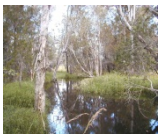
LAKE MANAGEMENT PLAN



TWIN WATERS – RESIDENTIAL LAKE

Latest revision: **Version 8: August 2013**

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1. INTRODUCTION

1.1 Management Plan Scope

Twin Waters is a large residential development on the north shore of the Maroochy River which was developed by Lend Lease Development. This Lake Management Plan (LMP) applies to the lake area shown on Figure 1. The lake consists of a brackish waterway some 40ha in area and is to be used for secondary contact purposes only. This Management Plan also details the associated weir and infrastructure which is deemed to be part of the lake and necessary for its successful operation.

1.2 Management Plan Objectives

The implementation and administration of the Lake Management Plan is the responsibility of the Council, as owners in freehold title of the lake and associated infrastructure (except as applicable to Lend Lease Development Pty Ltd during any maintenance period).

This document may be amended from time to time, subject to council policies procedures and budgets.

Objective	Issues to be Considered	Relevant Actions	Performance Indicators	Responsibility after handover
To ensure that the lake water quality is suitable for its intended use	- Stormwater Management - Maintenance of the weir - Public education	Water quality monitoring and inspections and maintenance of the weir	Compliance with water quality requirements.	Sunshine Coast Regional Council
To ensure that all lake infrastructure is maintained in a structurally sound and safe condition	Maintenance of structures revetments, scour protection, drainage outlets and navigation aids	A structured program of inspections and maintenance of lake infrastructure	Compliance with inspection and maintenance procedures of Council's Waterway Maintenance Management Plan	Sunshine Coast Regional Council
To ensure that usage of the lake by the public and by other organisations complies with established policies and guidelines	Public, residents and other organisations should be clearly informed of acceptable uses	Establishment of management system for lake usage and possible delegation of some management functions	Compliance with Council's policies and guidelines for lake usage	Sunshine Coast Regional Council or delegated management entity

The Lake Management Plan is intended to satisfy the requirements of the Environmental Protection Act, and to achieve best environmental management practice for maintenance activities associated with the Lake. The Lake Management processes comprise the following component plans, each of which is addressed through the formation of guidelines and policies adopted by council as part of its day to day operations.

Issue of Significance:	Aspect of operation with potential impact.
Potential Impacts:	Potential impacts which may occur as a result of an activity.
Performance Standard:	Establishment of agreed performance criteria and objectives for each element of the operation with potential impact in relation to appropriate policies, standards, guidelines, etc.
Control Measures:	Detailed prevention, minimisation and mitigation measures for the potential impacts to achieve the performance standard.
Monitoring	The monitoring requirements which will measure actual performance (specified limits to pre-selected indicators).
Auditing:	The auditing requirements which will demonstrate implementation of agreed construction and operation of environmental management strategies and compliance with agreed performance criteria.
Reporting:	Format, timing and responsibility for reporting and auditing of monitoring results.
Corrective Action:	The action, or the commitment for action, to be implemented when a performance standard is not reached, including responsibilities for action.

The aim of the Lake Management Plan is to facilitate the establishment of management practices to maintain the Lake's water quality and infrastructure to best practice requirements and to establish management parameters for activities and uses within the bounds of the water body.

2. BACKGROUND

The Twin Waters residential development consists of approximately 1300 allotments on the north shore of the Maroochy River. The construction of Twin Waters involved the creation of a tidally restricted lake with a surface area of 39.6ha, and an approximate volume of 1,934,000m^3. The development contributes 12% of the total 9.2km^2 catchment area, with surrounding land comprising of a mixture of residential, industrial, agricultural, recreational and undeveloped land uses.

A weir with a crest level equal to mean high water spring tide, 0.44m Australian Height Datum (AHD), was constructed in the entrance channel to the development from the Maroochy River. The weir also includes 2 x 1500mm diameter Reinforced Concrete Pipes (RCP's) to permit tidal exchange between the river and the lake during lesser tide events. The lake has been designed to be maintained in a brackish / semi-saline state to assist in maintaining water quality.

2.1 Rezoning Deed

The Rezoning Deed (10 August 1998) between the Council and the developer required the lake to maintained by the developer for a period of three (3) years following the completion of the lake and weir construction. The lake and weir construction were completed in 2003 and at the time of writing this document the developer Lend Lease have maintained the lake and associated infrastructure for approximately 9 years, during which an extensive range of maintenance and repair works have been completed. In 2010 the weir and its surrounds were totally rebuilt.

2.2 Historical Overview

Twin Waters residential estate has been progressively developed since the mid-1980s. An Environmental Impact Statement (EIS) on the project (as it was envisaged at that time) was prepared in 1996.

The lake is separated from the river by an artificial weir with a crest level of 0.44 m AHD. Water quality is maintained by the tidal interchange through 2x1500mm RCP's under the weir and tidal flows over the weir.

Consistent with best environmental practice a Lake Management Plan to control the use and maintenance of the lake has been prepared.

2.3 Proposed Development

The Lake is an artificial waterway, defined by revetment walls and beaches, consisting of a partially tidal water body with a nominal water level of RL 0.10m AHD. The lake and associated built infrastructure have been constructed in accordance with the relevant planning approvals granted by the Department of Natural Resources and Mines, Environmental Protection Agency and the former Maroochy Shire Council (now Sunshine Coast Regional Council).

The land abutting the lake has been developed for urban purposes in accordance with the Maroochy Plan. Access for the public is available at specific locations around the perimeter of the lake. All public access areas are created as public road reserve or parkland abutting the lake.

Rock scour protection has been placed along areas of the bank as protection against wave action. Storm water drainage enters the lake from the adjoining land through controlled outlet structures and pipes into the lake.

2.4 Major Assets

The intended use and on-going amenity of the lake has required the construction of major civil infrastructure as follows:

- Inlet / outlet weir (photo 1);
- Lake Edge (photo 2)
    - Revetment Walls
    - Beaches

The weir at the outlet of the lake regulates inflows to achieve an average lake water level of RL 0.10m AHD. High tides up to RL 0.85m AHD (HAT) will over top the weir on approximately two hundred and seventy (270) occasions per year based on tidal predictions at the time of lake construction.

The inlet weir is a broad-crested concrete structure (see attached Figure 2 for weir design drawings). Rock scour protection is provided on both upstream and downstream sides of the weir. The weir structure was designed to allow overtopping of the weir and scour protection, so as to maintain the health of adjacent mangroves in the Maroochy River and maintain a constant water level in the lake for general amenity.

Photo 1: Weir

The Lake Edges are required to maintain the stability of the lake perimeter whilst contributing to the aesthetics and usefulness of the lake. The Lake Edge does not include the revetment wall. The revetment walls are required to prevent wash from the lake damaging the lake edge or beaches and to provide appealing entry and exit points for the public to enjoy the lake for recreational purposes (see photo 2).

The monitoring and maintenance of these major assets all form part of this Management Plan.

Photo 2: A Beach and Revetment Wall in Twin Waters

2.5 Contributing Catchments

The total contributing catchment area for discharge waters through the site is 9.2km^2 consisting of a mixture of residential, industrial, agricultural, recreational and undeveloped land uses. The Twin Waters development comprises just 12% of this catchment area, hence the quality of the water contributing to this lake system is greatly affected by external catchment. Figure 3 shows the extent of this catchment. A golf course within the development is also a potential contributor of nutrients during a storm events.

2.6 The Lake

The lake is defined as the area contained within the revetments upstream of the outlet weir structure, to the end of the abutting Twin Waters Residential estate to the north with a depth ranging from approximately 1.5m – 11m. See Figure 1.

3. LAKE TENURE AND USAGE

3.1 Lake Ownership Details

Owners Name: Sunshine Coast Regional Council.

Owners Address: 141 Currie Street Locked Bag 72
Nambour Qld 4560 Sunshine Coast Mail Centre Q 4560
Ph: (07) 5475 7272
Email: mail@sunshinecoast.qld.gov.au

3.2 Lake Owner's Responsibilities

The lake is intended to be used by the community in a responsible way for their recreational enjoyment, with minimal adverse impact upon the amenity of those dwellings in proximity to the lake. To that end, the following uses and rules will apply.

- A Quay Line Plan has been established around the edge of the lake (refer to Appendix A). The Quay Line Plan defines the extent that structures may be permitted into the lake adjacent to residential allotments with frontage to the lake. No structures will be permitted outside the bounds of the respective quay line;
- Owners of land with frontage to the lake may make application to Council to erect structures within or over the lake. Any approved structure must be located within a lease site approved by Council;
- Following handover Council will be responsible for the erection and maintenance of signs within and around the lake to notify prohibitions and restrictions on activities in the lake, in accordance with the relevant Local Laws prevailing at the time;
- It is recognised that, during such time as Lend Lease Development Pty Ltd (LLD) remains as owner of land adjacent to the lake, any request from interested parties to vary any of the provisions of this Management Plan, will be referred to LLD for their action, to which due recognition will be given to Council in any decision LLD makes;
- A copy of the endorsed Lake Management Plan will be available for purchase by any interested party at a fee fixed by Council from time to time;
- Any request from interested parties to vary any of the provisions of this Lake Management Plan, will be subject to Council's or its delegates satisfaction. Any public response will be given due recognition by Council in any decision it makes regarding the request for a change;
- The water quality within the lake will be maintained to a standard suitable for secondary contact recreational activities, i.e. boating, since it is acknowledged that, from time to time, primary contact criteria may not be achievable due to the effects of storm water runoff into the lake and/or deterioration in the water quality from upstream catchments;
- The use of recreational motorised boats in the lake is limited. Council, or agents acting on its behalf, may use motorised boats or equipment for the purposes of inspection or maintenance.

3.3 Permitted Uses and Practices

The following types of activities and watercraft are permitted in the lake:

- Recreational fishing;
- Manually powered small craft (e.g.; canoes, kayaks, rowing sculls, etc.);
- Wind powered sail boats and sail boards;
- Motor powered pleasure craft with an inboard or outboard motor not exceeding 10 horsepower;
- Approved maintenance craft;
- Enforcement craft;
- Approved construction craft (dredges, support craft, barges, etc.); and
- Any other activity prescribed by Council from time to time.

Access to the lake other than for authorised maintenance, enforcement and construction activities will be via private dwellings with direct frontage to the lake and with approved structures or from parks or road reserves.

The maximum speed limit for motor powered boating anywhere within the lake is six (6) knots.

All users of the lake should be aware that sharks and stingrays may inhabit the lake.

