

City of Canada Bay

Rhodes East River Pool

Scoping Study Report

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Executive Summary

This Scoping Study was commissioned by the City of Canada Bay in order to investigate whether a river pool structure at Rhodes East is potentially feasible. The purpose of this report will be to inform decision-makers of the viability of the project to progress to next implementation stages.

This study of the river pool has been identified as a component of the draft *Rhodes East Priority Investigation Area - Structure Plan Report*. The river pool has been proposed in order to create opportunities for recreational activities that will accommodate the expected increase in urbanisation in Rhodes. The river pool will also likely augment the objective set by Parramatta River Catchment Group (PRCG) to make the ‘Parramatta River Swimmable Again by 2025.’

Preliminary consultation with key stakeholders has informed this study. Stakeholders that were consulted included RMS, Sydney Water, PRCG and City of Canada Bay. It is expected that the consultation process will be expanded to other parties and in higher detail at further stages of the project should it be deemed viable to proceed.

Two potential locations for the pool in Rhodes were nominated in the Structure Plan, one at the northern peninsula within Parramatta River, and the other in Brays Bay off the east of McIlwaine Park. Both locations were assessed under a multi-criteria analysis to determine their viability.

The optimal location selected for the river pool was influenced by a variety of criteria. The key criteria assessed in this study included consideration of transport access, available space, existing and future river use, sensitive environments, water conditions and benefits as a social structure.

Current land use differ between the two nominated locations with industrial zones identified at the northern peninsula and recreational zone at

McIlwaine Park. The structure plan proposes to adjust these zones to promote recreational use at both location.

In total, five structural designs were considered in conjunction with three different levels of water treatment methods.

It is expected that a fixed structure with an enclosed membrane will be the most appropriate design based on its feasibility as a structure and also budgetary expectations. The recommended water treatment method is expected to involve filtration and disinfection of the river water. Alternatively, potable water may instead be used as the main water source. The final treatment method may vary depending on water quality requirements and perceptions of standards in a river pool.

The river pool as a social structure will likely benefit the community through increased recreational and social activities. Potential benefits identified include enhance social environments, improvement of infrastructure and amenities, and increased tourism.

The key outcomes of the scoping study are summarised below:

- Existing water quality with consideration of local stormwater runoff, sewer overflow and sediment contamination suggests against directly using untreated river water or a simple netted swimming area
- The preferred location for the river pool is within Brays Bay off McIlwaine Park
- The recommended structural design option involves a fixed access platform with an enclosed membrane
- The recommended water treatment method involves filtration and disinfection of the river water

- The total infrastructure cost of the river pool based on recommended design and additional ancillary facilities is estimated to be in the order of \$10 million.
- As the quality of Parramatta River water improves over time, there is opportunity for a treated enclosed pool to convert to use natural river water without treatment, subject to river bed testing.

An example of a natural pool is Chiswick Baths which is an unpatrolled swimming area in Parramatta River. Water quality is suitable for swimming most of the time, but like the beaches, may be closed after heavy rain due to water quality not being considered safe for swimming.

1 Introduction

1.1 Background

Parramatta River is the main tributary of Sydney Harbour and despite once being the center of recreational activities in the 1950s, the majority of the river is currently polluted.

‘Our Living River’ is an initiative delivered by the Parramatta River Catchment Group (PRCG), which aims to improve the quality of Parramatta River. It is their vision to improve the water quality of the river to a level which will allow recreational activities such as swimming to frequently take place.

As a member of PRCG, and a supporter of the ‘Our Living River’ initiative, City of Canada Bay (CCB) is assessing the potential for a pool to be placed in Rhodes East within the Parramatta River. The vision is to make the river ‘swimmable’ again encouraging recreational activities within the river and also potentially treating and flushing the river water.

The river pool is one of the major components proposed in the work-in-progress *Rhodes East Priority Investigation Structure Plan*. The intent of the river pool in Rhodes East is to provide additional active recreational opportunity for the current and future residents that does not rely on the availability of green open space.

CCB has commissioned Arup to undertake a preliminary desktop assessment to scope the likelihood of a river pool existing in Rhodes East within site constraints and to provide associated pool design options.

This report documents the study processes and outcomes.

1.2 Locality

Rhodes is a Sydney suburb located approximately 16km west of Sydney CBD. The suburb lies on a peninsula between Brays Bay and Homebush Bay on the south bank of Parramatta River (refer to Figure 1).

Rhodes falls under the Local Government Area (LGA) of City of Canada Bay.

The study area for this report focused on Rhodes East, which is defined by the area to the east of Blaxland Road and the railway line.

There were two potential pool locations considered in this report. The first location was the body of water in the northern peninsula between Concord Road and Blaxland Road. The second location was to the east off McIlwaine Park in Brays Bay (refer to Figure 1 for more detail).

The two locations were identified within the work-in-progress Rhodes East Priority Precinct Structure Plan. Both were selected based on merit, given their close proximity to existing or new public transport nodes and alignment with new or existing open space.

These locations do not currently lend themselves to a netted natural river due to incompatibility of estuary marine environment with man-made river banks and also the likelihood of disturbance to riverbed soils that may contain contaminants.



Figure 1: Locality plan showing Rhodes East study area (in orange) (NSW Planning and Environment, 2016)

1.3 Study Objectives

The purpose of this report was to undertake a scoping study to inform decision makers whether a river pool is able to exist at either of the two locations identified by the work-in-progress Rhodes East Priority Precinct Structure Plan.

The study also included preliminary river pool designs that would enable swimming within site constraints, accompanied by high level capital and ongoing operational cost estimates.

1.4 Stakeholders and Consultation

There were a number of stakeholders that were identified in this study. The key entities identified are noted in the following table along with their potential interests associated with this project.

Table 1: Stakeholder interest and consultation

Stakeholder	Interests (Impacts and Opportunities)	Contact
Sydney Water (SW)	Water network management and improvement	Yes
City of Canada Bay (CCB)	Main driver of river pool project in support of swimmability and also precinct plan	Yes
Parramatta River Catchment Group (PRCG)	Vision to improve swimmability and recreational activities in Parramatta River	Yes
Roads and Maritime	Partial owner and management of	Yes

Services (RMS)	transportation within river	
NSW Environment Protection Agency (EPA)	Ecology and heritage and other environmental constraints	No
Community Associations	Interaction with recreational and conservation activities	No
General Community	Perception on spending and benefits	No

Initial consultation with CCB, PRCG, SW and RMS took place in the form of phone discussions and face-to-face meetings.

CCB, PRCG and SW consultations have generally exhibited positive support for river pool. Support was related to the prospect of improving water quality and also increasing recreational activity within Parramatta River and Rhodes.

A key finding from the RMS consultation was that RMS would be strongly opposed to a new river pool at the northern end of the Rhodes East peninsula due to the additional hazard presented from being close proximity of a proposed new ferry wharf and existing navigational channel. RMS also confirmed that as landowner of the seabed they would need to be consulted during the planning approvals process and some form of leasing arrangement to be agreed (with a likely relatively small annual leasing fee).

The feedback from the contacted stakeholders were taken into consideration in the development of this scoping study.

No consultations were made with EPA or other environmental planning agencies as their involvement will likely be more constructive with a more developed design and with a formalised consultation/legal group.

Consultation with the community parties will also be more effective once a comprehensive list of stakeholders have been identified and when river pool has been considered feasible.

Should a river pool be found to have capacity to exist in Rhodes East, the pool concept will be put on public exhibition for community comment as part of draft Rhodes East Priority Precinct plans.

Additional stakeholders identified in further stages would also be consulted.

2 Case Studies

Research and design of foreshore pools can be considered an emerging innovation. In terms of typology, most of the designs can be classified into edge, floating or fixed pools.

Edge pools are usually characterised by the extension of its physical structure off the land and supported over a body of water. The pool and its supporting jetties are usually fixed.

Floating pools are structures placed within water bodies with the freedom to move vertically. They will be able to float up and down with the changing waves and tides.

Fixed pools also sit on top of water bodies, however, unlike floating pools these structures are fixed to its foundations. This restricts any movement both vertically and horizontally. As such, its depth above water will vary with water levels.

There have been a few studies and designs completed locally and internationally in relation to foreshore recreational pools. The following section compiles relevant case studies around the world where a foreshore/river pool has been considered. The case studies can be used to contextualise the concept of river pools, especially in its proposed location on Parramatta River.

Based on the choice of final design, different features of these existing studies and designs can be applicable to the proposed river pool in Rhodes East. The relevance of each case study to the design options in Section 7 are also be noted.

The following case studies along with a few others are also summarised in Appendix A.

2.1 +Pool (Plus Pool)



Figure 2: Plus Pool (Conceptual), New York (WeUrbanist, 2016)

The Plus Pool in New York is a conceptual 50m by 50m ‘Plus’ shaped floating pool made of a concrete structure.

The filtration concept put for this concept design proposes to pass river water through concentric filtration layers and systems.

The suggested capacity is 2886 people per day.

Status: Concept

Relevance: The pool’s intended environment is quite similar to Rhodes. The design incorporates significant filtration systems in order to treat the river water which is currently in poor quality.

This case study is similar to Option 3b and 3c.

2.2 Harbour Baths at Island Brygge



Figure 3: Copenhagen Harbour Bath, Copenhagen (e-architect, 2016)

The harbour bath in Copenhagen consists of 5 pools including swimming and diving pools. The design of the pool itself consists of interconnecting decks that form around the baths/pool.

The water used is sourced directly from the river. There are no filtration systems as the pool is not enclosed and river water can flow freely underneath the decks.

It can support up to 600 people at any given time.

Status: Completed

Relevance: The baths currently use river water which is untreated. This example may have high relevance especially in the future, when water quality at the pool site has improved to 'swimmable' standards.

This case study is structurally similar to Option 3a.

2.3 Dun Laoghaire Harbour Floating Pool



Figure 4: Dun Laoghaire Harbour Floating Pool (Conceptual), Dublin (Windsorstar, 2016)

The floating pool in Dublin is a 250m² floating pool made of a recycled cargo barge.

The pool has additional amenities including café, guard building, changing facilities and maintenance/admin building.

The estimated construction cost of this pool is 2.5M euros (or ~\$3.7M AUD)

The pool uses potable water as its water source.

It can support up to 125 people per day.

Status: Under construction

Relevance: This pool is structurally comparable and its water source and treatment may be relevant if potable water is used.

This case study is similar to Option 1.

2.4 Andrew (Boy) Charlton Pool



Figure 5: Andrew (Boy) Charlton Pool, Sydney (TripAdvisor, 2016)

The Andrew (Boy) Charlton Pool is located on the shore of Woolloomooloo Bay. It is broadly classified as an edge pool, as it extends from the edge of the land. In principle, it is a conventional pool supported by jetties.

The pool uses salt water from Woolloomooloo Bay that is chemically treated to increase water quality. The pool is also heated in order to normalise temperatures especially during winter.

Status: Completed

Relevance: The pool represents an edge-pool that is viable structurally, but at a greater relative cost to other design options. Depending on the final design many aspects of this pool may have high relevance including structure, water usage, treatment and disposal.

This pool shares similar features to Option 2.

2.5 Yarra Pool



Figure 6: Yarra Pool (Conceptual), Melbourne (Picture Plane / Studio Octopi / Yarra Swim Co, 2016)

The Yarra Pool is located along Yarra River in Melbourne's CBD between Kings Bridge and Queens Bridge.

The likely dimensions of the pool will be 15m x 50m x 3m (depth). A fixed piling foundation will restrict movement, hence making this a fixed river pool type.

The pool will use clean saltwater from below the dirty freshwater. The saltwater will be recycled back into the river to improve river water quality.

Status: Concept

Relevance: This pool has high relevance due to its use of river water and structural design.

This pool shares similar features to Option 3b.

3 Pool Specification

Following discussions with CCB, the following outline the specification for a potential river pool have been adopted for this study.

3.1 Functional Requirements

It is anticipated that the dimensions of the areas dedicated for recreational swimming will be based on the specifications below. However, it is not anticipated that the pool will be of conventional pool design.

