# Site Servicing Strategy

## Barangaroo South

YN210079

Prepared for

Lend Lease Project Management and Construction

March 2013

Cardno
Shaping the Future

# Document Information

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# 1 Introduction

## 1.1 General Overview

Lend Lease Project Management and Construction (LLPM&C) has engaged Cardno to prepare a potable water and wastewater Servicing Strategy for Barangaroo South. This report includes allowance, where relevant, for capacity provision and wastewater discharge from Barangaroo Central and Headland Park.

This strategy encompasses discharge of waste water, supply of potable water and capture/treatment of internal and external wastewater flows for production of recycled water. The demand/discharge calculations and treatment processes are based on data provided by Lend Lease.

The strategy enclosed in this report outlines the method of providing services to the site and sets the basis for current and future Barangaroo South approved developments.

Existing applications submitted to Sydney Water are:

- Case number 123877* Feasibility Application for Barangaroo South Proposal
- Case number 128482 C3 building
- Case number 125232* C4 building
- Case number 128483 C5 building
- Case number 125663 Basement and Car parking
- Case number 127713 Potable Water Ring main

** NORs provided in Appendix A*

It is intended that Sydney Water will endorse this document as a record of agreement between Sydney Water and LLPM&C. This document will be used as reference for all current and future water and wastewater service applications for the Barangaroo South development through Sydney Water application process.

The Barangaroo development is divided into three main portions of work as indicated in Figure 1.1.

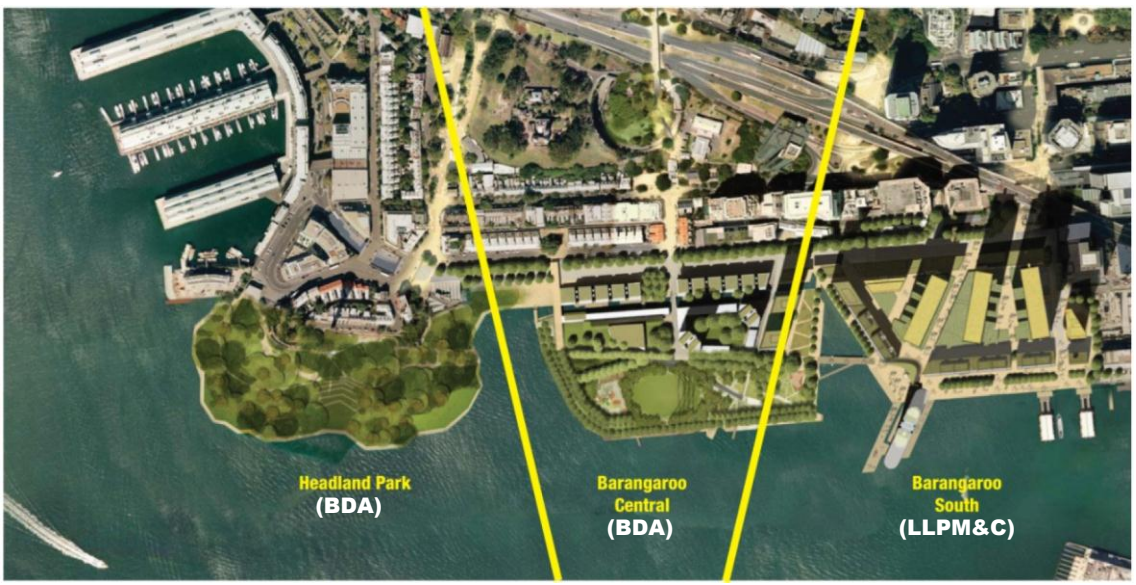


**Figure 1-1 Barangaroo Development Overview**

## 1.2 Site Ownership and Responsibility

The overall site is owned by the Barangaroo Delivery Authority (BDA). Lend Lease is delivering Barangaroo South development; BDA are delivering the Headland Park and Barangaroo Central developments. BDA has recently engaged Baulderstone as constructor for the Headland Park works.

BDA has granted a 99 year lease to Lend Lease and entered into a contract with Lend Lease for the delivery of the Barangaroo South development.

## 1.3 Barangaroo Sustainability Initiatives

When completed, the Barangaroo site will be a water positive development. A key component of the development objectives includes implementation of the following sustainability initiatives:

- Decommissioning of SP0014 and diversion of existing flows to SP1129,
- Installation of water efficient fixtures and fittings,
- Reduction of potable water use through an onsite recycled water plant and reticulation of recycled water throughout the Barangaroo development,
- Offsite export of recycled water to nearby buildings for non-potable uses such as cooling towers and toilet flushing. (It should be noted that potable water top up of recycled water system, if required, would occur within the Barangaroo development only. Potable water top up will not be used for export to surrounding buildings),
- Sewer mining to supplement wastewater source, and
- Use of “Harbour Heat Rejection” for cooling loads. This system eliminates the water demand that would normally be required for heat rejection by cooling towers.

In addition to the above, the following environmental initiatives are planned:

- Stormwater harvesting and re-use for irrigation of podium gardens,
- Gross pollutant capture,
- Reduction of Nitrogen and Phosphates in accordance with the City of Sydney Draft DCP2010 requirements,
- Improvement to current external to site stormwater drainage capacity to increase piped conveyance from 2 to 100 year ARI storm event, and
- Improvement to overland flow conveyance such that existing flooding in Hickson Road is removed during the 100 year ARI event.

# 2 Scale of Development

Table 2.1 summarises the total floor of the development for both Barangaroo South and Barangaroo Central by building type:

**Table 2-1 Proposed Floor Area**

| AREA SCHEDULE | |
|---|---|
| **BUILDING TYPE** | **Gross Floor Area (GFA) / No. Of APARTMENTS** |
| **Residential** | 1,092 apts |
| **Tourism** | 33,000 $m^2$ |
| **Commercial** | 343,700 $m^2$ |
| **Retail** | 33,777$m^2$ |

It is noted the area of the common basement and car parking is included in the areas of the buildings included in the above table.

It is proposed to submit a separate S73 application for the provision of services for each approved Development Planning Application.

As at the date of this report, the approved Development Planning Applications are the Concept Plan, Basement, Commercial Buildings C3, C4 and C5.

# 3 Anticipated Loading Programme

## 3.1 Calculation of Anticipated Loading

The Sydney Water WSA rates have not been used to calculate the water demand requirements or the wastewater discharge flows.

All calculations have been based on benchmarked data from developments across Australia that have adopted best practice for water management.

The key developments used to develop the benchmarked data were as follows:

Commercial:

- ANZ Office building Victoria Harbour, Melbourne, Victoria;
- Darling Harbour Stage 3 Sydney;
- The Bond Office building Hickson Road; and
- The Gauge office building in Victoria Harbour Melbourne Victoria.
- Real time monitoring in a recently completed commercial high rise building in Sydney CBD,

Retail:

- Rouse Hill Shopping Centre, Rouse Hill NSW;
- Charlestown Shopping Centre, Charlestown NSW;
- Sunshine Plaza Shopping Centre, Maroochydore, QLD; and
- Macarthur Shopping Centre, Macarthur NSW.

Residential:

- Distillery Hill residential development; Sydney
- Conservatory, Adelaide; and
- City Futures: Water Use and the Built Environment: Patterns of Water Consumption in Sydney.

Tourism (Hotel):

- Various Hotels in Sydney.

## 3.2 Staging of Anticipated Loading

The staging of the loading is presented as milestones related to key events, rather than building by building program, during the development of the Barangaroo site. Presenting the information in this manner provides a reasonable structure to assist Sydney Water planning for servicing of the development. The three milestones detailed below show when the key demands are required for the site.

The milestones are structured for:

**Milestone 1, June 2015, First Occupation:**

- Several buildings are planned to be occupied in a short period of time and the initial loading is for buildings as shown in the table below. At this phase of the development the first stage of the Recycled Water Plant (RWP) is implemented, capable of treating 500kL/day input.

**Milestone 2, Earliest Dec 2015, latest expected 2018, Required when Flow to RWP required exceeds 500kL/day:**

- When the required capacity of the RWP exceeds 500kL/day and the second treatment train of the RWP will be implemented. The current planning shows this loading will occur in December 2015, which is quite close to Milestone 1, and Sydney Water may consider it appropriate to combine Milestone 1 and Milestone 2

**Milestone 3, Stage 2 of Recycled Water Plant in operation; Total Capacity 1,000 kL/day:**

- When all buildings are constructed and occupied, this presents the ultimate loading for the development in December 2018

During periods when the recycled water plant is offline the waste water will discharge directly to the Sydney Water Sewer main in Hickson Road. The proposed connection is a gravity connection, and the method for determining discharge volumes during these events will be part of the Trade Waste agreement to be negotiated with Sydney Water.

