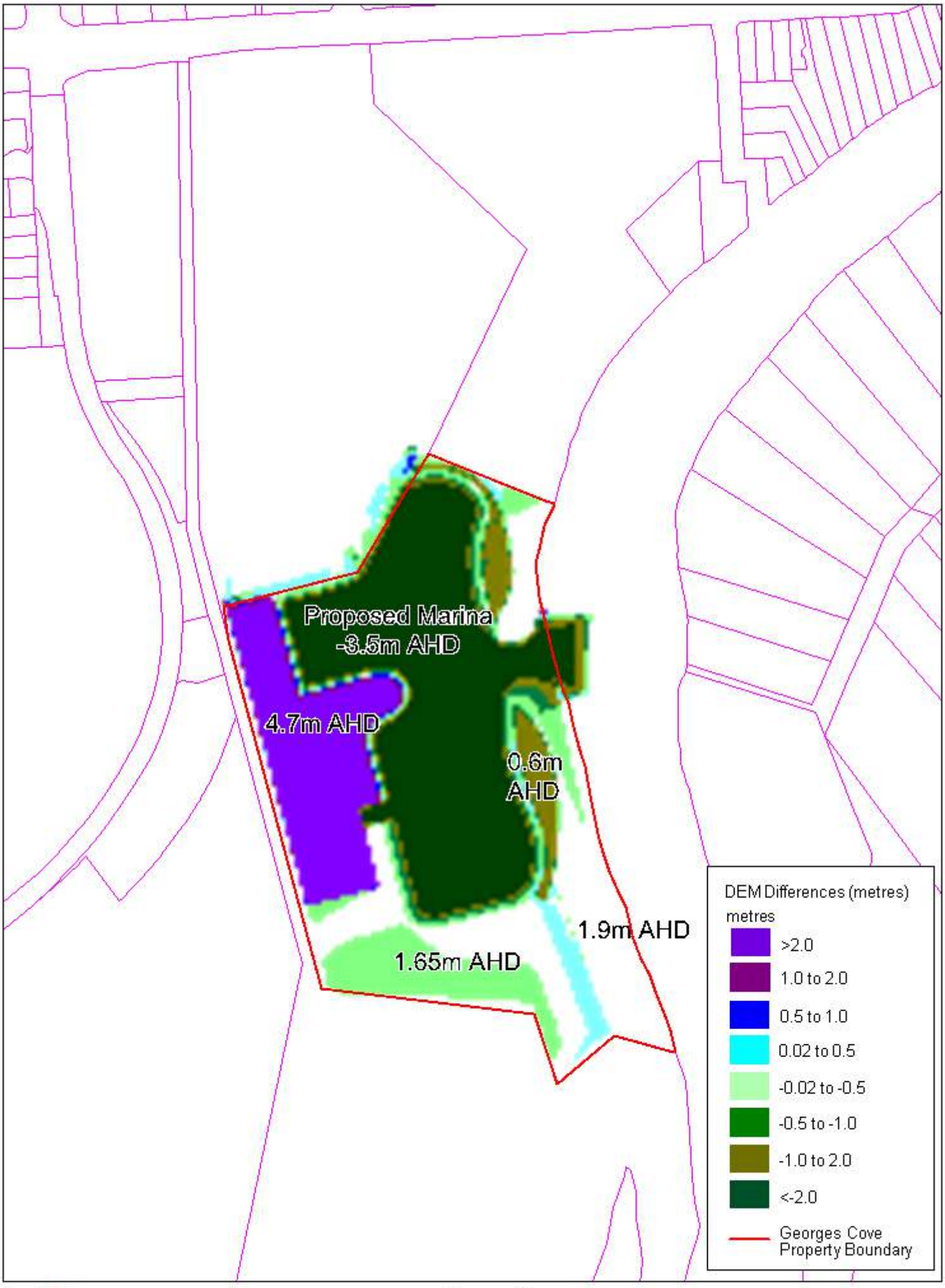


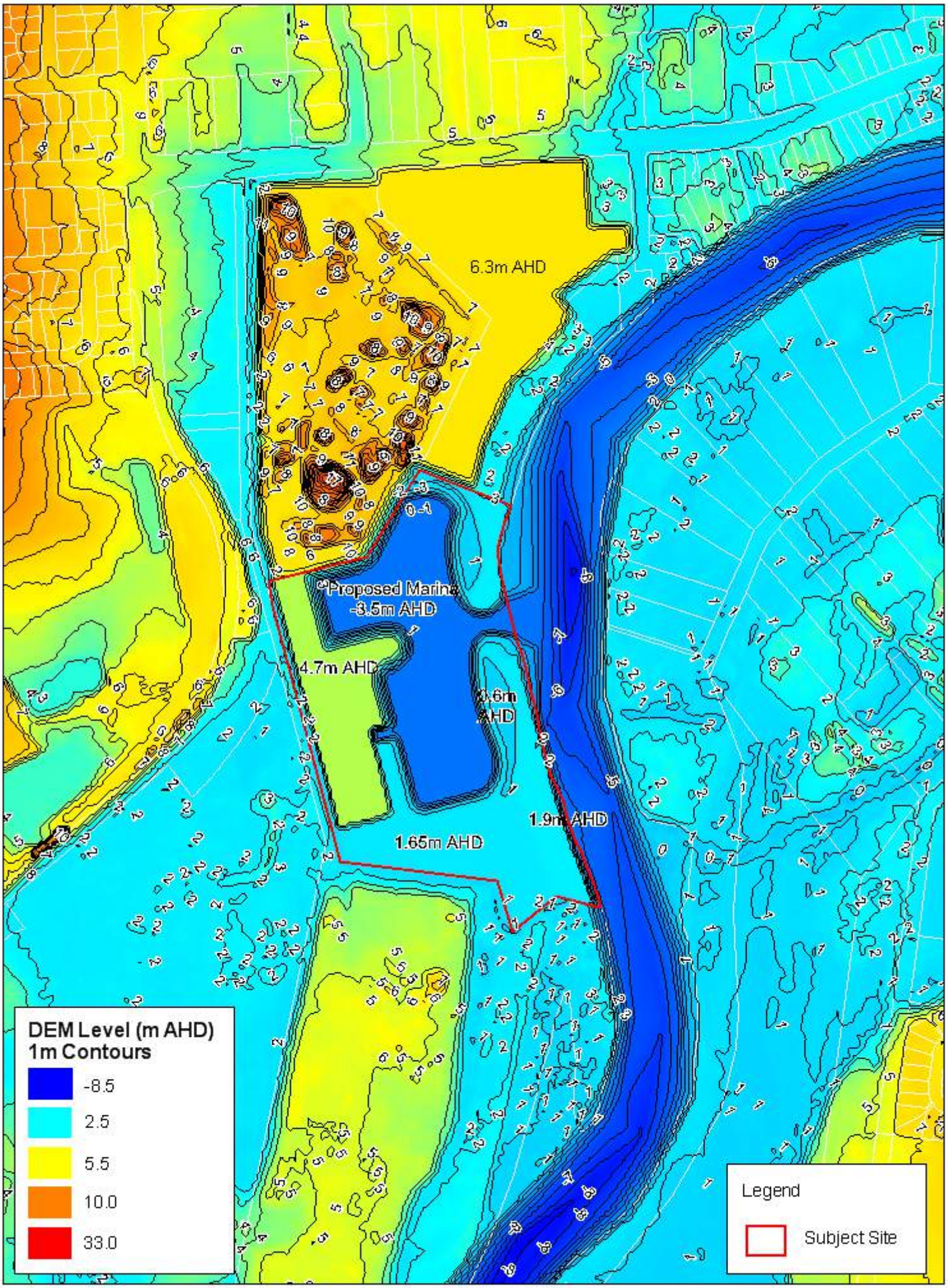
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Georges Cove
Flood Impact Assessment

Figure 2-8
Land-Use
Post-Development


Proposed Marina
-3.5m AHD
4.7m AHD
0.6m
AHD
1.9m AHD
1.65m AHD
DEM Differences (metres)
metres
>2.0
1.0 to 2.0
0.5 to 1.0
0.02 to 0.5
-0.02 to -0.5
-0.5 to -1.0
-1.0 to 2.0
<-2.0
Georges Cove
Property Boundary

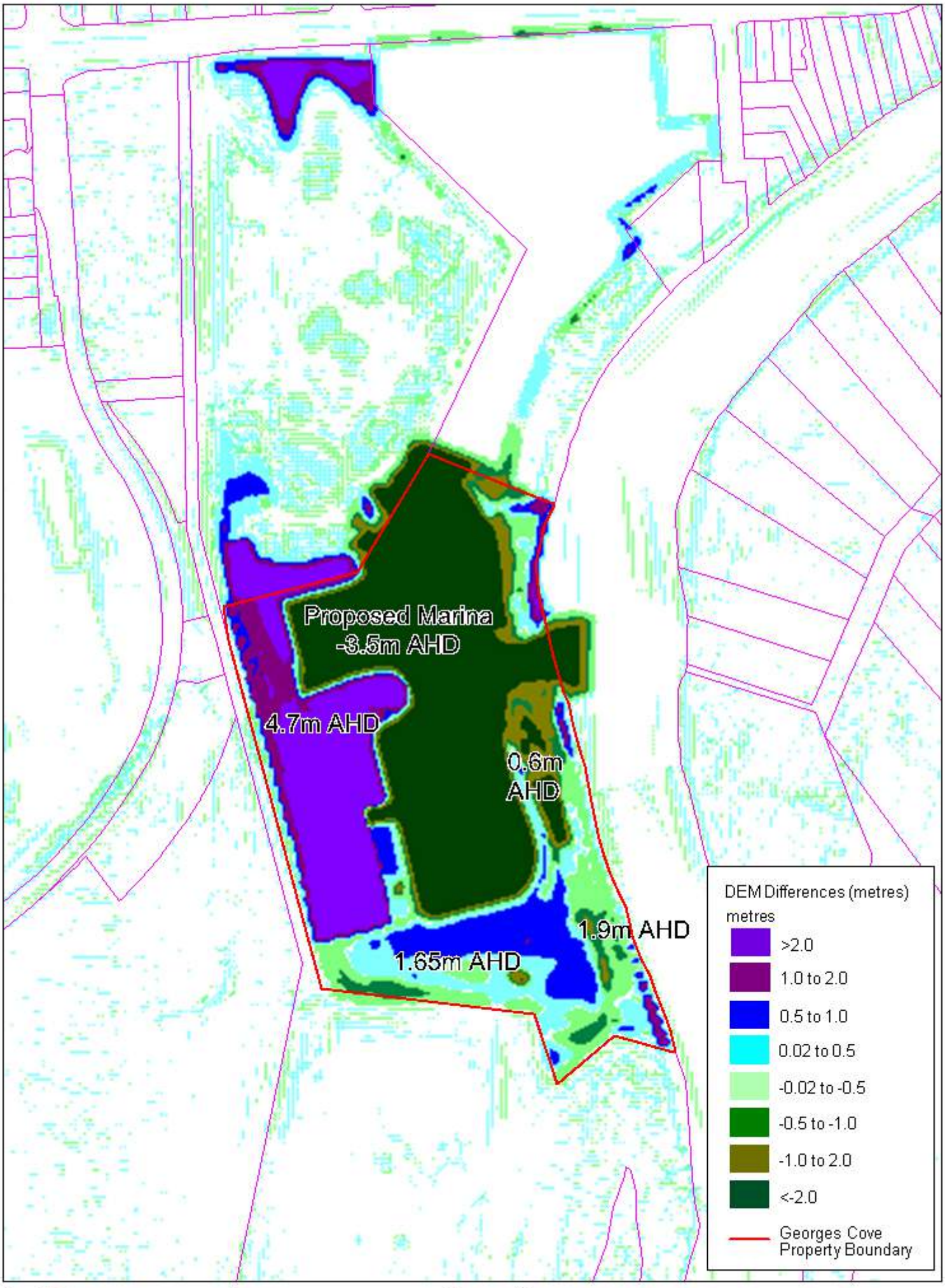


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Georges Cove
Flood Impact Assessment

Figure 2-10
DEM
Post-Development-Blockage

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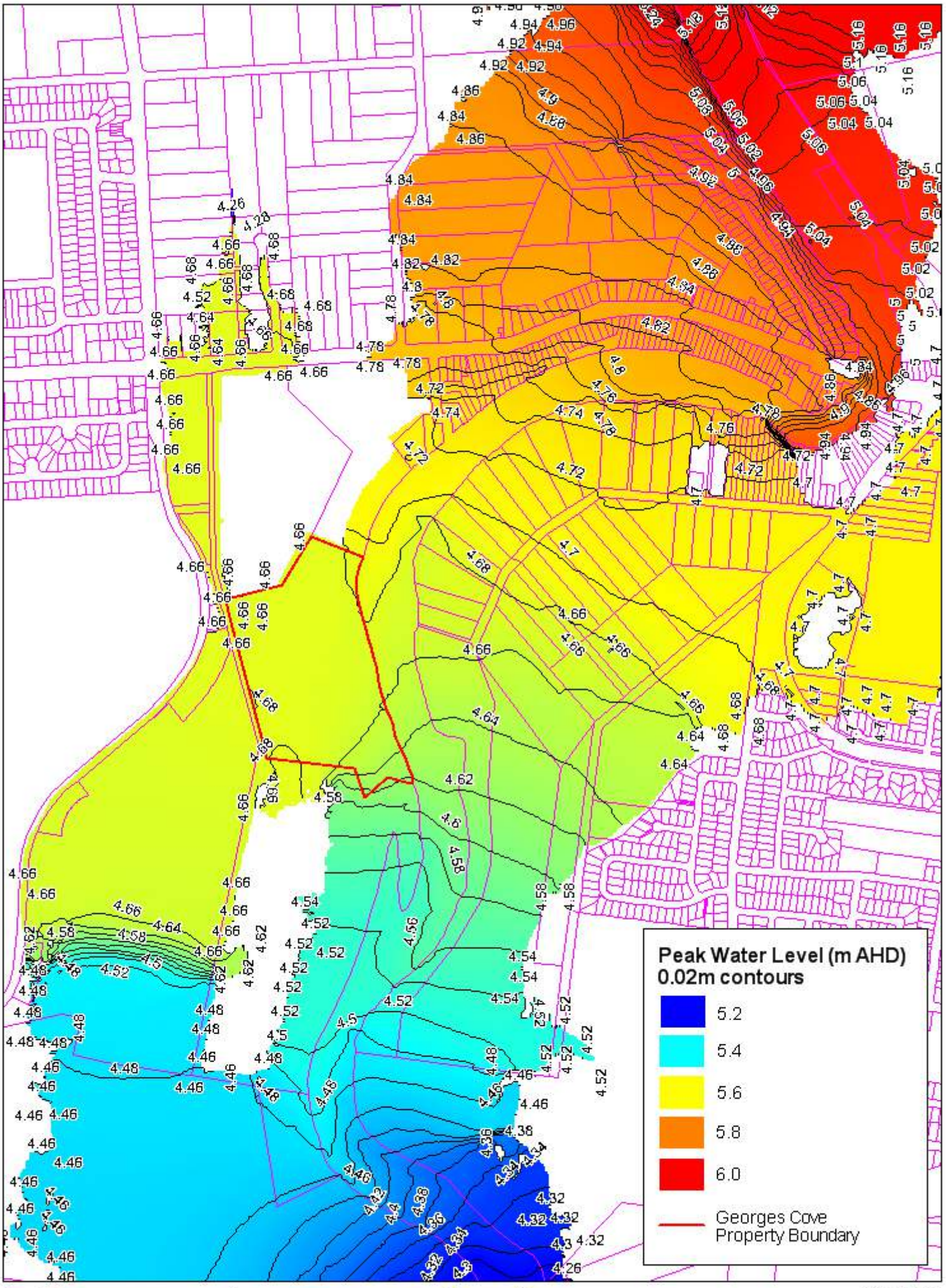


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Georges Cove
Flood Impact Assessment

Figure 2-11
DEM Difference
Post-development-Blockage Less Predevelopment

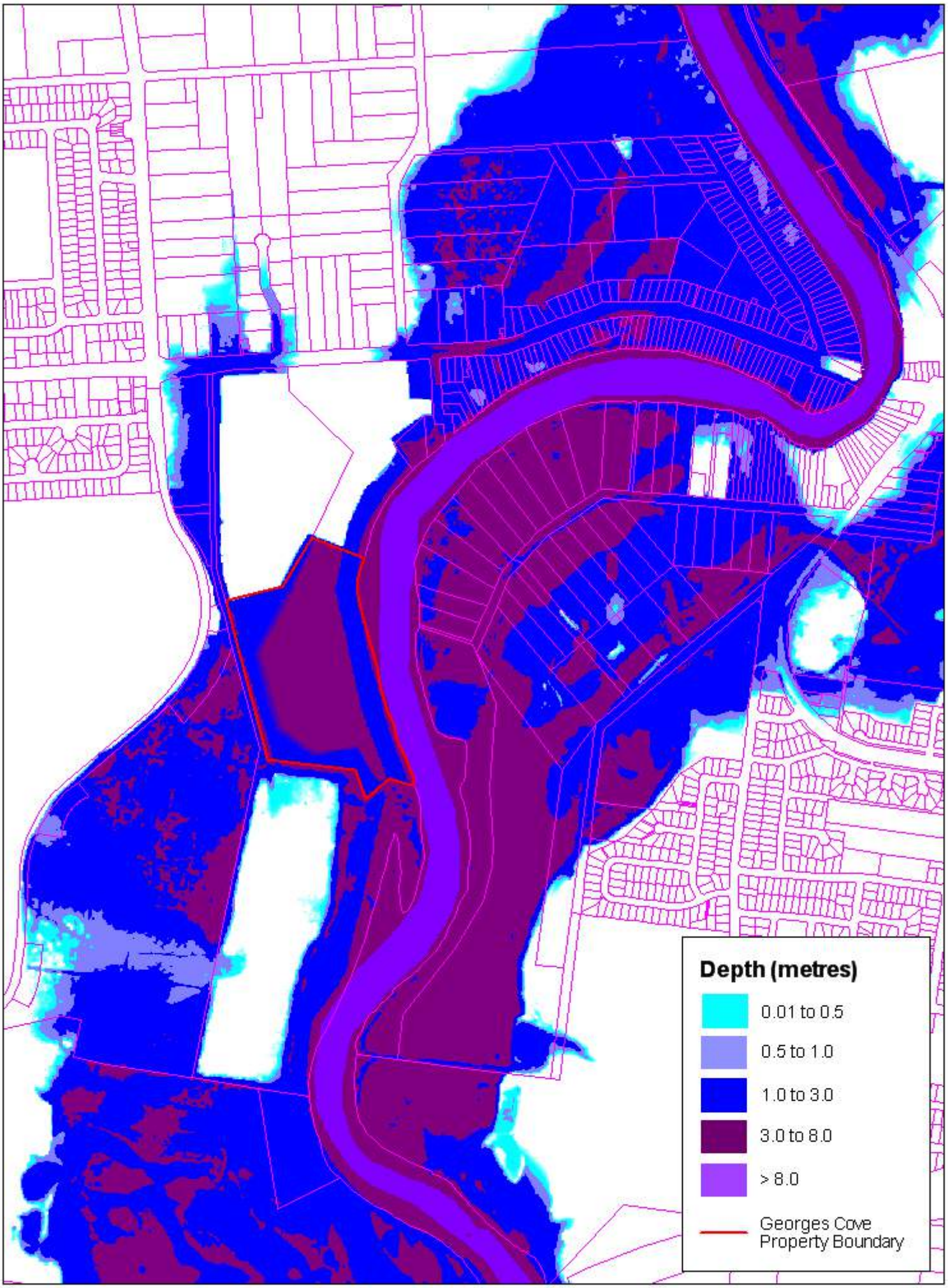


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Georges Cove
Flood Impact Assessment