- Multi-purpose pool suitable for lap and recreational swimming, which can be used by people of all ages and abilities.
- Lap pool: 25m length, 2.5m lane width, minimum 1.2m water depth.
- Play/children's pool: 5m x 10m, 0.2m-0.5m water depth.
- Design life: 30-50 years.

3.2 Ancillary Facilities

- Ticketing area.
- Small kiosk.
- Toilet and change room amenities.
- Seating areas with shade sails.
- Lighting around the pool.



Figure 7: Photograph of Cabarita Swimming Lap Pool (source: CCB).

3.3 Pool Water Quality Standards

For public swimming pools regulated by NSW Health, the following water quality standards apply¹:

¹ 2013, NSW Health, Public swimming pool and spa pool advisory document, <http://www.health.nsw.gov.au/environment/Publications/swimming-pool-and-spa-advisory-doc.pdf>

- The temperature of the water must not exceed 38 degrees Celsius.
- A pool must be fitted with an automated or a continuous metered disinfectant dosing system. A pool must be disinfected with chlorine or bromine.
- The pH level of the water must be, in the case of a chlorine disinfected pool, between 7.0 and 7.8
- The alkalinity of the water must be between 80 mg/L and 200 mg/L.
- Microbiological criteria:
 - Heterotrophic plate count < 100 cfu / 1 mL of water sample
 - Escherichia coli (E. coli) < 1 cfu / 100 mL of water sample
 - Pseudomonas aeruginosa < 1 cfu / 100 mL of water sample

A number of other water quality requirements are specified for monitoring.

As this pool is intended to be located in the river, the regulations pertaining to commercial indoor or outdoor swimming pools are not expected to be fully applied. As such, the water quality requirements for swimming in open water pools in Sydney harbour/marine water has also been considered:

The ANZECC guidelines comprise community-based environmental values and their associated national criteria. The Water Quality Objectives provide the trigger values for NSW rivers and estuaries to assist with water quality planning and management. In particular, the trigger values relating to primary contact recreation are applied relating to ‘maintaining or improving water quality for activities such as swimming in which there is a high probability of water being swallowed’.

Under the ANZECC guidelines for primary recreation the following trigger values apply:

Table 2: Water quality objectives for primary contact (ANZECC 2000 Guidelines)²

Indicator	Numerical criteria (trigger values)
Turbidity	6 NTU
Faecal Coliforms	Median faecal coliform density exceeds 150 colony forming units per 100 millilitres (cfu/100mL) for five samples taken at regular intervals not exceeding one month
Enterococci	Median over bathing season of < 35 enterococci per 100 mL
Algae & blue-green algae	< 15 000 cells/mL
pH	5.0 – 9.0
Temperature	15°-35°C for prolonged exposure.

² Water quality objectives for Sydney Harbour and Parramatta River - <http://www.environment.nsw.gov.au/ieo/SydneyHarbour/report-03.htm>, accessed 25 July 2016

Chemical contaminants	<p>Waters containing chemicals that are either toxic or irritating to the skin or mucus membranes are unsuitable for recreation.</p> <p>Toxic substances should not exceed the concentrations provided in tables 5.2.3 and 5.2.4 of the ANZECC 2000 Guidelines 2000.</p>
Visual clarity and colour	<p>Natural visual clarity should not be reduced by more than 20%.</p> <p>Natural hue of the water should not be changed by more than 10 points on the Munsell Scale.</p> <p>The natural reflectance of the water should not be changed by more than 50%.</p>
Surface films	<p>Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour.</p> <p>Waters should be free from floating debris and litter.</p>

Further discussion would be required with key stakeholders and include NSW Health in relation to the regulations applicable to the pool. It is expected that if the pool is open for public use, and located within the River, that the ANZECC guidelines would be applied.

3.4 Other Considerations

- The pool facility should be commercially viable to Council, with none to minimal subsidising of operating cost required. Further details of required subsidy detailed in Section 8.1.
- The pool location should consider accessibility to public and private transport linkages.
- Consider potential for additional usage e.g. retractable cinema screen for open air film viewing in order to generate additional revenue and to maximise usage of the river pool structure when not open for swimming.

4 Planning Context

4.1 Land Use

The land use in Rhodes East has been determined using zoning plans from the Canada Bay Local Environmental Plan (LEP) 2013.

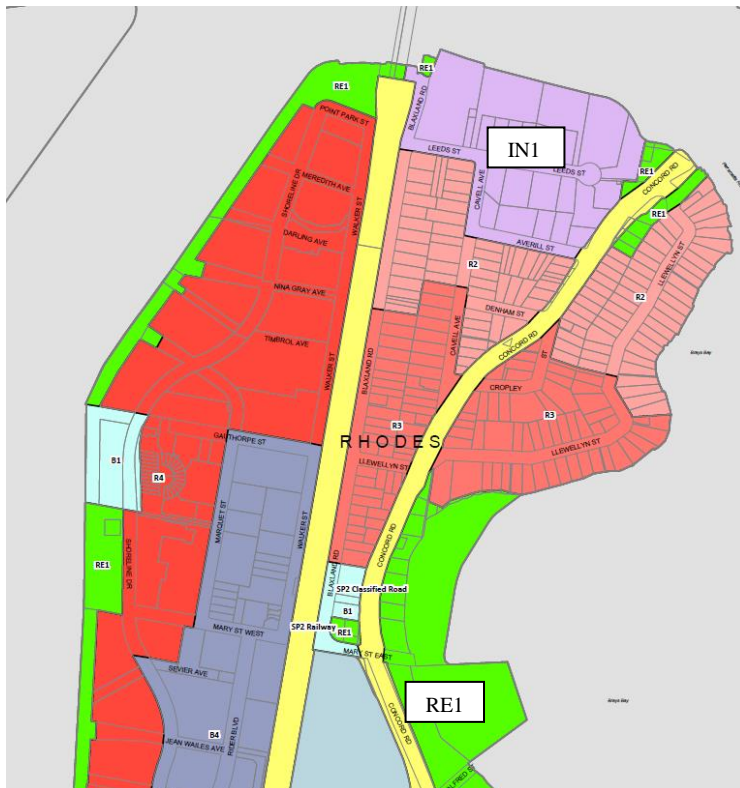


Figure 8: Land use map based off City of Canada Bay LEP 2013

The zoning map (Figure 8) has indicated that the potential pool location in the northern peninsula is categorised as IN1 (General Industrial). The other potential location to the east of McIlwaine Park is identified to be near a RE1 zone (Public Recreation).

At the northern location, the pool will likely clash with the industrial developments under the current zoning configuration. On the other hand, the eastern location will be quite suitable as the pool will be located near a public/recreational zone.

It is understood that the Structure Plan for Rhodes East Priority Investigation Area proposes adjustments to the land use zones which will accommodate and complement the river pool at their potential locations. Should the draft Rhodes East structure plan change the zoning of the Industrial area to the north of Rhodes Peninsular, this location could lend itself better for a river pool location. (This will be further discussed in Section 4.6.)

4.2 Land Ownership

Land ownership within Rhodes is distributed between the following entities:

- Crown land
- Council community land
- Council operational land
- Other land – various owners

The northern peninsula is not currently owned by the state or local government, plans to build a river pool under the Structure Plan will require purchasing of private land. The rezoning of this foreshore area into will complement the floating pool.

In the eastern location near McIlwaine Park, the current public space is considered Crown land. The use of the land will need to meet regulations set by the State Government in order to be leased or sold, although control or access may be directly granted to council for management. Council will need to seek approval from Crown reserve managers for the installation and use of the river pool and its associated facilities.

It is important to note that changes proposed in ‘*Crown Lands Legislation White Paper*’ may alter legislation in the near future especially in regards to the process of approvals and the overall management structure of Crown Land.

Roads and Maritime Services is the land owner of the river below the Mean High Water mark.

4.3 Environmental Planning

4.3.1 Local Environmental Plan

The Local Environmental Plan (LEP) is an important planning mechanism which aims to protect biodiversity. The key areas in Rhodes to consider existing biodiversity are likely under RE1 and SP2 zoned areas, although smaller areas of concern have also been identified in other areas.

There are a variety of legislations that must be used in conjunction with the LEP in order to identify restraints to development.

The development of the river pool will need to consider zoning including recreation, residential to waterways.

Additional environmental and legislative assessments will be required at further stages of the development.

4.3.2 Sydney Regional Environmental Plan (SREP)

The *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005* sets out aims for the management of the lands included in the catchment area including the Rhodes foreshore.

It has been noted in the SREP that the building of swimming pools in the waterway at either locations are forbidden as they do not immediately match the objectives set for the respective zones. At Location 1 a W1 maritime water zoning has been assigned, whilst at Location 2 a W2 environmental protection is assigned.

However, due to the predicted public benefits attached with the installation of the river pool, the development may still be approved for aligning with the broader objectives set in SREP. Formalised consultation with the Department of Planning will be required in order to potentially override the clauses stipulated in the SREP.

It is also important to note the Andrew Boy Charlton edge pool currently exists over a W2 zone despite its conflict with SREP. This case study may be referred upon for planning purposes and during the relevant consultations.

4.3.3 Biodiversity Legislation

A series of assessments and approvals will be required under *Environment Protection and Biodiversity Conservation Act 1999*. A major focus with relevance to CCB LGA will be the presence of a range of terrestrial, wetland and marine bird species. The *Threatened Species Conservation Act 1995* should also be considered with further threatened and endangered species that must be accounted for during the development of the pool.

4.4 Demographics

Demographics of the local area may assist in the planning of the pool. A comparison of the demographic of Rhodes with Cabarita and Drummoyne (location of the other local pools) can provide assist in planning factors such as patronage, pricing and also car spaces.

The following relevant statistics are based on the Australian Bureau of Statistics 2011 Census:

Table 3: Rhodes demographic and relevance of statistics (ABS, 2011)

Category	Rhodes	Cabarita	Drummoyne	Relevance
Population	5,679	1,928	11,378	Patronage, car spaces
Average motor vehicles per dwelling*	1.2	1.8	1.4	Car spaces required
Median weekly household income	\$1617	\$2435	\$2148	Patron willingness to pay

* Due to the framing of survey questions the exact number of vehicles per dwellings may be differ

Amendments can be made to forecasted pricing, car spaces and patronage numbers based off relative differences between the demographics of the three suburbs.

Patronage should reflect an average of visitors of the other two pools based on the assumption there is a direct correlation between local population and visitors. The prices set for the new pool should be dropped due to the relatively lower disposal income of each household. Car spaces required are expected to be less than the Drummoyne swimming centre and similar to car parking spaces at the existing Cabarita pool.

Current comparisons only consider the suburbs in which the pools are located, however, broader catchments based on factors such as proximity and accessibility will skew the analysis above. The 2016 Census will also provide a more up-to-date demographic of Rhodes. At further stages of approval and design and the new data and detailed demographic analysis of the broader catchment should be conducted and incorporated.

4.5 Rhodes East Structure Plan

The draft Structure Plan developed by NSW Planning and Environment and CCB and included proposed spatial adjustments within Rhodes East in order to meet future planning objectives in the area.

The draft plan has nominated the two locations used in this study with plans to rezone surrounding areas to increase public and recreational use. At both locations, the river pool appears capable of complementing the proposed areas under the master plan.

The major items on the plan that may enhance the development of the river pool include the east to west foreshore walk, the Leeds Street Plaza and also the pedestrian access. An excerpt of the draft plan is shown in Figure 9.

The planned foreshore walk from Rhodes East to the western foreshore aims to improve the public's access to the water, which is currently impeded by



residential and industrial developments. The foreshore walk will likely promote pedestrian traffic along the foreshore as well as access to the river pool at either location.

If a river pool is to be further pursued, the pool's design, access and surrounding amenities will need to be considered in more detail as part of the structure plan or detailed master planning of the precinct.

The river pool and Structure Plan has significant impacts over one another, and therefore both must be considered together at each stage of development.

5 Site Conditions

5.1 Transport Access

5.1.1 Road Networks

Rhodes East is served by a number of roads and bridges. Ryde Bridge is the main connector between suburbs to the north and south of Parramatta River and currently connects Rhodes to Ryde.