3.4 Prohibited Uses and Practices

The following types of activities and watercraft are prohibited in the lake:

- Use of jet skis and similar personal water craft;
- Use of motorised pleasure craft with an inboard or outboard engine capacity exceeding 10 horsepower;
- Business operation of vessels used for commercial purpose, except as permitted under section 3.5;
- Short or long term moorings, except in accordance with an approved lease and an approved pontoon, deck/stairs or slip structure;
- Fishing from the weir structure;
- Dumping of any wastes, contaminants or other pollutants into the lake, adjoining waterways or in a place (e.g.: road side gutter, stormwater drain) where it could be reasonably expected to move or be washed into the lake;
- Water skiing;
- Living on a watercraft whether temporarily, intermittently or permanently;
- The construction, reconstruction, refitting or undertaking of structural repairs on or to watercraft;
- All advertising devices;
- Refuelling watercraft;
- Release of sewerage or other wastes from water vessels, boats or the like into the lake waters;
- Pontoons or structures that are not approved by Council as part of a leased area; and
- Any other activity prescribed by Council from time to time.

The water quality in the lake is maintained to a secondary contact standard. Direct exposure through swimming is not recommended. At times post major rainfall events and when the water quality in the Maroochy River is poor, the water quality within the lake may be diminished below secondary contact standards.

No public boat ramps are provided in the Twin Waters Lake. Access to the lake via the existing boat ramp adjacent Anchorage Circuit is for Council maintenance purposes, or Council approved purposes only.

3.5 Concessions

Council may from time to time, agree to allow certain operations to occur on the lake, such as (but not limited to) the hire of sailboats, canoes, etc. by a commercial operator.

Before such operations may be considered by Council, Council will require a written submission detailing the type of activity and the likely impact of any such activity on the amenity of the residential premises around the lake and the impact the activity may have on the water quality within the lake.

Any request from interested parties for concessions in relation to the provisions of this Management Plan will be subject to Council's satisfaction. Any public response will be given due recognition by Council in any decision it makes regarding the request for concession. Any fee associated with a commercial right to carry out activities on the lake is the prerogative of Council.

3.6 Abutting Public Land

In general, this type of land will be either park or road reserve, under the control of Council. All normal activities that are allowed in park and road reserves are allowed on land fronting the lake, except as may be restricted elsewhere in this management plan, or by approved signs erected on such land by the Council.

3.7 Pontoons, Decks/Stairs or Slip Structures – Design, Tenure and Use Controls

The following provisions apply only to landowners with direct frontage to the lake.

Landowners with direct frontage to the lake may apply for approval from Council to erect structures over or within the lake. The following application process applies or as undated by council:

Where no structure currently exists, the landowner will need to submit –

- the approved lease application forms;
- detailed structural plans in accordance with the approved structural designs as shown in Appendix B of this Lake Management Plan;
- a survey plan, including metes and bounds description of the proposed lease area. The lease area should only cover the footprint area of the structure;
- a detailed site plan showing the location of the proposed structure in reference to the applicant's land and the quay line plan;
- the applicable fee (refer to Council's Fees and Charges).

Where a structure currently exists, the landowner will need to submit –

- details of any approval to erect the structure;
- the approved lease application forms;
- detailed structural plans, if any;
- a survey plan, including metes and bounds description, of the proposed lease area. The lease area should only cover the footprint area of the structure;
- a detailed site plan showing the location of the proposed structure in reference to the applicant's land and the quay line plan;
- the applicable fee (refer to Council's Fees and Charges).

Pontoons and decks will require Building Works approval by a Private Certifier.

Where approval of works is required, the signature of Council as the owner of the lake will be required on any required application – prior to lodgement for assessment.

Existing structures will be required to be removed where there is no structural certificate or approval in writing from Council or a Private Building Certifier for their construction.

Any new structure, including those replacing existing structures, must be designed and installed in accordance with the approved designs included in Appendix B of this Lake Management Plan.

Any approved pontoon, deck/stairs or slip structure must be contained within the approved lease site, the designated quay line area and building exclusion zone as shown on the quay line plan included as Appendix A of this Lake Management Plan.

The carrying out of any works to a lesser standard than that required by this Lake Management Plan, may result in an order to remove the subject works.

Prospective applicants should make contact with Council's customer service centres to obtain information which includes more information relevant to the lake and its approved uses and applications for lease over part of the lake.

The maximum lease term is 10 years, however, Council will not unreasonably withhold its consent for the issue of a new lease upon expiry of the nominated 10 year lease.

Temporary moorings of any kind are not permitted within the lake area.

4. INFRASTRUCTURE

4.1 Asset Management Plan Required

The Lake Management Plan is not an asset management plan. The Lake Management Plan provides a framework to consider lake usage, interface with the general public and the lakes general management. With respect to the future management of lake assets, Council is required to develop a detailed Asset Management Plan to guide both general maintenance and refurbishment works. The cost of asset management is to be considered as part of Councils normal budget deliberations.

4.2 Outlet Weir

A concrete outlet weir is located at the southern end of the lake adjacent to the Maroochy River. This weir is not navigable at any time and there is no boat access to the Maroochy River.

The weir structure is to be maintained in accordance with Council's maintenance standards and schedules within designated budgets.

No fishing or diving is permitted from the weir.

4.3 Revetment Walls

Revetment walls adjoining public land, i.e. parks, are the responsibility of council to maintain. Revetment walls that directly benefit landowners and form part of the allotment boundary are the responsibility of the private landowner. Also refer Section 6 Maintenance.

4.4 Signage

Signage is an integral part of council education in relation to park and open space usage. The Twin Waters Lake surrounds currently contains a variety of edicational signage that will in time be required to be replaced.

Such signage should be installed/replaced taking into account councils corporate signage and style standards.

5. ENVIRONMENTAL

5.1 General

Water quality performance relies on the continual flushing of the system with estuarine water, and the maintenance of a reasonable degree of salinity, to suppress the growth of aquatic vegetation. The objective is to replicate the performance of a natural estuary, and the variation in salinity which occurs in such a system is one of the key elements in preventing the establishment of potentially harmful algae.

This variation in salinity results in changing conditions with time, and limits the possibility of any species utilising an available niche in the ecosystem. Appropriate engineering design in relation to edge treatments and water level variations also prevent the establishment of marine vegetation such as mangroves that may degrade revetment wall stability.

5.2 Water Quality Objectives

The lake serves as a useful water quality control function without adverse impact on its own water quality. In particular, the lake acts as a polishing system to remove fine particulate matter and under normal conditions may remove minor nitrogen and phosphorous thereby improving protection for downstream areas (i.e. the Maroochy River estuary). The water quality efficiency and performance of the lake has been reported in detail in various reports and AQUALM models submitted to Council by Cardno consulting engineers

5.3 Water Quality Monitoring

Council will take responsibility for the on-going monitoring of water quality in the Lake in accordance with its general practice and budget for other such public lakes.

5.4 Water Quality Standard

Council will be responsible for the standard of the water quality in the Lake to ensure that quality is maintained at acceptable standards. This shall include:

- monitoring the waterway to assist in removing unsightly litter, both on the water and in public places
- monitoring the waterway and removing undesirable vegetation
- the maintenance of lake assets

5.5 Incident Response and Reporting

At the successful completion of the maintenance period prompt, co-ordinated responses to pollution and environmental incidents shall be the responsibility of Council. This will include the management of pollution spillages from waterways to minimise risk to the public and to the environment. Appropriate follow-up investigations should be undertaken to determine the source of pollution and the causes of environmental incidents such as fish kills.

5.6 Public Education

All Sunshine Coast residents and waterway users should be made aware of the potential effects of their actions on the Sunshine Coast's waterways. Educational material should be issued via local media to keep lake users informed.

Matters to be addressed in the educational material could include the effects on water quality of the following:

- dumping of garden refuse in waterways;
- dumping of litter in catchments and waterways;
- spillage or deliberate release of pollutants such as oil and paint;
- pollution from vessels such as oil and fuel, anti-fouling chemicals and toilet discharges;
- bacteriological and nutrient pollution from animal droppings;
- nutrient pollution from fertilisers and detergents (e.g. car washing);
- pollution from insecticides and herbicides;
- escape of exotic plants from gardens into waterways; and
- sediment runoff from building and construction sites.

LLD has regularly presented Lake Safety and Management information at their meetings with the Twin Waters Residents Association. This information encompassed the permitted uses, activities, water quality, safety, dangers etc. associated with the water body.

A flyer has been distributed to the Twin Waters Resident Association, the Sales Centre and any groups that contact LLD to use the lake.

LLD conducted a safety audit of the signs around the perimeter of the Lake and the following actions were completed:

* ‘no swimming’ signs installed in all public places adjoining the Lake edge at 40m intervals;
* ‘no jumping/diving etc.’ signs installed on all bridges (to ends and middle section of bridge);
* 'education/safety' signs installed in major parks and adjacent lake access ramps (signs refer to possible shark sightings).

LLD have also contacted all known groups who regularly use the lake for sporting and recreation purposes. Groups are required to address insurance and safety matters with LLD prior to using the Lake.

6. MAINTENANCE

6.1 General

All public infrastructure associated with the perimeter of the lake (parks, revetment walls, weir) has progressively been handed over to Council. The handover of the lake (water component and weir) will require ongoing maintenance and this will be the responsibility of Council. Activities will include:

- removal of siltation from bed and banks of the lake, as required, to ensure that it does not become a constraint on the use of the lake;
- removal of debris, rubbish and weed growth from the lake and public foreshore areas;
- maintaining navigation aids within the lake.

Council reserves the right to restrict the lake use for a specific purpose (i.e. sporting events) at any time, if such is required to either protect public health and safety or prevent pollution entering the lake.

The Twin Waters Residential Lake Layout Plan (Figure: 1) visually represents the area which Council maintain.

Council is also responsible for:

- drainage run off into the lake through the underground pipe system;
- ensuring no drainage is allowed to enter the lake from any dwelling, or other premises, abutting the lake, other than that which can, lawfully, be discharged into the underground piped drainage system contained within the road reserve.
- ensuring no materials or liquids likely to cause pollution are to be allowed to enter the lake;
- erecting and maintaining signage in appropriate locations; and
- the maintenance of any installations, fixtures and fittings required for the purposes of any organised, competitive sporting events shall be provided and maintained by Council or by the event organisers and shall be approved by Council.

No work may be undertaken in the lake without prior written approval from Council.