Figure 3-1
20 year ARI
Peak Water Level
Pre-Development

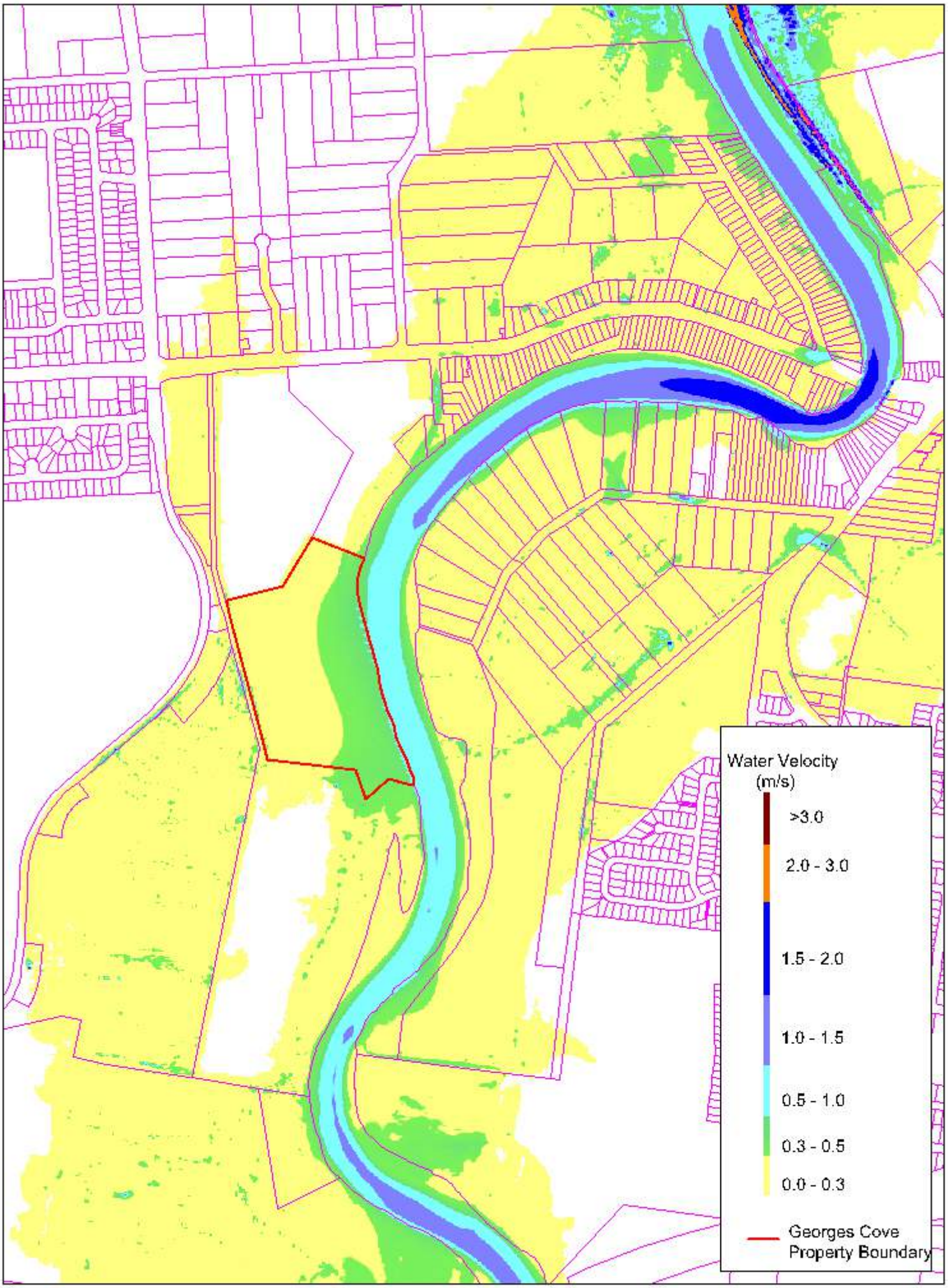


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Figure 3-2
20 year ARI
Peak Depth
Pre-Development

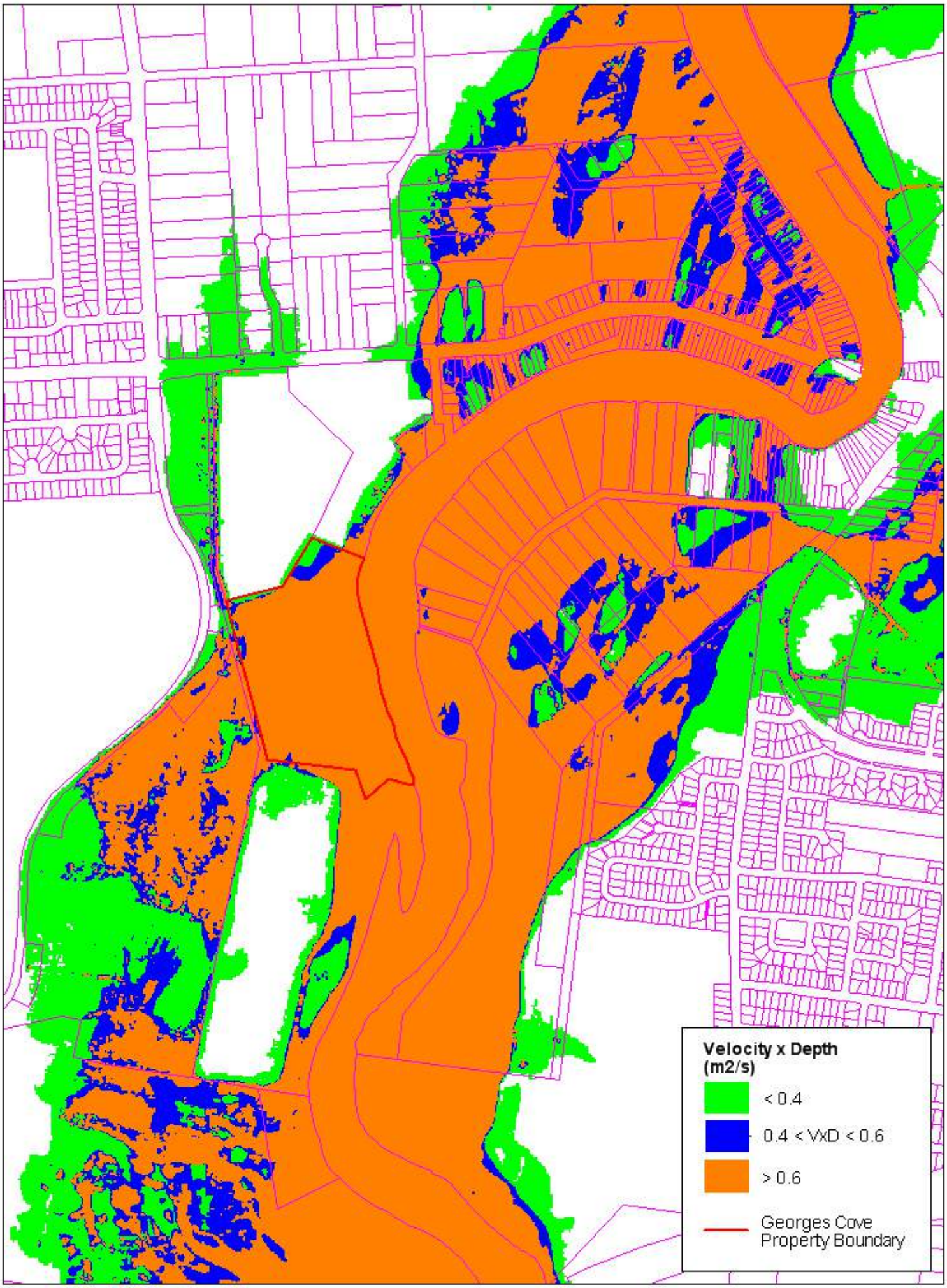


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Figure 3-3
20 year ARI
Peak Velocity
Pre-Development

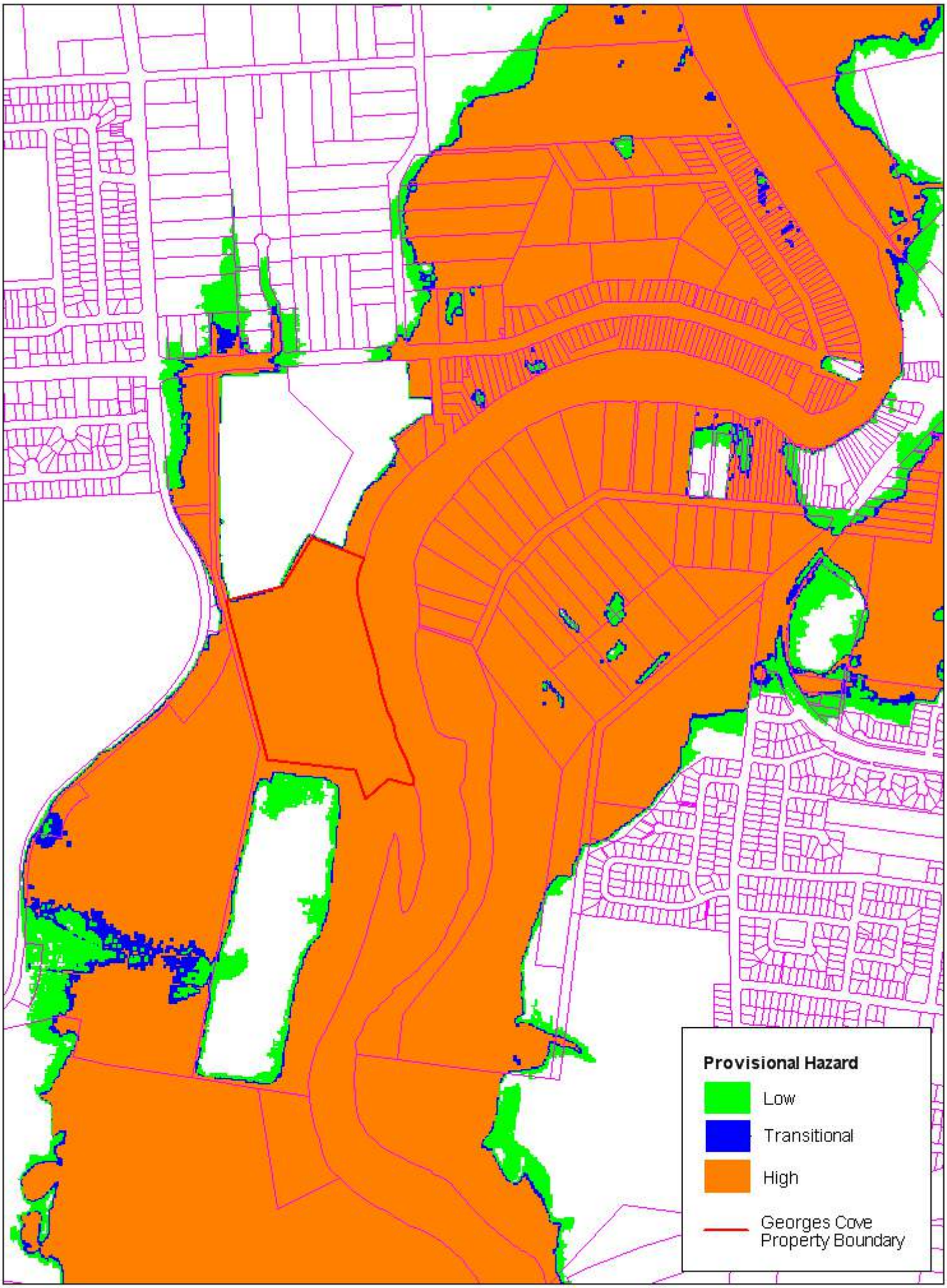


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Figure 3-4
20 year ARI
Peak Velocity x Depth
Pre-Development

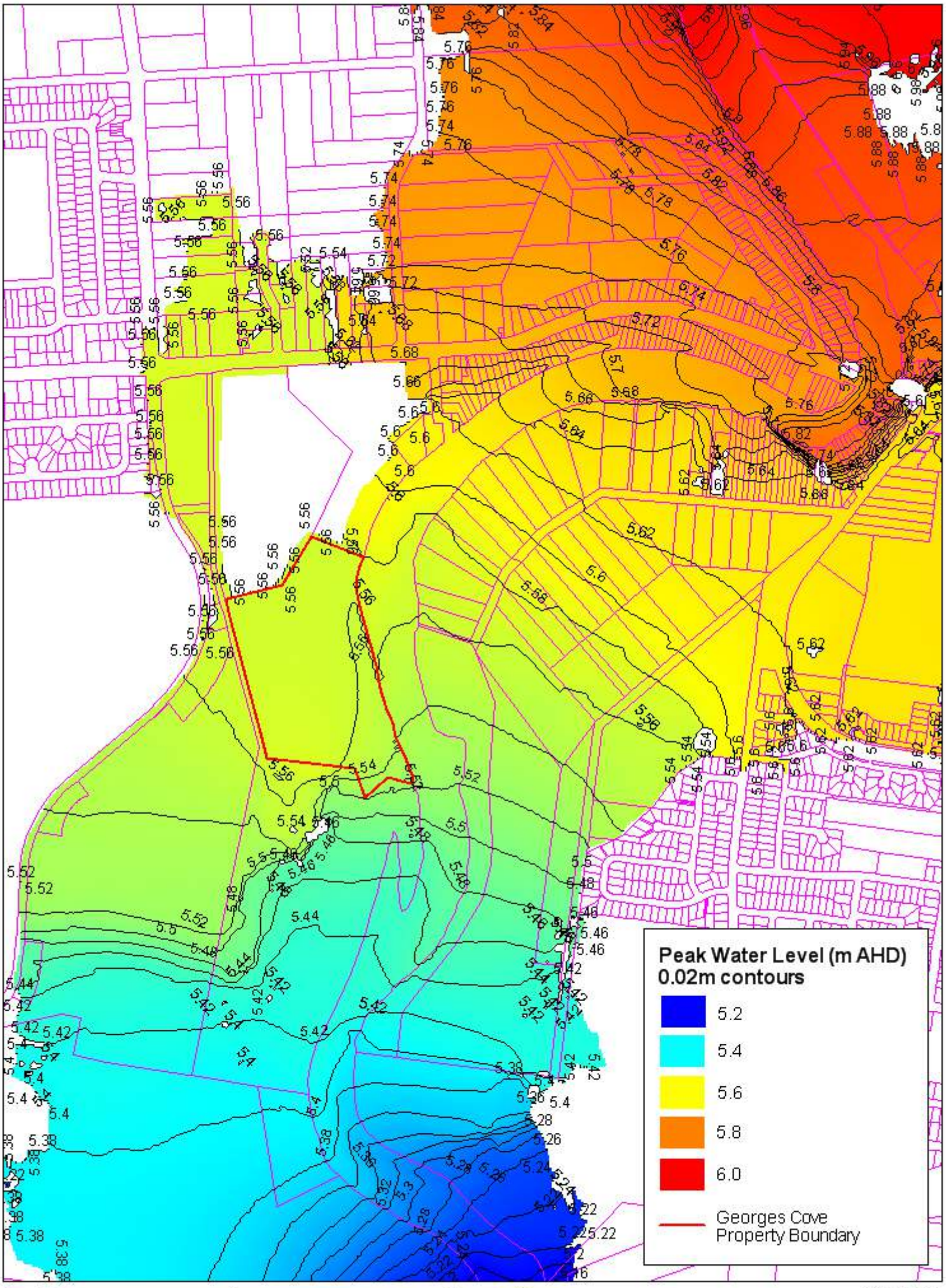


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Figure 3-5
20 year ARI
Provisional Hazard
Pre-Development

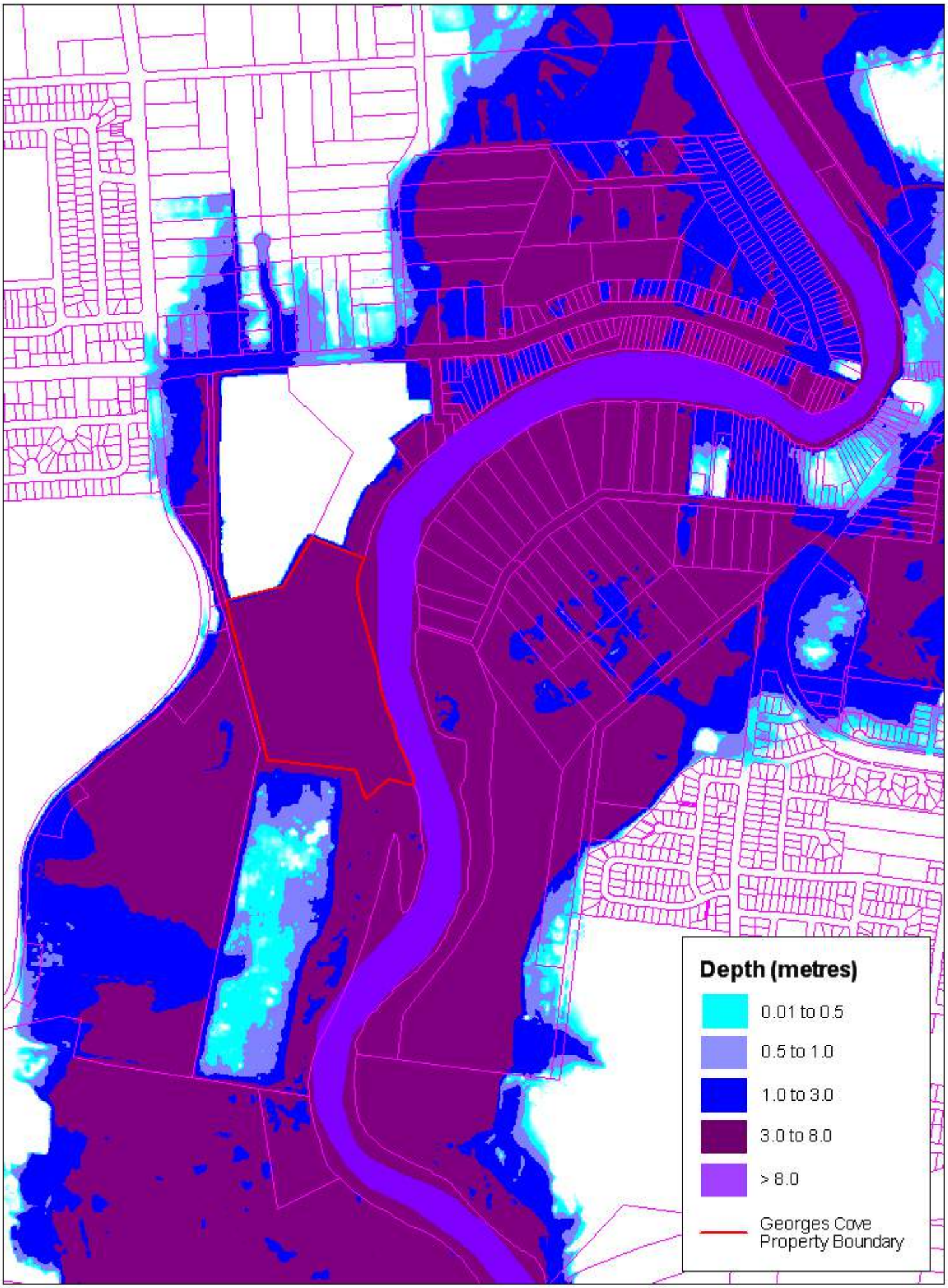


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Figure 3-6
100 year ARI
Peak Water Level
Pre-Development