There are also three main east-west links close to Rhodes and they are Victoria Road located in the north and Parramatta Road and M4 which are both to the south.



Figure 9: Concord Road intersection near Location 2

Concord Road shown in Figure 9 is one of the main roads in Rhodes East which provides access to side roads leading to both potential locations of the river pool.

Leeds Street will provide the closest access to Location 1 in the northern peninsula. Concord Road and Mary Street will provide nearest access to Location 2 in McIlwaine Park/Brays Bay Reserve.

5.1.2 Parking

Parking is available in Rhodes at various locations near the potential pool locations and also in Rhodes CBD.



Figure 10: Car park on Mary Street near Location 2

At Location 1, there are currently parking spaces west of the rail line with a mixture of parking restrictions. At the northern end of Blaxland Road is also

a car park with approximately 14 car spaces. Limited street parking spaces are also available along nearby streets including Leeds Street. Importantly, the available spaces may change as the draft Structure Plan proposes the Leeds Street Precinct to be an active transport and public transport precinct with no provision for public car parking.

Location 2, is close to two major car parks. The closest car park is on Mary Street in Figure 10 and consists of two major lots with moderate amount of parking which also services a nearby restaurant, Brays Bay Reserve as well as for pedestrians walking the Kokoda Track Memorial Walkway.

There is also a parking lot to the south of McIlwaine Park which is mainly used for the Kokoda Track Memorial Walkway which runs along the foreshore.

Rhodes Waterside Shopping Centre also provides 2400 parking spaces and can be accessed off major roads including Homebush Bay Drive and Rider Boulevard. The parking is free for the first 3 hours.

A 'Car Sharing Scheme' is currently implemented in Rhodes, whereby cars can be borrowed from designated parking spots. These parking spaces and rental cars can be used in conjunction with public transport for access throughout Rhodes.

The proposed extra car park requirements that are expected in the new river pool is estimated at about 35 based on expected patronage and comparison to existing parking spots at the other two local pools. At Location 2, the existing parking spots may have capacity to be augmented and increased to accommodate extra visitors to the swimming.

5.1.3 Public Transport

Rhodes is currently served by a variety of public transport modes including buses, trains and ferries.

A typical bus stop located on Concord Road near Location 2 is shown below in

Figure 11.

The main bus routes in Rhodes includes:

- M41, 459, 533 (along Concord Road)
- M41, 459, 533 (to Top Ryde)
- M41, 459 (to Macquarie University and Business Park)
- 533 (to Chatswood and to Sydney CBD)



Figure 11: Bus station on Concord Road

There is also currently a community bus ('BayRider') which operates to assist those in the community with transport difficulties.

Rhodes has a railway station on the Northern line of Sydney Trains network. The Northern line provides direct transport to and from the Sydney CBD as well as access to all other suburbs within the Sydney Trains network.

To an extent, Rhodes also has a ferry service provided by Sydney Ferries. The ferry is located on Meadowbank Ferry Wharf and provides transport to/from the City as well as Parramatta.

5.1.4 Walking and Cycling

Rhodes is accessible through a variety of footpath and shared pedestrian-cycleways.

A shared pedestrian cycle path runs from Rhodes to Silverwater Bridge, with some areas that are on-road bike lanes. The shared cycleway provides access to Wentworth Point, Liberty Grove, Bicentennial Park, Wentworth Common as well as the Parramatta river foreshore.

Another major cycleway in Rhodes links up Ryde Bridge with Rhodes Park. The shared cycle way provides access to McIlwaine Park, Brays Bay Reserve and Rhodes Park. This cycleway can also provide access to Concord Hospital and onto Majors Bay Reserve.

The Kokoda Track Memorial Walkway (Figure 13) also provides a walking track from the south of Rhodes into Brays Bay near Location 2

Bike racks are also available on a number of streets in Rhodes including the following locations:

- Hospital Road near Freemont Street.
- Concord Road at the end of Hospital Road.

- McIlwaine Park along the shared cycleway / walkway.
- Blaxland Road near Rhodes Railway Station.
- Walker Street near Rhodes Railway Station.



Figure 12: Kokoda Track Memorial Walkway

5.2 Existing River Water Quality

Interim water quality data has been obtained from grab samples at the two proposed locations. The interim water quality data has been analysed against the requirements for swimming as defined by the ANZECC 2000 guidelines. This analysis is summarised in Table 44 (next page) which compares the requirements against sampled data.

Table 4: Assessment of water quality samples with ANZECC 2000 Guidelines for primary recreation

Parameter	Unit	WQ Requirement	Location 1	Location 2
Turbidity	NTU	6	5.17	3.18
Faecal coliforms	cfu/100mL	<150cfu/100mL	1000 ³	870 ²
pH		5.0 – 9.0	7.9	7.9
Algae	Cells/mL	< 15000 cells/mL	Not sampled – Indicator nutrients were sampled to assess likelihood for algal blooms. TN – 0.6mg/L TP – 0.043mg/L	Not sampled – Indicator nutrients were sampled to assess likelihood for algal blooms TN – 0.6mg/L TP – 0.042mg/L
Temperature	°C	15-35	Typical <35	Typical <35
Chemical contaminant	Multiple		Tests have come back negative for toxic substances including Total Petroleum Hydrocarbons, pesticides, PCBs	Tests have come back negative for toxic substances including Total Petroleum Hydrocarbons, pesticides, PCBs
Visual Clarity and Colour	HU		3	4
Surface films and debris	mg/L (measured as free oil)	No visible film, typically <5 mg/L	<5	<5

³ Total coliforms measured.

Total coliform bacteria are common in the environment (soil or vegetation) and are generally harmless. Faecal coliform bacteria are a subgroup of total coliform bacteria. They exist in the intestines and faeces of people and animals. The sample data indicates that there is a potential that the faecal coliforms could exceed the water quality requirement and represent a potential risk to primary recreation.

The E. coli concentration as sampled at the two locations were found to be 60 and 81 orgs/100mL respectively. These concentrations are within the range typically accepted for primary recreation. As an example, the E. coli water quality limit in Victoria for primary recreation is <200 orgs/100mL.

In general the water quality meets most of the requirements for primary recreation activities (i.e. swimming) without treatment. The principal concern regarding treatment and water quality will remain the potential variability in water quality due to storm events and potential sewer overflows and the resulting microbiological concentrations with the potential to cause illness. Secondly, it is understood that the sediment on the River bed may be contaminated in the area and the location of a pool in the area should consider the potential to mobilise these pollutants and the risk to swimmers.

5.2.1 Sewer overflows

Sydney Water has provided information relating to sewer overflows to assess the level of risk to water quality in the vicinity of the two proposed pool locations. The data provided contained all modelled overflows in terms of location, frequency in 10 years, volume (ML) in 10 years, upstream of Putney.

The data indicates that there are a large number of sewer overflows upstream of the proposed pool locations. As a result there is a risk for

increased microbiological contamination, particularly during and immediately after storm events which could lead to poor water quality.

Furthermore, there are at least four overflow locations within the vicinity of Location 2 which increases the risk of localised spills and therefore reduced water quality. The frequency and volume of spills modelled over the last 10 years from these locations have been summarised in the table below.

Table 5: Sewer overflow locations, frequency and volume in vicinity of Location 2

Overflow Location No.	Frequency (last 10 years)	Volume (ML) (last 10 years)
1378611	13	4.03
1378299	3	0.22
1382136	2	0.047
1379160	13	4.68

The data indicates that there is a high risk of sewer spills near Location 2 occurring as often as every year. Therefore, it is expected that the faecal coliform quality is expected to exceed the water quality requirements at times during the year, being influenced significantly from local sewer spills, and to a lesser extent from sewer overflows occurring upstream.

5.3 River Water Level Variations

5.3.1 Astronomical Tides

The following astronomical tide levels in Table 66 are taken from the Australian National Tide Tables (2016) for Fort Dennison, which is sufficiently close to Rhodes East (approximately 13km eastwards) to reasonably adopt for the project.

Table 6: Astronomical Tidal Plain Levels at Fort Dennison, Sydney

Tide Levels	(m CD ¹)	(m AHD)
Highest Astronomical Tide (HAT)	2.10	1.17
Mean High Water Springs (MHWS)	1.60	0.67
Mean High Water Neaps (MHWS)	1.40	0.47
Mean Water Level (MWL)	1.00	0.07
Mean Low Water Neaps (MLWN)	0.60	-0.33
Mean Low Water Springs (MLWS)	0.40	-0.53
Lowest Astronomical Tide (LAT)	0.00	-0.93

1. CD = Chart Datum which approximates to LAT and is about 0.93m below AHD.

5.3.2 Extreme Water/Flood Levels

Present day extreme still water levels at Fort Denison based on a statistical analysis of measured historical records are provided in Table 77 below based on Watson P.J and D.B Lord (2008), “*Fort Denison Sea Level Rise Vulnerability Study*”, a report prepared by the Coastal Unit, NSW Department of Environment and Climate Change. The extremes analysis is based on water level data measured continuously at Fort Denison for over 100 years. The data reflects the astronomical tide levels as well as anomalies or variations from the predicted tide from storm surge and freshwater flows (assumed very minimal at the site).

Table 7: Extreme Water Levels at Fort Dennison, Sydney (present day)
2

Average Recurrence Interval (ARI) (years)	(m CD ¹)	(m AHD)
1	2.17	1.24
10	2.28	1.35
50	2.34	1.41
100	2.37	1.44

1. CD = Chart Datum which approximates to LAT and is about 0.93m below AHD.
2. From Watson P.J and D.B Lord (2008), *Fort Denison Sea Level Rise Vulnerability Study*.

The contribution of fluvial flooding to extreme water levels can be assumed to be non-governing as the tide-surge components will dominate at the lower reach of the Parramatta River where the study site is located (Lower Parramatta River Flood Study, 1986).

5.3.3 Sea Level Rise Allowance

A projected future sea level rise allowance from climate change is discussed in Section 10.1. Over the design life of the pool a sensitivity assumption of 0.4m should be adopted when considering typical and extreme (flood) scenarios).

5.4 Wave Climate

Waves impacting the site are assumed to consist of local wind-generated waves, and wake from passing recreational and commercial vessels.

Wind-generated wave disturbance in the river is generally limited to a significant wave height of around 0.5 metres with peak period of 2 to 3 seconds for up to a 500 year Average Recurrence Interval (ARI) event.

As part of a previous investigation for small craft berthing facilities at Walsh Bay (Water Research Laboratory), typical wave heights and periods from passing vessels were observed and recorded. The following in Table 8 are some typical boat wash amplitude and period measurements.

Table 8: Typical Vessel Wash Characteristics in Unrestricted Waters

Vessel Type	H_{max} (metres)	T_s (seconds)
Power Boat	0.35	3.0
First Fleet Ferry	0.62	3.0
Contractor's Workboat	0.55	2.5
Commercial Fishing Boat	0.40	2.5
Harbour Charter Boat	0.35	2.7
Small Police Boat	0.30	1.8
Large Police Boat	0.72	2.5

In addition to these shorter period wash waves, it has been observed that vessels such as the high speed catamaran ferries, when travelling at normal cruise speed, have a bow wave of about 6 seconds, albeit with relatively small amplitude of 0.15m to 0.20m.

5.5 River Currents

Currents along the Parramatta River are dominated by tidal/coastal surge currents, and to a much lesser degree fluvial currents. At the lower reach of the Parramatta River where the study site is located current velocities are relatively low, and can be considered to be less than 0.5m/s in the centre of the channel, and lower at the river banks and bays.

5.6 River Water Depths

Figure 14Figure 13: Extract of AUS Chart 203 (Australian Hydrographic Service showing approximate river water depths within the study area at Chart Datum which approximates to Lowest Astronomical Tide). provides an indication of river water depths within the study area at the Lowest Astronomical Tide (LAT) level. At the northern boundary of the Rhodes East peninsula along the main river channel, the 2m depth contour is approximately 50m offshore, and the channel centre less than 5m in depth. Within Brays Bay water depths are generally less than 1.5m, with around 0.6m depth (1.0m at Mean Low Water Springs) 100m offshore from the western foreshore and 1.0m depth (1.4m at Mean Low Water Springs) 250m offshore.