6.1.1 Stormwater Control

Stormwater run-off if not managed correctly can have a detrimental effect upon the stability of lake revetment walls and adjacent infrastructure. Residents are responsible for the surface run off from their properties including, structures, paving, grassed and landscaped areas. Residents can reduce the effect of surface run off from their property by taking a range of measures:

- Provide drainage to minimise water discharge directly onto beaches, by installing stormwater pipes in at a level below the low tide
- Provide adequate drainage for roof water including piping to the street instead of toward the revetment walls

- Place infiltration pits inside revetment walls to lower water table and reduce surface run off
- Maintain wall weep holes
- Regular inspection by qualified engineer familiar with structures in a marine environment

It is in the best interest of property owners with pontoons that stormwater is managed appropriately. Poor stormwater management will result in the slumping of the revetment walls or adjacent scour protection which can cause costly structural failure.

While the maintenance of revetment wall is the sole responsibility of residents, Council may provide advice if requested.

6.1.2 Revetment Walls: Generally

Revetment walls divide private properties and public land, and are owned by the allotment owner. A residential property owner is responsible for the maintenance and upkeep of revetment walls which benefit their property. For residents with revetment walls on their property boundary, it is important to note the following:

- Revetments are part of the property for the land it serves to protect
- If a property owner has concerns about the stability of a revetment wall, it is their responsibility to employ a qualified professional engineer to access and report on the structural integrity of their revetment wall
- Like any structure, revetment walls have a design life and require regular inspection and proper maintenance to prevent structural deterioration
- The Body Corporate of multi-unit developments has responsibility for revetment walls that benefit the community title development
- Large trees or plants with invasive root systems must not be planted on top of, or adjacent to, revetment walls as they may contribute to structural failure.
- Council may serve a notice to rectify a failed revetment wall where it believes a hazard exists
- Council maintains the revetment walls that protect public areas i.e. parks
- Maintenance of the banks, where the property fronts a man-made waterway, is the responsibility of Council. Maintenance is preformed to original profile and where funds permit

Note: The construction or a new revetment wall, or the modification to an existing revetment wall, may require approval under Councils Planning Scheme or other State Legislation. In this regard the professional engineer employed by the property can advise if an approval is required and the nature of the required approval process. Council's Development Services can also advise the property owner in this regard and the current fee for applications that may apply.

6.1.3 Revetment Walls: Concrete

Concrete revetment walls may be constructed with precast panels or poured concrete formed on site. The loss of sand or earth on either side of the wall can affect their stability. Maintenance should include cleaning out weep holes of sand and crustaceans and keeping vertical joints sealed.

Construction of additional retaining structures or the use of heavy machinery must not be undertaken on top of the original revetment wall without obtaining technical advice from a qualified professional engineer. Additional loading may cause walls to bow or fail and lead to costly repairs or replacement.

Note: Council places sand against the original revetment wall only. Council does not place additional sand against any wall extensions.

6.1.4 Revetment Walls: Rock

Rock revetment walls can differ greatly in construction technique due to the size, type and placement of rock. Rock revetment walls may or may not include a continuous concrete capping.

The base of rock revetment walls is generally protected from erosion by scour protection. Scour protection generally consists of a bed of rock above a layer of geo-fabric material. Where rock scour protection has formed part of the original design of the revetment, Council will continue to maintain it.

Geo-fabric is also included behind the rock of the revetment. Its purpose is to prevent the loss of material from behind the revetment wall during flood events that overtop the wall or during a receding tide. Whilst this geo-fabric may look untidy, it is vital to the functioning of the wall and its removal will undoubtedly lead to wall failure.

After the installation of piles associated with private pontoons, the geo-fabric material must be secured around the pile so as not to allow soil or sand to escape.

Interference with the rock protection (e.g. the creation of perpendicular rock groynes) can also expose the geo-fabric and cause structural problems for both the property owner and neighbouring revetment walls.

Given the potential structural complexities and problems that can arise with rock revetments, residents must engage the services of a qualified engineer to regularly inspect revetments and prior to commencing any works associated with wall repair, maintenance or replacement.

Note: Property owners are solely responsible for all repairs and maintenance to revetment walls that benefit their property. Council is only responsible for revetment walls that adjoin public lands i.e. parks.

6.1.5 Beach Maintenance

Sandy beaches adjacent residential properties provide an aesthetic appeal to residents, however, they have an equally important function. Beach levels and profiles are designed to allow artificial waterways to be stable at design depths generally 1.5 metres below low tide.

Beaches adjoining private property can be subject to erosion from stormwater runoff, boat wash and wind action.

To assist in avoiding beach erosion, waterfront property owners must manage stormwater run-off (refer section ‘Stormwater Control’)

Grass banks and built structures may also contribute to beach erosion. Contrary to their intended purpose, grass and temporary retaining walls prevent natural systems from being restored and can cause beaches to erode more quickly.

6.1.6 Decks, Jetties, Pontoons, Structures: General

Residents' Responsibility

Decks, pontoons and structures located within the lake require the approval of Council. Once erected, these **structures are the sole responsibility of the landowner**, who must maintain them and ensure their functionality and safety. Also refer Section 3 Lake Tenure and Usage.

Council has no responsibility for the maintenance of private structures such as pontoons or decks. Council is required to maintain the waterway proper and any private infrastructure must not restrict Council in carrying out dredging or other maintenance activities.

Note: Council may request the repair or removal of private structures if they become dilapidated or unsafe.

6.1.7 Inspection Procedures

Inspection Procedures shall be in accordance with the Lake Management processes provided in Section 7.

Action	Frequency
Monitor water quality	Generally quarterly
Inspect and remove rubbish from lake	Generally quarterly
Check weir for debris	Generally quarterly
Check navigation and safety signage	Generally quarterly
Check for siltation	Generally Annually
Check for illegal usage activities	Generally Ongoing

6.1.8 Inlet / Outlet Weir

Council will undertake appropriate maintenance of the rock scour protection works to ensure the structural integrity of the weir.

6.1.9 Management Assessment Techniques

Council will review, on a periodic basis, the processes used for managing the lake and associated infrastructure, maintaining water quality, policing use and the maintenance of structures. Inspection programs may vary in accordance with council procedures for managing other similar public lakes.

6.1.10 General Maintenance Costs

General costing for maintenance and refurbishment for key components of the lake and stormwater management systems for the ten year period 2003-2013.

Component	Detail	Maintenance and Running Cost over 10 years ($)	Comment
Water Quality Monitoring	Sampling and lab testing	70,600	Refer Water Quality Report for testing regime.
General Lake maintenance	Rubbish collection, edge repairs	23,000	Maintenance expenditure over 10 year period
Salinity Control	Outlet weir repairs	12,500	Maintenance expenditure over 10 year period
Weir refurbishment 2010	Replace wire gabions and replenish rockwork	200,000	Major refurbishment project
Emergency works	associated with undermining of footbridge piers	30,000*	Associated with general Sunshine Coast flooding and extraordinarily high tides
Total		$336,100	Average of $33,610 per yr

*Council expenditure

6.1.11 Lake Maintenance: Water Quality

The management of the actual water with the lake is minimal. Particular elements that will require routine inspection to determine if any maintenance is required include:

- Monitoring
- Clean up after major regional floods; and
- Algal and aquatic plant growth management.

The proposed lake system is expected to operate without the need for significant manual intervention. To ensure that the system is operating as proposed routine visual monitoring is recommended. In the event that the visual monitoring indicates unacceptable conditions, maintenance may be required.

It should be noted that the placement of hard infrastructure within a marine environment can be subject to failure due to natural events such as cyclone, changes in river patterns etc. As such there is always the risk that reinstatement works may be required if failure or damage has occurred. Whilst these events are difficult to predict Council should make budget allowance for a major works in accordance with asset management practices.

The routine inspections should monitor the following:

- Colour of the water, which includes clarity, turbidity and light penetration;
- Condition of the retaining wall and batters associated with park and Council owned land;
- Condition of inlet/ outlet structures including scour protection and sediment deposition;
- Dissolved oxygen levels, which relate to turnover and incoming water quality;
- Health, quantity and type of fauna using the lake and appropriate control;
- Biting insects;
- Sediment deposition;
- Weed intrusion;
- Litter.

Observational indicators such as algae build-up or fish kills are a useful method of identifying a poorly functioning lake system. The presence of observational indicators is in some instances evidence of failure of the system and a sign that the turnover and monitoring procedures are inadequate.

Lake Observational Maintenance Indicators

Indicator	Observational Signs
Algae	Presence of floating surface scum, unicellular algae (reducing water clarity), and layers of dead organic matter accumulating on the lake bottom and increasing lake sediment.
Weed Growth	Presence of floating and attached plants.
Nutrient Load	Signs of excessive nutrient load include algal blooms and reduced lake clarity. Monitoring may show depleted dissolved oxygen levels.
Sediment	External sources of silt combined with internal build-up of excess organic matter causes sedimentation.
Pests	Signs of biting insects larvae and excessive aquatic bird habitation will require maintenance to reduce health hazards.
Thermal & Haline Stratification	The top layer of water on the lake maybe noticeably warmer than the cooler layer of water underneath. The bottom of the Lake will be anoxic. (Actually desirable in this water body)
Structural Integrity	Signs include bank erosion or bank slumping, deterioration of inlet and outlet structures including metal corrosion, concrete cancer and spalling.

Both thermal and haline stratification is encouraged as it actually results in a decrease in water quality problems. Mechanical mixing of the lake is not recommended.

Sludge and sediments are expected to settle into the deep sections of the lake. With the depths and surface area of the lake it is not expected that routine de-silting of the lake will be required.

6.2 Emergency Lake Maintenance Plans

SCHEDULE OF SITE VISITS													
Purpose of Visit	**Frequency**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Routine inspection	12/year	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Annual inspection	1/year				✓								

Two possible observations that may trigger a maintenance requirement are, in some cases, interrelated. These are:

- A change in the physical characteristics. (That is significant variance in the water level and change in the area, depth or bed profile of the lake);
- A change in the physiochemical and/or biological characteristics of the lake waters.

For the lake the maintenance indicators can be split into water quality parameter indicators, measured by monitoring equipment, and observational indicators assessed by site inspections.

The water quality parameter indicators are specifically related to the required water quality for the health of the lake and for regulation of the discharge off the site. Detailed monitoring has been supplied to Council.

INSPECTION	
1.	**Routine Inspection**
1.1	Routine inspection should be carried out on a regular monthly basis. The purpose of the inspection is to indicate when maintenance of the lake is required.
1.2	Inspections will be for the following indicators: • Algae and Weed growth • Sediment and Nutrient Loads • Pests • Thermal Layering • Structural Integrity
1.3	Complete appropriate maintenance form. Routine maintenance should be scheduled when the performance indicators above shown a need for maintenance.
2.	**Annual Inspection**
2.1	Once a year, the condition of the lake should be closely inspected. Any damage or problems should be noted on the Maintenance Form for action.