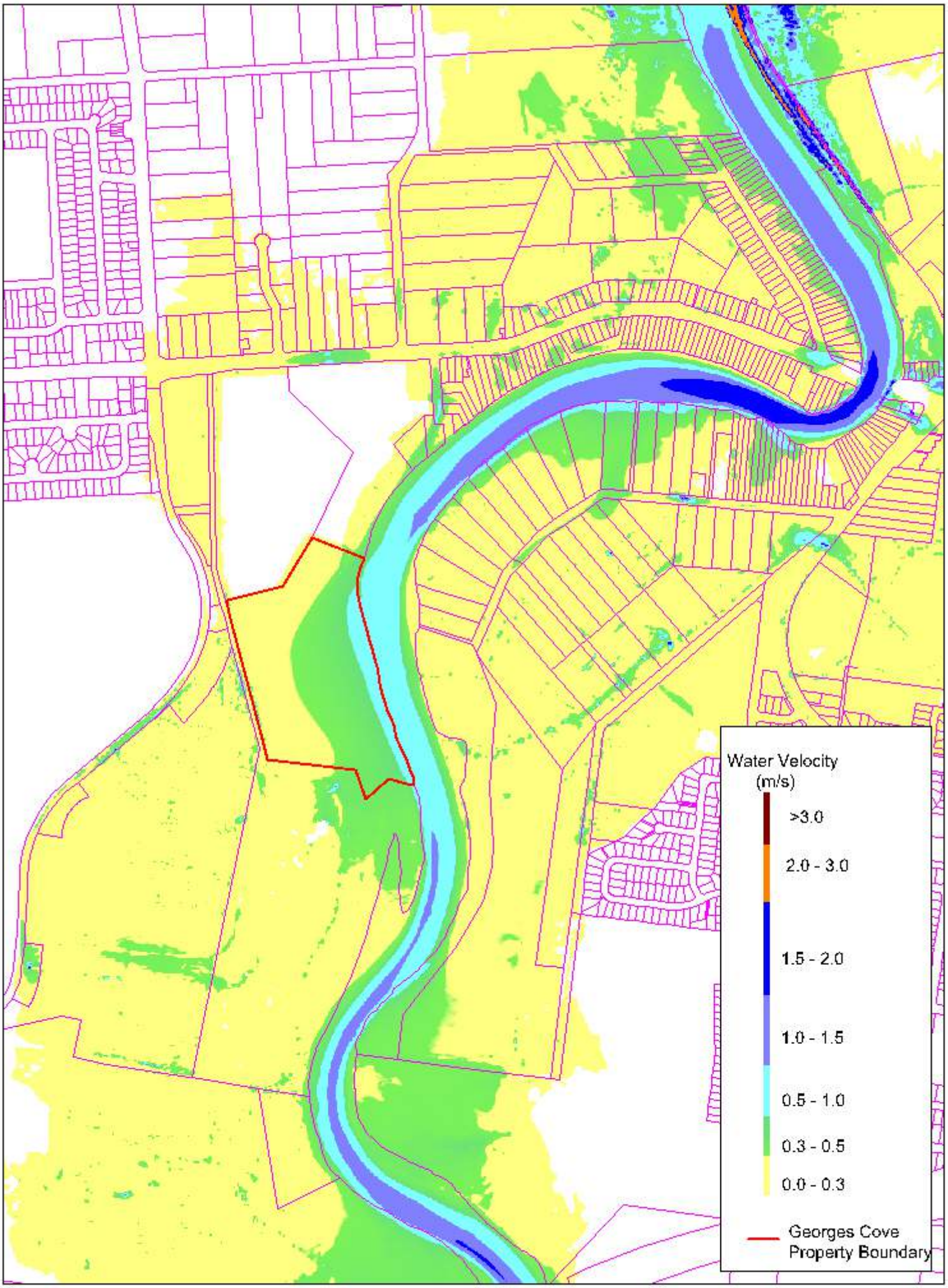


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Figure 3-7
100 year ARI
Peak Depth
Pre-Development

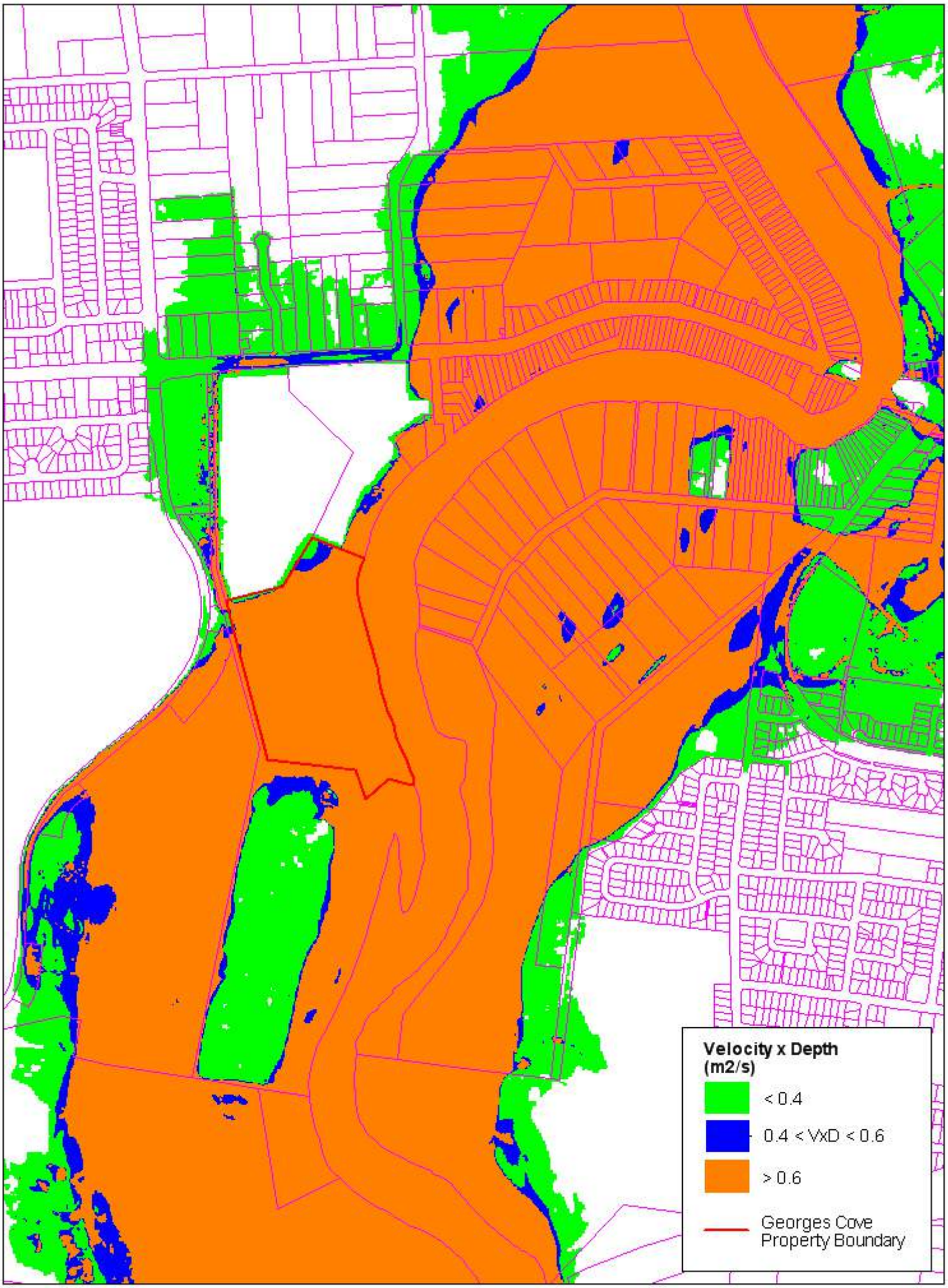


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Figure 3-8
100 year ARI
Peak Velocity
Pre-Development

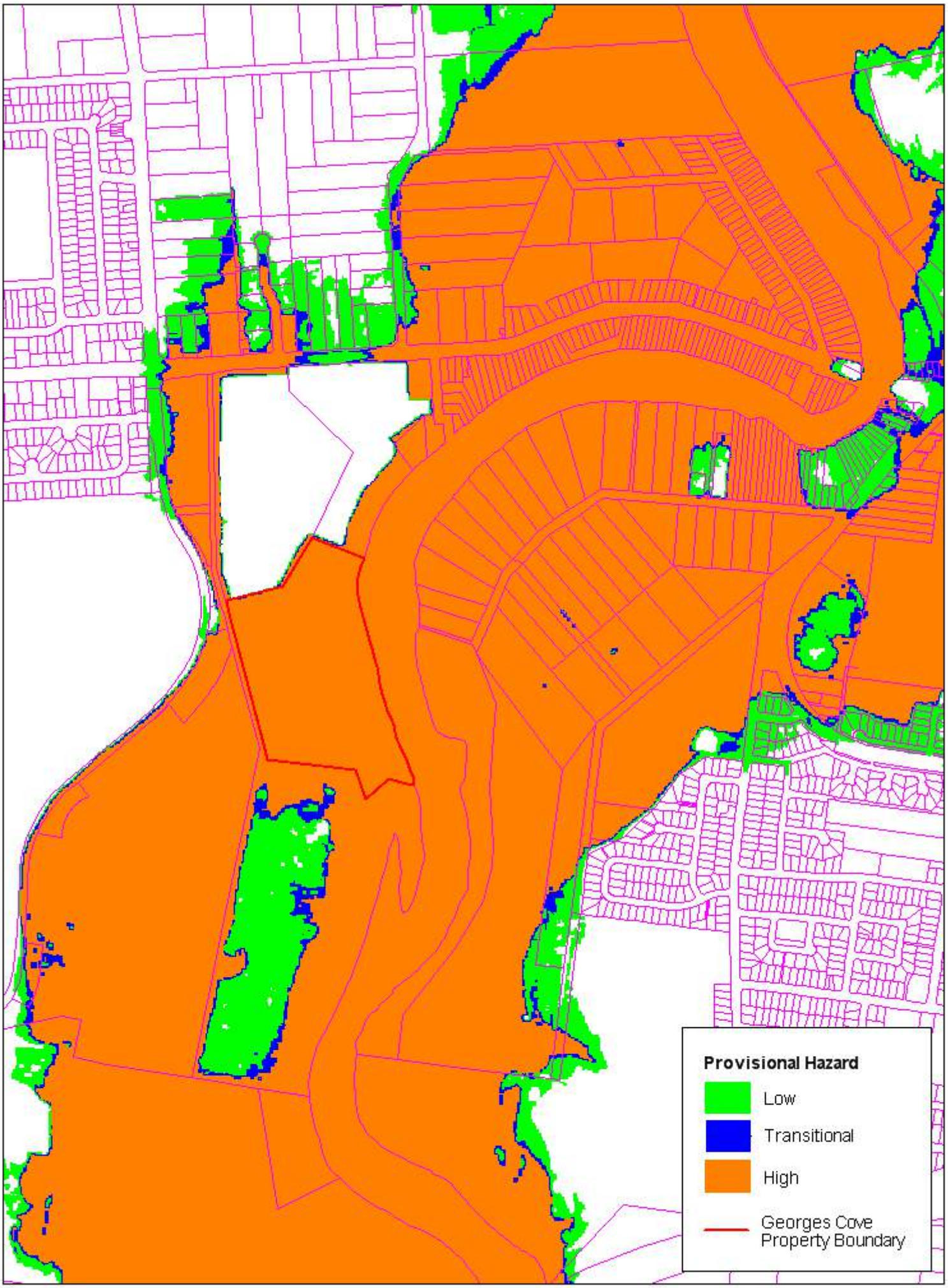


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Figure 3-9
100 year ARI
Peak Velocity x Depth
Pre-Development

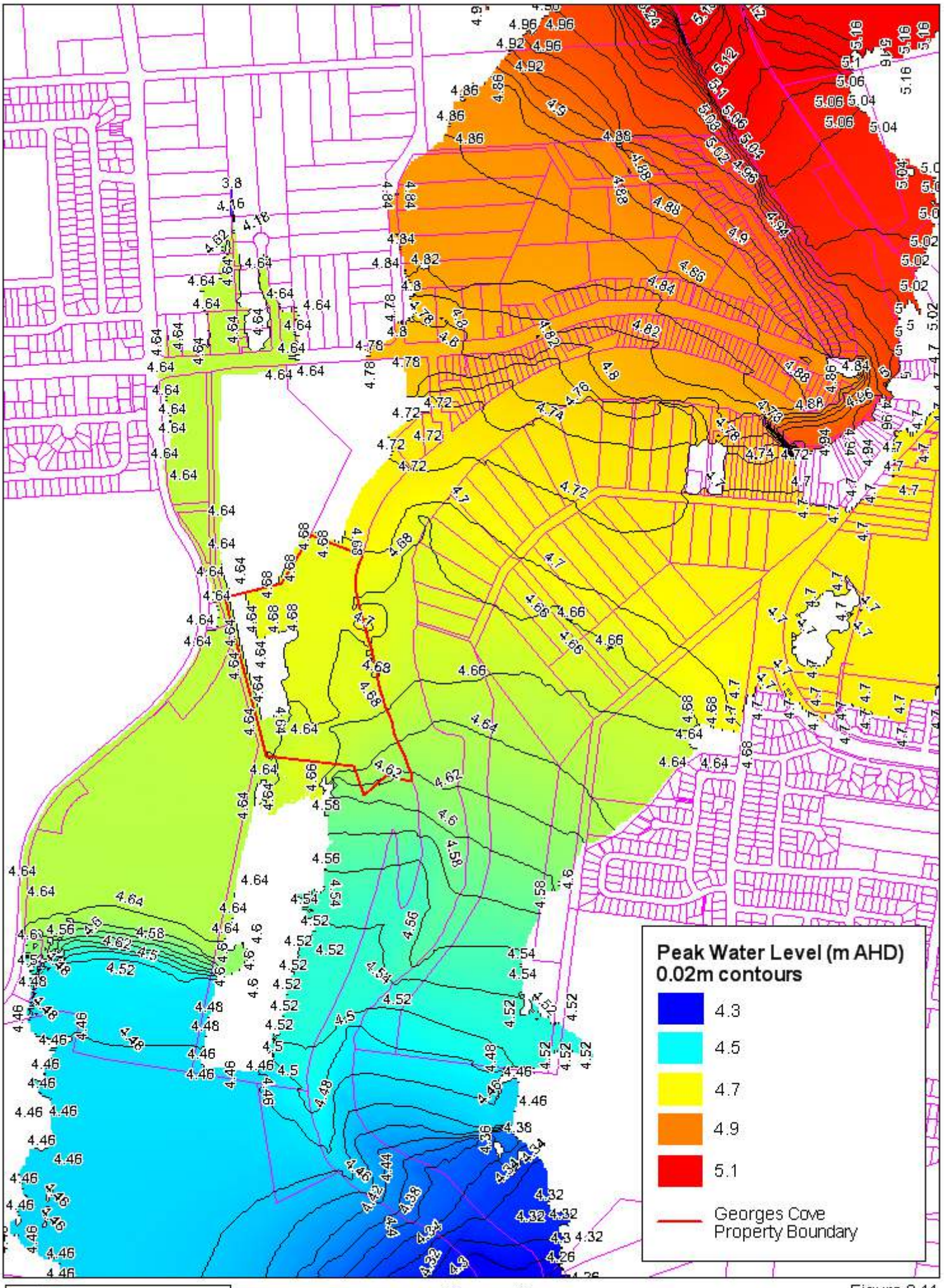


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Figure 3-10
100 year ARI
Provisional Hazard
Pre-Development

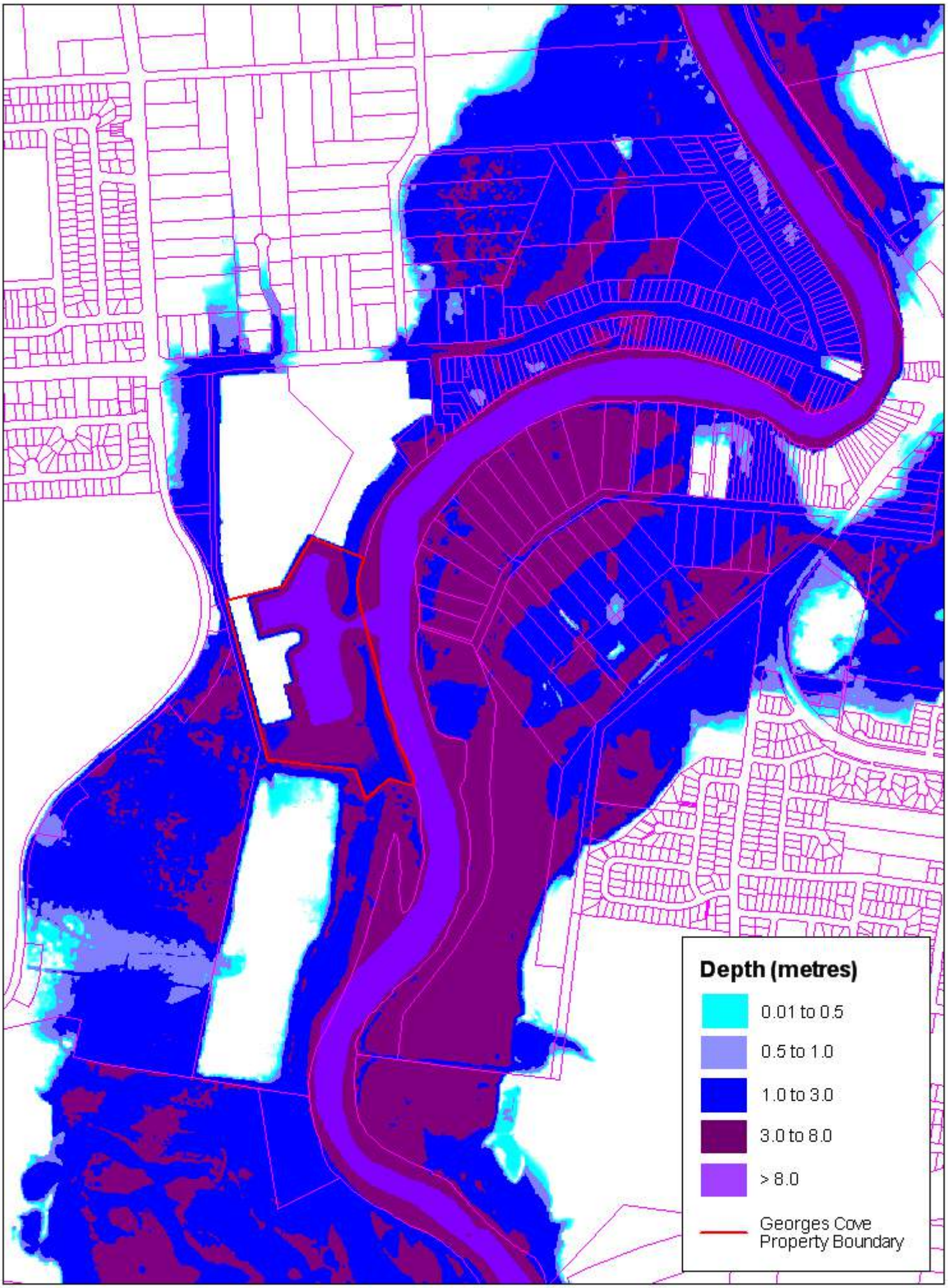


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Figure 3-11
20 year ARI
Peak Water Level
Post-development