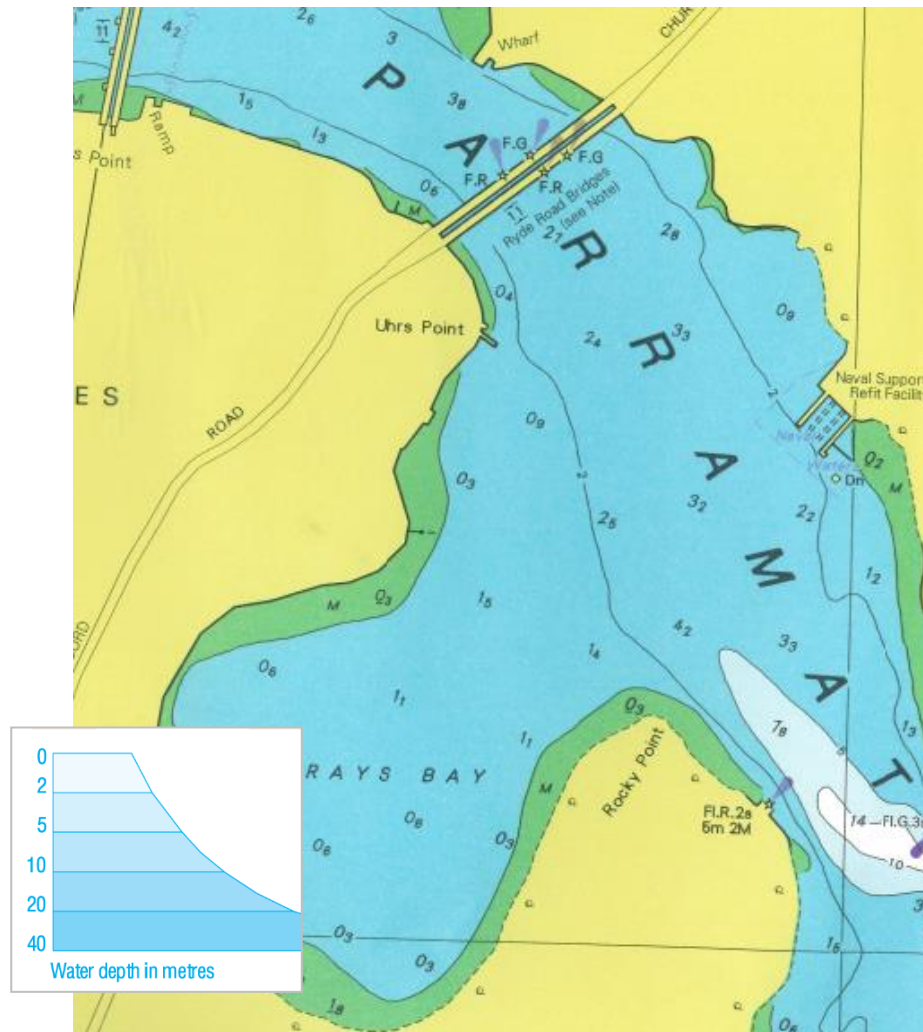


Figure 13: Extract of AUS Chart 203 (Australian Hydrographic Service showing approximate river water depths within the study area at Chart Datum which approximates to Lowest Astronomical Tide).

5.7 Landside Topography

Rhodes East Peninsula has a relatively flat topography. Near the water's edge a level of approximately 2-2.5m AHD is assumed.

5.8 Shoreline Edge Treatment

The shoreline along the northern perimeter is characterised by an engineered sandstone block seawall structure (Figure 14).

The shoreline along Brays Park Reserve is characterised by an engineered seawall consisting a grouted rock face (Figure 15).



Figure 14: Seawall along northern perimeter of East Rhodes Peninsula



Figure 15: Seawall along Brays Park Reserve

5.9 Services and Utilities

The existing services and utilities in the study area were sourced from Dial-Before-You-Dig (DBYD) databases. A variety of underground utility has been identified using this methodology and will need to be considered when designing the pool and its connecting utilities.

The construction and operation of the floating pool will likely involve water and wastewater infrastructure as well as telecommunication and electrical utilities. However, all utilities must be considered to ensure they are not damaged during excavation/construction, utility designs do not clash and sufficient cover between utilities is achieved.

The connectivity of the pool utilities to existing utilities will require further assessment especially to determine capacity issues.

Where appropriate, detailed surveys will be required in order to gather more accurate information on utilities in the study area.

It is also important to note, with the proposed rezoning in the Structure Plan, existing utilities may be diverted and/or removed prior to the construction of the pool.

The following services and utility checks are based off DBYD plans sourced on the 14th July 2016.

5.9.1 Telecommunications

DBYD plans indicate the presence of a major Optus optic fibre line along Concord Road and another along Blaxland Road. These utilities will likely have minimal impact on the development of the river pool, but may be important for connectivity.

5.9.2 Water/Stormwater/Sewerage

DBYD plans at Location 1 identified sewerage pipes running east-west across the industrial zone and connecting to Blaxland Rd and John Witton Bridge. Water mains and sewerage pipes were identified along Leeds Street. Stormwater pipes also run along the industrial development and also discharges into the northern peninsula to the east of the potential pool location.

At Location 2, DBYD plans indicated sewerage pressure mains running along the west of McIlwaine Park. A pumping station is also located on the eastern verge of Concord Road near the park. Water mains also run along Concord Road on both the eastern and western verges. Two stormwater

pipes at McIlwaine Park have been identified and both discharge towards the east into Brays Bay.

Connectivity and capacity assessments should be conducted at later stages of design. Gravity mains and pipes must also consider minimum grade from pool to point of connection.

It is expected that potable water will be used for ancillary facilities such as showers and therefore connections to water mains will be required. Potable water can also be used as the main source of water in Option 2 and Option 1.

Recycled water from the pool or sourced from stormwater tanks may be used for flushing of toilets and watering of park plants. It is likely that the used water from the pool will need to initially discharge into the sewerage system especially if chlorine is used as a disinfectant.

5.9.3 Power

Overhead and underground electrical power utilities have been identified in DBYD plans.

At Location 1, overhead cables run along Leeds Street at both northern and southern verges.

At Location 2, underground electrical cables are more prominent.

Connectivity options will need to be considered alongside further assessment of existing assets at the final pool location.

5.9.4 Gas

DBYD databases suggests that there are underground gas utilities along Leeds Street near Location 1.

At Location 2, gas network in its immediate vicinity have been identified along Llewellyn Street on the southern/eastern verge and also near the intersection of Concord Road and Llewellyn Street.

5.9.5 Geotechnical Conditions

The expected geotechnical conditions at the pool locations have been assumed using a combination of *Sydney Geological Map* scale 1:100,000 and a previous investigation in the western foreshore of Rhodes.

The geophysical stratum expected at the potential locations will include a layer of alluvium above a layer bedrock. The bedrock will likely include medium to coarse grained quartz sandstone, very minor shale and laminate lenses for bedrock. The alluvium layer will likely include silty to sandy clay.

A detailed geotechnical investigation will need to be undertaken in order to inform the detailed design of the floating pool. Such an investigation should include a geophysical survey below the pool location. Selected tests will need to identify the exact geotechnical stratum as well as compressibility characteristics of alluvial deposits and bedrock.

6 Pool Location Assessment

6.1 Criteria

The optimal location for a river pool is influenced by a range of criteria. The following criteria has been considered by Arup in assessing the preferred location:

- a) **Proximity to the existing road and public transport network.** Good public transport links are important to maximise patronage, especially as the pool will likely have limited private car parking options.
- b) **Potential impact on existing and future river users.** River users include ferry vessels, commercial vessels, recreational craft (motor boats and self-propelled vessels e.g. kayaks), and construction vessels.
- c) **Available space available for landside facilities.** Encroaching of open space will likely arise from landside ancillary facilities.
- d) **Protection offered from waves and currents.** This affects construction and serviceability of the pool. A certain level of protection is necessary for a viable location.
- e) **Potential impact on sensitive ecological and heritage areas.** Assessed using heritage registers and environmental protection maps.
- f) **Distance offshore to the required water depth for a floating system**
This influences the length of approach structures needed to the pool and therefore whole of life infrastructure costs and access distance for customers (less length is better). A water depth of at least 2m at all tides has been adopted as the minimum required. For the purposes of this study it has been assumed that dredging of the seabed to create closer

access to the shoreline is to be avoided. Although dredging could be deemed beneficial at further design stages of the project, dredging would likely trigger significant environmental approvals, and ongoing maintenance challenges to manage.

- g) **River water quality.** This is important for the option where river water is proposed to be utilised in pool operations from originally treated to the ultimate aim of converting to a naturally-flushed pool.
- h) **Sense of place for community.** This assesses the potential benefits of the river pool as a social infrastructure
- i) **Impact on existing landside usage** The river pool and its ancillary facilities may encroach on existing open space

6.2 Locations Considered

Two different pool siting locations along the East Rhodes foreshore have been considered, as proposed in the Rhodes East Priority Investigation Plan. These options are:

Location 1: At the northern end of Cavell Street adjacent to the main river channel (refer Figure 16).

Location 2: Within Brays Bay with access from McIlwaine Park (refer to Figure 17).

The two locations on plan are shown in Figure 18 and tagged as the number 6. The locations considered are to be considered with the planned rezoning as different features of the immediate environment may be altered in the future.



Figure 16: Location 1 along the northern peninsula of Rhodes



Figure 17: Location 2 near Brays Bay/McIlwaine Park



Figure 18: Siting locations considered for new river pool (source: Roberts Day 2016)

6.3 Assessment

A semi-quantitative multi-criteria assessment of the two pool location options has been undertaken to ascertain their feasibility. This assessment has considered both options against the criteria described in Section 6.1.

The outcomes of this assessment are presented in Table 9.

6.4 Discussion

Location 2 (Brays Bay) is a preferred option for many of the criteria. In particular, Location 2 would have a much lesser impact on existing and future river users than Location 1 situated along the main river navigation channel, and RMS has stated that they would strongly oppose this location for that reason.

The key criterion where Location 1 is optimal is regarding distance offshore to the required water depth for a floating system. The relatively shallow water depths in Brays Bay (<2m at low tide) may in fact preclude a floating pool system being adopted at that location (i.e. a pool on fixed foundations may be the only practical solution).

Table 9: Location options assessment matrix (1=higher preference, 2=lower preference)

CRITERION	LOCATION 1	LOCATION 2
	<i>At the northern end of Cavell Street adjacent to the main river channel.</i>	<i>Within Brays Bay with access from Mcllwaine Park.</i>
a) Proximity to the existing road and public transport network.	2	1
	Location is approximately 950m from Rhodes Train Station (about a 15 minute walk). The existing Meadowbank Ferry Wharf is location within 500m on the northern river bank. A new public ferry wharf on the southern river bank is proposed to be located less than 150m away. Bus stops along Concord Road within 400m.	Location is approximately 250m from Rhodes Train Station (about a 5 minute walk). A new public ferry wharf on the southern river bank is proposed to be located approximately 850m away. Good proximity to busses stopping along Concord Road. Bus stops along Concord Road within 150m.
b) Potential impact on existing and future river users.	2	1
	In initial consultation, Roads and Maritime Services (RMS) has indicated that they would be strongly opposed to positioning a river pool at this location due to its close proximity to the main river channel where ferries and other craft regularly transit. The pool in this location presents a potential hazard. Notwithstanding this, a navigation risk assessment would need to demonstrate that this risk could be adequately managed (e.g. with specific aids to navigation).	Brays Bay, particularly its western side is not regularly transited by vessels and therefore not likely to pose a significant impact on navigation. The bay currently provides a number of private boat moorings located approximately 200m offshore from the proposed pool location which need to be avoided.
c) Available space for landside facilities.	2	1
	Some landside space may be available within the proposed new master plan public domain for locating ancillary facilities. Space for new car parking would be limited.	The existing park provides space that may be able to be acquired for locating ancillary facilities and potentially a small number of car spaces.