**Table 3-1 Detailed Anticipated Water and Sewer Loading Programme Milestones**

| MILESTONE | BUILDING | OCCUPATION DATE | TOTAL WATER CONSUMPTION *(Demand from Sydney Water Main when RWS is offline <1%)* | | | POTABLE WATER CONSUMPTION NORMAL OPERATION | | | SEWER DISCHARGE *(normal operation discharge to RWS. Discharge to Sydney Water Sewer <1%)* | | NETT FLOWS TO SYDNEY WATER | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | No export (Winter) | With Export (Summer) | |
| | | | | | | | | | | | Normal Operations including excess recycled Water | Flow to sewer Normal operations full demand recycled water | Sewer Mining |
| | | | Avg kL/day | Peak Hr kL | Peak Inst L/s | Avg kL/day | Peak Hr kL | Peak Inst L/s | kL/day | Peak Hr kL | NO EXPORT kL/day | WITH EXPORT kL/day | SEWER MINING kL/day |
| | Building R1 | Jun-15 | 3.5 | 0.4 | 0.6 | 2.8 | 0.3 | 0.5 | 3.2 | 0.3 | 1.7 | -0.4 | 1.1 |
| | Building R8 | Jun-15 | 23.1 | 2.3 | 2.8 | 18.1 | 1.8 | 2.2 | 20.8 | 2.1 | 11.0 | -2.3 | 7.5 |
| | Building R9 | Jun-15 | 36.7 | 3.7 | 4.3 | 28.8 | 2.9 | 3.3 | 33.0 | 3.3 | 17.6 | -3.7 | 11.9 |
| | Building C2 | Jun-15 | 50.3 | 5.0 | 5.8 | 33.5 | 3.3 | 3.9 | 45.2 | 4.5 | 24.1 | -5.0 | 16.3 |
| | Building C4* | Jun-15 | 160.6 | 16.1 | 11.9 | 72.0 | 7.2 | 6.0 | 144.8 | 14.5 | 77.1 | -16.1 | 52.2 |
| | Building C6 | Jun-15 | 160.6 | 16.1 | 11.9 | 72.0 | 7.2 | 6.0 | 144.8 | 14.5 | 77.1 | -16.1 | 52.2 |
| | R8 Retail | Jun-15 | 164.6 | 16.5 | 12.6 | 75.2 | 7.5 | 6.6 | 148.5 | 14.9 | 79.1 | -16.5 | 53.5 |
| | R9 Retail | Jun-15 | 168.7 | 16.9 | 13.3 | 78.5 | 7.8 | 7.1 | 152.2 | 15.2 | 81.0 | -17.0 | 54.8 |
| | C2 Retail | Jun-15 | 172.8 | 17.3 | 13.9 | 81.7 | 8.2 | 7.6 | 155.8 | 15.6 | 83.0 | -17.4 | 56.1 |
| | **C4 Retail** | Jun-15 | 183.6 | 18.4 | 15.8 | 90.4 | 9.0 | 9.1 | 165.6 | 16.6 | 88.2 | -18.4 | 59.6 |
| | Building R7 | Dec-15 | 203.7 | 20.4 | 18.0 | 106.1 | 10.6 | 10.8 | 183.6 | 18.4 | 97.8 | -20.5 | 66.1 |
| | Building C5 | Dec-15 | 312.0 | 31.2 | 24.0 | 144.0 | 14.4 | 12.9 | 281.5 | 28.2 | 149.9 | -31.4 | 101.4 |
| **MILESTONE 1: 500kL Plant On Line** | **C5 Retail** | **Dec-15** | **331.0** | **33.1** | **26.1** | **159.2** | **15.9** | **14.6** | **298.6** | **29.9** | **159.0** | **-33.3** | **107.5** |

| MILESTONE | BUILDING | OCCUPATION DATE | TOTAL WATER CONSUMPTION *(Demand from Sydney Water Main when RWS is offline <1%)* | | | POTABLE WATER CONSUMPTION NORMAL OPERATION | | | SEWER DISCHARGE *(normal operation discharge to RWS. Discharge to Sydney Water Sewer <1%)* | | NETT FLOWS TO SYDNEY WATER | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | No export (Winter) | With Export (Summer) | |
| | | | | | | | | | | | Normal Operations including excess recycled Water | Flow to sewer Normal operations full demand recycled water | Sewer Mining |
| | | | Avg kL/day | Peak Hr kL | Peak Inst L/s | Avg kL/day | Peak Hr kL | Peak Inst L/s | kL/day | Peak Hr kL | NO EXPORT kL/day | WITH EXPORT kL/day | SEWER MINING kL/day |
| | Building C8 | Feb-16 | 337.4 | 33.7 | 27.2 | 161.4 | 16.1 | 15.0 | 304.3 | 30.4 | 162.0 | -33.9 | 109.6 |
| | C8 Retail | Feb-16 | 340.8 | 34.1 | 27.7 | 164.1 | 16.4 | 15.5 | 307.5 | 30.7 | 163.7 | -34.3 | 110.7 |
| | Building C3 | Apr-16 | 468.8 | 46.9 | 34.9 | 208.8 | 20.9 | 17.9 | 423.1 | 42.3 | 225.3 | -47.1 | 152.4 |
| **MILESTONE 2: 1,000kL Plant On Line** | **C3 Retail** | **Apr-16** | **490.5** | **49.1** | **37.3** | **226.2** | **22.6** | **19.9** | **442.6** | **44.3** | **235.6** | **-49.3** | **159.4** |
| | Building R2 | May-18 | 505.9 | 50.6 | 39.0 | 238.2 | 23.8 | 21.2 | 456.4 | 45.6 | 243.0 | -50.8 | 164.4 |
| | Building R3 | May-18 | 557.2 | 55.7 | 44.7 | 278.4 | 27.8 | 25.7 | 502.5 | 50.2 | 267.5 | -56.0 | 181.0 |
| | HOTEL | May-18 | 601.6 | 60.2 | 47.1 | 313.9 | 31.4 | 27.6 | 542.4 | 54.2 | 288.8 | -60.4 | 195.3 |
| | R3 Retail | May-18 | 608.3 | 60.8 | 48.3 | 319.3 | 31.9 | 28.5 | 548.5 | 54.8 | 292.0 | -61.1 | 197.5 |
| | Barangaroo Central Commercial | May-18 | 632.4 | 63.2 | 50.9 | 327.7 | 32.8 | 29.5 | 570.2 | 57.0 | 303.6 | -63.5 | 205.3 |
| | Barangaroo Central Residential (apt) | May-18 | 721.6 | 72.2 | 55.9 | 397.5 | 39.8 | 33.4 | 650.3 | 65.0 | 346.2 | -72.4 | 234.2 |
| | Building C1 | Sep-19 | 743.8 | 74.4 | 58.4 | 405.3 | 40.5 | 34.2 | 670.3 | 67.0 | 356.9 | -74.7 | 241.4 |
| | Building C7 | Sep-19 | 743.8 | 74.4 | 58.4 | 405.3 | 40.5 | 34.2 | 670.3 | 67.0 | 356.9 | -74.7 | 241.4 |

| MILESTONE | BUILDING | OCCUPATION DATE | TOTAL WATER CONSUMPTION *(Demand from Sydney Water Main when RWS is offline <1%)* | | | POTABLE WATER CONSUMPTION NORMAL OPERATION | | | SEWER DISCHARGE *(normal operation discharge to RWS. Discharge to Sydney Water Sewer <1%)* | | NETT FLOWS TO SYDNEY WATER | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | No export (Winter) | With Export (Summer) | |
| | | | | | | | | | | | Normal Operations including excess recycled Water | Flow to sewer Normal operations full demand recycled water | Sewer Mining |
| | | | Avg kL/day | Peak Hr kL | Peak Inst L/s | Avg kL/day | Peak Hr kL | Peak Inst L/s | kL/day | Peak Hr kL | NO EXPORT kL/day | WITH EXPORT kL/day | SEWER MINING kL/day |
| | C1 Retail | Sep-19 | 749.2 | 74.9 | 59.3 | 409.6 | 41.0 | 34.9 | 675.2 | 67.5 | 359.5 | -75.2 | 243.2 |
| | Building R4 | May-20 | 797.2 | 79.7 | 64.6 | 447.2 | 44.7 | 39.1 | 718.3 | 71.8 | 382.4 | -80.0 | 258.7 |
| | R4 Retail | May-20 | 804.0 | 80.4 | 65.7 | 452.6 | 45.3 | 40.0 | 724.4 | 72.4 | 385.7 | -80.7 | 260.9 |
| | Building R10 | Jul-20 | 817.1 | 81.7 | 67.2 | 462.9 | 46.3 | 41.2 | 736.2 | 73.6 | 392.0 | -82.0 | 265.1 |
| | R10 Retail | Jul-20 | 819.9 | 82.0 | 67.6 | 465.1 | 46.5 | 41.5 | 738.6 | 73.9 | 393.3 | -82.3 | 266.0 |
| | Building R5 | Aug-20 | 857.8 | 85.8 | 71.9 | 494.8 | 49.5 | 44.8 | 772.7 | 77.3 | 411.4 | -86.1 | 278.3 |
| **MILESTONE 3: Ultimate Development** | **R5Retail** | **Aug-20** | **860.5** | **86.0** | **72.3** | **496.9** | **49.7** | **45.2** | **775.1** | **77.5** | **412.7** | **-86.4** | **279.1** |