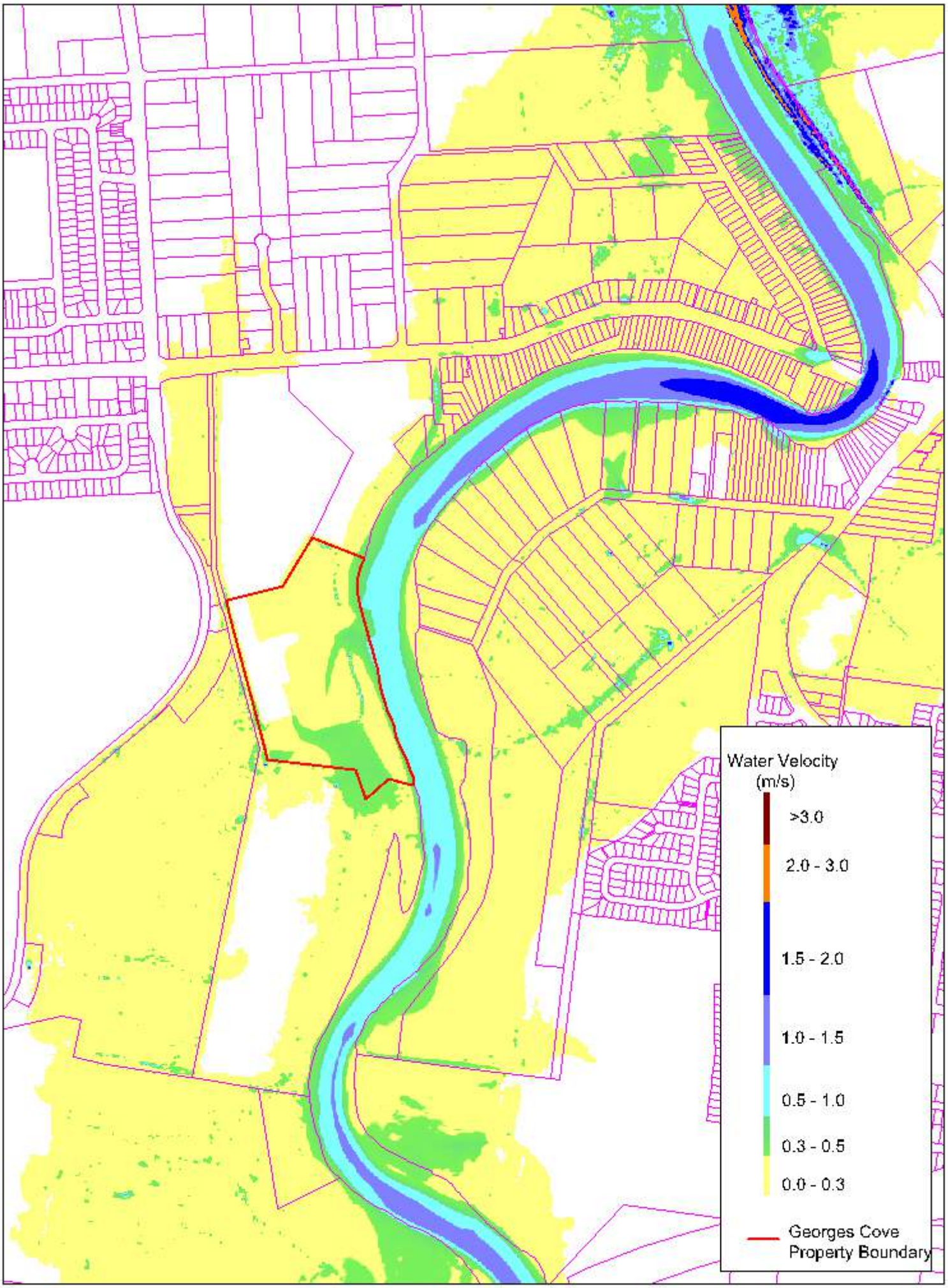


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Figure 3-12
20 year ARI
Peak Depth
Post-development

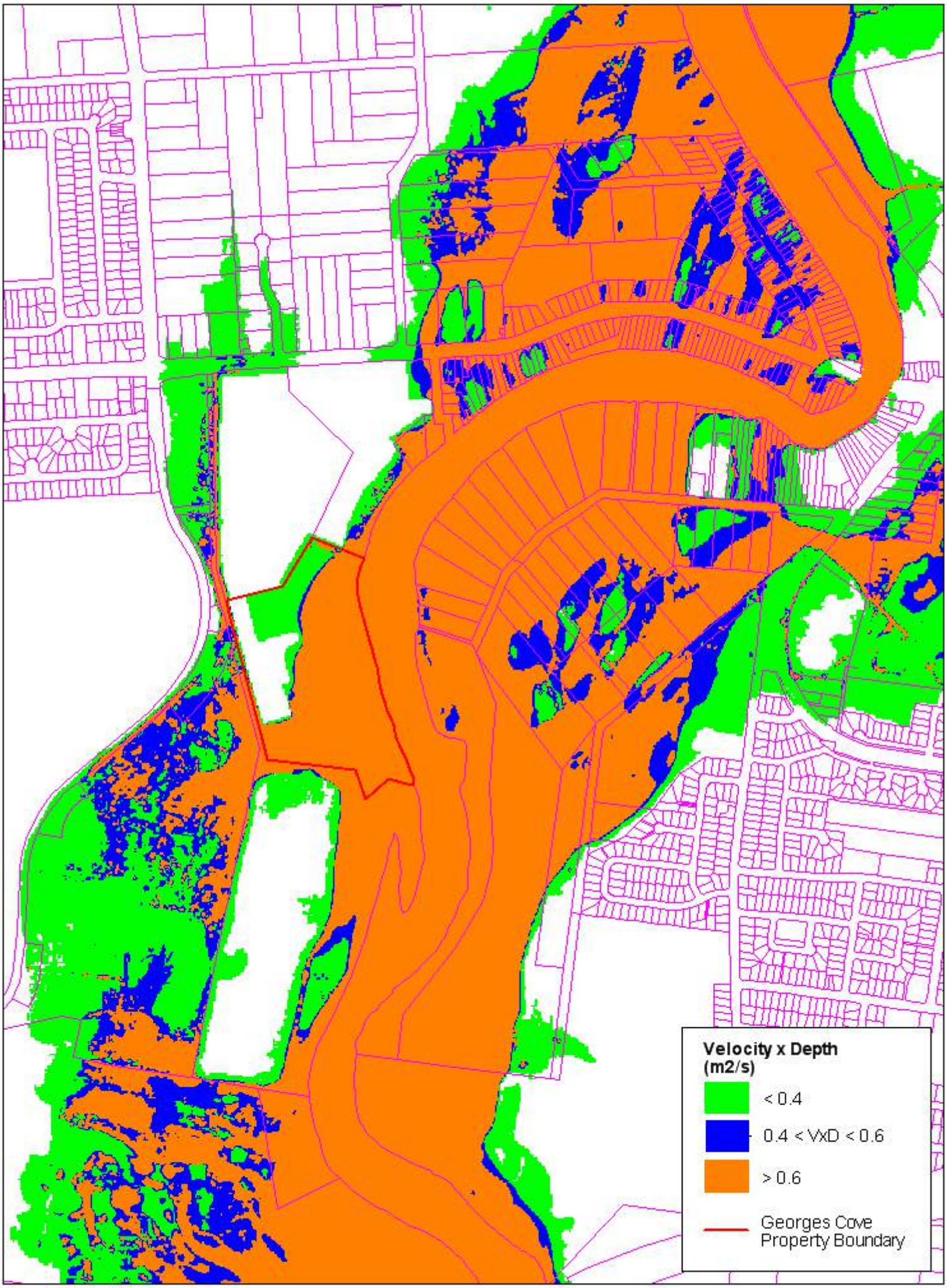


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Figure 3-13
20 year ARI
Peak Velocity
Post-development

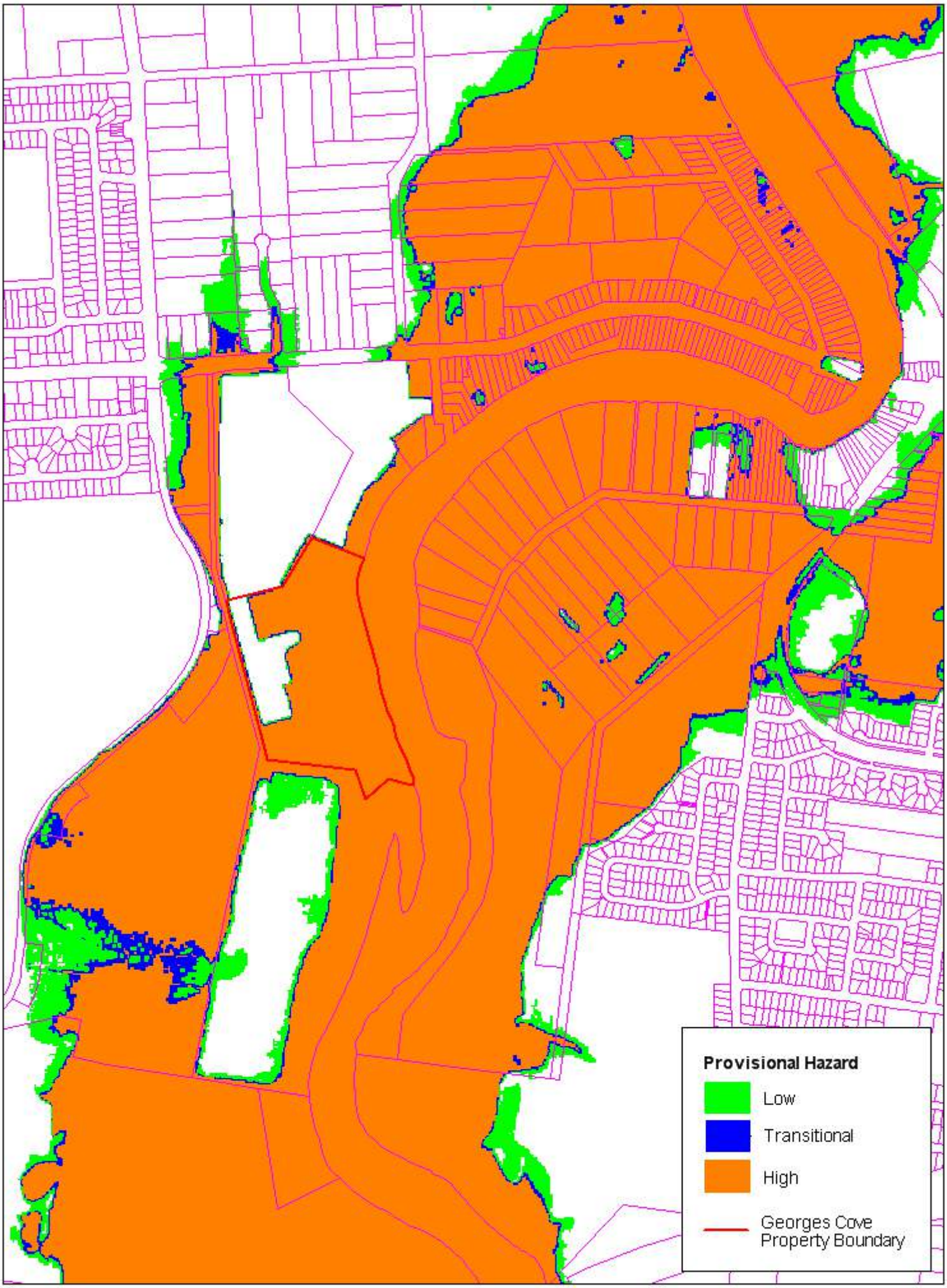


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Figure 3-14
20 year ARI
Peak Velocity x Depth
Post-development

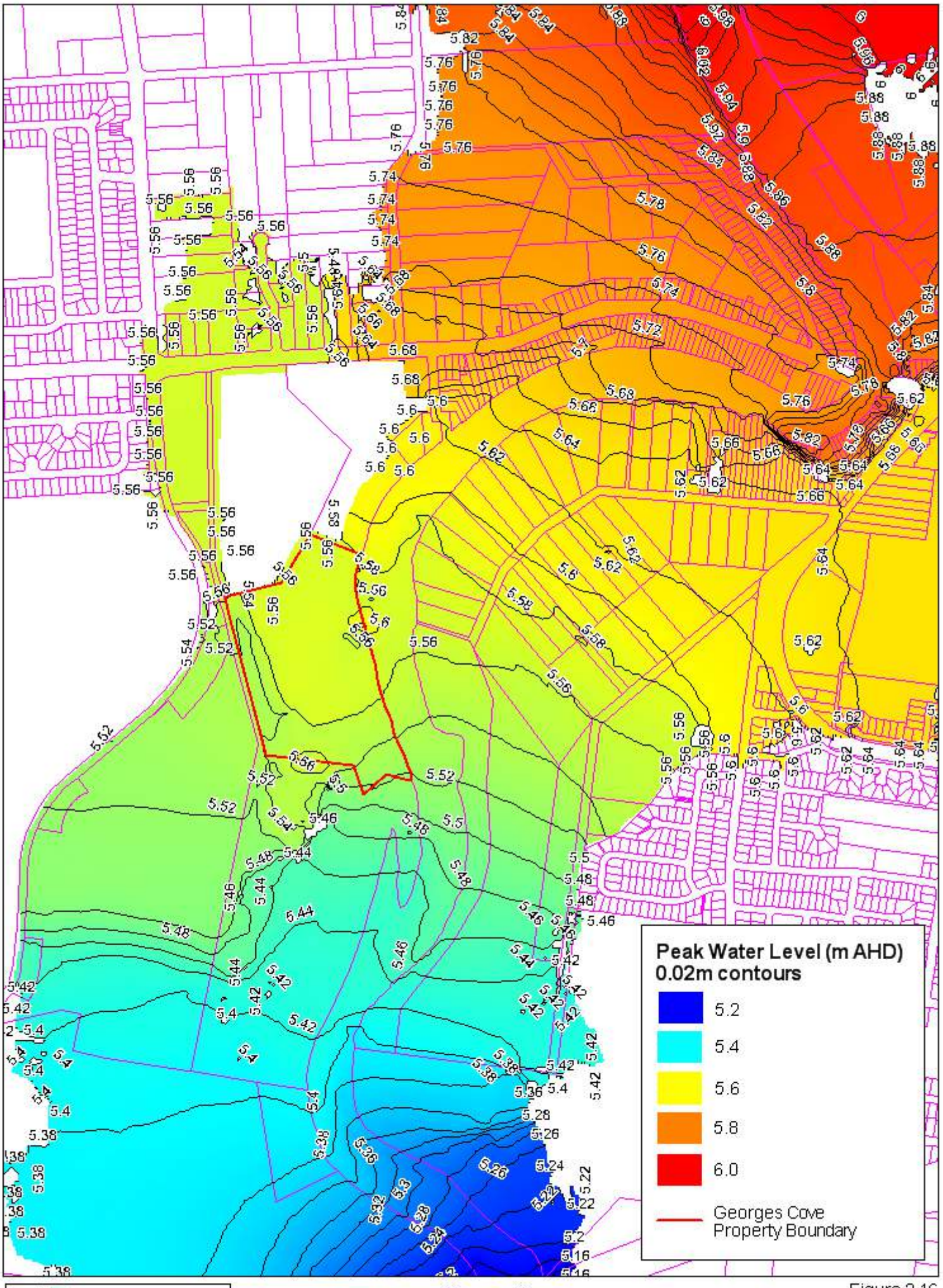


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Figure 3-15
20 year ARI
Provisional Hazard
Post-development

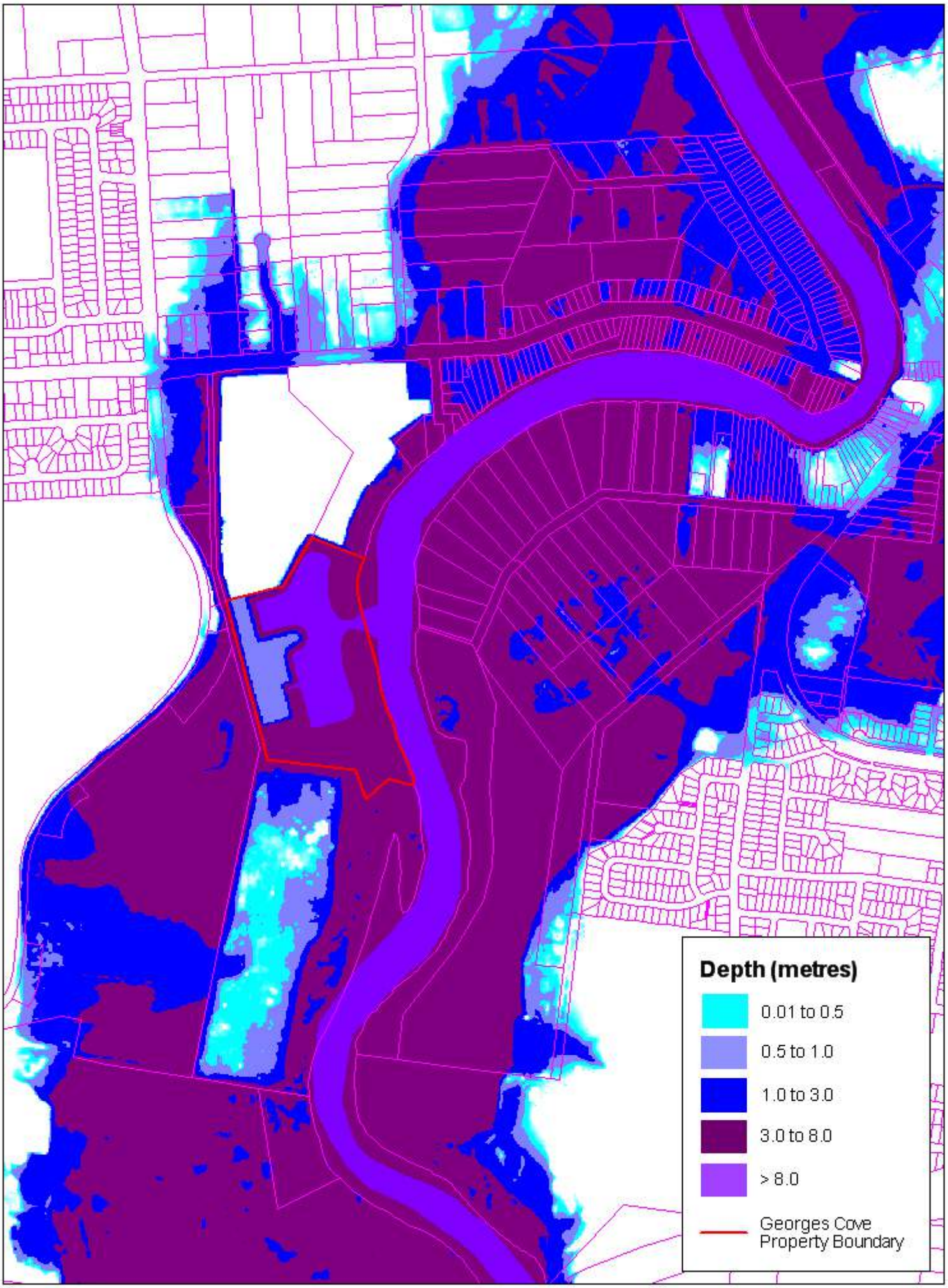


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Figure 3-16
100 year ARI
Peak Water Level
Post-development