CRITERION	LOCATION 1	LOCATION 2
	<i>At the northern end of Cavell Street adjacent to the main river channel.</i>	<i>Within Brays Bay with access from Mcllwaine Park.</i>
d) Protection offered from waves and currents.	2	1
	<p>This location is relatively close to the main river channel and therefore relatively exposed to long-period vessel wake waves. These vessel waves can adversely impact a floating pool and require adequate</p> <p>Wind-generated waves not likely to exceed approximately 0.5m in height during extreme storm event, and smaller during typical conditions.</p> <p>Tidal currents are not expected to be a governing design issue.</p>	<p>Brays Bay is relatively well protected from long-period vessel wake waves.</p> <p>Slightly more exposed to wind-generated waves due to the longer fetch across the bay than Option 1.</p> <p>Tidal currents are not expected to be a governing design issue.</p>
e) Potential impact on sensitive ecological and heritage areas.	1	1
	<p>Preliminary investigations have not identified any presence of sensitive ecological and heritage sites. Therefore unlikely to have a significant during construction or operation.</p>	<p>Preliminary investigations have not identified any presence of sensitive ecological and heritage sites</p>
f) Distance offshore to the required water depth for floating system	1	2
	<p>The distance offshore to the 2m water depth mark (at LAT) is approximately 50m.</p>	<p>Brays Bay is a relatively shallow water body and from the limited seabed levels information less than 2m. There is a risk therefore that a floating pool system is not feasible at this location.</p>

CRITERION	LOCATION 1	LOCATION 2
	<i>At the northern end of Cavell Street adjacent to the main river channel.</i>	<i>Within Brays Bay with access from McIlwaine Park.</i>
g) River water quality and natural flushing potential	2	1
	Sampled river water quality is similar to Brays Bay. Natural flushing potential is considered higher than Brays Bay, but water quality expected to be impacted by more frequent water craft and vicinity to pollution sources.	Similar water quality to main river channel. Enclosed bay may have less flushing than main river channel, however less impact from water craft and stormwater pollution
h) Sense of place for community	2	1
	This location has great potential to improve the sense of place for community with the proposed Leeds Street Plaza along the foreshore.	McIlwaine Park is already a popular social destination for the community and the installation of the river pool will greatly increase social networks in the area

7 Pool Concept Designs

7.1 Structural Design Options

7.1.1 General

This section outlines a range of potential design options for the river pool in terms of structural form and setout. A description of each option is provided below with accompanying conceptual plan and section sketches for each contained in Appendix B.

7.1.2 Option 1: Floating pool

Description

Successfully-implemented floating public pools around the world have generally been retrofitted/converted used steel cargo barges to suit as a cost effective option compared to custom-made. This option depends on the availability of a suitable vessel at the time (e.g. second hand river cargo or hopper barge vessel regionally or elsewhere e.g. Asia/Europe). Alternatively, a bespoke floating structure/pontoon could be fabricated.

If a bespoke pontoon, best whole of life cost would likely utilise steel or aluminium form rather than concrete. This could be fully fabricated in a drydock (e.g. Asia) and shipped/floated to site by sea. Alternatively it could be fabricated in parts and transported by road/sea and connected in-situ.

To manage wave overtopping, propose a nominal freeboard of 1000mm. A reduced freeboard may be possible if a wave return wall/barrier is adopted.

Options for effective movement restraint include:

- Guide piles
- Self-releasing anchor system (e.g. Seaflex)
- Fixed jack-up piled system
- A combination of the above.

Advantages

- Being tidal, there is a constant freeboard with the water at all tides creating an intimate user experience.
- Relatively easy to decommission/relocate.

Disadvantages

- Requires a minimum structural depth below water level (draught) of at least around 2-3m at all tides. This will therefore preclude this option at East Rhodes, especially in Brays Bay, due to the available water depth at low tide of <2m. Local deepening of the seabed to accommodate such a system could be an option however this has high environmental/planning approval risks and potential future maintenance dredging obligations.
- Structural maintenance obligations are likely higher than for a fixed structure. The floating pontoon structure would be effectively treated as a vessel and will therefore likely require annual inspection/survey in situ and 5-yearly inspection/survey and

maintenance in a dry dock. The pontoon will need to be disconnected from its moorings and floated to dry dock elsewhere in the harbour.

7.1.3 Option 2: Conventional pool on piled platform (edge pool)

Description

This option involves a conventional pool arrangement that would be created landside, but founded on top of a constructed piled platform over water near the edge of the shoreline, effectively reclaiming land. The piled platform would allow the pool basin to consist of a conventional concrete material form. The offshore piled platform effectively creates additional space beyond the shoreline to locate the pool minimising encroachment on existing land uses (although with some ancillary pool functions to be on land), and enhancing the user experience with water surrounds on 3 sides. A relevant example is the Andrew (Boy) Charlton Pool at the Botanical Gardens.

Advantages

- Tried-and-tested arrangement, with relatively low design and construction risk.
- Minimum maintenance obligations on structural elements.
- Not reliant on river tides so can be situated close to shore or any other desired location in the bay.

Disadvantages

- This is likely to be the most expensive capital cost of all options considered.

- Limited flexibility to augment from water treated to natural scenario.

7.1.4 Option 3A: Open baths with access platforms

Description

This option consists of utilising the river water directly for swimming with access provided with platforms. The platforms could be fixed (deck on piles), floating (with restraint piles or similar), or a combination of both. This arrangement would be similar to the existing open baths at other Sydney locations (e.g. Dawn Fraser Baths, Northbridge Baths, Watsons Bay Baths), and the Copenhagen example.

Advantages

- Least capital and whole of life cost of all options.
- Natural use of river without requiring water treatment – meets long term strategy of direct interaction with river.

Disadvantages

- Reliant on river tides – needs access to extend more than 100m offshore to be serviceable for the majority of low tidal conditions.
- No control of river water quality.
- No/limited control of temperature and natural waves/currents.

7.1.5 Option 3B: Enclosed baths with impermeable basin

Description

This option would have a similar set out to Option 3A, however the swimming area within the access platforms would be fully segregated from the river water to allow water treatment and control. This would be proposed to be achieved by installing an impermeable basin to the support piles of the platform with intermediate span supports potentially also needed. More design development would be needed to determine the optimal structural solution for the basin, although might consist of an impermeable flexible membrane, or a rigid fibreglass or marine grade plastic.

Advantages

- Compared to Option 3A, allows control of water quality and temperature (if desired).
- Has flexibility to relatively easily revert to an open bath system (Option 3A) in the future should river water quality improve.
- Similar functional outcomes as Option 2, but with likely lower capital cost.

Disadvantages

- Reliant on river tides – needs access to extend more than 100m offshore to be serviceable for the majority of low tidal conditions.
- Relatively higher capital and operating costs than Option 3A.
- More complex design of the enclosed pool basin than Option 2.

7.1.6 Option 3C: Enclosed baths with permeable membrane

Description

This option is very similar to Option 3B, except that the pool basin would be formed by an impermeable flexible membrane which is specially designed to act as a passive water treatment filter of the outside river water. This membrane treatment system is very similar to the NYC Pool Plus proposal.

Advantages

- No requirement for water treatment infrastructure and operations.
- Has flexibility to relatively easily revert to an open bath system (Option 3A) in the future should river water quality improve.
- Similar functional outcomes as Option 2, but with likely lower capital cost.

Disadvantages

- Reliant on river tides – needs access to extend more than 100m offshore to be serviceable for the majority of low tidal conditions.
- This type of permeable membrane system for passive water treatment is a relatively new concept with limited examples of being proven in the field. Feedback from CCBC is that it is unlikely that CCBC would be in a position to accept this high design risk.

7.2 Water Treatment Options

The treatment options for the pool have been considered based on the river water quality, pool use and availability and the potential form of the pool. Based on this, there are three potential options for treatment of the water. These are summarised in the table below:

Table 10: Water treatment options

Design Option	Treatment Requirement
<p>‘Natural’ river pool utilising river water without treatment.</p> <p>The pool is likely to be unsuitable due to poor water quality for extended periods during the year.</p> <p>Suitable for Option 1 and 3a</p>	<p>The water quality results generally indicate that the river meets the requirements for primary contact (namely swimming). However, the broader analysis of risks to water quality would indicate a high risk of poor water quality at various times through the year due to stormwater runoff and sewer overflows. As such, ‘no treatment’ is not likely a viable option for the pool in the short term.</p> <p>In-situ filtration, such as that proposed for the New York Plus Pool, may offer a suitable alternative to provide the level of disinfection required.</p>

Design Option	Treatment Requirement
	<p>Similarly, ‘natural’ water sensitive urban design elements have demonstrated low levels of removal of microorganisms and could be incorporated in to the pool form.</p> <p>With long term plans to continue to improve the water quality in the Parramatta River, this may become a viable option in the future.</p>
<p>Enclosed pool structure with water recirculation</p> <p>Suitable for Option 1,2 3b</p> <p>Advantages and disadvantages relating to this treatment option are provided below.</p> <p>Advantages:</p> <ul style="list-style-type: none"> • High quality water for swimming • Low risk to swimmers • High availability of pool 	<p>To achieve the water quality requirements on a consistent basis throughout the year, treatment is expected to be required. This would include media filtration and disinfection (generally with chlorine). Water would be recirculated through the filtration system and pool in a similar way to Council’s existing pools which are supplied from River water.</p> <p>With this arrangement, the pool may effectively become regulated by the NSW Health and required to meet the strict water quality requirements for Council’s</p>

Design Option	Treatment Requirement
<p>Disadvantages</p> <ul style="list-style-type: none"> High operating costs for recirculation, disposal to sewer and chemical consumption (chlorine) Reduces the 'natural' perception of the pool 	<p>existing pools. As a result, the pool becomes less like a River pool and ultimately just a pool in the River.</p> <p>The waste backwash and bleed from the treatment system would be directed to sewer. The chlorinated pool water would not be suitable for discharge to the River.</p>
<p>Enclosed pool structure with discharge to the River</p> <p>Suitable for Option 1 and 3c</p> <p>Advantages and disadvantages relating to this treatment option are provided below.</p> <p>Advantages:</p> <ul style="list-style-type: none"> High quality water for swimming Treated water discharged to River after being used in pool High availability of pool 	<p>As an alternative, media filtration and disinfection with a process such as Ultraviolet irradiation could achieve the water quality requirements while also allowing the treatment water to be discharged to the River. In doing so, the pool could retain a more natural aesthetic and would meet the expectations associated with swimming in a river pool.</p> <p>The pool water would need to be refreshed regularly from the River and may lead to increased pumping requirements.</p>

Design Option	Treatment Requirement
<ul style="list-style-type: none"> Maintains 'natural' perception (due to lack of odour from chlorine) <p>Disadvantages</p> <ul style="list-style-type: none"> Would not meet NSW Health regulations if regulated New technology (such as UV) which Council may not be familiar with 	

Based on the assessment of water quality, treatment of the river water is expected to be required. This will be driven by regulation from NSW Health and the potential risk to swimmers. It is recommended that filtration and disinfection using an alternative to chlorine would provide a balance between water quality requirements and the perceptions of a river pool.

7.3 Ancillary Facilities

Ancillary facilities should be included in all considerations of the pool design. These facilities will help accommodate the users of pool beyond recreational swimming. The following facilities in Table 11, includes facilities that have been identified. It is not be an exhaustive list.

Table 11: Ancillary Facilities

Facilities	Importance
Toilets/Change Rooms	High
Ticketing Booth	High
Seating areas with shade sails	High
Lighting	High
Kiosk (food and swimming equipment)	Moderate
Outdoor showers	Moderate
Bicycle rack	Moderate
Electric barbecue	Low
Cafe	Low

The location of these facilities will likely be land based however, smaller facilities may be able to be fit with the river pool structure. Further suggestions of ancillary facility location for each pool design option can be found in Appendix B.

8 Costs

Indicative cost estimates for each river pool design option is presented in Table 14. This methodology uses a top-down estimate based on Arup's experience, supplemented with historic costing of nearby pools as well as construction industry benchmarks and guidance. The costs are categorised into different stages of expenditure from initial outlay to renewal of the structure when a major refurbishment is required.