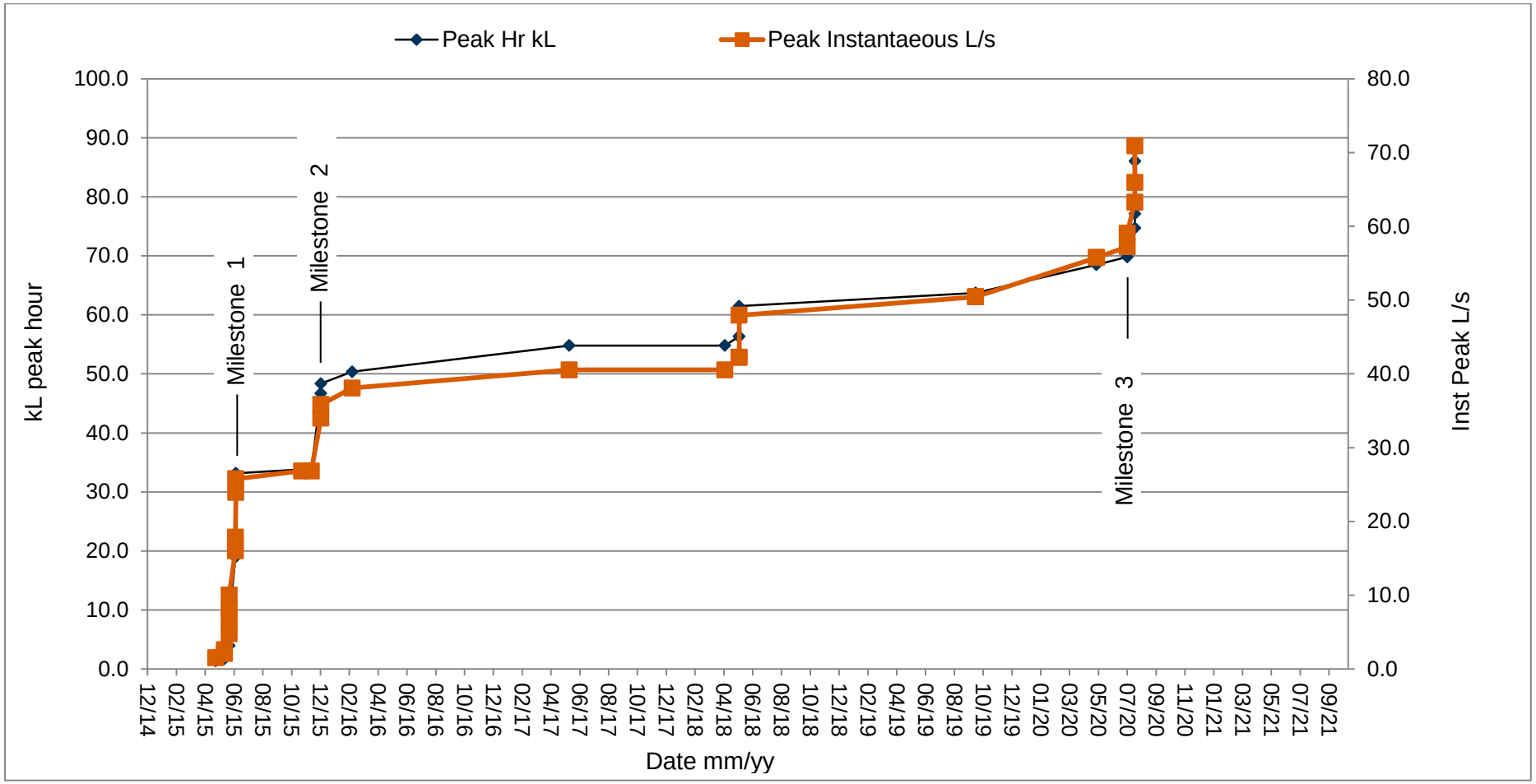


**Figure 3-1 Potable Water Supply Peak – RWP Offline**

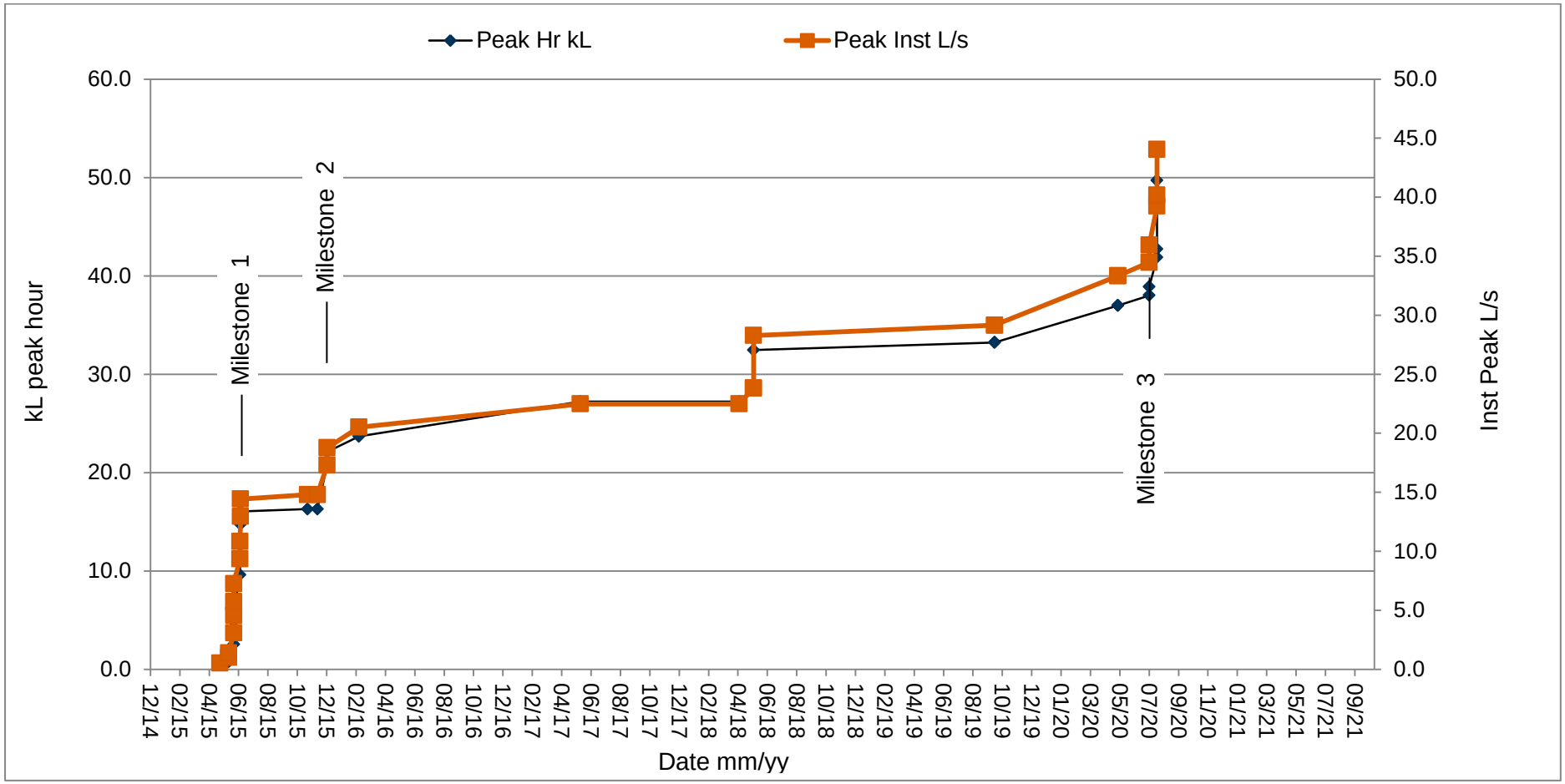


**Figure 3-2 Potable Water Supply Peak – RWP Online**

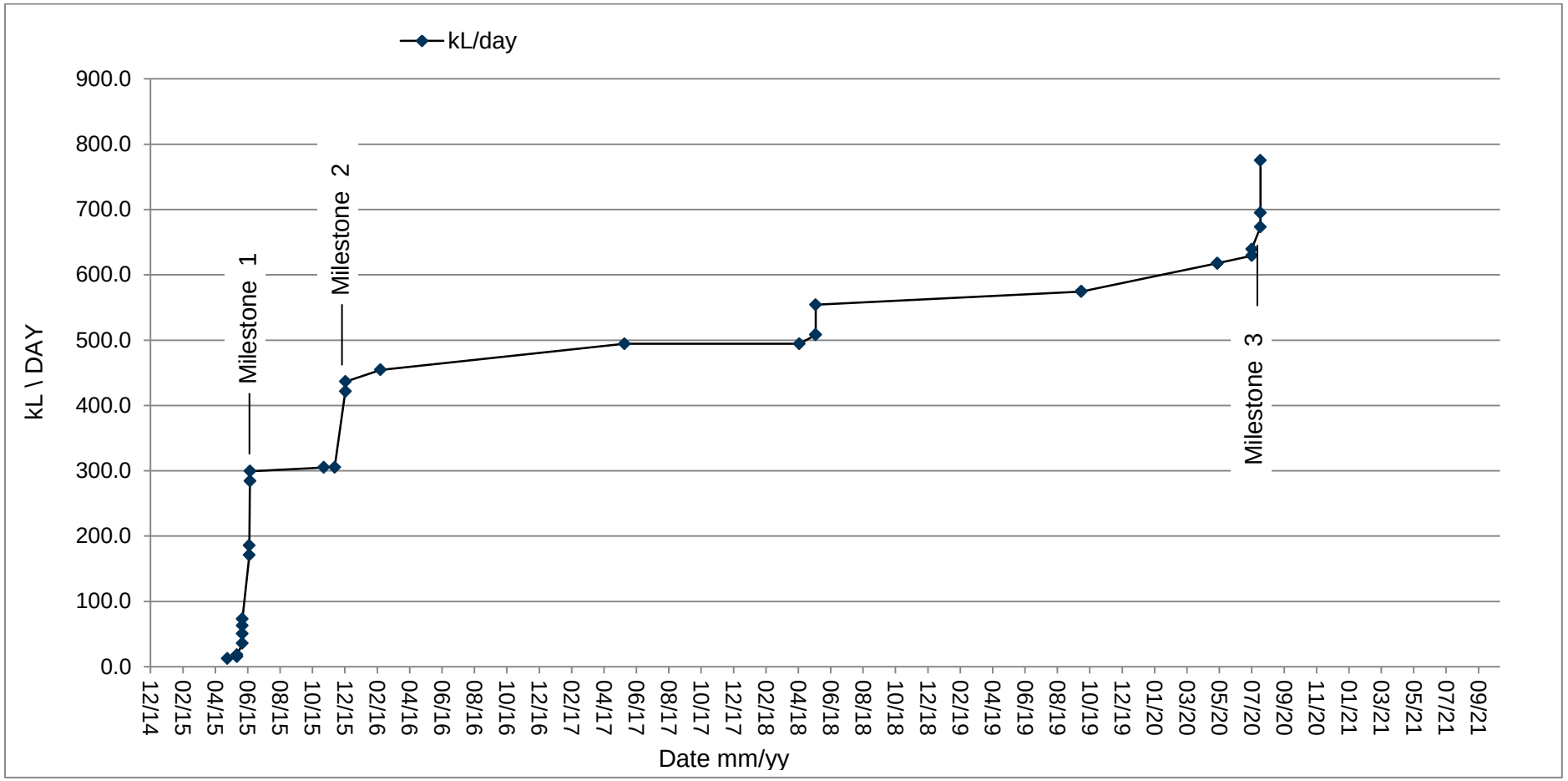


**Figure 3-3 Sewage Discharge – RWP Offline**

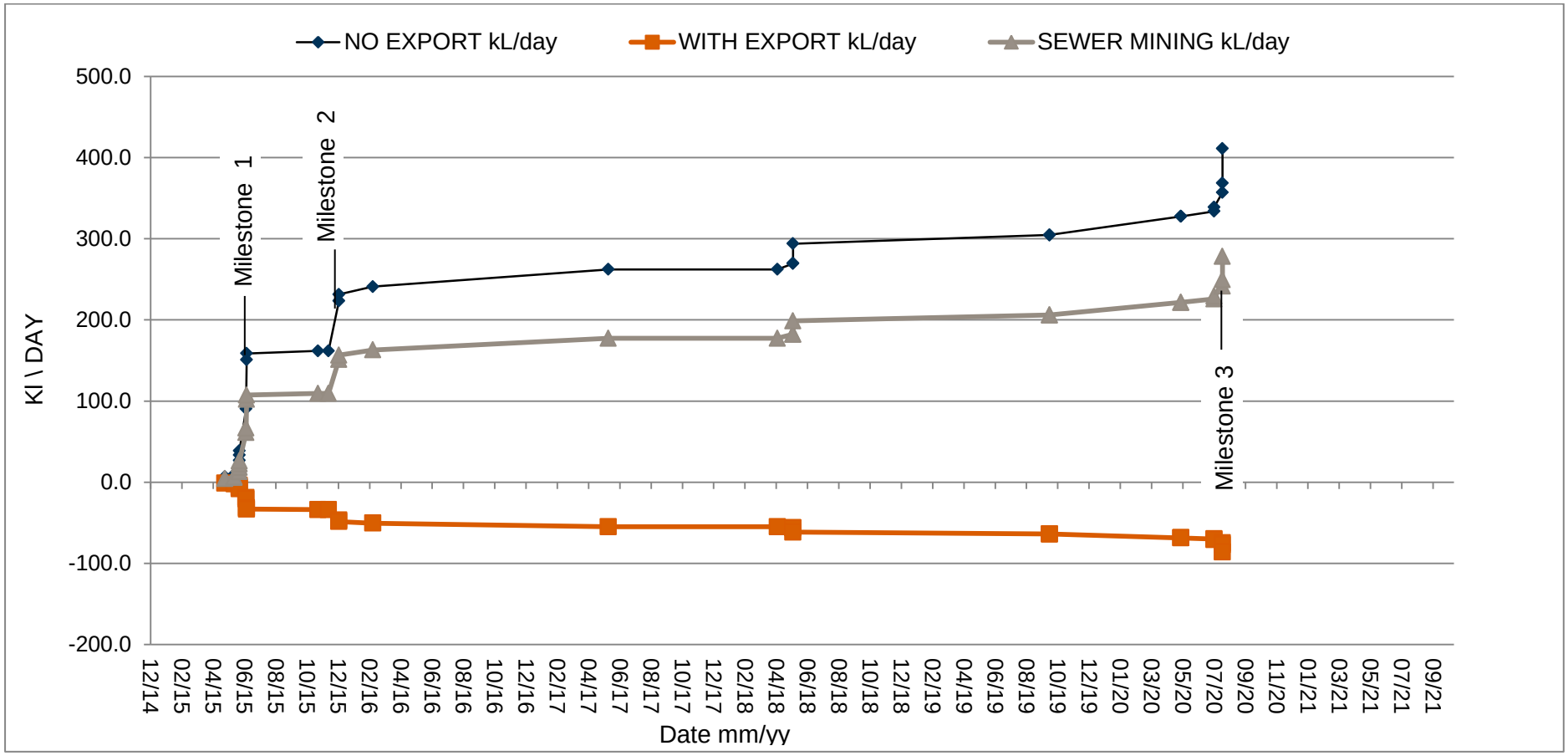


**Figure 3-4 Sewage Discharge – Normal Operation**

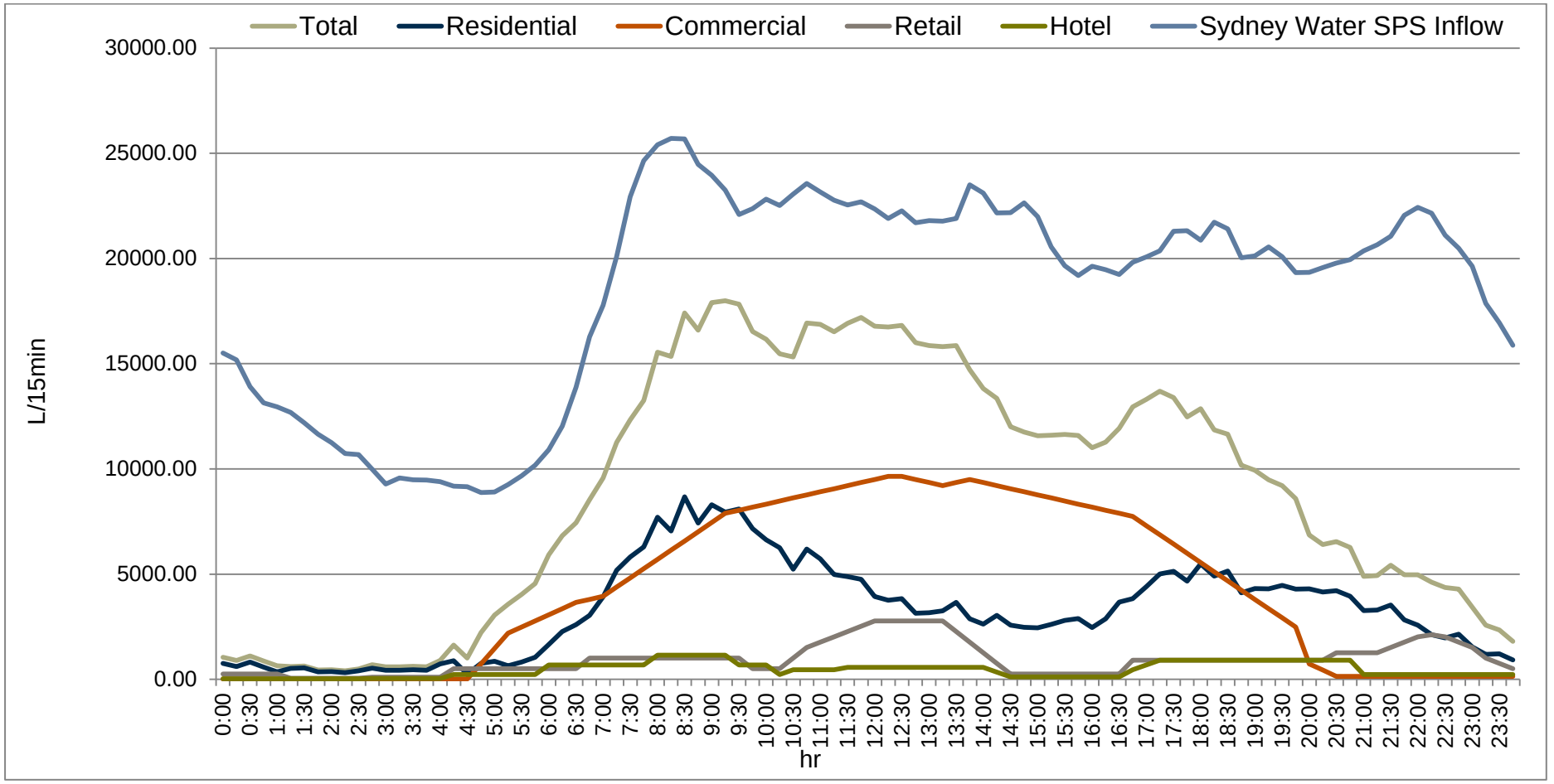