MAINTENANCE	
1.	**General**
1.1	Maintenance of the lake involves: • Removal of material impacting on inlet/outlet structures • Maintenance of floodways, including sediment and cut grass removal/disposal • Monitoring and removal of floating and attached exotic weed • Collection of any litter • Removal of any pests
2.	**Weed Management**
2.1	If weeds have been observed, these weeds should be removed from the lake and lake edge. Weeding generally involves manual removal of perennial species.
2.2	The aim is to remove the weed including the roots when the weed is less than 3 months old, otherwise weeds infestation rapidly occurs and is difficult to control.
2.3	Herbicides should be avoided as they have the potential to contaminate the water in the Lake and receiving waters.
2.4	The weeds should be disposed offsite at appropriate waste management facility.
2.5	Replant appropriate plant species, where necessary, in areas that have been extensively weeded.
3	**Pest Management**
3.1	If pests have been observed during routine inspection, these should be removed from the lake.
3.2	The aim is to ensure a healthy lake system, which does not impinge neighbouring human health and the creek receiving waters.
3.4	Removal procedures include: • Use of insect and fish predators • Seek professional advice • Ensure method is acceptable to local health authority
4.	**Litter Management**
4.1	Remove and dispose of litter that may be visible around the lake.
5	**Structure Management**
5.1	Check for signs of metal corrosion, concrete cancer and spalling. Obtain advice from an engineer for maintenance requirements.

6.3 Extreme Event Triggered Maintenance

Additional maintenance may be required if the lake system is subject to extreme conditions outside normal operations or if, based on observational indicators and monitoring, the lake conditions are found to be outside acceptable standards. In summary, these events include:

- flood inundation;
- algae blooms;
- fish kills;
- illegal dumping of waste;
- aquatic plants.

Specific Event Triggered Maintenance issues are discussed below.

(a) Flood Inundation

In the event of flood inundation, the lake may have received sediment loads, debris and infestation of floating weeds. Debris and floating weeds should be removed manually. Chemical control, as an absolute last resort, could be considered if the existing aquatic flora around the lake perimeter has been damaged and needs to be re-established. If chemical control is used, additional emergency turnover is recommended over a short period of time. It is strongly recommended that chemical treatments of any kind be used as only an absolute last resort.

Flooding may also put considerable strain on the banks of the lake, particularly at the inlet structures. Areas that may have been damaged by erosion and scour should be corrected.

(b) Algal Blooms

Algae are an important aquatic plant in the ecological environment. Algae, of course, occur naturally; however several factors can exacerbate their numbers causing harm to other plant and animal life. Possible causes of algal outbreaks include:

- pollution of waterways with nutrients;
- insufficient lake turnover;
- prolonged warm, sunny and calm weather; and
- decomposition of excess organic matter in the lake.

Based on information derived from previous studies and literature review, it has been determined that the maintenance of an average salinity at about 20% seawater will prevent the growth of most algae. Provided that the periods of lower salinity within any lake system extend for no longer than two months, it is considered that no substantial growth problems will occur. The maintenance of saline conditions is therefore important in this system since the conditions may otherwise favour the establishment and perhaps dominance of cyanobacteria.

A simple one-dimensional hydraulic simulation of the final lake was set up and found that the minimum salinity achieved was about 49% seawater. Therefore the lake should never experience trouble with freshwater algal blooms.

However, if algal growth is noticed, Algal control methods depend very much on the level of algal growth. Maintenance measures are detailed as follows.

Trigger Level 1: Potentially Toxic Blue Green Cell Count approaches 2000 cells/mL
• Prevention is far better than treatment after the bloom has occurred • Chemical Fertiliser activity is to be prohibited by all residents and Council. • Maintain regular monitoring
Trigger Level 2: Potentially Toxic Blue Green Cell Count exceeds 2000 cells/mL
• Fertiliser activity and sprinkling must be limited where possible in the vicinity of the site of concern. • Monitoring frequency to be increased at the affected site to once a week. • Harvest and land dispose of any dead fish.
Trigger Level 3: Potentially Toxic Blue Green Cell Count exceeds 15000 cells/mL
• All fertiliser activity and sprinkling must be stopped for all areas draining to the lake. • Warning signs to be posted around the lake, warning people to stay clear and to avoid contact with the water. • All neighbouring residents to be notified. • Monitoring frequency to be increased to weekly. • Follow the Queensland Governments '*Queensland Harmful Algal Bloom Operational Procedures*'. • Contingency measures are to be considered, including: - harvesting and land disposal of algae and dead fish; and - allowing the bloom to run its course.

(c) Fish Kills

Fish kills should not occur in the lake, water quality monitoring notes that the general health of the lake is very good.

Possible causes for fish kills are similar to the possible causes for algal outbreaks as detailed above, but may also include toxicants derived from the lake catchment, the Maroochy River, or illegal dumping in lake waters. The requirements as for algae bloom trigger levels 2 & 3 should be enforced, (depending on the severity of water pollution) until the source of water pollution is identified and water quality restored.

In the event of fish kills, an environmental consultant should be contacted and water quality testing commenced immediately to identify the cause. EPA notification is only required if Council and the environmental consultant consider it necessary. In the event of potentially toxic blue-green algal blooms, water sampling should be undertaken without skin contact. Action criteria and responses are as follows:

i. Up to 15 dead fish: Investigate, identify probable cause via water quality testing and analysis, and monitor situation to ensure that no further fish mortality occurs;

ii. 16 to 30 dead fish: Investigate, identify probable cause via water quality testing and analysis, and monitor situation to ensure that no further fish mortality occurs; notify EPA of the event, and of possible degraded water quality once results are to hand; notify affected residents if potentially toxic algal blooms are suspected;

iii. Over 30 dead fish or in the event that continuing fish mortality occurs: Investigate, identify probable cause via water quality testing and analysis, and biopsy of fish; monitor situation to ensure that no further fish mortality occurs; notify EPA of the event. When monitoring results received take necessary

actions and notify affected residents if potentially toxic algal blooms are suspected, and erect temporary warning signs if these are required.

In all cases, harvest the dead fish, and dispose via land burial.

(d) Illegal Dumping of Waste

The illegal dumping of waste includes both solid and liquid forms of waste. The water quality monitoring as well as the observational indicators will provide warning signs of illegal dumping of wastes. Applicable Local, State and Federal laws apply to those caught dumping waste in the lake system.

If the waste that is dumped is of a harmful or toxic nature the different monitoring stations will be able to establish the general area in which the waste was dumped. The monitoring of the water quality will allow the analysis of the water's current suitability for human contact. Signs should then be erected alerting the public of the situation and should be kept informed until the water is deemed safe. Depending on the type of wastes allegedly dumped in the lake, monitoring parameters may need to be adjusted accordingly to include appropriate analyses (i.e. hydrocarbons, heavy metals etc.

If the waste is in solid form it will be detected by general observation, it is common that the residents or general public will inform the Council of such matters. The waste should then be recorded, removed and disposed of properly.

(e) Aquatic Plants

Aquatic plants are an important part of the ecological environment, and an appropriate density of aquatic fauna is desirable, to promote development of an ecosystem comparable to those that occurs in natural inlets and embayments in tidal rivers. However, aquatic plant numbers can increase out of hand due to a number of factors, one of which is sustained excessive nutrient inflows to the lake, from whatever source. Fortunately, excessive aquatic plant growth is progressive and detectable over a longer time scale than fish kills, and hence there is more time to investigate and take corrective action.

If excessive or nuisance aquatic plant growth is detected, an aquatic plant specialist should be contracted to investigate the phenomenon, and interpret same in conjunction with accumulated water quality data. Additional water quality monitoring may be required.

After the investigation, if so advised, plant harvesting is recommended to remove the plants from the lake system, thereby removing accumulated nutrients, principally phosphorus, which is accumulative. Plants are to be cut off well below water level and removed and disposed at an appropriate waste disposal facility. If plant harvesting on its own is not sufficient; the source or sources of excess nutrients need to be identified, and appropriate remedial action taken.

7. LAKE MANAGEMENT PROCESSES

7.1 General Water & Sediment Quality

General: To ensure the Twin Waters development in no way contributes to the further degradation of water or sediment quality within the Maroochy River, and that waters and sediments within the subject site are able to sustain a diverse range of wildlife.

Performance Requirement: Current guidelines for water and sediment quality applicable to the Lake will be used to determine acceptable levels of water and sediment quality parameters. There should be no accumulation of pollutants in either waters or sediments within or adjoining the subject site.

Control Measures: Maintenance of impervious and/or general overland flow paths to the lake to reduce eroded material reaching the lake.

a. Maintenance of litter traps.
b. Cleaning of stormwater drainage systems to remove potential pollutants from the waterway systems.
c. Education program for residents to:
   (i) use environmentally sensitive fertilisers and
   (ii) to minimise runoff to drainage system and hence negate the colonisation of seeds within this environment.

Monitoring: Monthly sampling has been implemented by the Developer during establishment of the lake at the eight designated sites shown on Figure 4.

Water Quality Testing (Monthly)

Parameter	Lake System	Maroochy River
Total Dissolved Solids	X	X
Dissolved Oxygen (also refer Note 2)	X	X
pH (also refer Note 1)	X	X
Faecal Coli forms	X	X
Turbidity	X	X

Note 1: Weekly pH sampling shall be taken at 0.25m depth intervals to a depth of 1.0m for the first twelve month period after construction of the completed lake system.

Note 2: Weekly D.O. sampling shall be undertaken for the first twelve month period after construction of the completed lake system.

Reporting: The results of monitoring have been made available to Council.

Corrective Action: If the relevant guidelines are exceeded or a trend develops of declining water quality over a continuous two year period, it is considered to indicate the need for a reassessment of the appropriateness and effectiveness of existing water and sediment quality management measures.

7.2 Infrastructure (Including Drainage Systems)

General: To ensure that performance of all infrastructure items, including drainage systems, are maintained indefinitely.

Performance To maintain the completed project in a condition suitable.

Requirement: For its intended purpose indefinitely and to effectively control silt runoff and debris transportation and long term nutrient runoff into the Maroochy River.

Control Measures: Routine and extraordinary maintenance as required by the nature of any deterioration. Replacement of elements as necessary, in accordance with Local Authority guidelines and Council budgets.

Maintenance of stormwater pipe drains and outlets, the lake exchange system, litter traps, etc.

Monitoring: Inspections to record the status of the visible components by Council at six monthly intervals.