The capital cost estimate below includes cost of the pool structure and associated water treatment plant and equipment (where applicable to the option). Maintenance cost includes maintenance of treatment plant (2% of asset) and structure (2.5% for floating and 0.5% for fixed structures).

Cost of ancillary facilities may vary greatly depending on what will be constructed. Based on the facilities in Table 11 shown to have high to moderate importance level, an estimate of \$0.5M to \$1M has may be reasonable. This has not been included in capital costs in Table 11, and should be included once choice of facilities has been determined.

Detailed cost estimation is recommended once concept designs have been approved.

The cost estimates detailed in Table 14 are of a very high-level and are only for indicative purposes. With progression in planning and designs these costs may vary greatly.

Table 14: Design option cost breakdown

Design Option	Description	Capital Cost estimate*	Maintenance Costs	Operation costs	Renewal costs
1	Floating encased structure	\$5-10M	\$150,000-\$275,00	\$300,000-\$350,000	25%-50% of capital cost
2	Conventional pool on piled platform (edge pool)	\$15-20M	\$90,000-\$125,000	\$300,000-\$350,000	25%-50% of capital cost
3a	Open baths pool with floating access platforms	\$2-5M	\$50,000-\$125,000	\$275,000-\$325,000	25%-50% of capital cost
3b	Enclosed pool with fixed floating access platforms	\$5-10M	\$60,000-\$70,000	\$300,000-\$350,000	25%-50% of capital cost
3c	Enclosed pool with fixed floating access platforms	\$5-10M	\$60,000-\$70,000	\$300,000-\$350,000	25%-50% of capital cost

9 Community and Socioeconomic Benefits

9.1 Social and community benefits

A new river pool in Rhodes East has great potential to benefit the community especially through increased recreational activity. A rise in recreational activity will enhance the image of the Parramatta River as well as the City of Canada Bay. The pool will likely attract a patronage similar to the two existing pools in the CCB with potential for additional patronage from tourists. It will also provide access to activities beyond swimming, including picnicking and relaxing.

There are a multitude of benefits that are linked to increased recreational activities such as improved health, social interactions, and public amenities.

The floating pool as a local attraction can potentially increase the social activities within the community. There will be a broad range of activities that will be encouraged beyond swimming. With the increase in usage of the pool and its surrounding areas, both the local community and tourists are exposed to a social environment that promotes interaction.

It has also been suggested that an alternative use for the pool can act as a cinema, this can also enhance social activities and interactions beyond normal operation both in terms of day/night and also in different climates.

The increase in activities in the area can also lead to improvements to infrastructure and amenities. Park benches, public toilets, shower and various other facilities will not only improve for the users of the pool but also improve access to everyone in the area. Figure 19 below shows

some of the existing facilities that might be upgraded and increased to cater for the river pool.



Figure 19: Park bench overlooking Brays Bay at Location 2

The benefits that are expected from the river pool may also improve and extend to everyone that is affected by the Parramatta River.

Depending on the design choice, the pool structure has the potential to act as a filtration device within the river, allowing it to improve the water quality in its vicinity.

9.2 Tourism benefits

A new river pool has the potential to be a drawcard for visitors to East Rhodes as well as the neighbouring areas from other parts of Sydney.

Rhodes is located in close proximity to Olympic Park and Parramatta River which has established a steady flow of tourists in Rhodes. In addition, the variety of parks, playgrounds, open spaces, shopping centres and local events also attracts further locals and tourists.

With the addition of a river pool, Rhodes will likely see an increase in visitors which may have an added benefit of helping nearby local businesses such as restaurants and waterfront venues. Any additional facilities and infrastructure built for tourists would also benefit the local users.

10 Environmental and Sustainability Considerations

10.1 Climate Change

Climate change projections for the Sydney Metropolitan region are provided by the NSW DEH, through their NSW and ACT Regional Climate Modelling (NARCLiM) project. By 2030 they include:

- An average annual maximum temperature rise of 0.7°C
- 5-10% increased autumn rainfall
- Increased severe summer Severe Fire Weather (additional 1 day)
- An average of 4 more days above 35°C per year
- An average of 5 fewer nights below 2°C per year

The NSW Government had previously adopted a Sea Level Rise Policy which supported using a projected sea level rise of 0.4m by 2050 and 0.9m by 2100 to make planning decisions. This policy has since been withdrawn, with the State preferring local government to adopt their own local policies.

OzCoasts (published by Geoscience Australia and the Australian Government) map projected sea level rise based on a likely sea level rise of 0.8m by 2111.

These impacts should be considered as sensitivity scenarios during the design stages and should be able to be adequately managed.

In addition, CCB has also identified a number of strategies and opportunities to address climate change and long term sustainability within the '*Climate Change Resilience Strategy and Asset Plan*'. Impact assessments as well as opportunities for CCB to address challenges to climate change should be considered together.

10.2 Ecology

Sensitive ecological areas around the foreshore area of Rhodes must be assessed in detail, as a rich array of ecologically-important species are likely to be present. Constraints will likely arise from areas that are determined sensitive due to presence of flora and fauna such as salt marshes, mangroves, sea grass and also bird and fish habitats.

In assessing the Environmental Protection Map within the *Canada Bay Local Planning Strategy 2010*, it appeared both locations are clear of sensitive vegetation communities. The maps are attached in Appendix C for further details.

Locations of vulnerable fauna especially threatened species of birds and frogs will need to be identified to ensure impacts are mitigated or otherwise minimised.

Both constraints as well as opportunities can be identified from an ecological study of the final river pool location. There are opportunities that may arise from an innovative design of the river structure. These designs may accommodate and enhance habitat areas for aquatic plants and fauna.

10.3 Heritage

Heritage-sensitive sites that may be impacted by the river pool must be identified and accounted for prior to development.

The Aboriginal Places & State Heritage Register indicated two major sites within Rhodes which were the Meadowbank Rail Bridge and Rhodes Railway Station. However, both sites are located in areas that will have minimal impact to the river pool development.

Aboriginal and European heritage sites, especially along the foreshore may be further investigated as retention of these areas may be a high priority. Extended facility and further works outside the immediate footprint of the pool should also be included in this assessment.

10.4 Contamination

There are currently areas within Rhodes East that have been identified with high contamination risk and will require complex remediation steps. (Jacobs, 2016)

The contamination risk and locations were identified as follows:

1. Timber treatment chemicals such as cresosote and CCA (Copper Chromium Aresenic) may have been used historically and present in the saw mill located in the land currently zoned IN1.
2. Dioxin contaminated waste may be present due to reclamation work in the northern end of 1 and 3-5 Leed St.

If found to be present, remediation of these chemical contaminants may require complex procedures that are also costly. The report by Jacobs have detailed possible implications including:

- Requirements to develop an Environmental Impact Statement and an Environment Protection Licence
- High costs which may trigger reconsideration of developments in order to reduce the requirements or scale of the new developments
- Additional protective or management protocols depending on staging of the redevelopment

The economic viability of the floating pool as well as the plans to redevelop Rhodes East may be impacted depending on the outcomes of the contamination investigations.

During construction it is likely minimal temporary disturbance of sediments is expected from piling and should be well managed. As no dredging or seabed re-profiling has been proposed it is not likely contamination will greatly affect the pool once construction has finished.

Further investigations of soil and water may be necessary to ascertain the degree of contamination and associated remediation that will be required. Water quality test results suggest adequate targets have been reached for treated river water be sourced for treatment but inadequate for direct usage.

The results of the investigations and subsequent remediation steps will be vital to determining the feasibility of the floating pool.

10.5 River water quality

It is understood that in line with the 'make Parramatta swimmable again by 2025' vision, Parramatta River will benefit from a design option that treats the river water and reintroduces cleaner water into the river system. This will allow the river to act as a filtration device within

the river, continuously improving the water quality. The implementation of this design at earlier stages of rehabilitating Parramatta River will likely greatly assist in the vision of CCB and PRCG.

10.6 Waste

The presence of waste will vary based on the final chosen design of the river pool. The main consideration of waste created by the river pool will be the removal of the filtered materials if an on-site filtration is adopted. The consistent filtration of river water will lead to filtered waste that will need to be regularly removed and transported away to be treated or otherwise disposed.

If the pool water quality after usage is determined to be inadequate for release into the river, a sewerage system will be required to transport the water for treatment. The design of such a system should involve consideration of current sewer overflow abatements and capacity of existing infrastructure. Solid or larger sized wastage may also require a different method of removal.

A system should be considered for the efficient long term removal of the pool's waste.

10.7 Visual impact

Rhodes East lies on a peninsula in one of the major bodies of water in Sydney, and as such, its foreshore can be considered quite scenic.

Major visual impacts to be expected from the river pool will be from the river pool structure, light spill and also noise and vibration.

The peninsula currently offers waterfront views along the outer edges of Rhodes.



Figure 20: Waterfront views from the foreshore at Location 1

Location 1 has views across to the north bank of Parramatta River as shown in Figure 20. However, the majority of this view is currently impeded by industrial development along the foreshore. Currently, the water's edge in the northern end of the peninsula is separated from the rest of Rhodes due to large light industrial building complexes. The buildings currently disrupt the Rhodes horizon overlooking the river and the north bank of Parramatta River, and also currently prevents clear access to the water's edge.

Under the new rezoning plan for Rhodes East, the floating pool in conjunction with new connections to the northern waterfront will greatly improve the northern peninsula visually and also restore the connection of the public to the water.

Location 2 also has waterfront views into Brays Bay as well as northern banks of Parramatta River. Figure 21 shows an example of this waterfront view from McIlwaine Park.



Figure 21: Waterfront view from McIlwaine Park near Location 2

At this location, the adoption of a fixed pool design may interrupt the waterfront view. The fixed pool will have a modest height above water especially during low tide. However, with the adoption of an aesthetic design, it may improve Rhodes landscape character.

Overall, the pool will likely have minimal visual impact to the water front views that surround Rhodes. A fixed river pool has the potential to disrupt views and aesthetic, however, adopting an aesthetic design will instead improve the view from McIlwaine Park.

Light spill can also be an issue especially if the pool is operational at night. Excessive light spill may affect the view across the waterfront from either bank of Parramatta River.

Overall, the river pool will unlikely disrupt existing views into Parramatta River and beyond, instead it will have potential to provide a visually enhancing addition to Rhodes waterfront.

11 Conclusions

11.1 Key Outcomes and Recommendations

Key recommendations from this study are summarised below:

- Following a multi-criteria assessment of two potential locations, it is apparent that Brays Bay is a preferred option for many of the criteria. In particular, this location would have a much lesser impact on existing and future river users than the other location situated along the main river navigation channel, and RMS has stated that they would strongly oppose this location for that reason.
- The key criterion where Brays Bay is less optimal is regarding distance offshore to the required water depth. A floating pool system is not feasible at this location (assuming dredging is not a viable option) and other pool structural options that will initially or be planned to utilise the natural tidal waters will need to be sited sufficiently far enough offshore to be serviceable for the majority of low tide conditions (estimated to be at least 100m).
- Based on the assessment of water quality, treatment of the river water is expected to be required. This will be driven by regulation from NSW Health and the potential risk to swimmers. It is recommended that filtration and disinfection using an alternative to chlorine would provide a balance between water quality requirements and the perceptions of a river pool.
- Five design options for the river pool have been considered. Of these options, Option 1 (floating pool), Option 3A (open baths with access platform), and Option 3C (enclosed baths with permeable

membrane for passive water treatment) are considered to have a low feasibility for being suitable. The remaining options have a range of relative advantages and disadvantages that should be considered by CCB each on their merits and particularly against budgetary expectations. These most feasible options include (with high level estimated capital cost excluding ancillary facilities):

- Option 2: Conventional pool on piled platform (edge pool) (\$15-20million)
- Option 3B: Enclosed baths with impermeable basin (\$5-10million)

11.2 Next Steps

The immediate next step is for CCB to consider the outcomes of this study and determine if it is deemed feasible to pursue the project to the next stages.