**Figure 3-5 Typical Waste Water Diurnal Profile**

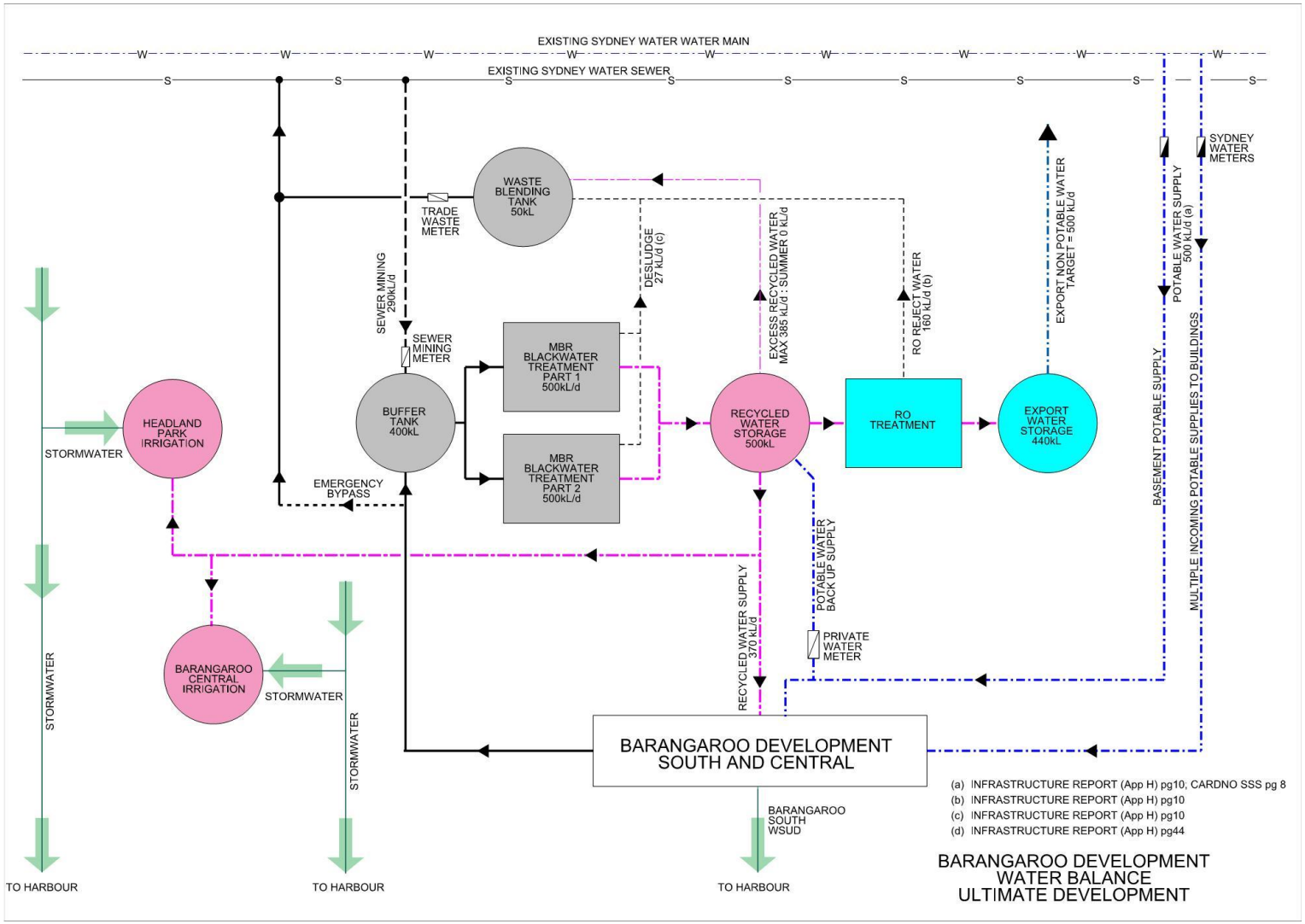


**Figure 3-6 Ultimate Case Water Balance**

# 4 Title and Ownership Strategy

## 4.1 Title Strategy

The title strategy calls for each building to be created as its own lot extending vertically from the basement through podium level and the tower buildings. A DRAFT title strategy is provided in Appendix C.