Bed surveys of the lake system (if necessary) and entrance channel to Maroochy River to record profile changes and bed scour by Council after major flood events.

Assessment of condition of civil, electrical and mechanical works, in accordance with Council's Asset Management System.

Reporting: Annual reporting by Council covering all monitoring and any maintenance undertaken.

Corrective Action: Routine maintenance of exposed elements by Council on a regular basis, including revetment walls, beaches and the weir structure.

8. SUMMARY & RECOMMENDATION

The key elements of the Lake Management Plan are summarised as:

- To facilitate the orderly enjoyment of the lake by the public;
- To maintain the lake water quality in accordance with the approved criteria; and
- To inform council with respect to lake infrastructure such that it can be considered as part of budget discussions and funds allocation

The proposed lake system is expected to operate without the need for significant manual intervention, however infrastructure works in mobile marine environment can be subject to changed conditions and as such Council should in its long term infrastructure planning make allowance for major refurbishment works approximately each 10-20 years.

REFERENCES

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Department of Natural Resources 2002 (Qld), *"Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines (Version 3.7).*

Environmental Protection (Air) Policy 1997 (Qld).

Environmental Protection (Noise) Policy 1997 (Qld).

Environmental Protection (Water) Policy 1997 (Qld).

Environmental Protection (Waste Management) Policy 2000 (Qld).

Environmental Protection (Interim Waste) Regulation 1996 (Qld).

Environmental Protection Regulation 1998 (Qld).

Environmental Protection (Waste Management) Regulation 2000 (Qld).

FIGURE 1 TWIN WATERS RESIDENTIAL LAKE LAYOUT PLAN

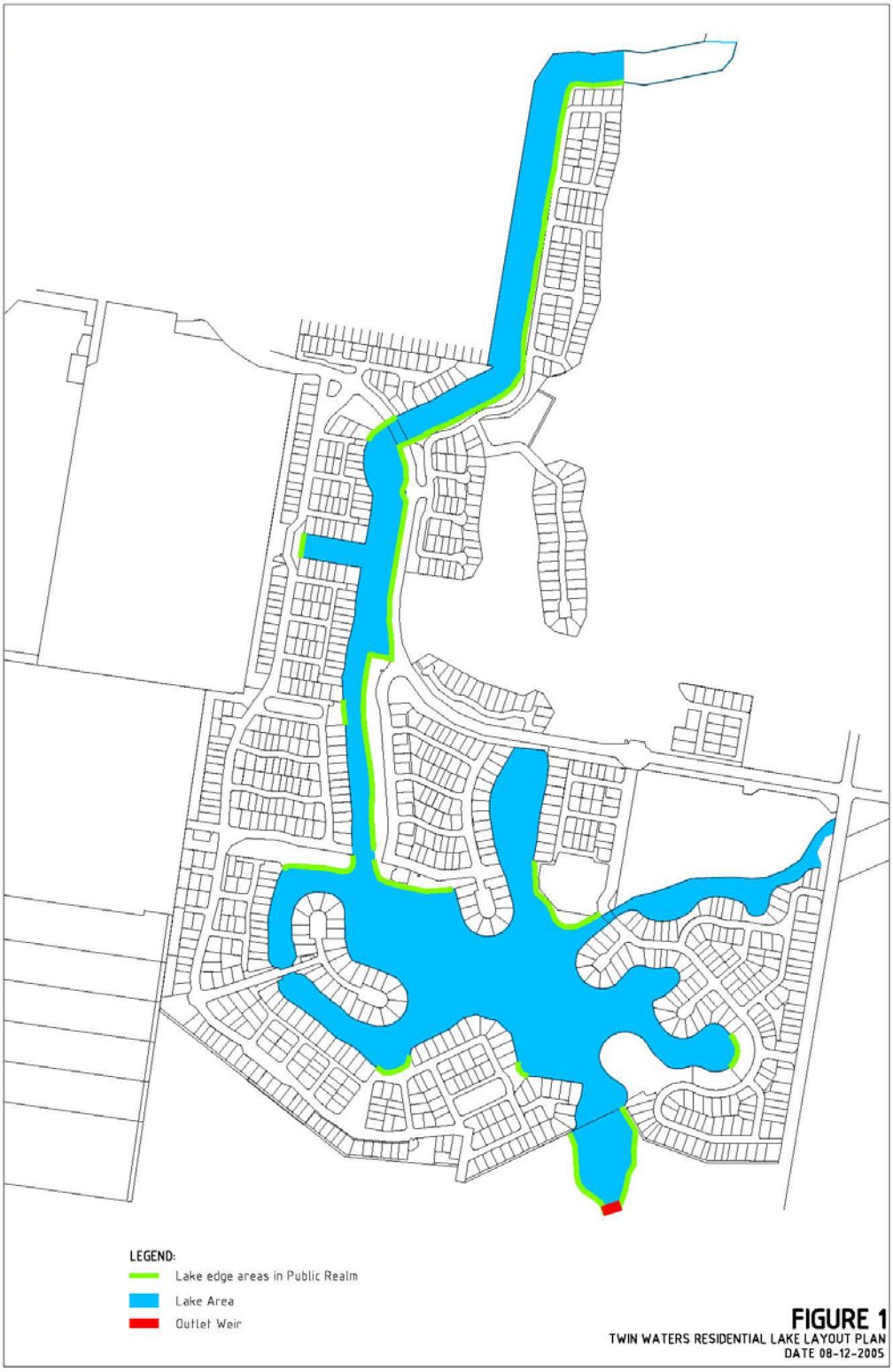


FIGURE 2 TWIN WATERS LAKE: WEIR STRUCTURE DESIGN

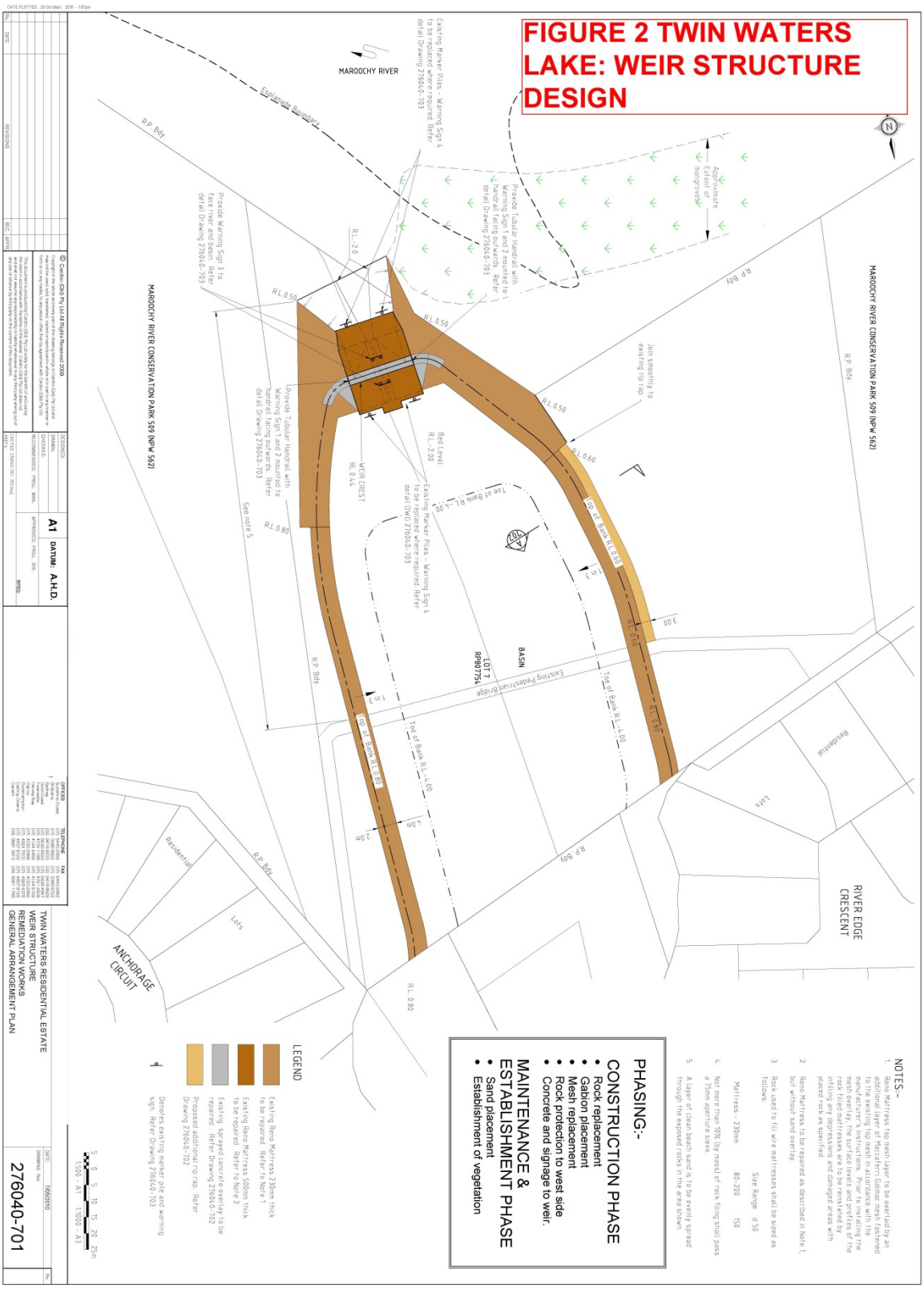
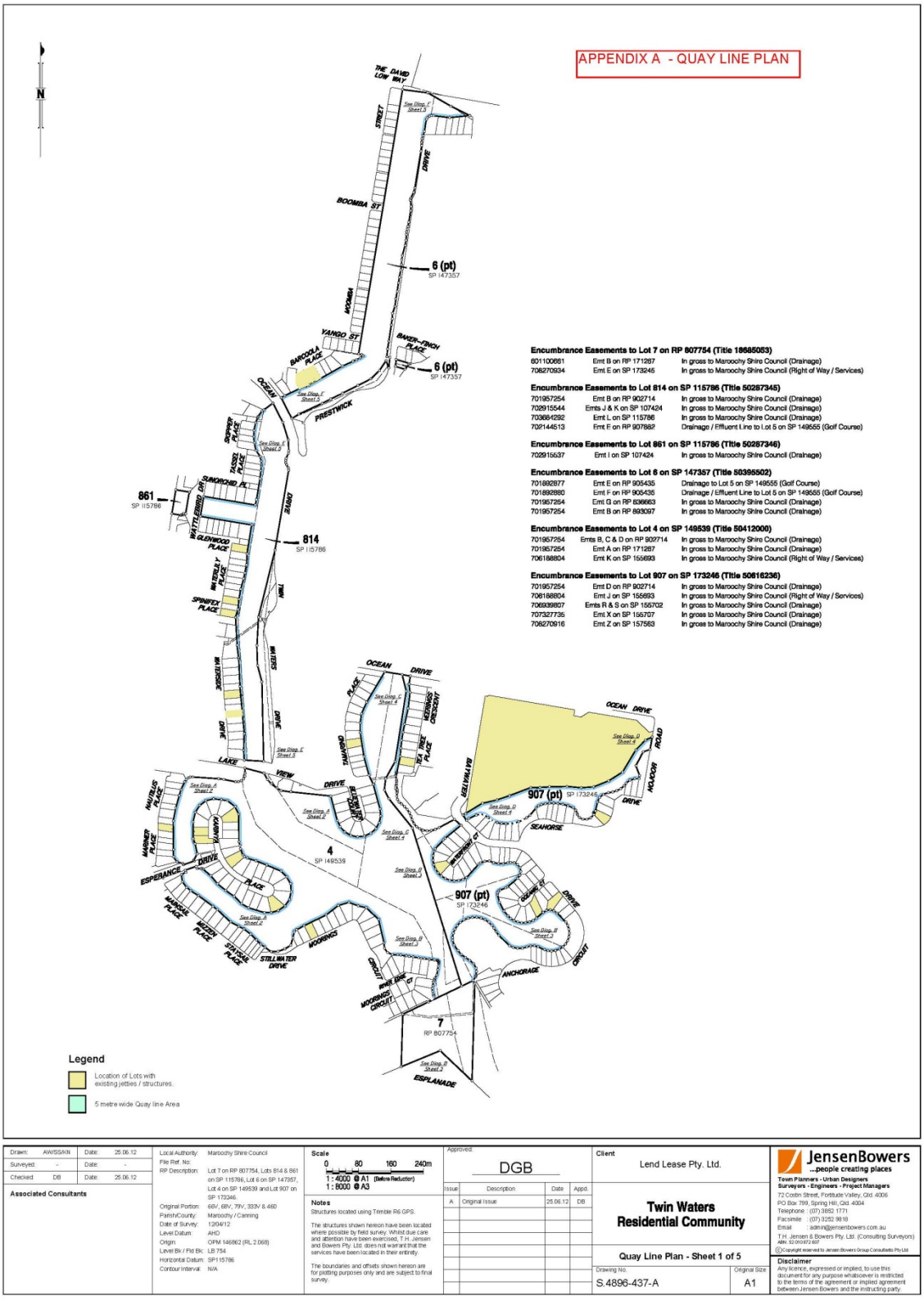