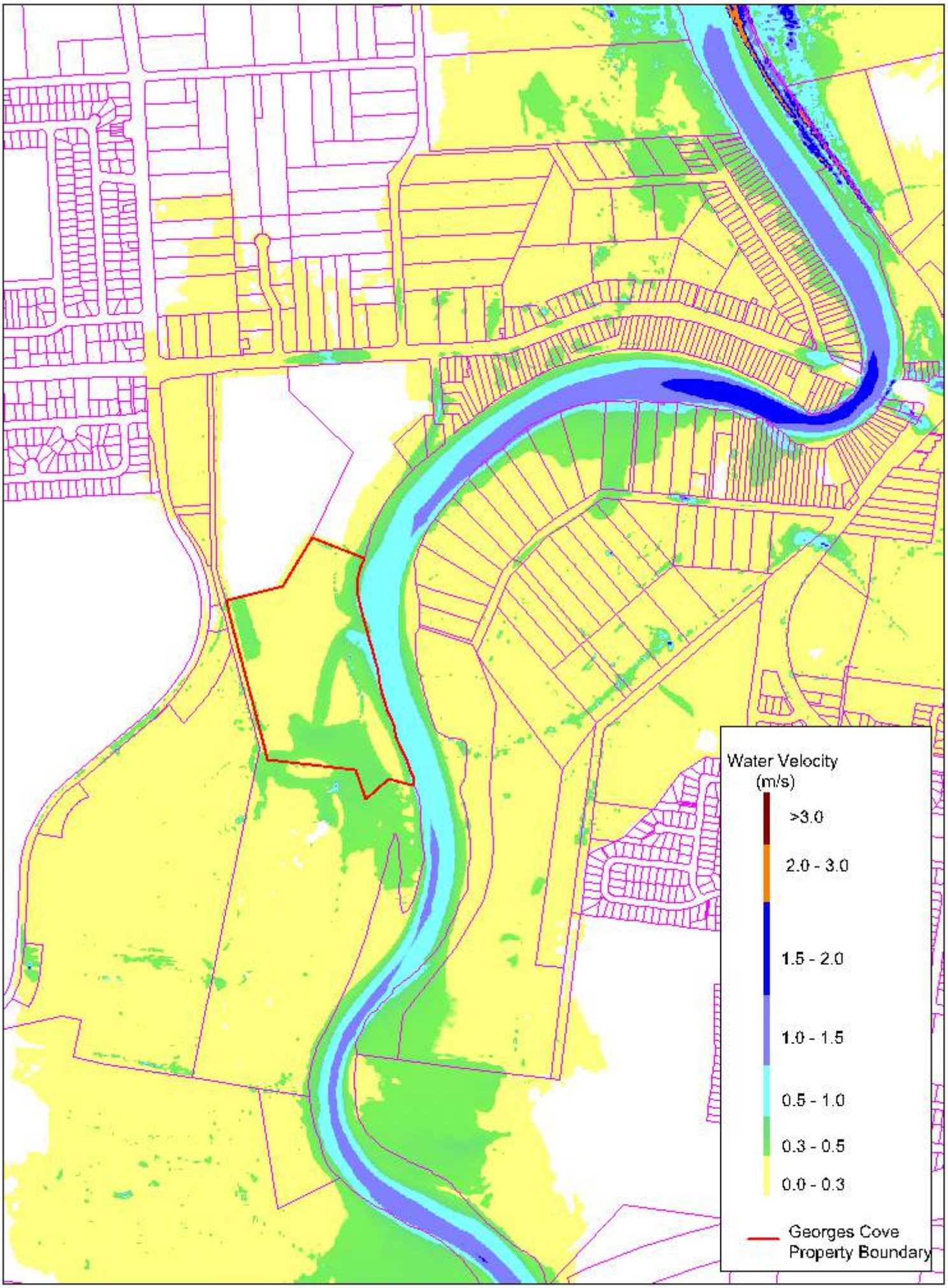


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Figure 3-17
100 year ARI
Peak Depth
Post-development

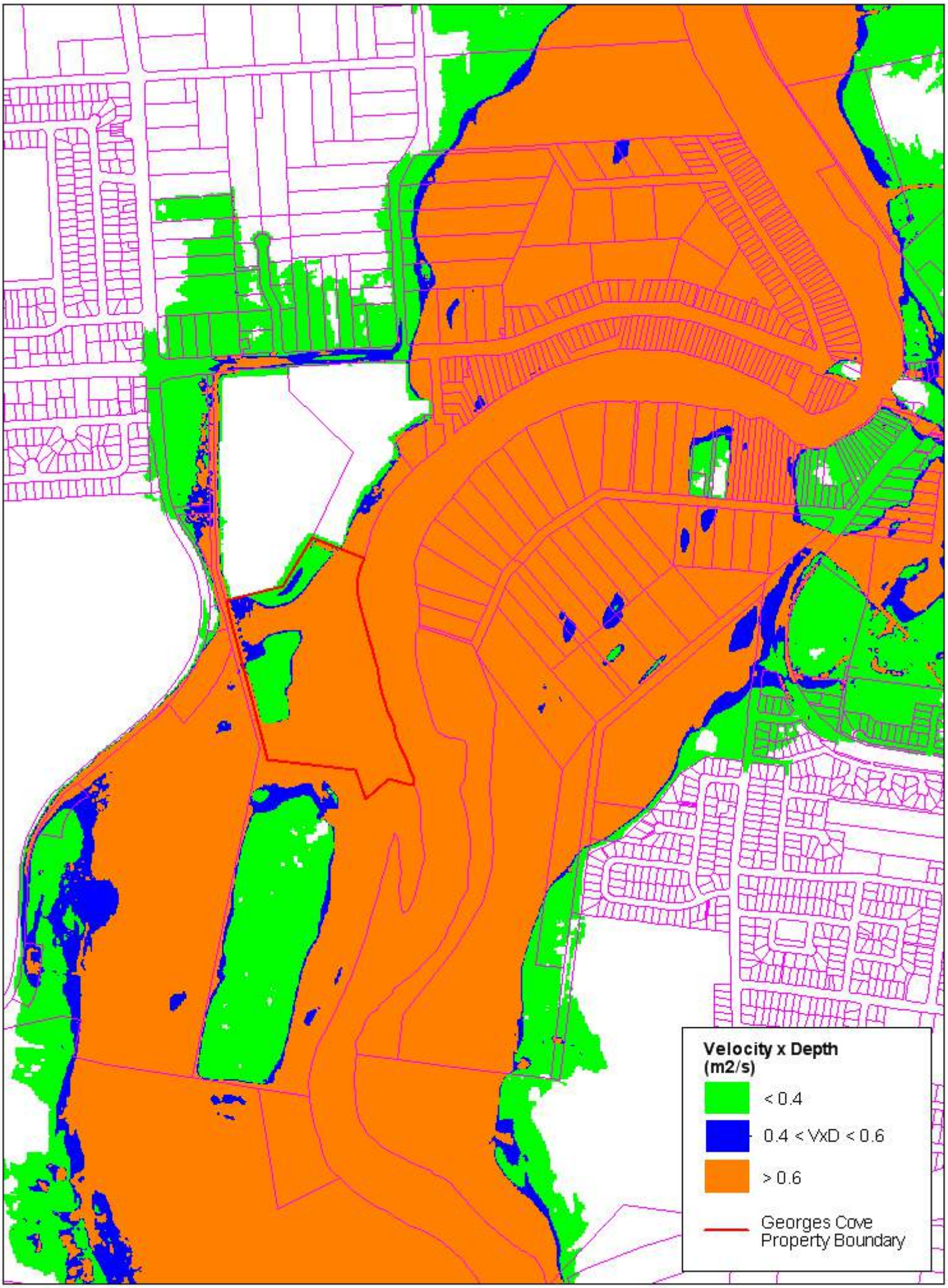


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Figure 3-18
100 year ARI
Peak Velocity
Post-development

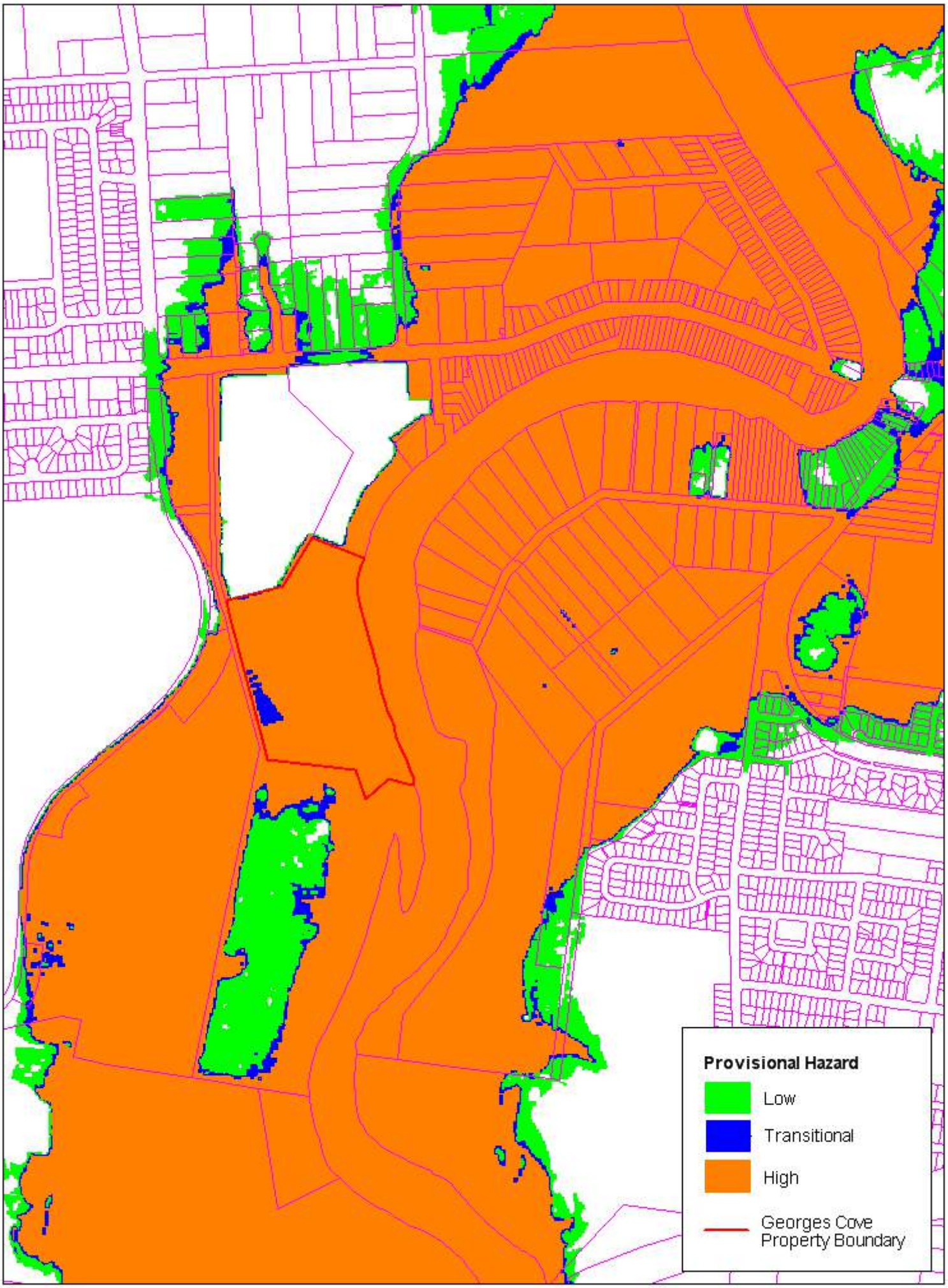


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Figure 3-19
100 year ARI
Peak Velocity x Depth
Post-development

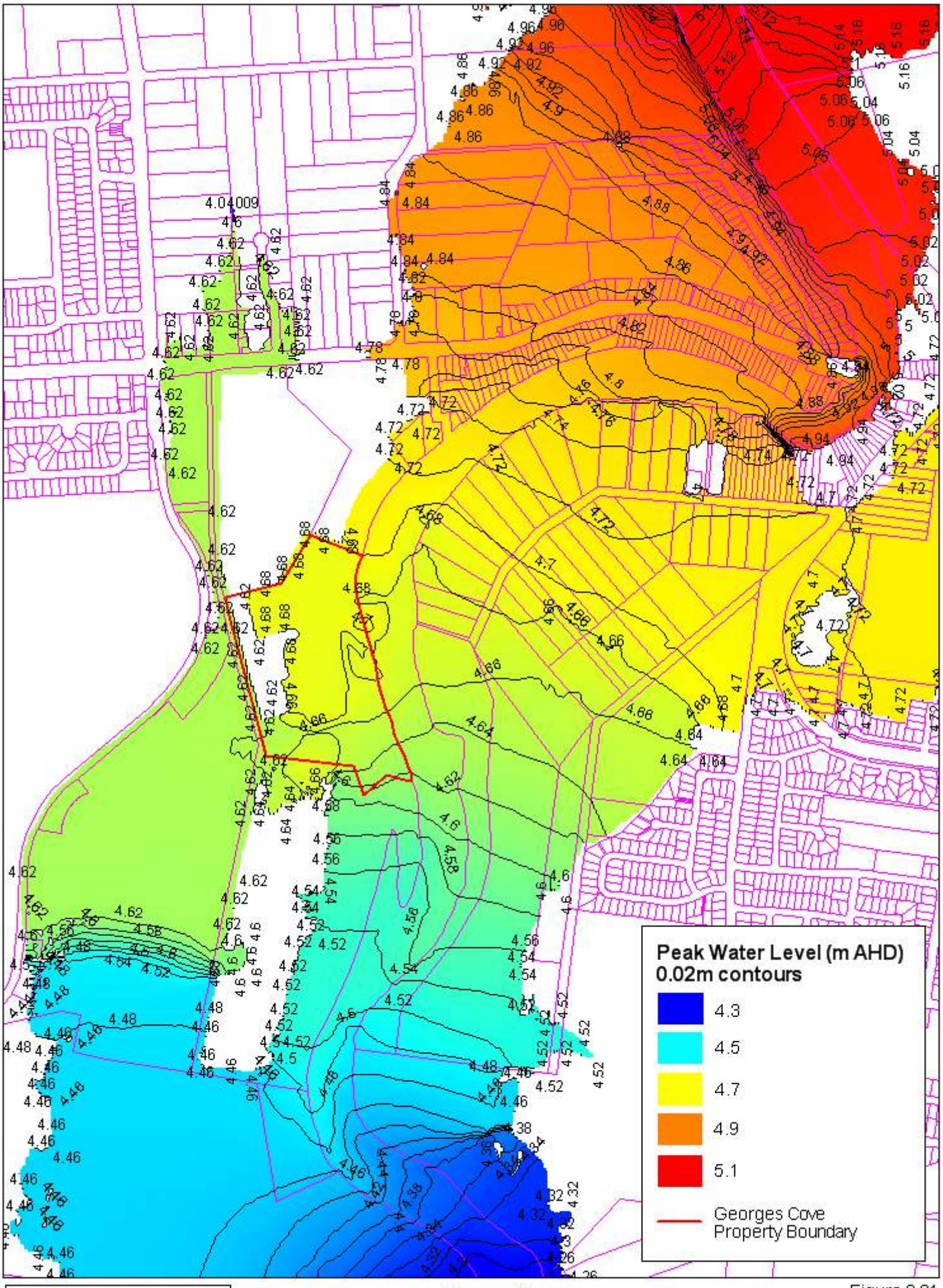


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Figure 3-20
100 year ARI
Provisional Hazard
Post-development

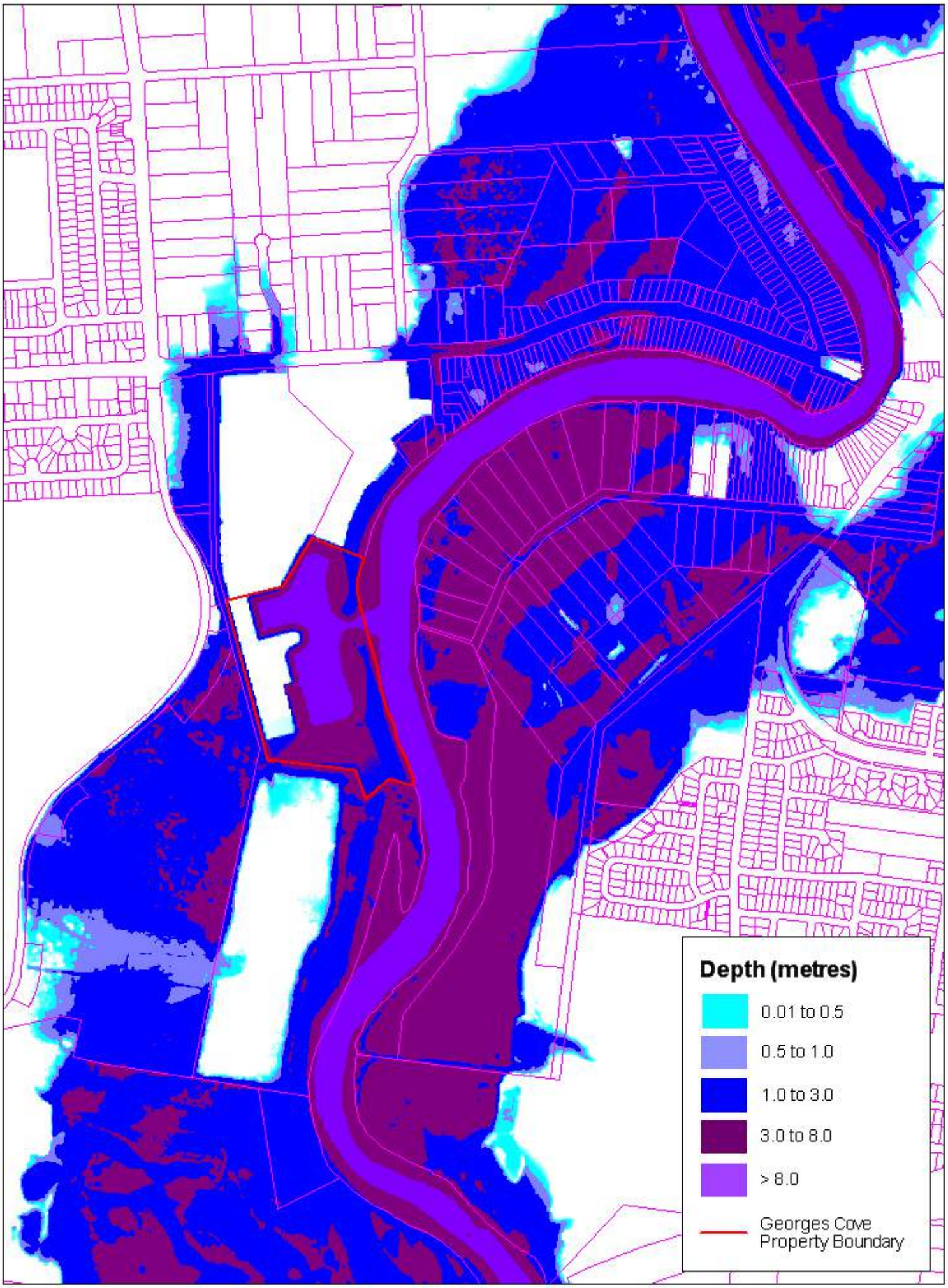


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Figure 3-21
20 year ARI
Peak Water Level
Post-development-Blockage

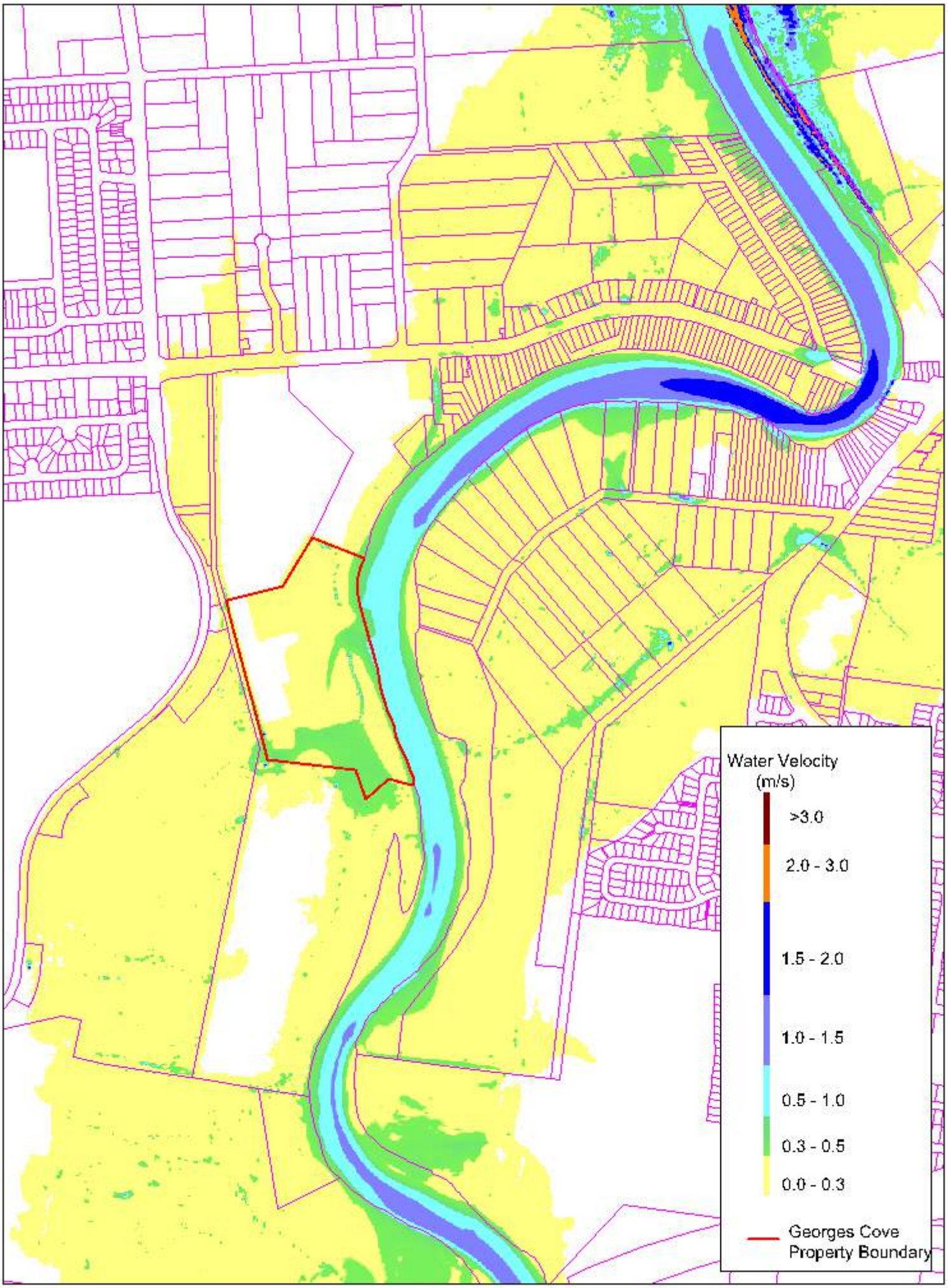


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Figure 3-22
20 year ARI
Peak Depth
Post-development-Blockage