## 4.2 Road Ownership Strategy

The road ownership strategy is outlined in the documentation attached in Appendix B. It is expected the roads at surface level are to be dedicated to Council or other Road Authority and will become public roads. This will be achieved through the use of a structural ”fold” in the ground plane slab creating a zone above the slab for construction of road pavement, footpaths and services.

## 4.3 Services Operational Management

The future operation of utilities at Barangaroo will be through a combination of a traditional public utility service and private network service. The Barangaroo Management Plan, Building Management Statements, Leases, Easements and Licences will be the core governance arrangements adopted by key stakeholders for the ongoing management and operation of Barangaroo South.

The figure below shows a high-level diagram of the utilities likely to be privately owned versus ownership by traditional public authorities at Barangaroo South.

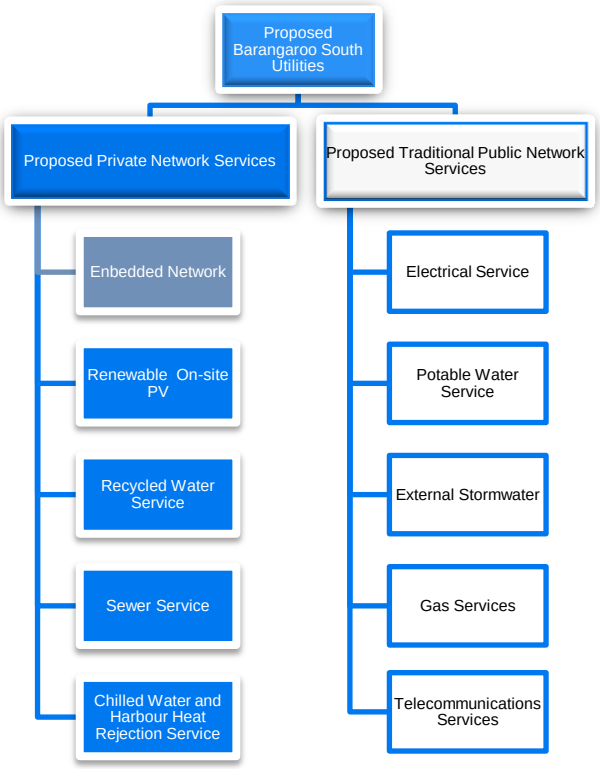


**Figure 4-1 Proposed Utility Ownership**

The principles for ownership and management are subject to on-going discussion and agreement with relevant parties.

## 4.4 Services Ownership

In line with Figure 4.1, the following key services owners are outline in the table below.

**Table 4-1 Service Ownership**

| ASSET | OWNER |
|---|---|
| Potable Water | Sydney Water |
| Recycled Water | Lend Lease Recycled Water (Barangaroo South) |
| Waste Water | Lend Lease Recycled Water (Barangaroo South) |
| Stormwater within Barangaroo | BDA / City of Sydney Council. SHFA or other authority in line with transfer of road ownership |
| Stormwater external to Barangaroo | Sydney Water / City of Sydney Council |

The provisions and requirements of the Water Industry Competition Act (WICA) will apply to the ownership and operation of Recycled and Waste Water treatment and distribution.

The following table outlines areas of interface between key service owners.

**Table 4-2 Operational Interface**

| ASSET | INTERFACE |
|---|---|
| Potable Water | Potable water for the Barangaroo development will be supplied by Sydney Water.<br>Operational interface will be a standard connection, 150mm back-up water supply extended from the potable water supply in the basement that is connected to the proposed Sydney Water ring main. The back-up supply is required when the RWP is offline or during seasonal variations to cover the peak demand if required.<br>Potable water top-up facility will be provided to the Recycled Water Plant and will service only the Barangaroo development. When the recycled water demand exceeds the supply from the RWP, potable water will be used for Barangaroo South and Barangaroo Central to top up the recycled water tank. Backflow prevention will be provided to isolate the potable water top up from the recycled water storage.<br>It is proposed that the potable water supply will be a branched connection from the basement potable water supply. |
| Recycled Water | Recycled water will be provided to customers within the Barangaroo development and to customers external to the Barangaroo development.<br>There is an operational interface during periods where the RWP is offline but not with any other service authority.<br>Potable water top up supply shall not be provided for the export recycled water supply to offsite customers. If the export recycled water demand exceeds the supply, and no export recycled water is available from the Barangaroo Recycled Water system, then supply to the offsite customers will stop. External customers will have their own potable water top-up facility at their premises with an automatic changeover to the alternate water supply within their property. |
| Waste Water | Within the Barangaroo development Lend Lease Recycled Water (Barangaroo South) will collect waste water through a private sewerage network which will discharge to an internal Recycled Water Plant.<br>Wastewater discharge from the treatment plant, containing treatment by products, will flow to Sydney Water sewer in Hickson Road which discharges to SP1129. Wastewater discharge will be covered under consent to discharge industrial trade wastewater.<br>In an emergency situation, when the RWP is not operational or during planned maintenance period, partial or full discharge of wastewater from the Development will be discharged in Sydney Water 450mm sewer main in Hickson Road via a gravity overflow connection. In this situation, RWP Operator is to inform Sydney Water Service that the emergency discharge from Barangaroo is required. This will allow Sydney Water service to prepare for accepting the flow and also avoid any maintenance activities on SP1129.<br>In addition, an alarm/alert system will be installed such that SWC are made aware of any overflow above normal discharge conditions agreed in the Trade Waste Agreement. |

Formal arrangement of these interfaces will be subject to agreement during negotiation for establishment of an Industrial Trade Waste Agreement.

# 5 Sewer Servicing Strategy - General

The following sections build on the initial work completed under the “Integrated Services Infrastructure Plan” provided as Appendix H of this document.

## 5.1 Sydney Water’s Growth Servicing Plan and Overview

The Barangaroo development has been identified in both the 2009 to 2014 and 2011 to 2016 (draft) Growth Servicing Plan(s) (GSP).

Under ordinary circumstance, development sites identified as part of the GSP are to be provided with services to the boundary of the development as part of Sydney Water’s capital works programme.

This document assesses technical solutions for works that may be required to the local sewerage network or to SP1129 to provide wastewater capacity for the Barangaroo development. The recommendations of this strategy aim to provide a solution that is the most feasible from perspectives of:

- Capital and life cycle costing,
- System hydraulic performance,
- Sustainability,
- Buildability, and
- Programme.

## 5.2 Outline of Sewage Collection Strategy – Barangaroo South, Central and Headland Park

The sewage collection system on the site will discharge to a central Recycled Water Plant (RWP) located in the Barangaroo South basement. A bypass overflow from the RWP connection shall be provided, connecting the Development to the existing Sydney Water Sewer located in Hickson Road.

When the RWP is offline or there is surplus recycled water available for the needs of the buildings, then the wastewater shall be diverted to discharge directly to the Sydney Water sewer in Hickson Road, and ultimately to the Sewage Pumping Station SP1129. It is proposed to discharge the waste by-products from the RWP system to the Sydney Water sewer, including the de-sludging from the Membrane Bioreactor (MBR), and the reverse osmosis-reject water. This is addressed further in trade waste discussion provided in Section 8 of this document.

The buildings on the eastern section of the site, including the office towers C3, C4 and C5 will drain by gravity connection to the inlet works of the RWP. The buildings on the western side of the development, including sections of the retail outlets below the commercial towers, will discharge to private sewage pump stations located in the Basement of Barangaroo South. The discharge from the sewage pump stations shall connect into the high level gravity collection system upstream of the inlet works of the RWP.

All private sewage pump stations shall be provided with minimum 8 hours average flow storage. Due to the Development water strategy and proposed implementation of a recycled water system and off-site export, the flow to sewer will be reduced (on average by 110%) when compared to a Business as Usual case.

The Development will be required to enter into Industrial Trade Waste Agreement with Sydney Water for discharge of waste water, excess recycled water and RWP process by-products into the Sydney Water sewer system. Discussions with Sydney Water have commenced to address this requirement.

In addition, the Development will require sewer mining to increase the quantity of recycled water as required for off-site export. The proposed sewer mining connection is into the Sydney Water sewer main in Hickson Road. The Development will be required to enter into a Sewer Mining Agreement

with Sydney Water. Discussions with Sydney Water have commenced with respect to the proposed Sewer Mining Agreement and an approval in principal on the Feasibility Application has been received from Sydney Water. In addition, Lend Lease has completed flow monitoring and testing of the sewage at the proposed sewer mining collection point.

Prior to issue of a Construction Certificate for the relevant works, a detailed design of the RWP shall be submitted to and approved by the Director General (Director General of the Department of Planning). It is acknowledged that a license to construct and operate the RWP will be required under the provisions of the Water Industry Competition Act (WICA).

The proposed Barangaroo Central buildings will be served by a network of gravity drainage and pumped waste water systems throughout the development discharging to the Barangaroo South RWP. Further internal project level discussions are required to determine the final arrangement and concepts.

The proposed sewer works on Headland Park will include the decommissioning of sewer pump station SP0014. This will involve the realignment and diversion of the existing Sydney Water mains via a new sewer mains along Towns Place and Hickson Road to connect with the SP1129 pump station located within Barangaroo Central.

The superstructure of SP0014 is to be relocated for adaptive reuse as a toilet block within the Headland Park.

## 5.3 Outline of the Internal Barangaroo South Sewage Collection System

A concept of the sewage system within the development is included in Appendix C of this document.