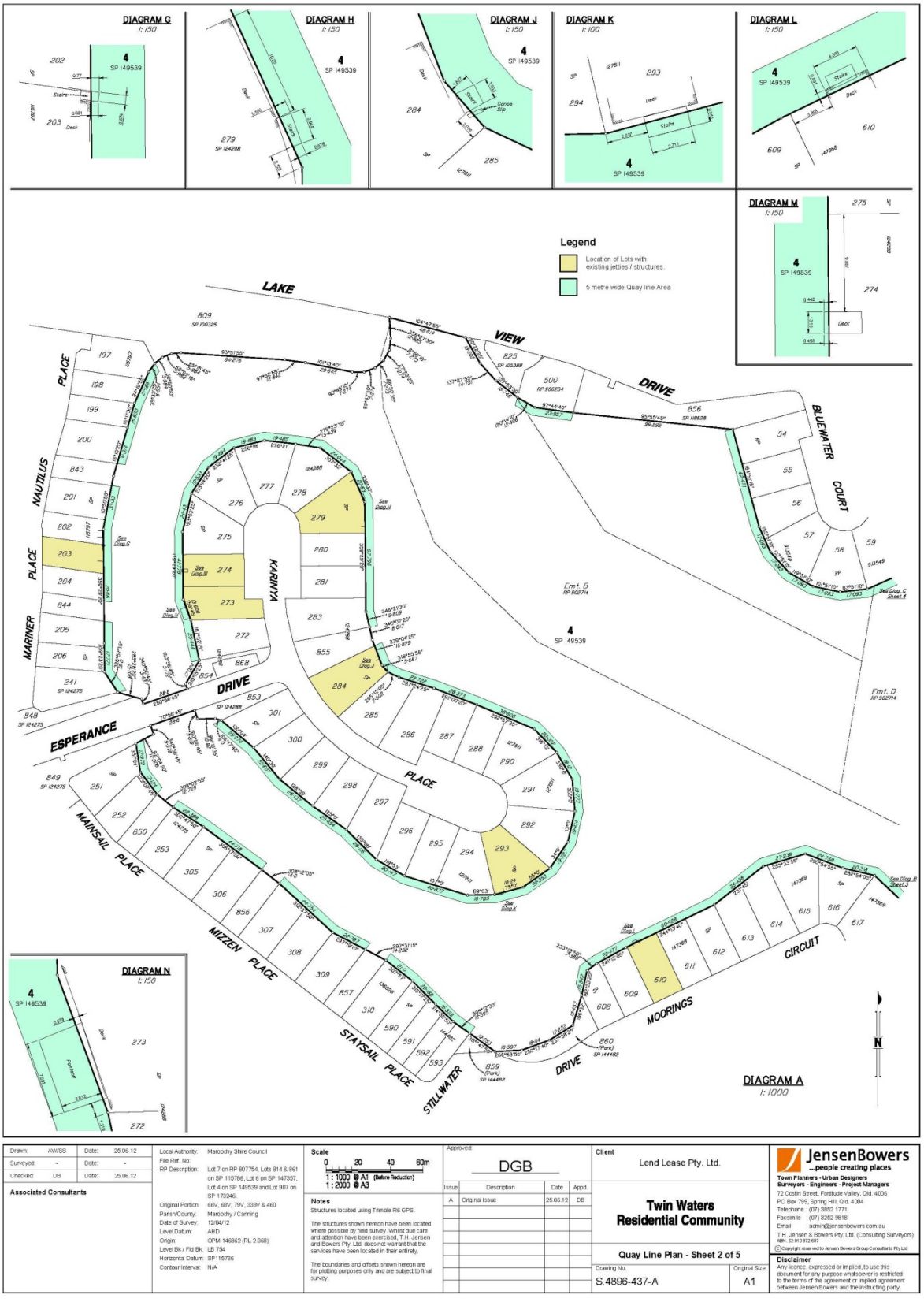
FIGURE 3TWIN WATERS LAKE: STORMWATER CATCHMENT BOUNDARY PLAN

FIGURE 4 TWIN WATERS RESIDENTIAL LAKE WATER QUALITY MONITORING LOCATION PLAN

FIGURE 5 TWIN WATERS RESIDENTIAL COMMUNITY (GENERAL LAYOUT)

APPENDIX A TWIN WATERS LAKE: QUAY LINE PLANS





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Surveyed: -	Date: -	File Ref. No:	Approved: DGB
Checked: DB	Date: 25.06.12	RP Description: Lot 7 on RP 807754, Lots 814 & 861 on SP 115786, Lot 6 on SP 147357, Lot 4 on SP 149539 and Lot 907 on SP 170346.	Client: Lend Lease Pty. Ltd.
Associated Consultants		Original Portion: 66V, 68V, 79V, 303V & 460	Twin Waters Residential Community
		Parish/County: Maroochy / Canning	Quay Line Plan - Sheet 2 of 5
		Date of Survey: 12/04/12	Drawing No. S.4896-437-A; Original Size A1
		Level Datum: AHD	
		Origin: OPM 146862 (RL 2.068)	
		Level Bk / Fld Bk: LB 754	
		Horizontal Datum: SP115786	
		Contour Interval: N/A	

Notes
Structures located using Trimble R6 GPS.
The structures shown hereon have been located where possible by field survey. Whilst due care and attention have been exercised, T.H. Jensen and Bowers Pty. Ltd. does not warrant that the services have been located in their entirety.
The boundaries and offsets shown hereon are for plotting purposes only and are subject to final survey.

Issue	Description	Date	Appd.
A	Original Issue	25.06.12	DB

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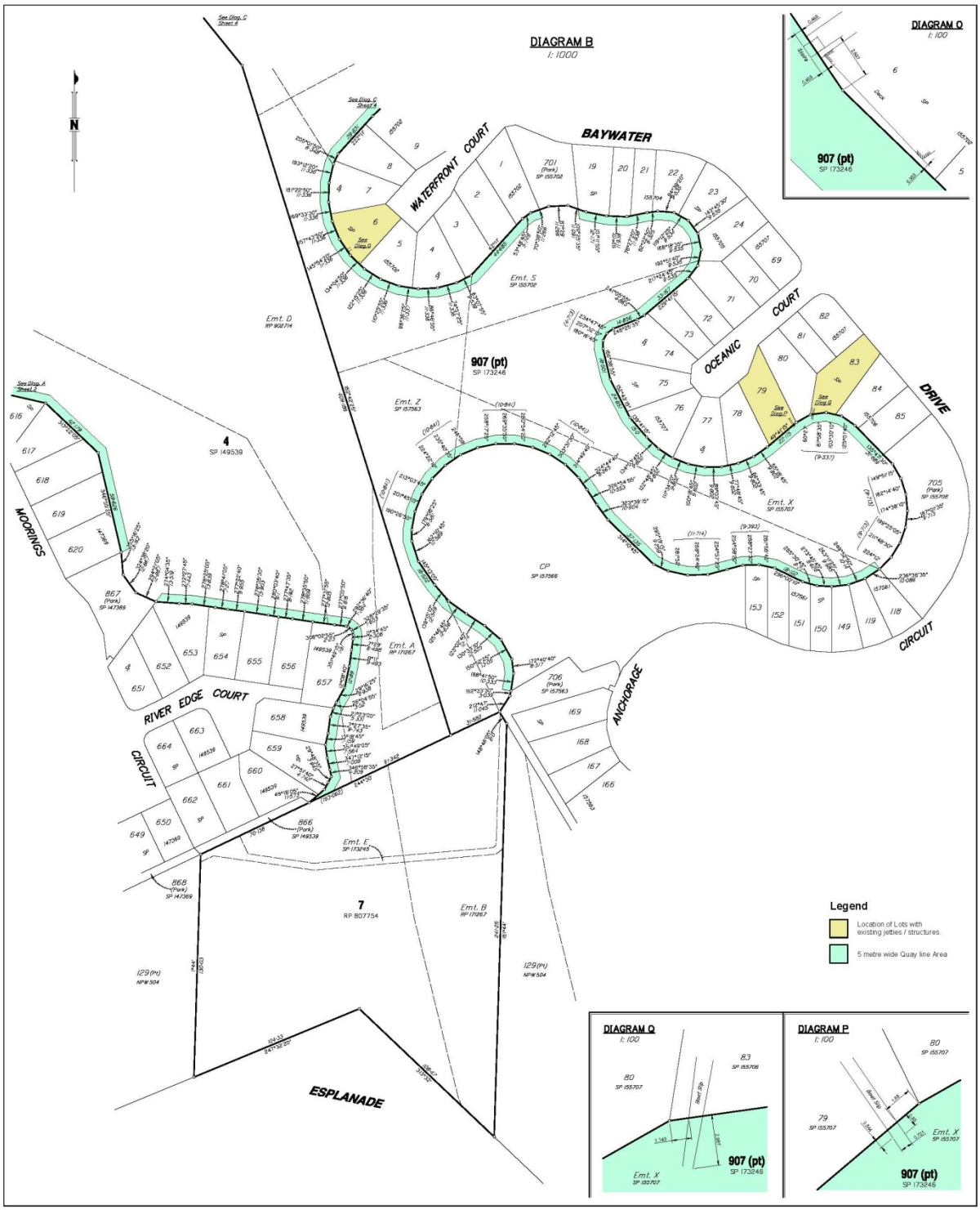