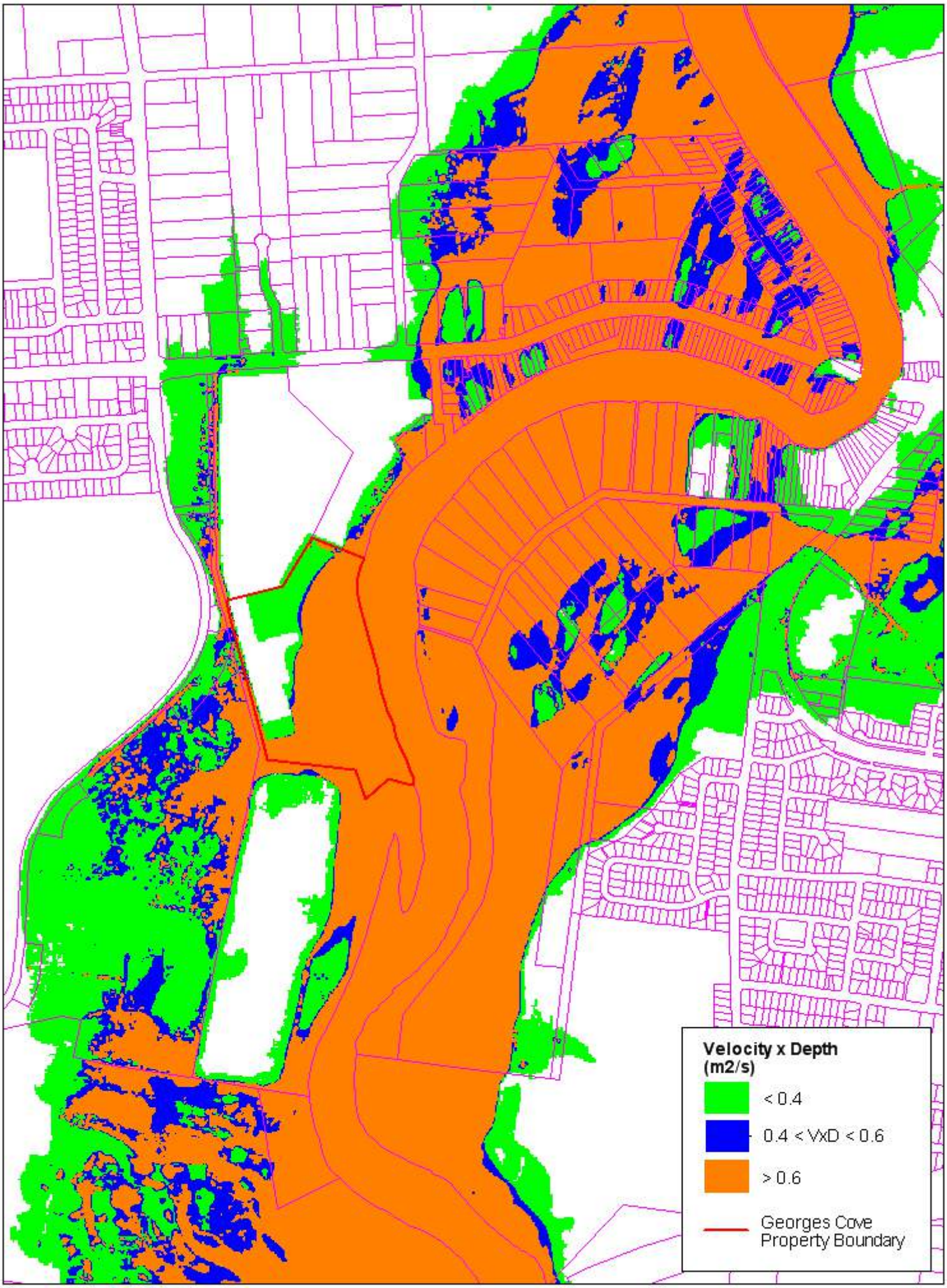


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Figure 3-23
20 year ARI
Peak Velocity
Post-development-Blockage

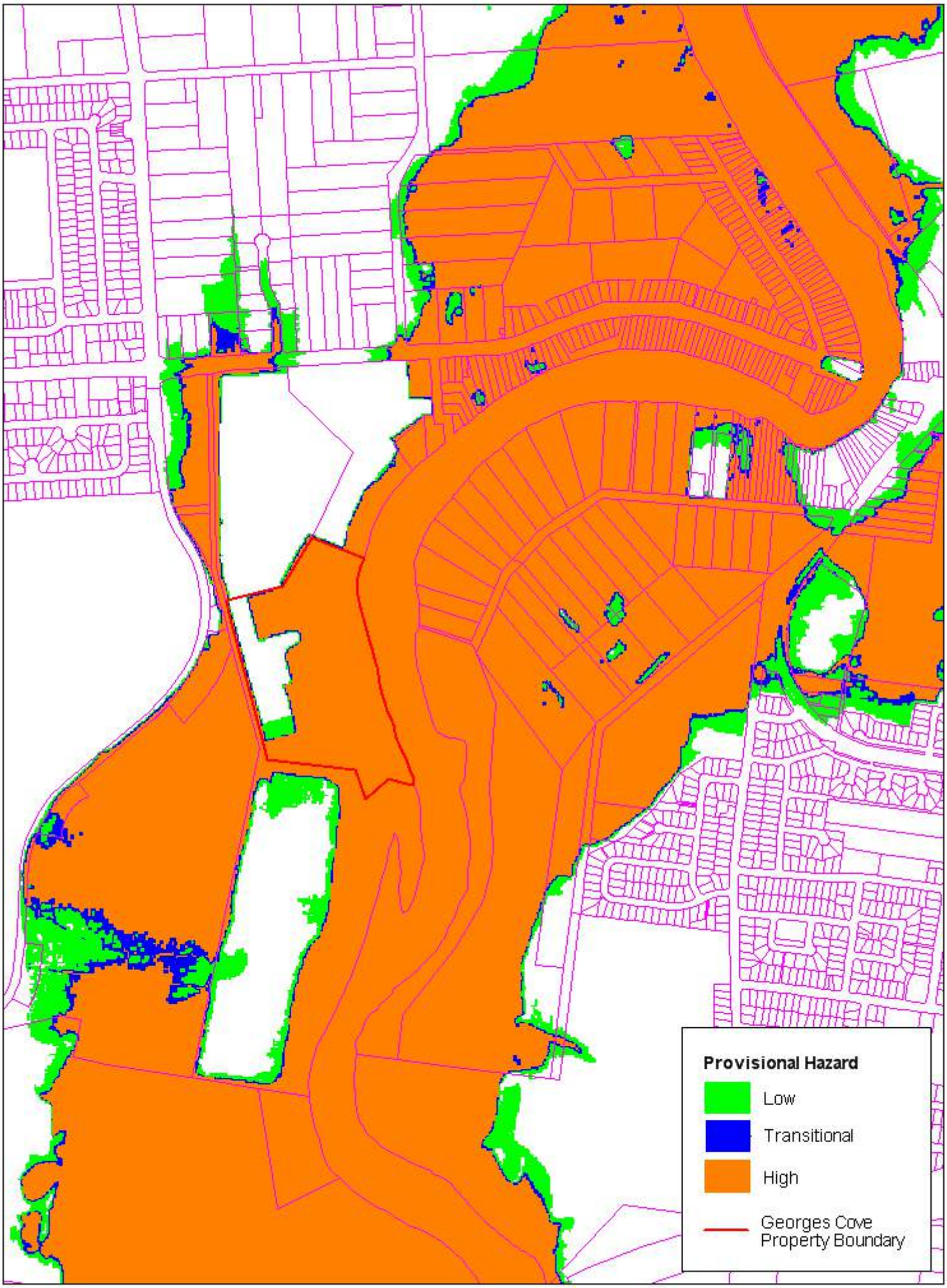


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Figure 3-24
20 year ARI
Peak Velocity x Depth
Post-development-Blockage

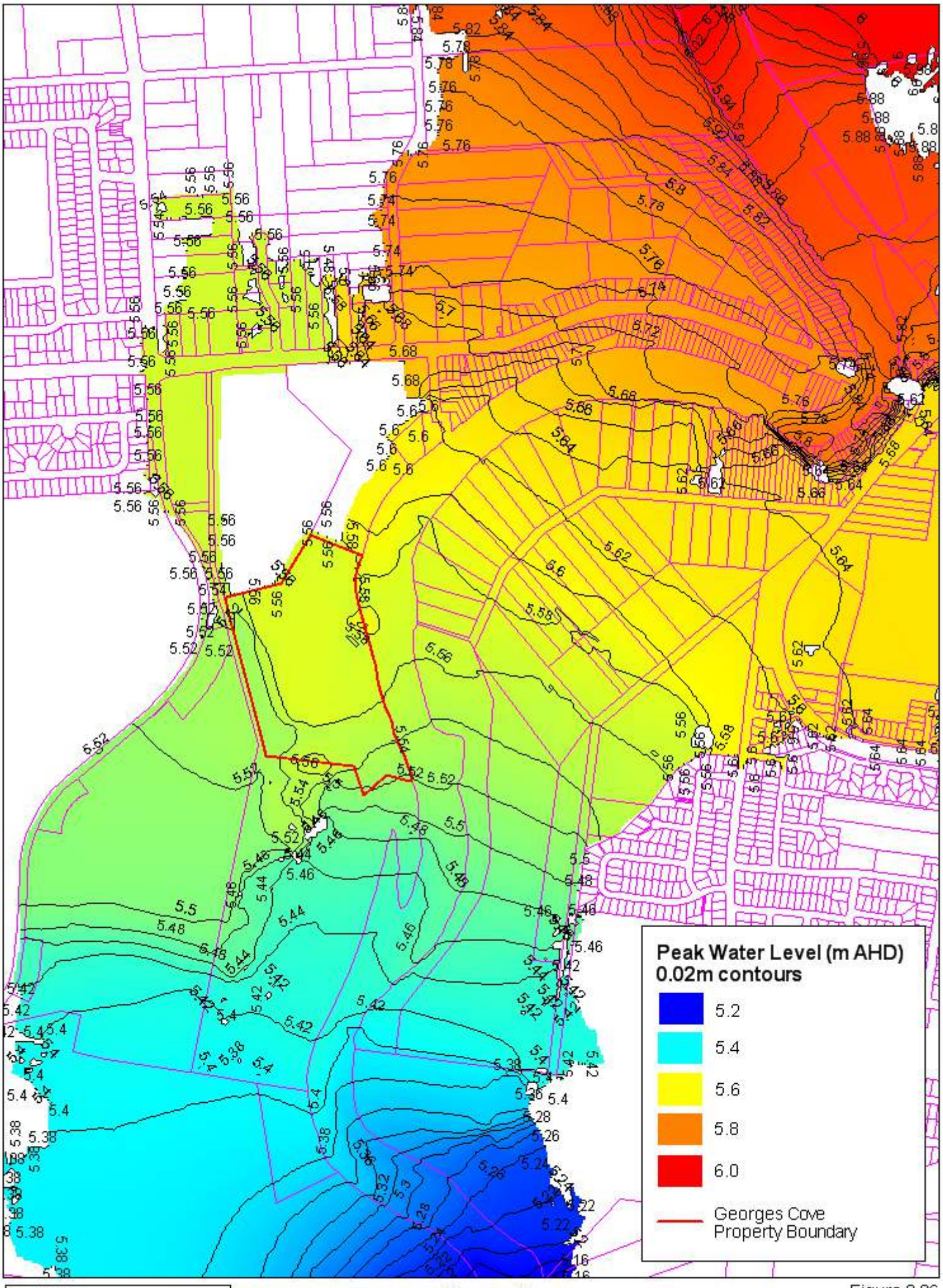


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Figure 3-25
20 year ARI
Provisional Hazard
Post-development-Blockage

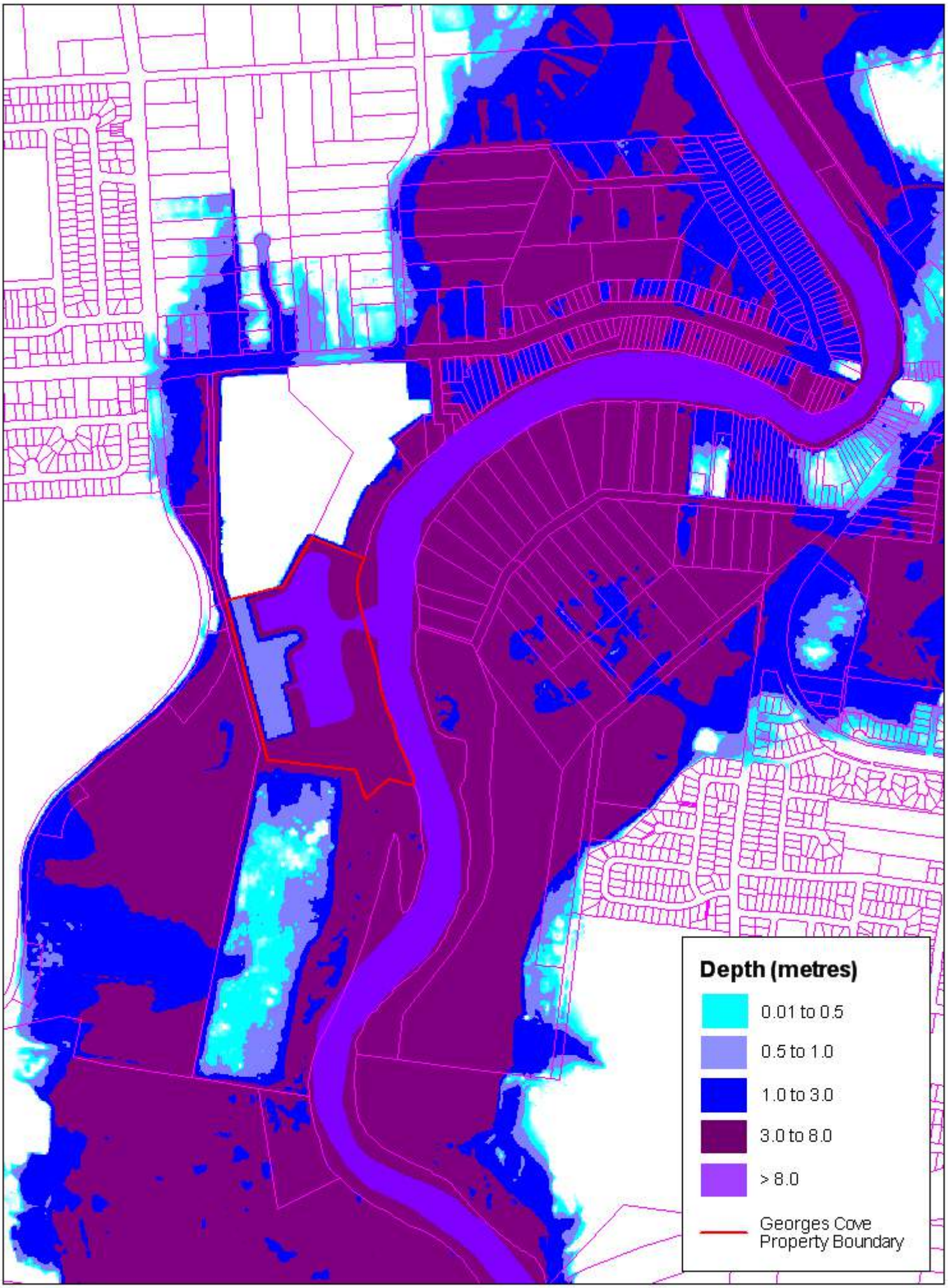


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Figure 3-26
100 year ARI
Peak Water Level
Post-development-Blockage

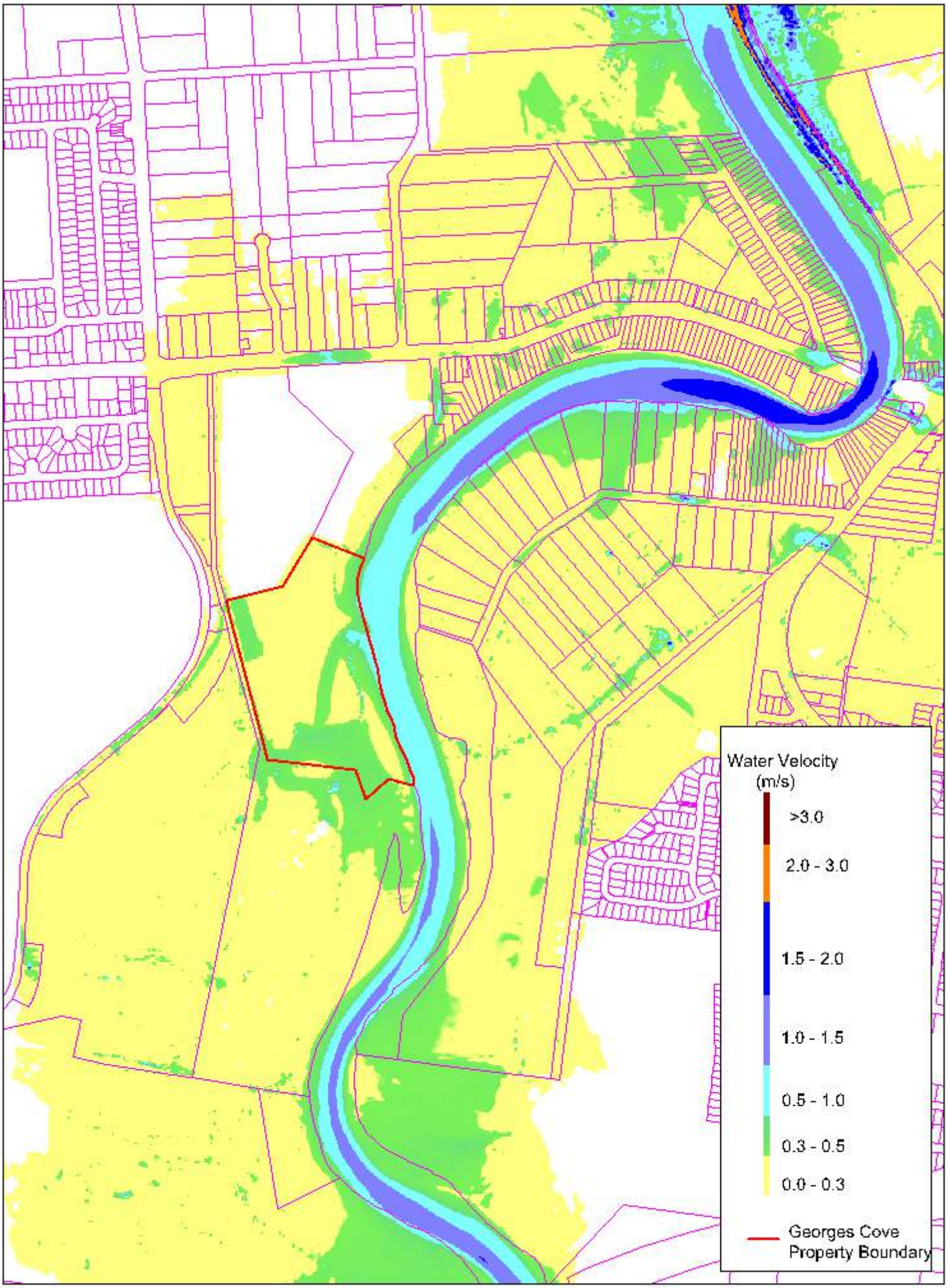


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Figure 3-27
100 year ARI
Peak Depth
Post-development-Blockage