The internal sewage collection network will be privately owned and operated. Sydney Water will have a single customer with respect to discharge of sewage flows from the development.

Sewage within the development will be routed via private gravity drainage and pump stations to a sewage treatment plant owned and operated by Lend Lease Recycled Water (Barangaroo South). Lend Lease Recycled Water (Barangaroo South) will invoice and collect sewer rates and charges from customers.

It is noted the sewerage system within the Barangaroo development will be suspended from the roof of the basement structure. As such, infiltration has not been considered in the calculations of expected discharge.

Sydney Water have agreed that the wastewater product will be discharged in the Sydney Water system via a single overflow from the treatment plant under an Industrial Trade Waste Agreement. The wastewater discharge will include wastewater from the Development, brine from the RO treatment, sludge and screenings form the wastewater treatment process, excess treated effluent and excess sewage.

Modelling of SP1129 and Bondi catchment has been undertaken by GHD. The results of this modelling are presented in Section 7.2 of this report.

# 6 Staged Sewer Servicing Strategy

To support the construction program Sydney Water has agreed, as per section 3.2 of the NOR for case 125232V2, to accept wastewater discharge into the 450mm gravity sewer carrier in Hickson Road. This agreement would apply to flow scenario prior to Milestone 1, as described in Section 3 of this document.

# 7 Ultimate Sewer Servicing Strategy

## 7.1 Overview

It is expected that the existing 450mm trunk sewer main and the SP1129 in Hickson Road will provide facility for discharge of the entire Barangaroo Development.

Two main scenarios are to be considered with respect to operational discharge from the Barangaroo development:

- Normal Operation: Treatment process (MBR or RO) by-product will be discharged from the Barangaroo site to the existing 450mm sewer in Hickson Road, and
- Emergency Operation: When the Recycled Water Plant (RWP) is offline full rate site flows will be discharged to the existing 450mm trunk sewer in Hickson Road.

Both scenarios above will be managed through an Industrial or Commercial Trade Waste Agreement with Sydney Water.

In addition to the operational stage discharge requirements, there will be a requirement for discharge to Sydney Water sewer prior to completion i.e. during the validation and proving of the RWP. This scenario will be managed through the above trade waste agreement.

Lend Lease has commissioned GHD to undertake an investigation into the current and future operation of SP1129. This report concluded that additional storage should be provided for both Sydney Water and Lend Lease to ensure that the ongoing operation of SP1129 is not compromised.

The following sections address requirements for full discharge from the Barangaroo development during the emergency operation scenario noted above.

## 7.2 SP1129 Catchment Modelling

Lend Lease Project Management and Construction (LLPM&C) has engaged GHD to undertake modelling of SP1129 including:

- Decommissioning of SP0014,
- Assessment of existing SP1129 and Bondi catchment capacity,
- Inclusion of sewer flows from Barangaroo within existing model, and
- Assessment of network performance for year 2036 projected growth loads under scenarios with and without the Barangaroo development.

The modelling undertaken sought to determine any existing spare capacity at SP1129 and the impact of the Barangaroo development and future growth on this spare capacity.

The GHD modelling report is attached to this document in Appendix F. The following summary, including tables extracted from the GHD report, is provided for convenience.

The GHD report concludes that additional storage at SP1129 is required as shown in the table below. These values include future catchment growth and Sydney Water and Barangaroo load. The table below references the following criteria:

- 3.4 hour storage condition (i.e. the current performance of SP1129), and
- 4 hour storage condition (i.e. requirement for new pump stations).

**Table 7-1 SP1129 Emergency Storage Requirements (2036)**

| Source of Additional Storage | 3.4 hour Storage Criteria | 4 hours Storage Criteria |
|---|---|---|
| **Barangaroo** | 156 $m^3$ | 181 $m^3$ |
| **SWC Growth (2036)** | 178 $m^3$ | 307 $m^3$ |
| **Total** | 334 $m^3$ | 488 $m^3$ |

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**Table 4 System Performance Summary**

| Performance Criteria | Current 2012 System (With SP0014 decommissioned) | 2012 incl BD (Lend Lease) | 2012 incl BD (Sydney Water) | 2036 without Barangaroo | 2036 incl Barangaroo (Lend Lease) | 2036 incl Barangaroo (Sydney Water) |
|---|---|---|---|---|---|---|
| Model Run | BOFZ | BOFX | BOFY | BOHZ | BOGZ | BOIZ |
| Dry Weather Performance | | | | | | |
| Dry Weather Overflows | Nil | Nil | Nil | Nil | Nil | Nil |
| Pipes with PDWF >60% of pipe depth | Nil | Nil | Nil | Nil | Nil | Nil |
| Average and Peak Dry Weather Flow (l/s) | 30.7 - 51 | 38.3 - 64 | 39.8 – 67 | 40.1 - 71 | 47.6 - 84 | 49.2 - 86 |
| SP1129 Dry weather storage (hrs) | 3.4 | 2.7 | 2.6 | 2.5 | 2.1 | 2.0 |
| Required Storage at SP1129 (m3)<br>(Existing storage volume is 620 m3) | 709 | 890 | 927 | 976 | 1157 | 1194 |
| Additional Storage required at SP1129 (m3) | 89 | 270 | 307 | 356 | 537 | 574 |
| Wet Weather Performance | | | | | | |
| Pipe running full at 6M ARI event | Nil | Nil | Nil | Nil | Nil | Nil |
| MH spillage or overflow - 6M ARI event | Nil | Nil | Nil | Nil | Nil | Nil |
| MH spillage – 2 YR ARI event | Nil | Nil | Nil | Nil | Nil | Nil |
| MH overflows – 2 YR ARI event<br>No from MH 1040511 (volume) | 1 (5.2m3) | 1 (16.7m3) | 1 (16.7m3) | 1 (202.8m3) | 1 (212m3) | 1 (213m3) |
| Peak Wet Weather Flow to SP1129 (for 6M ARI )<br>(Existing pump capacity is 2x88=176 l/s) | 110 l/s | 121 l/s | 123 l/s | 130 l/s | 141 l/s | 143 l/s |

**Table 5 Emergency Storage requirements to maintain existing performance of 3.4 hrs**

| Performance Criteria | Current 2012 System (With SP0014 decommissioned) | 2012 incl Barangaroo (Lend Lease) | 2012 incl Barangaroo (Sydney Water) | 2036 without Barangaroo | 2036 incl Barangaroo (Lend Lease) | 2036 incl Barangaroo (Sydney Water) |
|---|---|---|---|---|---|---|
| Model Run | BOFZ | BOFX | BOFY | BOHZ | BOGZ | BOIZ |
| Peak Dry Weather Flow (L/s) | 51 | 64 | 67 | 71 | 84 | 86 |
| Volume Required for 3.4 hours storage | 620 | 770 | 802 | 847 | 1003 | 1035 |
| Current Available Storage | 620 | 620 | 620 | 620 | 620 | 620 |
| Additional Storage @ 3.4 hours | 0 | 150 | 182 | 227 | 383 | 415 |
| minus 49 cum from SP0014 | -49 | 101 | 133 | 178 | 334 | 366 |
| Additional storage to be provided by Barangaroo | N/A | 101 | 133 | N/A | 156 | 188 |

**Table 6 Emergency Storage requirements to provide a minimum of 4 hrs**

| Performance Criteria | Current 2012 System (With SP0014 decommissioned) | 2012 incl Barangaroo (Lend Lease) | 2012 incl BD (Sydney Water) | 2036 without Barangaroo | 2036 incl Barangaroo (Lend Lease) | 2036 incl Barangaroo (Sydney Water) |
|---|---|---|---|---|---|---|
| Model Run | BOFZ | BOFX | BOFY | BOHZ | BOGZ | BOIZ |
| Peak Dry Weather Flow (L/s) | 51 | 64 | 67 | 71 | 84 | 86 |
| Volume Required for 4 hours storage | 709 | 890 | 927 | 976 | 1157 | 1194 |
| Current Available Storage | 620 | 620 | 620 | 620 | 620 | 620 |
| Additional Storage 4 hours | 89 | 270 | 307 | 356 | 537 | 574 |
| minus 49 cum from SP0014 | 40 | 221 | 258 | 307 | 488 | 525 |
| Additional storage to be provided by Barangaroo | N/A | 181 | 218 | N/A | 181 | 218 |

## 7.3 Sewer Servicing Options

The following provides discussion of options for provision of sewer services to the Barangaroo development. Included in the discussion is development of high level capital cost and ongoing maintenance costs associated with the options presented. This information builds on the assessments undertaken by GHD.

The following items are common to all options:

- All capital costs include for design development, contractor profit, and contingency,
- All capital costs exclude allowance for contaminated soil,
- All maintenance costs are expressed as current value, and
- Net Present Value calculations are based on 100 year working life, 5% discount rate and assumptions for repair, replacement and renewal as noted in each option.

### 7.3.1 Option 1: Additional Storage at SP1129

This option considers provision of additional storage required through construction of additional storage facilities within or adjacent to the existing SP1129 site directly connected to existing emergency storage.

Existing BDA led decommissioning of SP0014 proposes to add 49$m^3$ of storage via linked culverts at the SP1129 location. The option and costs presented include this requirement and provides a larger storage to encompass both SP0014 and Barangaroo based storage requirements.