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Checked:	DB	Date:	25.06.12

Associated Consultants

Local Authority:	Maroochy Shire Council
File Ref. No:	
RP Description:	Lot 7 on RP 807754, Lots 814 & 861 on SP 115786, Lot 6 on SP 147357, Lot 4 on SP 149539 and Lot 907 on SP 173246.
Original Portion:	68V, 68V, 79V, 333V & 460
Parish/County:	Maroochy / Canning
Date of Survey:	12/04/12
Level Datum:	AHD
Origin:	OPM 146862 (RL 2.068)
Level Bk / Fld Bk:	LB 754
Horizontal Datum:	SP115786
Contour Interval:	N/A

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1 : 2000 @ A3

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Client
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Twin Waters Residential Community

Quay Line Plan - Sheet 3 of 5

Drawing No. S.4896-437-A
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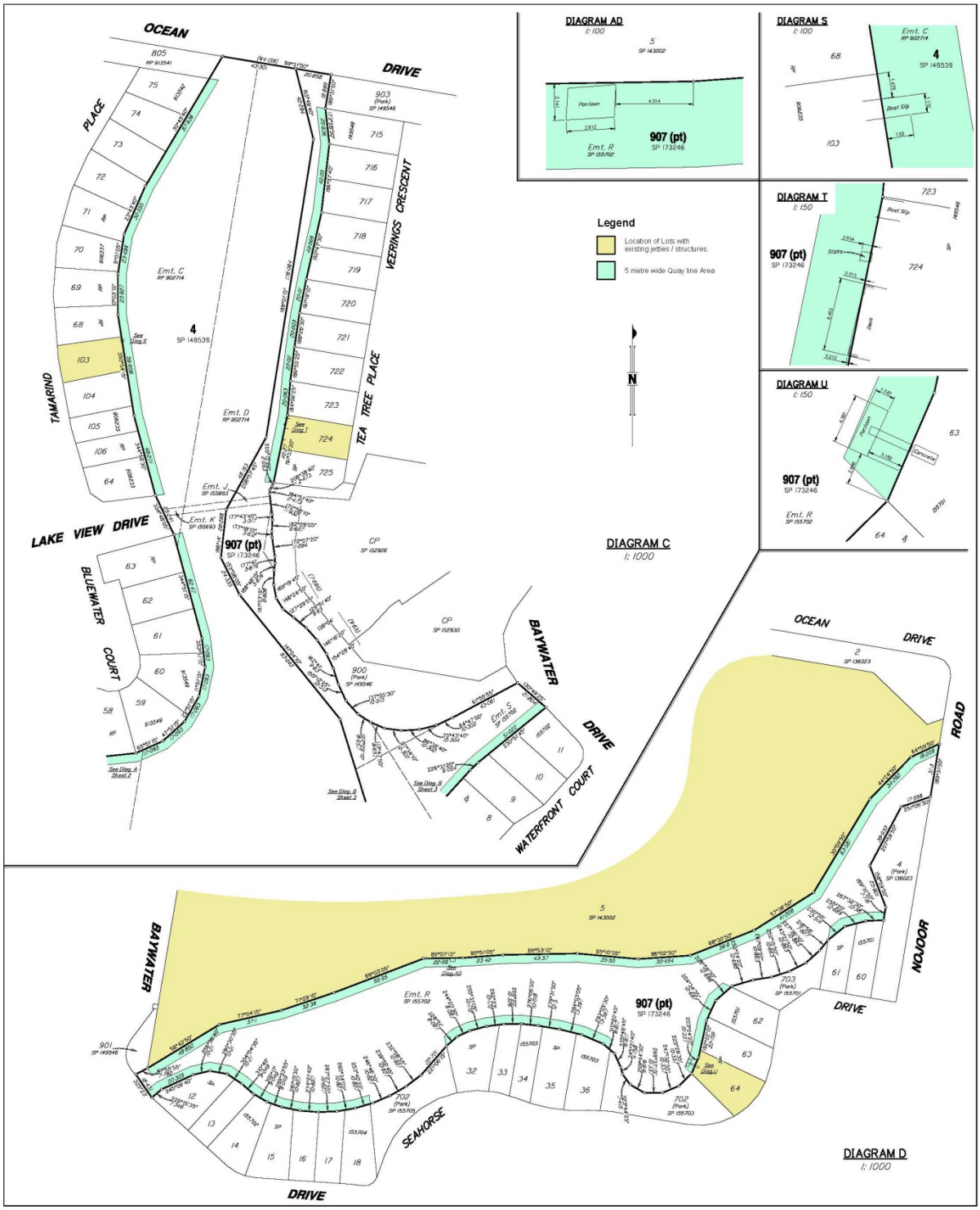

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Surveyed:	-	Date:	-
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Associated Consultants

Local Authority: Maroochy Shire Council
File Ref. No:
RP Description: Lot 7 on RP 807754, Lots 814 & 861 on SP 115786, Lot 6 on SP 147357, Lot 4 on SP 149539 and Lot 907 on SP 173246.
Orginal Portion: 66V, 68V, 75V, 333V & 460
Parish/County: Maroochy / Canning
Date of Survey: 12/04/12
Level Datum: AHD
Origin: OPM 146862 (RL 2.068)
Level Bk / Fld Bk: LB 754
Horizontal Datum: SP115786
Contour Interval: N/A

Scale 0 20 40 60m
1 : 1000 @ A1 (Before Reduction)
1 : 2000 @ A3

Notes
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Issue	Description	Date	Appd.
A	Original Issue	25.06.12	DB

Client: Lend Lease Pty. Ltd.

Twin Waters Residential Community

Quay Line Plan - Sheet 4 of 5

Drawing No. S.4896-437-A
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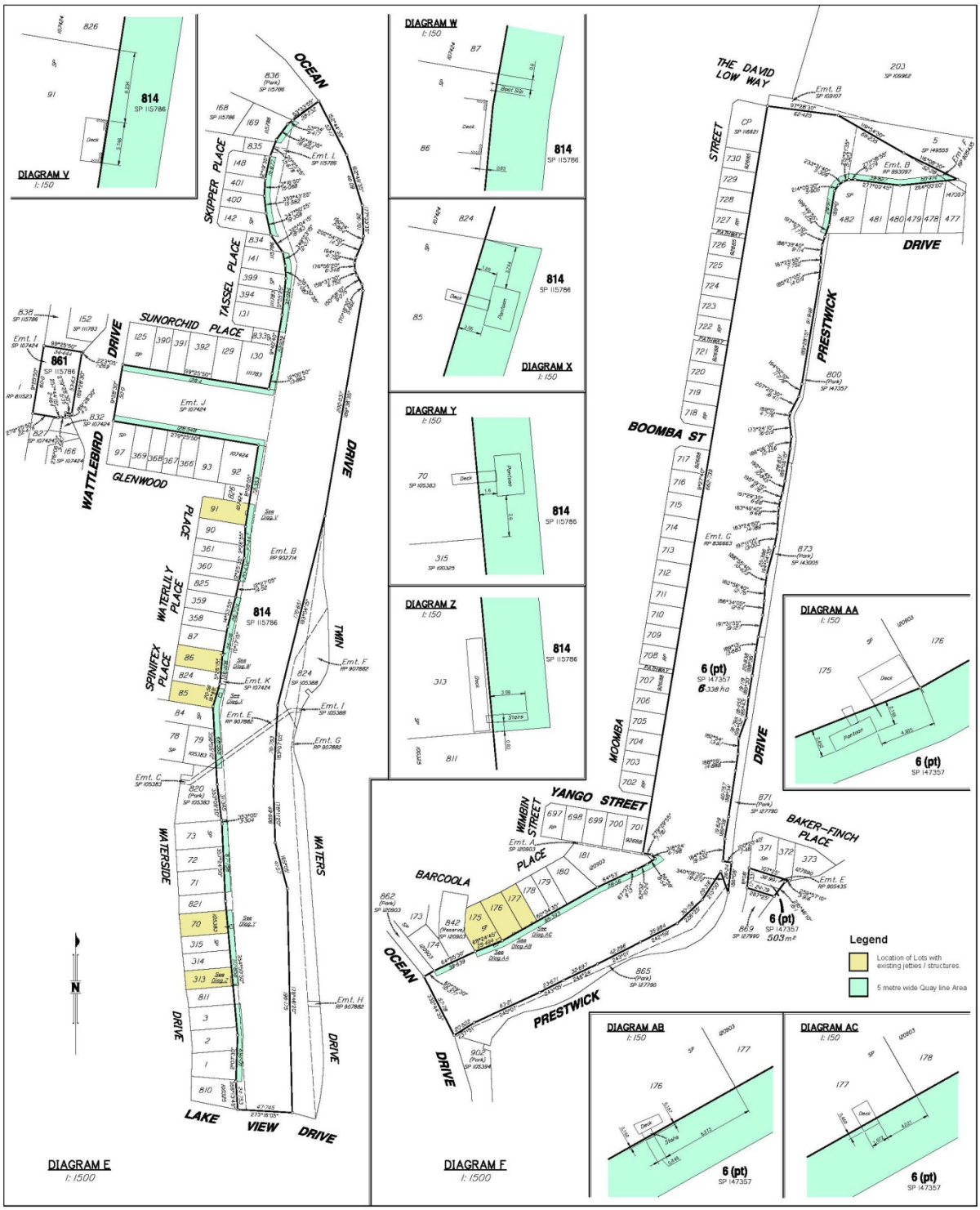