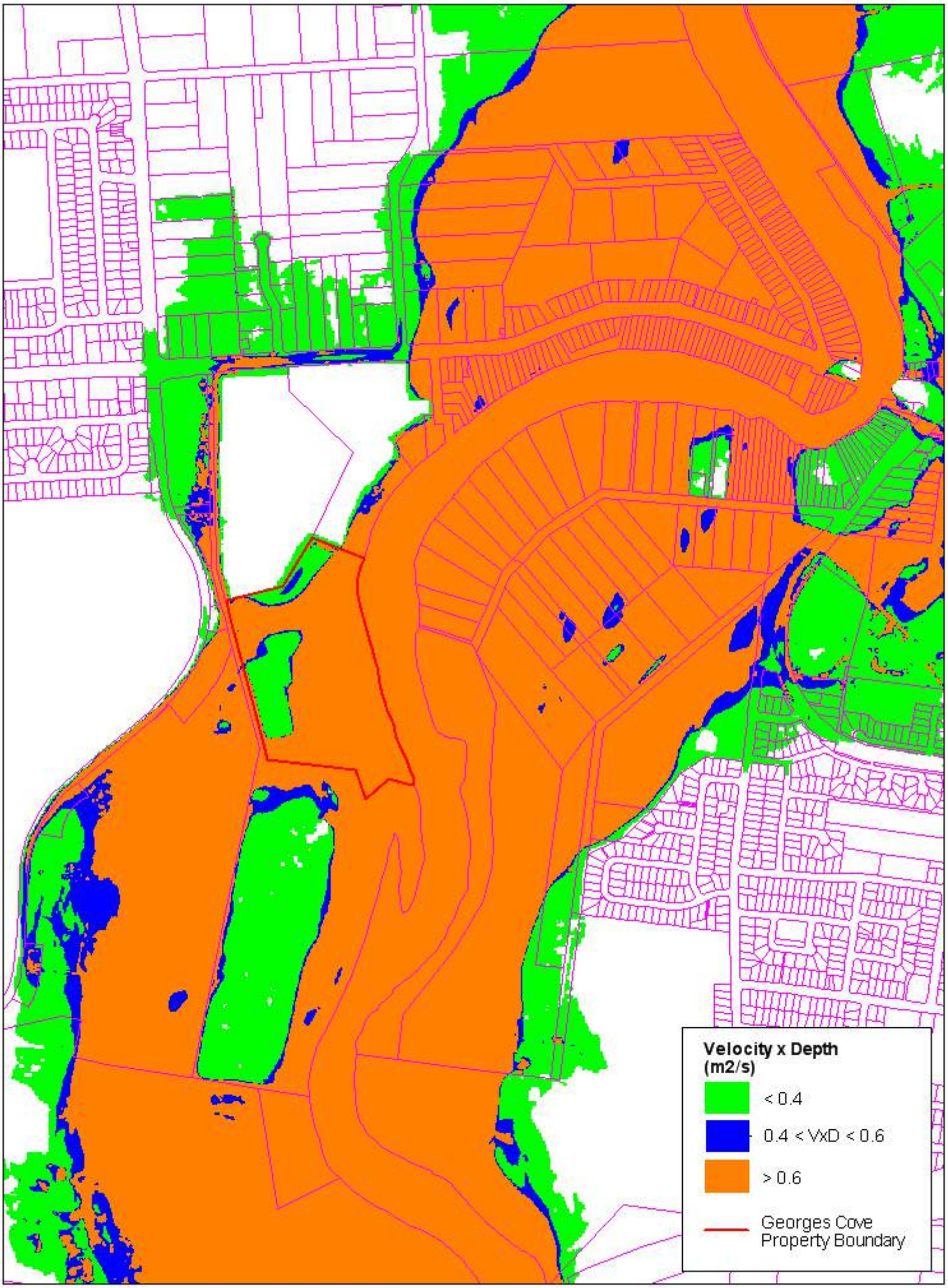


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Figure 3-28
100 year ARI
Peak Velocity
Post-development-Blockage

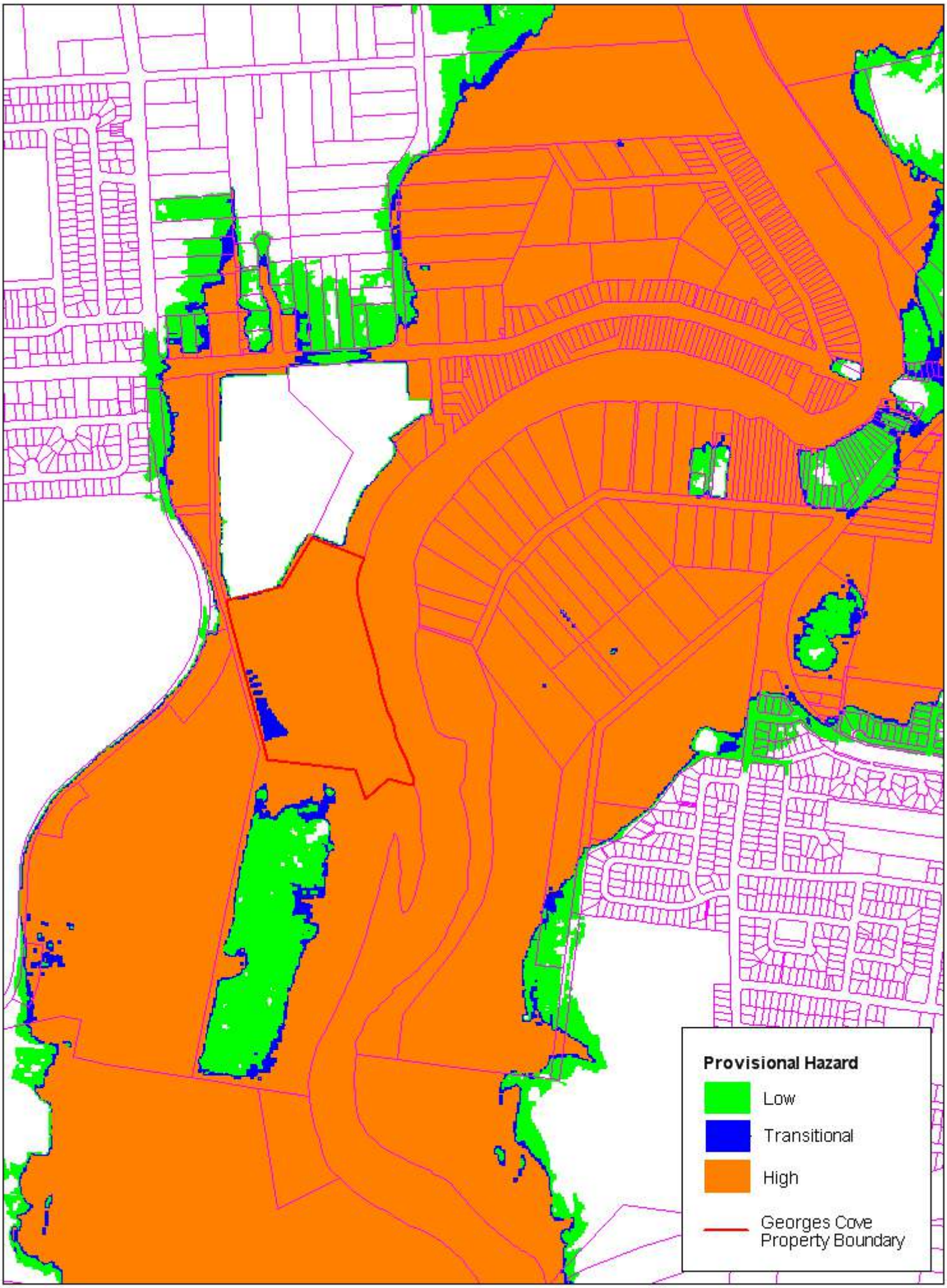


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Figure 3-29
100 year ARI
Peak Velocity x Depth
Post-development-Blockage

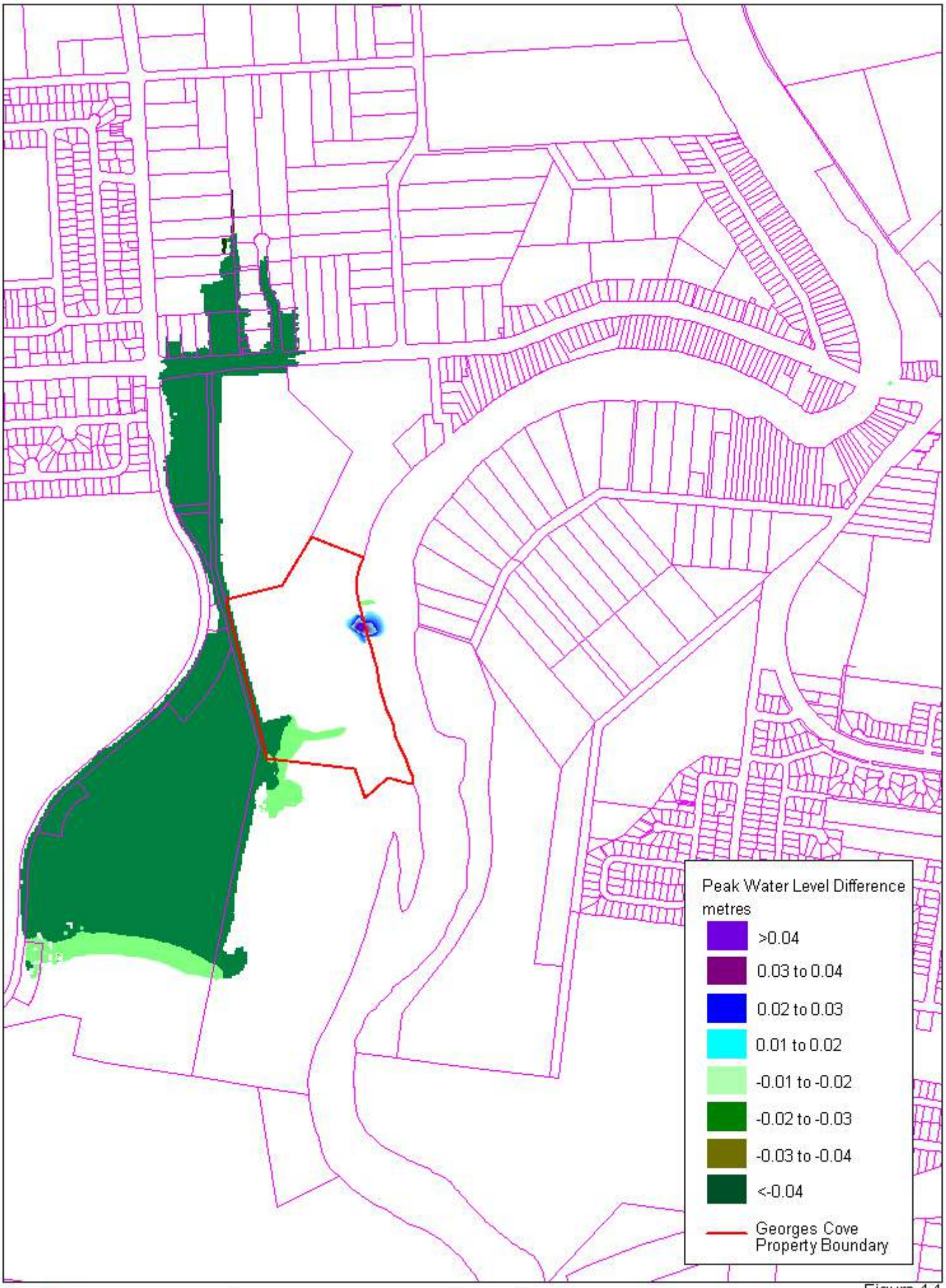


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Figure 3-30
100 year ARI
Provisional Hazard
Post-development-Blockage

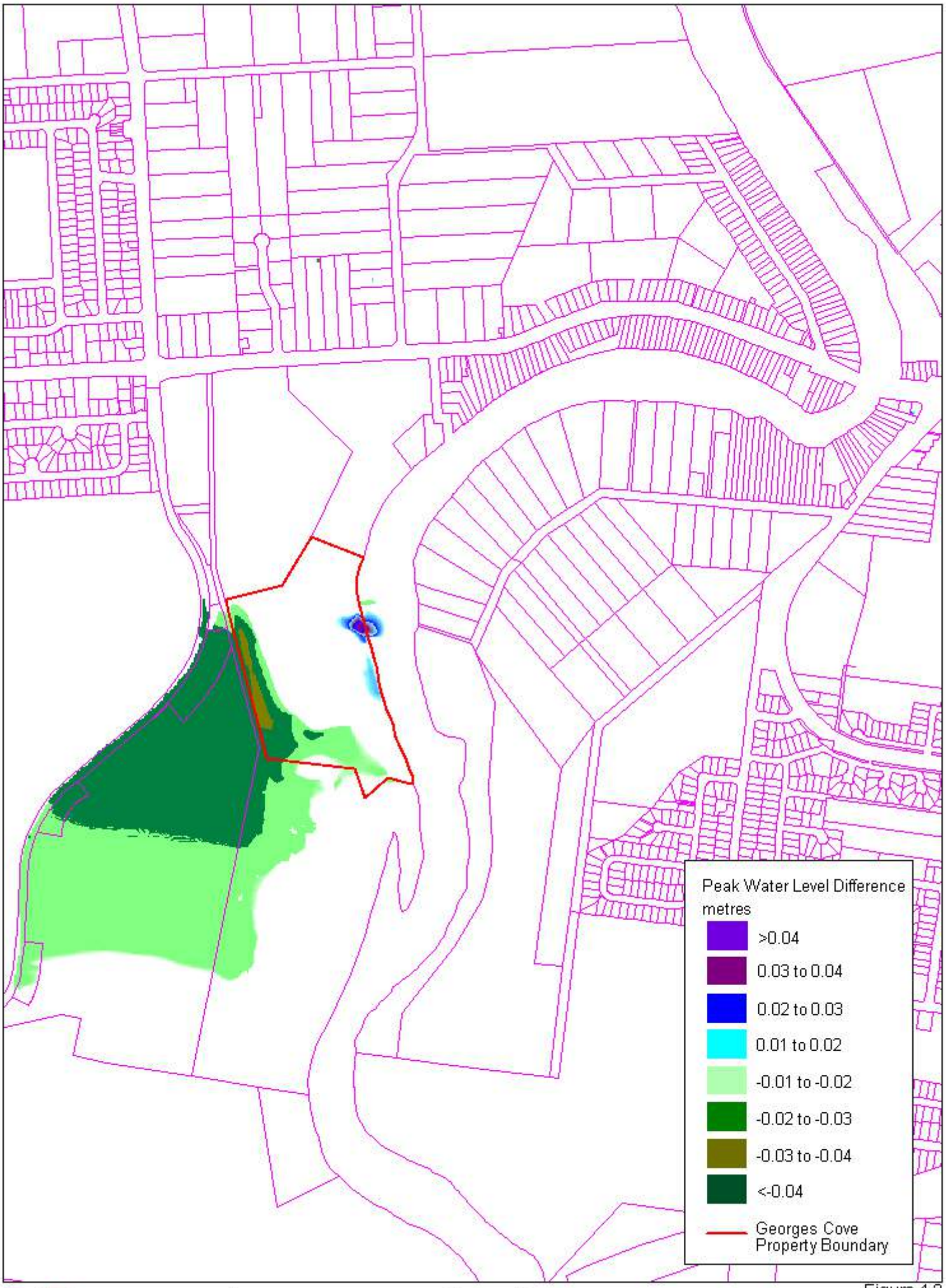


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Figure 4-1
20 year ARI
Peak Water Level
Post-development Less Predevelopment

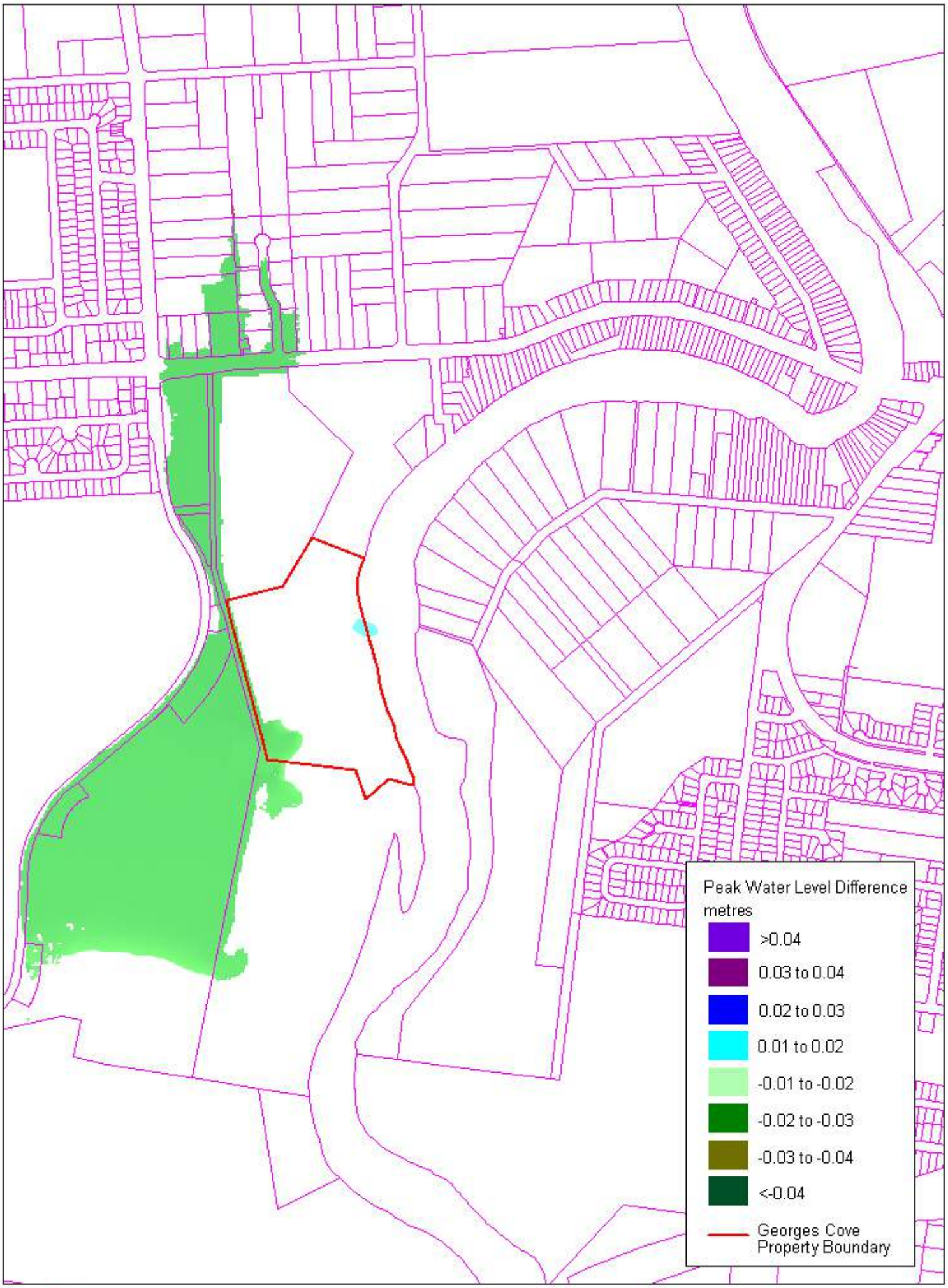


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Figure 4-2
100 year ARI
Peak Water Level
Post-development Less Predevelopment