It has not been confirmed whether required area exists within the Barangaroo site to construct the required additional storage. The area surrounding SP1129 is currently within declared contaminated land subject to future remediation. Any works prior to remediation of the declared area are subject to planning approval.

| **CAPITAL COST** | | | | |
|---|---|---|---|---|
| **Item** | **Unit** | **Quantity** | **Rate** | **Total** |
| Demolition | $m^2$ | 175 | $ 252 | $ 44,186 |
| Earthworks | $m^3$ | 530 | $ 893 | $ 473,266 |
| Foundations | $m^2$ | 115 | $ 2,046 | $ 235,236 |
| Ground Slab | $m^2$ | 115 | $ 1,036 | $ 119,193 |
| Exterior Wall | $m^2$ | 110 | $ 1,615 | $ 177,688 |
| Roof Slab | $m^2$ | 10 | $ 13,087 | $ 130,871 |
| Hydraulics | $m^2$ | 115 | $ 379 | $ 43,562 |
| External Works | Item | 1 | $ - | $ 62,000 |
| **Total** | | | | **$ 1,286,002** |

| **MAINTENANCE COST** | |
|---|---|
| **Item** | **Depreciated Costs** |
| *Cleaning/Wash-down assumed 4 times per year @ $2,000 per event* | $ 175,501 |
| Periodic Maintenance: *5 year part replacement (epoxy coating replacement, etc) allowed at 5% of Capital Cost.* | $ 257,200 |
| Major Maintenance: *20 year refurbishment (structural repairs, etc) allowed at 10% of Capital Cost.* | $ 228,136 |

| **NET PRESENT VALUE** | |
|---|---|
| **Item** | **NPV** |
| Capital Cost | $ 1,286,002 |
| Maintenance and Renewal Costs | $ 660,837 |
| **Total** | **$ 1,946,839** |

### 7.3.2 Option 2: Additional Storage within Sewer Network

This option considers provision of any additional storage required within the sewer network rather than at the existing SP1129 site. The current proposal is for reuse of the 1650mm diameter reinforced concrete pipe installed under works associated with Sydney Water Case Number 127637.

The 1650mm diameter pipe is currently associated with a temporary stormwater diversion and will be disused once the permanent diversion, Sydney Water Case Number 126589, is commissioned and connected to Sydney Water's local stormwater network.

This option proposes to re-use a reinforced concrete pipe installed under current Sydney Water approved works to provide temporary stormwater diversion. This pipe will be disused by the end of 2013 following the construction of a permanent stormwater diversion.

From the perspective of cost, buildability, sustainability and program the re-use of the 1650mm diameter pipeline presents favourably. It is proposed that the 1650mm diameter stormwater pipe is lined and connected to the existing sewerage network. The pipe sits between the alarm and overflow levels.

| **CAPITAL COST** | | | | |
|---|---|---|---|---|
| **Item** | **Unit** | **Quantity** | **Rate** | **Total** |
| PolyUrea Lining | $m^2$ | 215 | $ 186 | $ 40,000 |
| Manholes | Each | 2 | $ 20,000 | $ 80,000 |
| Connection to existing sewer | Each | 2 | $ 10,000 | $ 20,000 |
| Ancillary works (Excludes connections from Barangaroo development) | Item | 1 | $ - | $ 120,000 |
| **Total** | | | | **$ 260,000** |
| **MAINTENANCE COST** | | | | |
| **Item** | | | **Depreciated Costs** | |
| *Cleaning/jetting assumed 2 times per year @ $1,500 per event, traffic management for cleaning/clearing @ $4,000 per event (including lights for night works and allowing 6 ppl for 8 hours).* | | | $ | 241,314 |
| Periodic Maintenance: *5 year part replacement (Poly Urea coating repairs, etc) allowed at 5% of Capital Cost.* | | | $ | 33,000 |
| **NET PRESENT VALUE** | | | | |
| **Item** | | | **NPV** | |
| Capital Cost | | | $ | 260,000 |
| Maintenance and Renewal Costs | | | $ | 274,314 |
| **Total** | | | **$** | **534,314** |

Maintenance cost assessment has been based on night-works, including traffic management, when and where required to clean or re-line as required through its operating life.

This option delivers approximately 180 $m^3$ of storage. It will satisfy the storage required to offset the Barangaroo development load under current operating condition, i.e. 3.4 hours emergency storage and 4 hours storage using Lend Lease demand rates. Storage upgrades required to cater for other catchment flows would remain the responsibility of Sydney Water.

It is the responsibility of Barangaroo, Sydney Water and BDA to identify the most feasible option when considered against hydraulic performance, life cycle cost, buildability and program, environmental and safety requirements. This option is recommended for approval due to its ability to meet all these requirements.

### 7.3.3 Option 3: Transfer Pump Station to Existing Rising Main

This option, as requested to be considered by Sydney water – refer Option 2 from the current "Notice of Requirements", considers provision of a transfer pump station from the Recycled Water Plant, located in the basement of the Barangaroo development. The option proposed by Sydney Water includes a Sydney Water owned rising main that would discharge to the existing 375mm dia. rising main serviced by SP1129.

While technically feasible, this option presents significant concern as follows:

- Qualitative decrease in general efficiency when compared to a single pump station option,
- Ownership, easement and access issues associated with pump station and rising main within the basement of the Barangaroo South development approximately 15m below the surface level,
- Additional space requirements within the Barangaroo South development,
- Extensive external works within Hickson Road causing significant disruption to local traffic and residents,
- Creation of mixed Sydney Water and Developer owned assets attracting future operation and maintenance costs,
- Reliance, by Sydney Water, on future development owners to operate, maintain and abide by operating licence conditions,
- Significant disadvantage with respect of cost both in capital and maintenance requirements,
- Operational complexity due to rising main to rising main discharge scenario that may affect hydraulic performance of the SP1129, and
- Operational risk in the Barangaroo basement (RL -10.9) with flooding, odour and other risks.

This option is not considered to be preferred and is not recommended for implementation. Sydney Water have accepted this position and agreed that no further consideration of this option is required.

| **CAPITAL COST** | | | | |
|---|---|---|---|---|
| **Item** | **Unit** | **Quantity** | **Rate** | **Total** |
| Storage Tank | | | | |
| Site Preparation | item | 1 | $ - | $ 95,000 |
| Structure | item | 1 | $ - | $ 1,175,000 |
| Interiors | item | 1 | $ - | $ 185,000 |
| Supply and Install Mechanical Equipment | item | 1 | $ - | $ 585,000 |
| Supply and Install Rising Main | item | 1 | $ - | $ 1,575,000 |
| **Total** | | | | $ **3,615,000** |
| **MAINTENANCE COSTS** | | | | |
| **Item** | | | **Depreciated Costs** | |
| Minor Maintenance: *Annual maintenance allowed at 2% of Capital Cost of PS only (less structure).* | | | $ | 379,520 |
| Periodic Maintenance: *5 year part replacement (impellor, etc) allowed at 10% of Capital Cost of PS only (less structure).* | | | $ | 310,048 |
| Major Maintenance: *20 year refurbishment (pump replacement, rising main repair) allowed at 20% of Capital Cost of PS + 10% Capital Cost of RM.* | | | $ | 290,807 |
| **NET PRESENT VALUE** | | | | |
| **Item** | | | **NPV** | |
| Capital Cost | | | $ | 3,615,000 |
| Maintenance and Renewal Costs | | | $ | 980,375 |
| **Total** | | | **$** | **4,595,375** |

### 7.3.4 Option 4: Modified Option 2

This option repeats the requirements of Option 2 with ownership of the existing 1650 mm being retained by the Barangaroo development. This storage would be isolated from the Sydney Water network through reflux valves or other engineered structures and fittings.

This option would provide a specific emergency storage, dedicated to and managed by the Barangaroo development including easements for access and maintenance. As this storage would be installed within public road there would be traffic management requirements for access to maintain the storage. There is a benefit to Barangaroo development in having a dedicated storage however, significant additional engineering, legal and authority approvals would be required to allow this option to be considered viable.

This option is not considered to be preferred and is not recommended for implementation. The following comments apply:

- The land on which Hickson Road resides is owned by City of Sydney Council. The Road Authority for Hickson Road is currently BDA. BDA may relinquish this authority and both ownership and control of Hickson Road will rest with City of Sydney Council or other government authority.
- As per Sydney Water discussion, the RWP is proposed to discharge to SWC systems no more than twice per year and will have an internal reflux valve to prevent backflow from SWC systems into the Barangaroo development owned storage and emergency operation facility,
- The probability that both, RWP and SPS1129 being offline at the same time is very low.,
- Considering that SWC license for SP1129 is based on dry weather overflow, provision of an additional 180m$^3$ storage within the sewer network would be a general positive contribution to the sewerage network and would further decrease the potential for overflows from SP1129 outside of license conditions,
- If owned by SWC, the storage would be used more frequently, and thus provide more total benefit, than if owned by and dedicated for the sole use of the Barangaroo development, and
- There are potential legal and licensing hurdles if the privately owned emergency storage asset was an integral part of the overflow protection mechanism at a sewage pumping station owned and operated by Sydney Water. The implication is a possible contractual arrangement will be required for the provision and maintenance of the emergency storage, and the arrangement may not be considered favourably by the licensing authority if there was an overflow event at SPS1129.

### 7.3.5 Option 5: Transfer Pump Station to Kent Street Carrier

This option is broadly similar to Option 3. Similarly, this option is not considered to be preferred and is not recommended for implementation.

### 7.3.6 Option 6: Discharge to Alternative Catchment

This option was presented, by Sydney Water, as a potential option in the event a local storage or pumped option could not be achieved.

The results of the GHD modelling indicate that a local storage is achievable from a technical perspective. Further, the GHD modelling confirms that a local storage option would require minor control upgrade to SP1129 but would not require upgrade to the mechanical components.

There is no requirement to undertake further assessment of this option.

## 7.4 Recommended Sewer Servicing Option

Option 2, Additional Storage within Sewer Network, owned and operated by Sydney Water, is recommended for adoption as it provides immediate local benefit for the SP1129 system and allows the Barangaroo development to discharge full load without reduction to existing SP1129 performance.

It is noted both capital and ongoing maintenance/renewal costs are significantly lower under this option than for other options discussed above.

# 8 Trade Waste

The sources of Trade waste at the Barangaroo Development are categorised into three groups:

**GROUP 1:** Trade Waste discharge from the RWP during normal operations:

- These are waste streams from the RWP treatment process including de-sludging, discharge of reverse osmosis reject water, and discharge of macerated screenings.

**GROUP 2:** Trade Waste from basement areas where the discharge bypasses the RWP The discharges include flows from plant rooms, car park run-off and waste water from the subsoil collection treatment system deemed not acceptable to discharge to the RWP, because of potential adverse effect on the waste water biological treatment process, or waste water with potential for containing contaminates not suitable for discharges to the proposed RWP.

- The flows from the car park surface run-off and any flows containing sea water will not be discharged to the Sydney Water sewer system.
- The flow from a carwash bay will require pre-treatment before discharged to sewer system
- The flow from sub-soil collection system flow is preferred not to discharge to the Sydney Water sewer system. Further review will be undertaken when the nature of contaminated on the site are understood.