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Surveyed: -	Date: -	File Ref. No:	Approved: DGB
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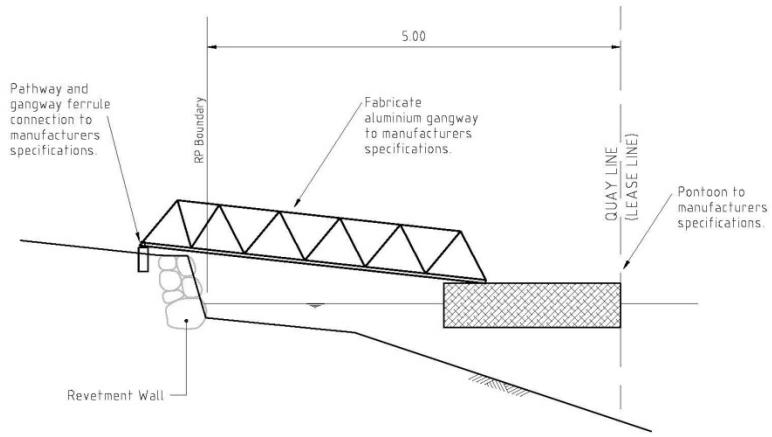
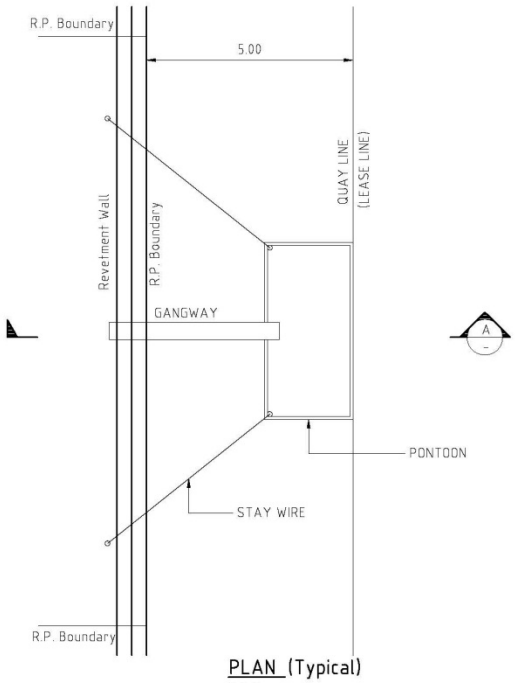
APPENDIX B TWIN WATERS LAKE: TYPICAL STRUCTURE DESIGN: 2.1 Floating Pontoon, 2.2 Deck/Stairs, 2.3 Ramp/Slip Structure



This drawing shows general design parameters only and is not intended to be a detailed construction drawing. Detailed construction drawings prepared and certified by a qualified structural engineer are required for each individual installation.

SECTION A (TYPICAL)
N.T.S.



PLAN (Typical)
N.T.S.

MOORING ARRANGEMENTS:

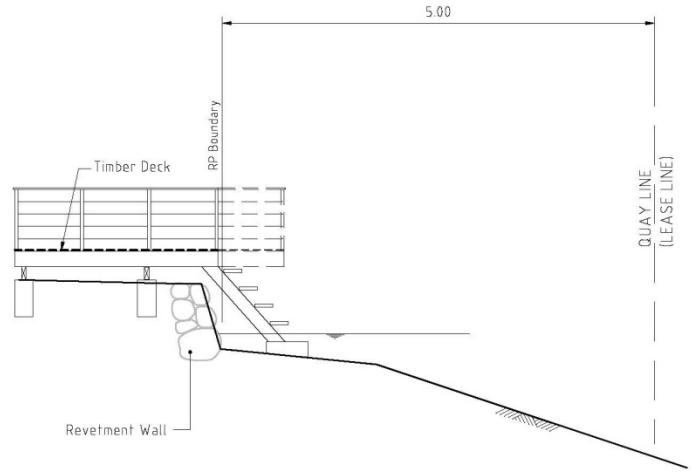
Any vessel berthed at the the pontoon must not at any time :-

1. Extended into that area within 1.5m of the side boundaries of the designated Quay Line.
2. Exceed the design limitations of the pontoon.
3. Impede the safe navigation of vessels that utilise the waterway.
4. Compromise the safe ingress and egress of vessels to and from neighbouring structures.

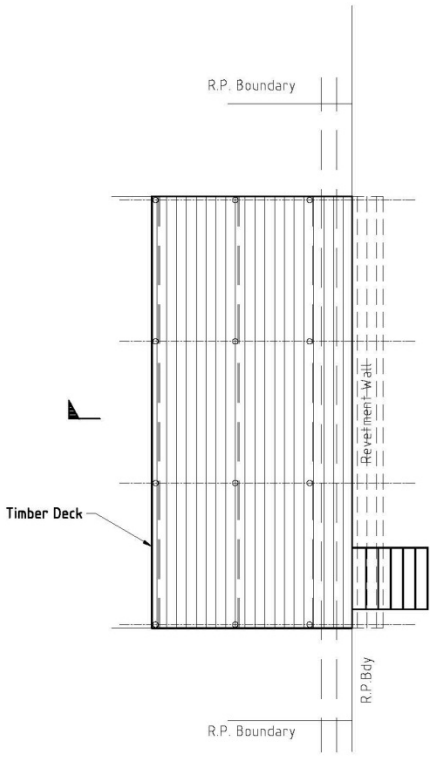
GENERAL NOTES:

1. Design live loads for gangways and pontoons (Private use only):
   - single user residential site 2.0kPa
   - multi user residential site 3.0kPa
2. All structures shall be designed to withstand berthing impact and hydraulic loadings for a channel velocity of 0.75m/s.
3. Pontoons must be stable at all times . When the specified live load is distributed over half the width of the pontoon and over the walkway , there shall be not less than 75 mm of reserve bouyancy ; the bottom corner shall not emerge from the water and the angle of tilt shall not exceed 15°.
4. Pontoons must be constructed of materials suitable for the purpose . Thin walled steel oil drums shall not be permitted for pontoon floats. Pontoons must be protected against corrosion , attack by marine organisms and deterioration of the materials by abrasion or immersion in sea water.
5. Pontoons are not to extend beyond quay line or closer than 2.0m to the projection of the side boundary of the quay line.
6. The pontoon must contain fixed lighting sufficient to indicate the presence of the pontoon. The lighting must be adequately shielded as to not cause a risk to the safe navigation of other vessels or a nuisance to surrounding properties.
7. All stay wires are to be fitted with retro-reflective tape or a similar material, sufficient to be clearly visible from approaching vessels.
8. The length of the pontoon must extend to the outer edge of the Quay Line.
9. Both pontoons and walkway shall be fully carpeted, fitted with mooring cleats and fender rubber to three sides.

LEND LEASE DEVELOPMENT PTY LTD
TWIN WATERS PRECINCT
TYPICAL PONTOON
FIGURE 2.1



SECTION A
N.T.S.



PLAN
N.T.S.

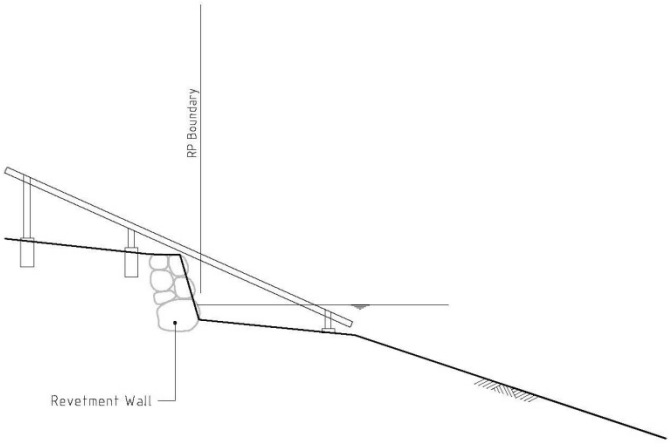
GENERAL NOTES:

1. All structures shall be designed to withstand berthing impact and hydraulic loadings for a channel velocity of 0.75m/s. No loads are to be imposed on revetment wall by deck.
2. Design live loads for decks (Private use only):
   - single user residential site 2.0kPa
   - multi user residential site 3.0kPa
3. No fixing or deck support shall be made onto the existing revetment wall.
4. Maximum deck level of R.L.2.50

This drawing shows general design parameters only and is not intended to be a detailed construction drawing. Detailed construction drawings prepared and certified by a qualified structural engineer are required for each individual installation.

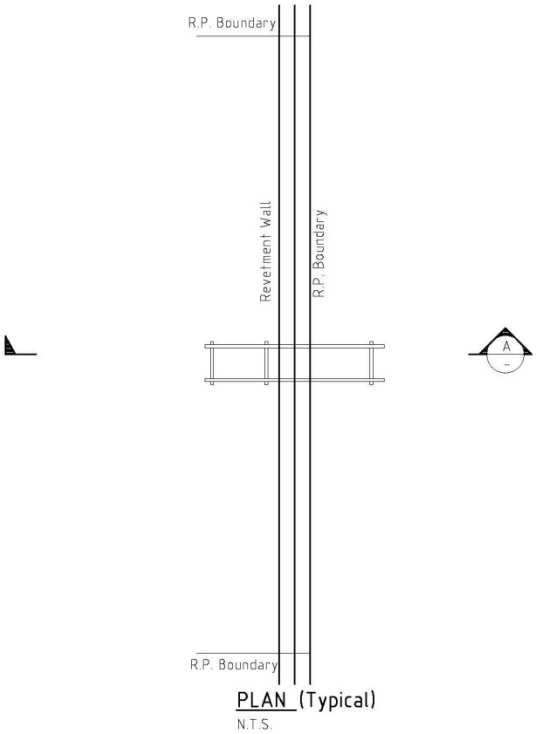
TWIN WATERS PRECINCT

TYPICAL DECK/STAIRS
FIGURE 2.2



This drawing shows general design parameters only and is not intended to be a detailed construction drawing. Detailed construction drawings prepared and certified by a qualified structural engineer are required for each individual installation.

SECTION A (TYPICAL)
N.T.S.



PLAN (Typical)
N.T.S.

TWIN WATERS PRECINCT

TYPICAL BOAT RAMP
FIGURE 2.3