Should the project be decided to progress beyond this current study, the next steps are expected to generally consist of the following (within CCB's framework):

1. Undertake further stakeholder, and potentially initial community consultation.
2. Undertake further project-specific investigations which might:
 - Detailed land and seabed surveys,
 - Detailed water quality testing;
 - Ecological and heritage surveys;

3. Reassess design options to reflect outcomes of 1) and 2), and prepare preliminary/scheme design of the preferred option; including the likelihood of utilising/converting to natural river water (unpatrolled bath) based on water quality and water bed surveys.
4. Review costs and revenue associated with operating a patrolled pool.
5. Securing funding/investment sources for the pool infrastructure capital costs. Explore opportunities for State/private grants and contributions.
6. Undertake an Environmental Assessment pursuant to obtaining planning approvals with stakeholder and community consultation.
7. Prepare detailed design and documentation.

Contractor procurement implementation and operation.

Appendix A

River Pool Case Studies Summary

Appendix A - Case Studies of Floating Pools

Project Title	Location	Water Body	Facility Type	Project Status	Opening Date	Construction Cost	Project Team	Swimming area dimensions
Plus Pool	New York, NY	East River	Floating Pool	Concept Design, Testing	Mid 2016	\$15M	Family +, Playlab, Arup, IDEO, One Nature, Storefront for Art and Architecture, Columbia University	285,000 gallons, 164ft x 164 ft
Naturbad Riehen	Riehen, Switzerland	Wiese River	Natural Pond	Completed	Jun-14		Architect: Herzog, de Meuron, Hardt General planning: Rapp Arcoplan AG Civil engineering: gemeinde riehen	1,127 cbm, 324 sqm
Allas Helsinki Pool	Helsinki, Finland	Helsinki Harbor	Floating Pool	Under construction	Spring 2015		Huttunen Lipasti Pakkanen Arkkitehdit	3 to 4 outdoor pools
Harbour Bath at Islands Brygge	Copenhagen, Denmark	Copenhagen Harbour	Natural bath	Expansion	2003, 2010	\$787,000	JDS Architects and Bjarke Ingels Group.	5 pools
House of Water	Copenhagen, Denmark	Copenhagen Harbour	Pools and baths created in the grooves of rounded concrete hills	Concept Design			Tredje Natur, PK3	
Kings Cross Pond Club	London, UK						Studio Ooze, Arup (structural design)	
Badeschiff	Berlin, Germany	Spree River	Floating Pool	Completed	2004		Gilbert Wilk + Susanne Lorenz	32.5m x 8.2m x 2m, 395 cbm
Dun Laoghaire Harbour Urban Beach and Floating Pool	Dublin, Ireland	Muir Eireann, Dublin Harbor	Floating Pool	Under construction	Spring 2015	€2.5M	Arup, Wilk-Salinas, Fitzgerald Kavanagh and partners	250 sqm, 60m x 10.5m
Floating Pool	Melbourne, Australia						Damian Architects, Arup	

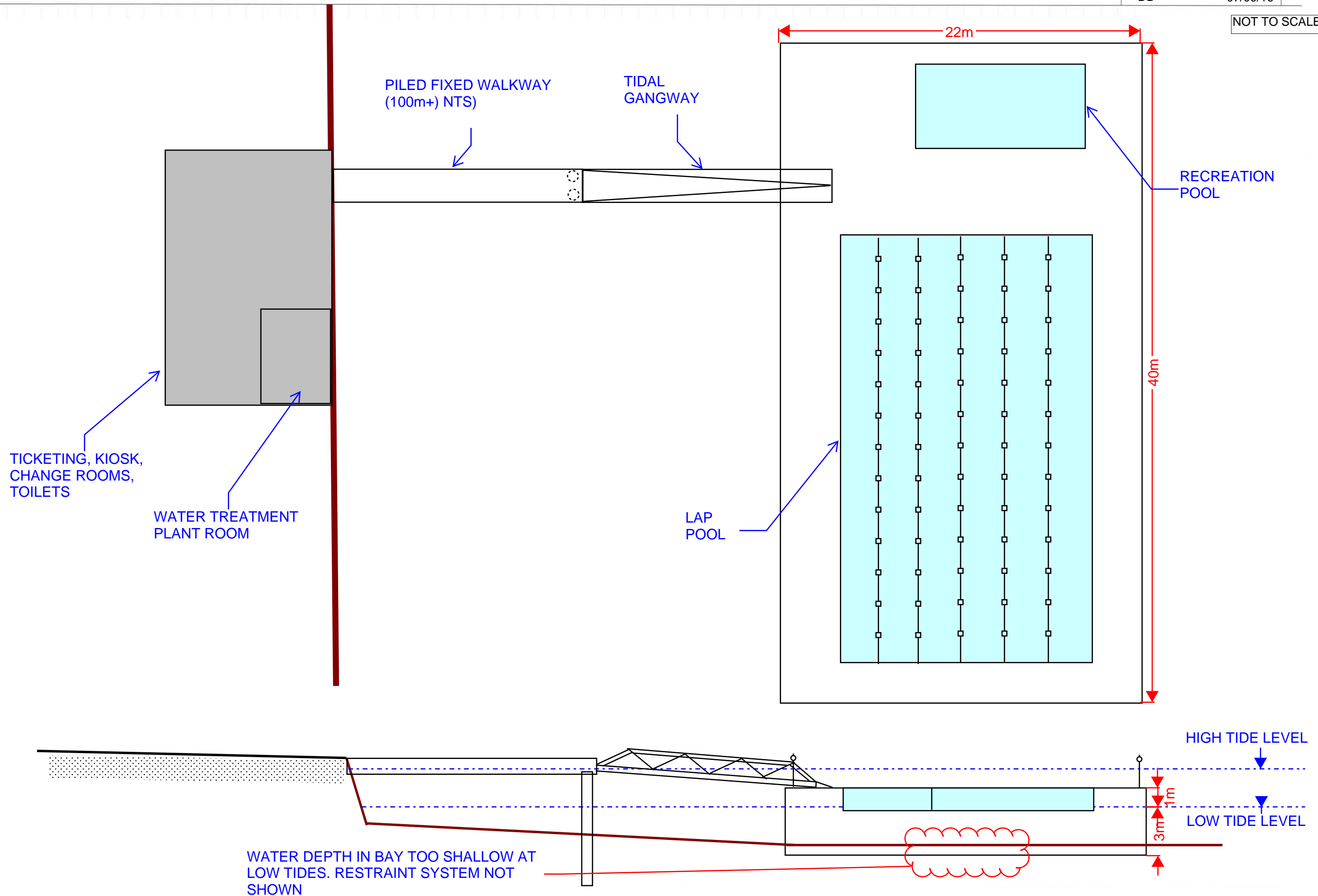
Appendix A - Case Studies of Floating Pools

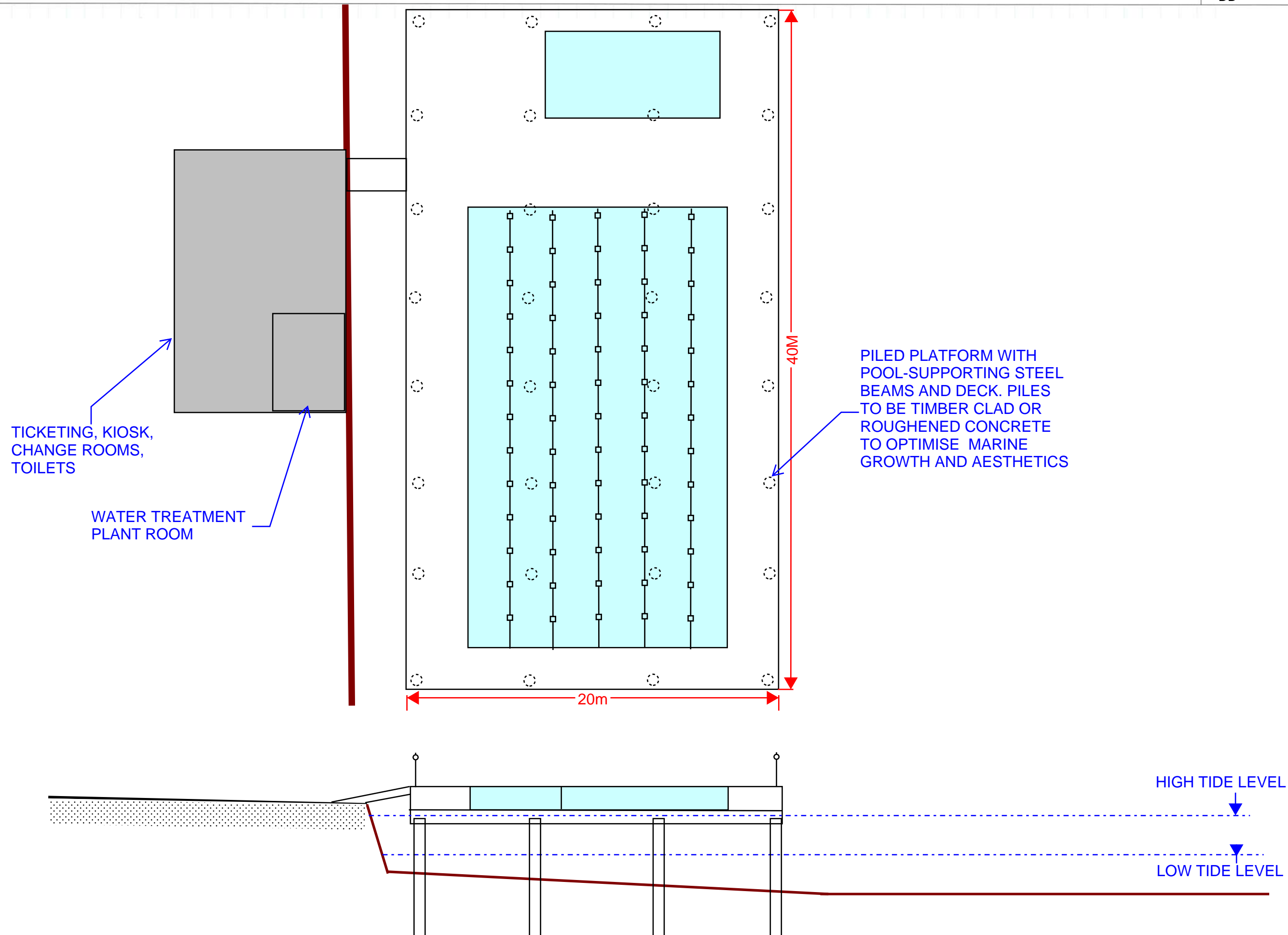
Project Title	Structure Type	Water Supply	Water Treatment	Amenities	Permitting and approvals	Annual Patronage	Patronage Fee	Website
Plus Pool	Concrete cruciform structure	Filtered water from river	Layered filtration system	TBD	TBD	TBD	TBD	http://www.pluspool.org/home/
Naturbad Riehen	Inground structure	Potable water	Biological filter terraces; Layers of gravel, sand and soil. Phytoremediation	Diving area, recreational swimming area, kid's pool, grassy area, changing rooms and bathrooms		Treatment capacity for 2000 people / day	6CHF adults, 4CHF Students, 2.5CHF Children	http://www.naturbadriehen.ch/
Allas Helsinki Pool	Pool on Floating Pier, rest of facility set up on the shore			Sea view sauna, café, restaurant, wellness center, rooftop garden and urban outdoor activities		600 people / day		
Harbour Bath at Islands Brygge	Decks allowing direct access to water	Water from river						http://kulturogfrid.kk.dk/havnebadet-islands-brygge
House of Water								http://www.rethinkwater.dk/houseofwater
Kings Cross Pond Club	Aboveground earth structure		Biological filtration processes			163 people / day		
Badeschiff	Cargo barge	Potable water					€ 5	http://www.arena-berlin.de/portfolio/badeschiff/
Dun Laoghaire Harbour Urban Beach and Floating Pool	Recycled barge			2 Urban beach area, small administration/maintenance/pool guard building, café/restaurant, changing facilities		125 people / day,	TBD	http://dlharbour.ie/projects/urbanbeach/
Floating Pool								