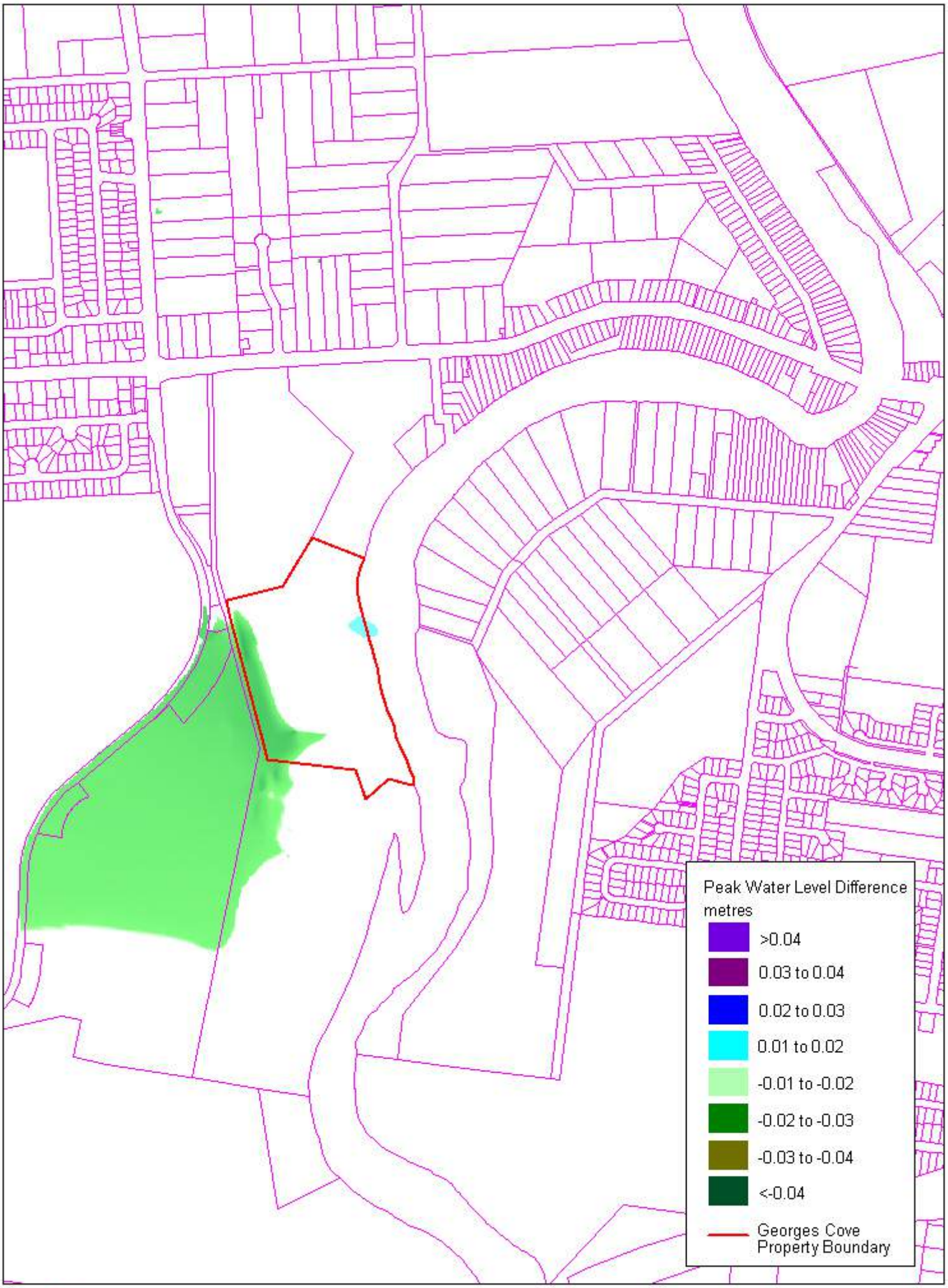


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Figure 4-3
20 year ARI
Peak Water Level
Post-development-Blockage Less Predevelopment

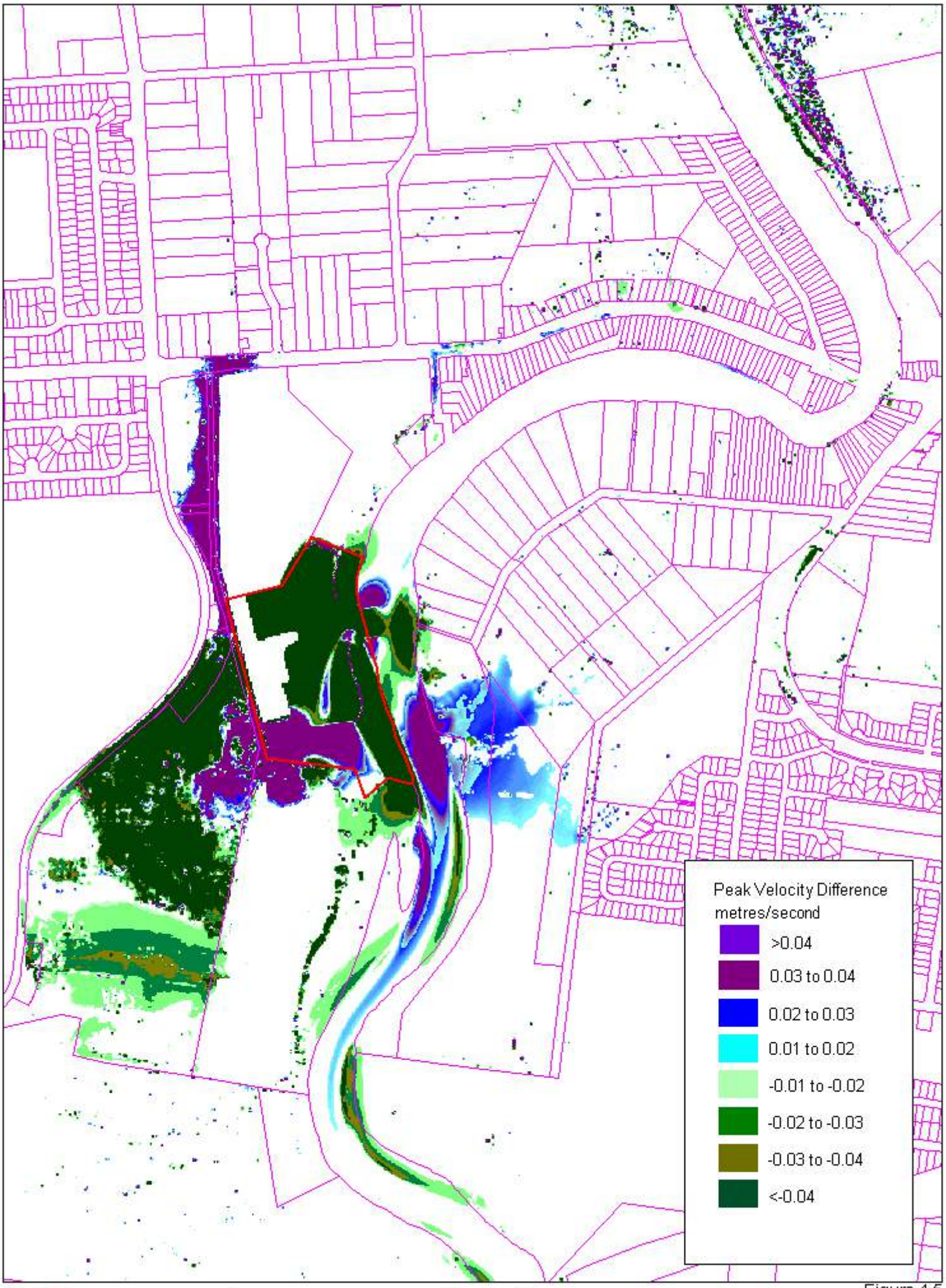


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Figure 4-4
100 year ARI
Peak Water Level
Post-development-Blockage Less Predevelopment

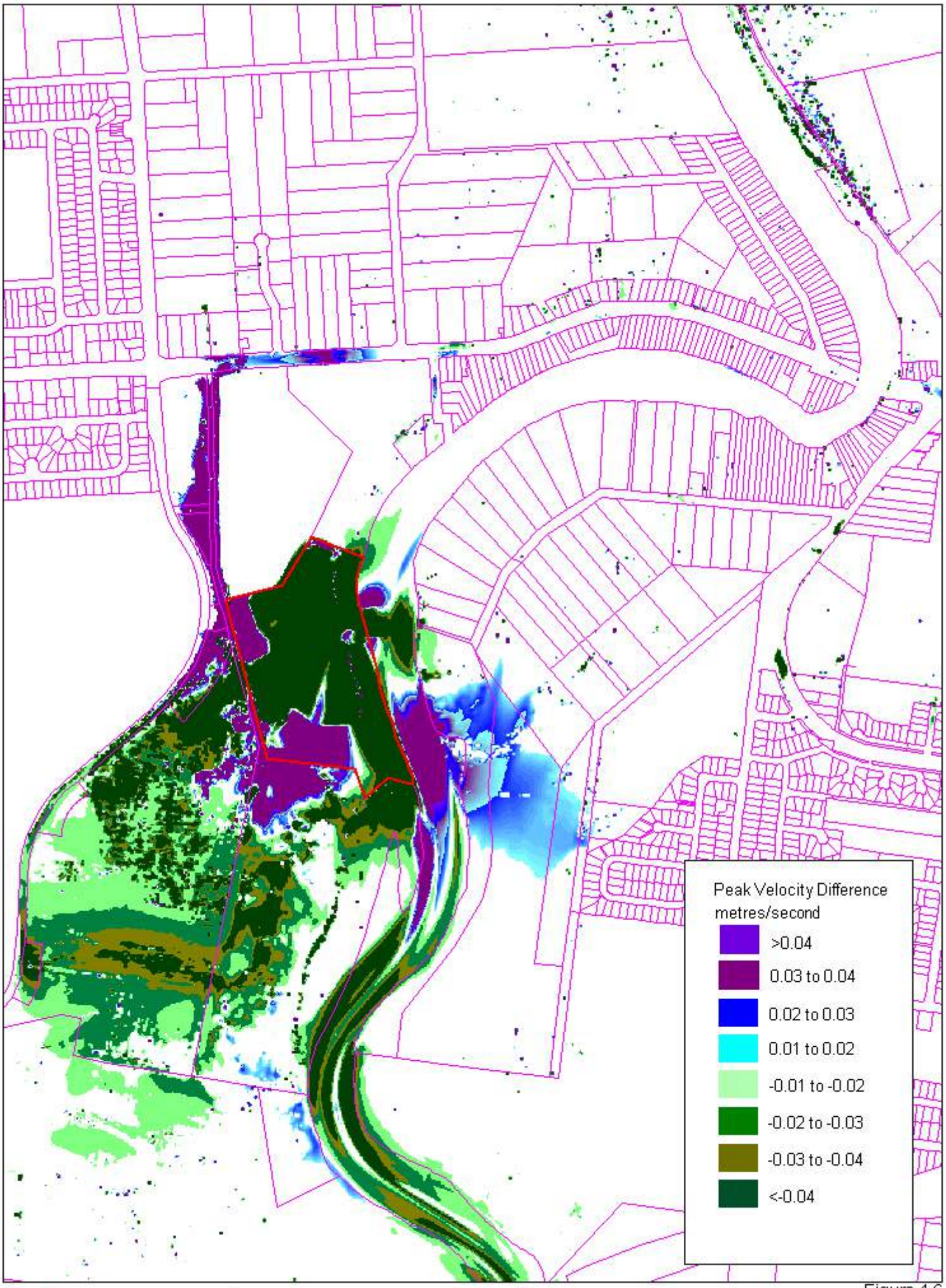


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Figure 4-5
20 year ARI
Peak Water Velocity
Post-development Less Predevelopment

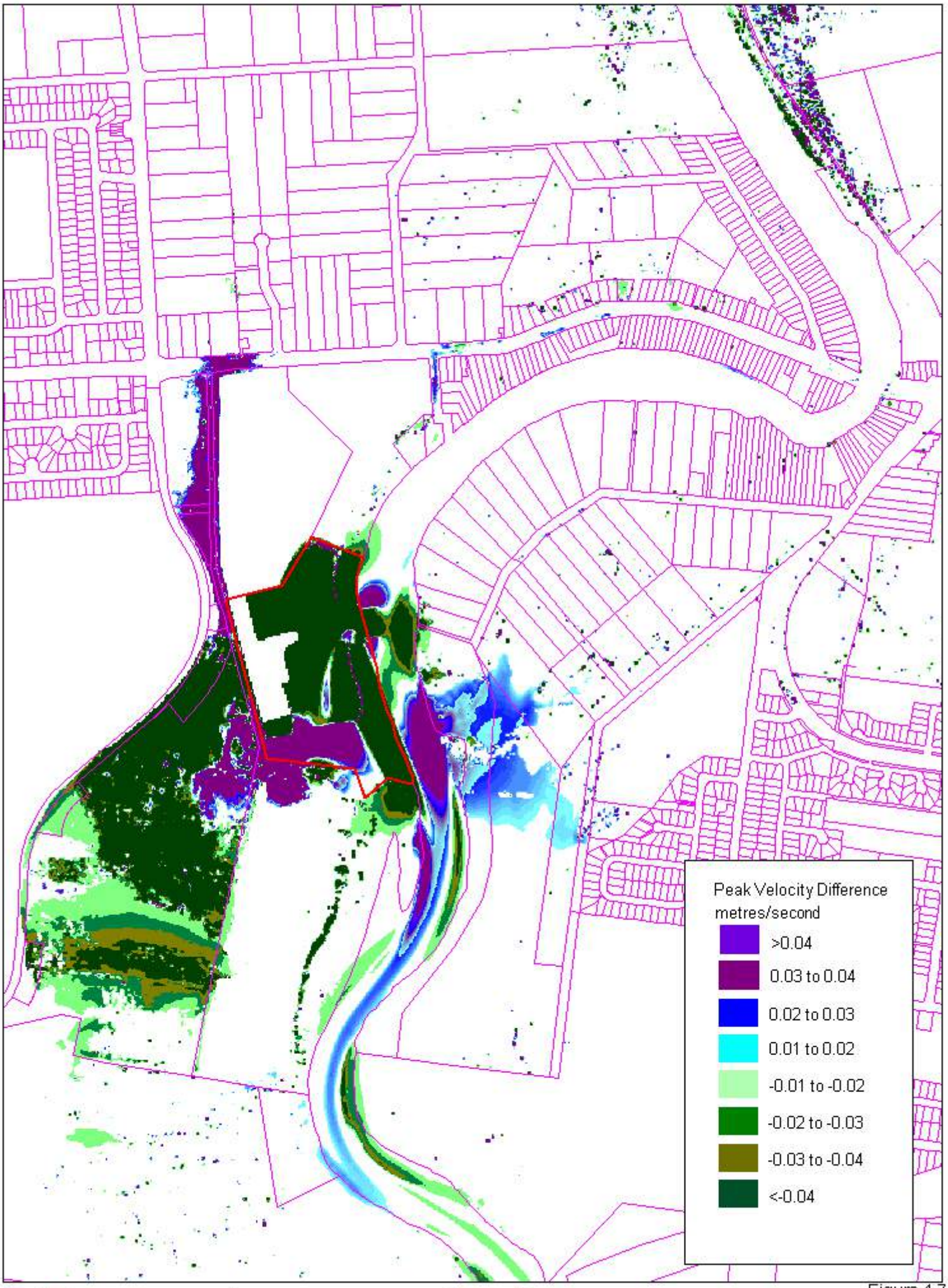


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Figure 4-6
100 year ARI
Peak Water Velocity
Post-development Less Predevelopment

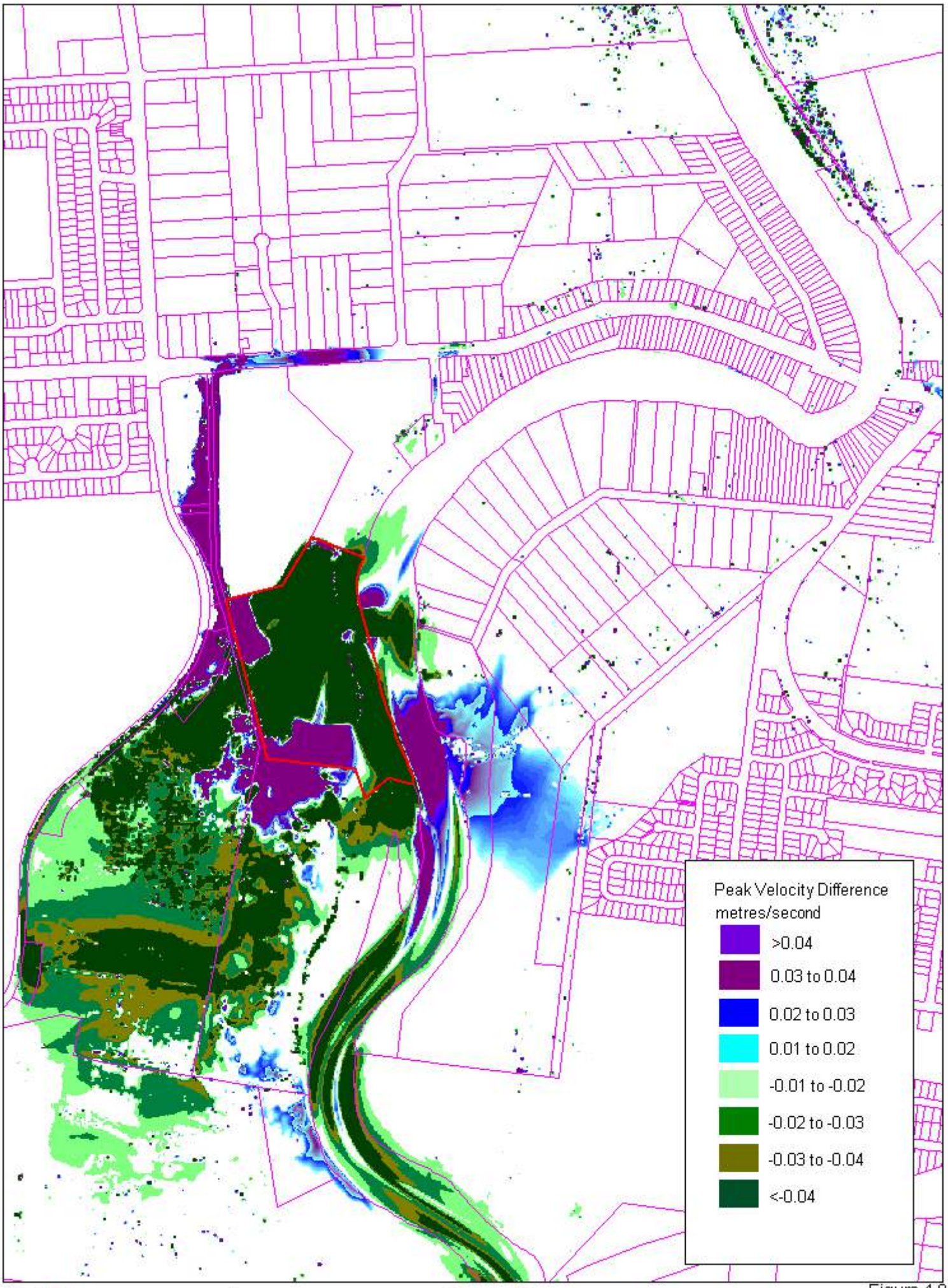


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Figure 4-7
20 year ARI
Peak Water Velocity
Post-development-Blockage Less Predevelopment



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Figure 4-8
100 year ARI
Peak Water Velocity
Post-development-Blockage Less Predevelopment