Appendix B

River Pool Design Options

NOT TO SCALE





RIVER POOL OPTION 3A: OPEN BATHS WITH FIXED OR FLOATING ACCESS PLATFORMS (FIXED SHOWN) CONCEPT PLAN AND SECTION SKETCH

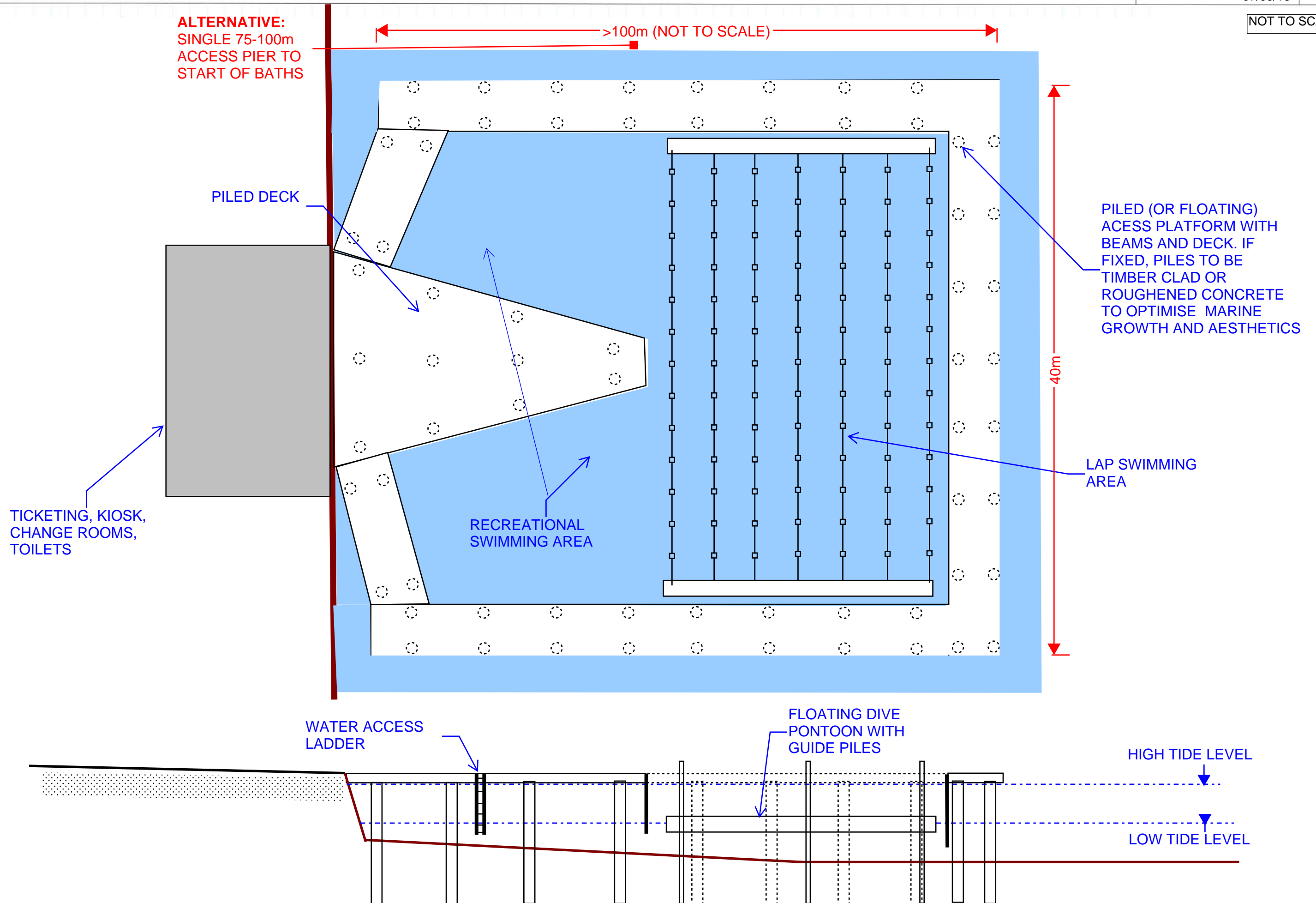
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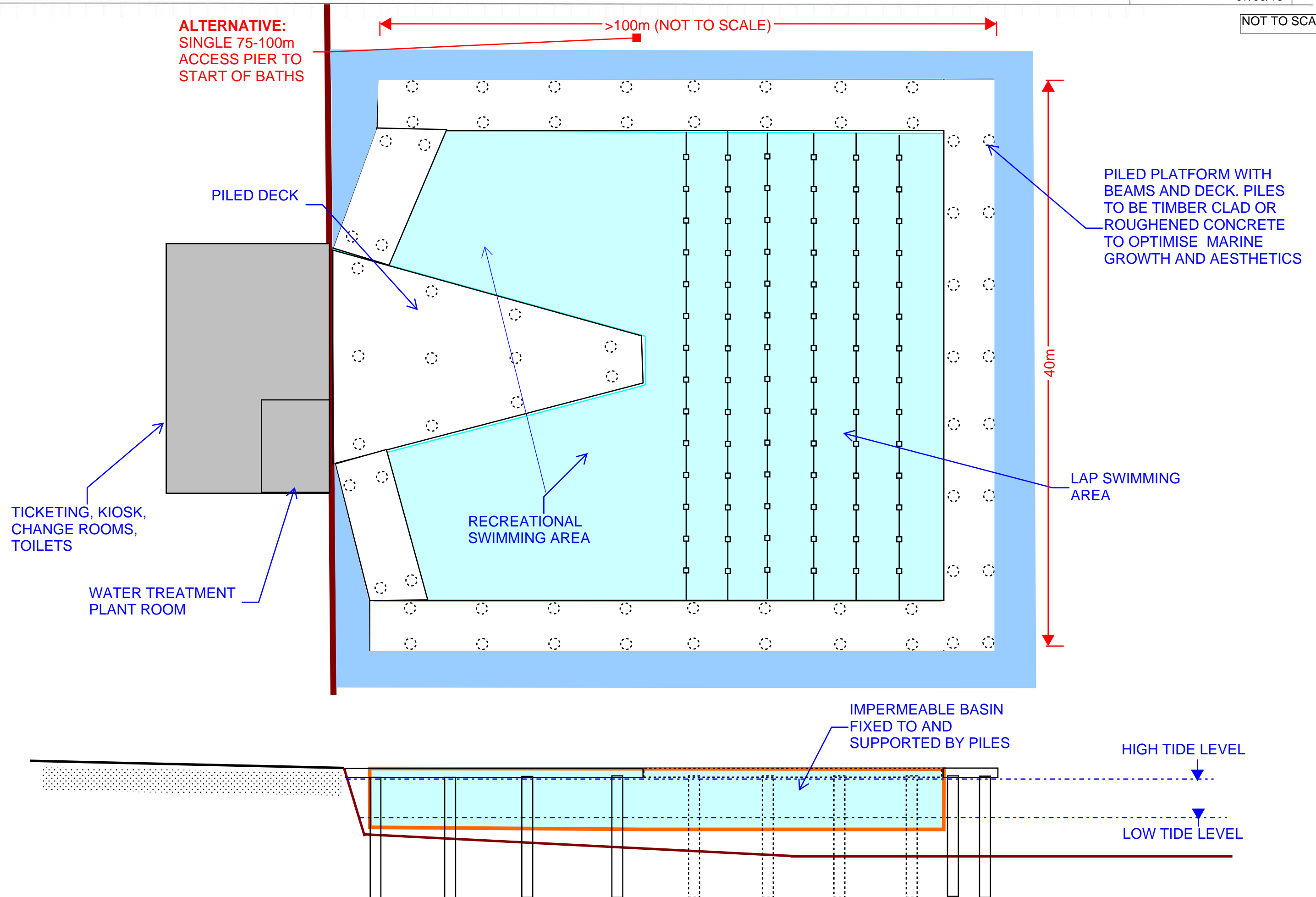
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RIVER POOL OPTION 3C: ENCLOSED BATHS WITH FIXED ACCESS PLATFORMS AND PERMEABLE MEMBRANE FOR WATER TREATMENT CONCEPT PLAN AND SECTION SKETCH

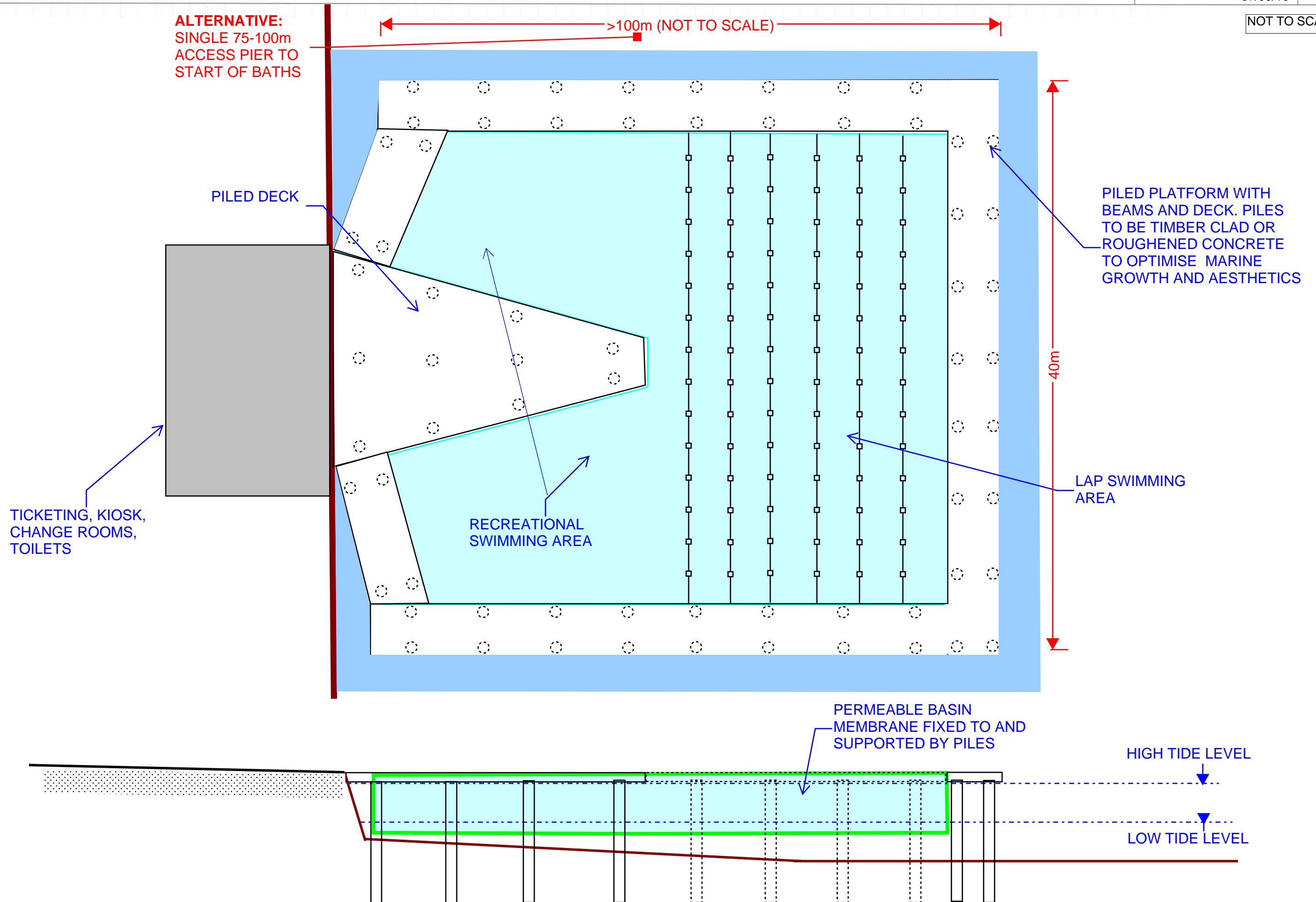
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Appendix C

Rhodes Environment Protection Map

Map 7.1: Biodiversity Map