**GROUP 3:** Trade Waste discharge from processes on site discharging into the waste RWP:

- E.g. Grease Waste Systems. In normal operations these systems do not discharge to the Sydney Water sewer system.

Further detail with respect to trade waste type, quantity and quality is provided in Appendix G of this document.

It is proposed the treatment plant will be on-line at the time of the first occupation of a building at Barangaroo. However, the trade waste agreement may need to address requirements for discharge from the site during the validation and proving period, prior to completion of the RWP. Further negotiations will take place with SWC for completion of the trade waste requirements.

# 9 Potable Water Servicing Strategy

## 9.1 Review of Information Received

The following sections build on the initial work completed under the "Integrated Services Infrastructure Plan" provided as Appendix H of this document.

### 9.1.1 Location of Available Connection

The feasibility letter received from Sydney Water, under Case Number 123877, notes the following:

*"The development fronts a 300 mm water main in Hickson Rd, which is part of the Crown St Reservoir supply zone. This 300mm water main currently has a trunk connection off the 500 mm water trunk main in Kent St that provides a secure supply from the northern and southern directions and the Barangaroo precinct.*

*The 300 mm water main in Hickson Rd has sufficient capacity for the development and exceeds the minimum main size required for the Barangaroo Development. Sydney Water has confirmed that this main is available for connection."*

Pressure and flow information provided by Sydney Water, included in Appendix A, supports the expected potable water peak instantaneous flow of 70 L/s.

### 9.1.2 Concept Potable Water Design – Barangaroo South

It is proposed to install a loop main, connected at two points to the existing 300mm diameter potable water main fronting the development, to ensure supply to the development. This main would be installed within public roads (Hickson Road, Shelley Street and Globe Street).

Sydney Water provided advice that sufficient size for potable water requirements would be 200mm diameter.

The new loop main would provide potable water and fire supply to the Barangaroo development.

The loop main is required to ensure that continuous supply is available to the development and to ensure that supply is not interrupted from a single valve closure. This main may be constructed in stages due to construction requirements. However, the first building that connects to this service requires the looped main to be constructed in full.

The required size of the ring main is not yet confirmed and is subject to formal and detailed design development. This will be addressed through application to Sydney Water under the eDeveloper process.

### 9.1.3 Concept Potable Water Design – Barangaroo Central and Headland Park

Barangaroo Central & Headland Park have a number of water supplies supplying existing buildings from water mains adjacent to the site. The water mains that supply the site are:

- 300mm water main in Hickson Rd,
- 150mm water main in Merrimam St,
- 300mm water main in Dalgetty Rd, and
- 100mm water main in Town Place and extends to the sewage pump station SP0014.

Connection to these mains, and associated Section 73 applications, will be progressed by BDA as part of their development works.

The potable water is to be supplemented by rain water that is collected from the roof areas. In the event of dry weather, and where the stored rainwater has been used, a top up supply from the recycled water plant in Barangaroo South will supply the non-potable water system. As a secondary non potable water system back up, when no rainwater and no recycled water is available, water from

Sydney Water will be used to maintain the system operation. Backflow prevention will be provided to isolate potable water top up from non-potable water sources.

### 9.1.4 Metering Arrangements

It is proposed that each lot, and therefore each building, within the development would have a separate connection and meter in line with current Sydney Water metering policy.

There may be a requirement for "extended private water service" connections as temporary measures.

As at the date of this report, metering arrangements are the subject of ongoing discussions between Sydney Water and Lend Lease.

### 9.1.5 Fire Supply

Sydney Water has provided pressure/flow outputs indicating in excess of 30m head at 100l/s at two locations along the frontage of the Barangaroo development. This is sufficient to provide primary or secondary supply but not both. A storage tank is required within the development to provide secondary supply and to allow the primary supply to be drawn from the Hickson Road water main.

Based on advice from Sydney Water, no further works are proposed. Pressure Flow Enquiry information received from Sydney Water is included in Appendix A.

## 9.2 Potable Water Servicing – Staging Requirements

Due to the timing of the development, staging arrangements will be required such that the basement and building C4 are serviced by connections off the existing 300mm water main in Hickson Road.

These connections are subject to separate case numbers for tower C4 and Basement under case numbers 125232 and 125663 respectively. The application drawing for case 125663 is included in Appendix D.

It is proposed that provision for this connection be made via connection to the existing main in Hickson Road and for an extended private water service (EPS) to be constructed for each of the basement and C4 connections. The proposed EPS connections will be metered in accordance with ongoing discussions as previously noted.

## 9.3 Potable Water Servicing – Proposed Ultimate Development

Sydney Water has confirmed that, the new potable water main would be owned and operated by Sydney Water. Where installed in public land, this asset would be available for connection. If installed in basement areas the main would be constructed as "maintenance free" and no connections would be permitted.

Connections for each building will be made from the proposed loop main with meters provided, as noted previously, in line with agreement reached between Sydney Water and Lend Lease.

Sydney Water will require an easement over the loop main where it is constructed in basements or other private land.

Sydney Water may require easements over Extended Private Service connections.

A concept for potable water servicing arrangement is shown in Figure 9.1. It is noted the design is concept at this stage. Final size of this main will be determined based on detailed design and formal approval through eDeveloper application.

## 9.4 Fire Supply Servicing – Proposed Ultimate Development

The looped main will provide connection to on-site fire storage tanks. These will be sized by the Hydraulic Engineer, Warren Smith and Partners. Connections will be provided during construction of the ring main to avoid future shut downs.

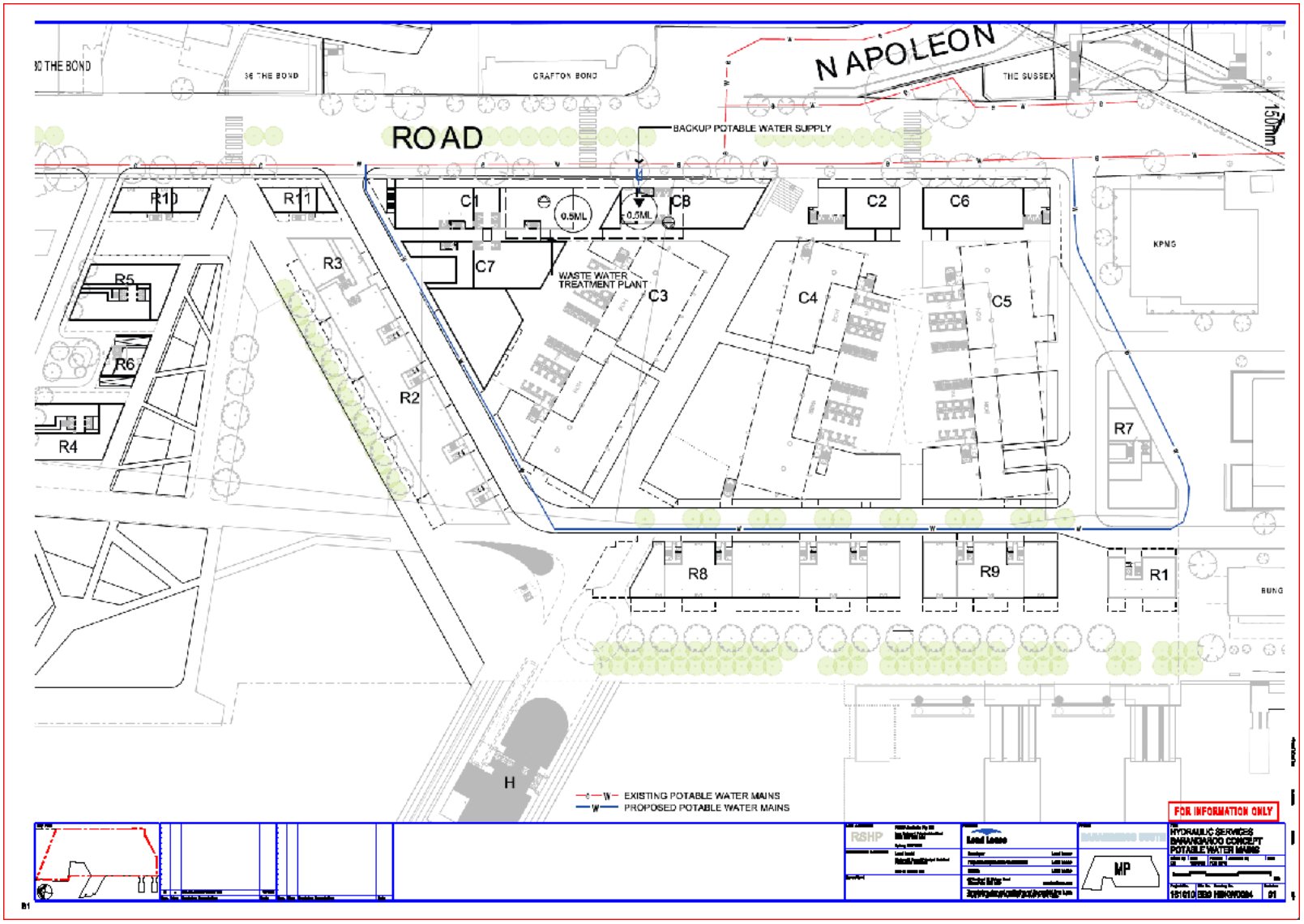


**Figure 9-1 Permanent Water Strategy**

# 10 Recycled Water Strategy

## 10.1 Recycled Water Overview

Barangaroo's objective is to be a water positive development. It is intended to provide capability for treatment and export of an amount of recycled water that is not less than the amount of potable water used. In order to meet this objective it is proposed to:

a. Capture, treat and recycle waste water from within the development,

b. Mine sewer flows external to the development, and

c. Export recycled water offsite.

Captured wastewater will be treated by an onsite "Recycled Water Plant" (RWP), based generally on MBR technology, before re-use for non-potable water uses within Barangaroo South, Barangaroo Central and Headland Park. It is proposed that the recycled water treatment plant will receive all sewage flows from within the development (Barangaroo South and Barangaroo Central), treat these flows and produce recycled water for non-potable water use within the Development and for offsite export.

The water balance calculations have been based on annualized demand rates. Seasonal variations in on site and off site recycled water demand and have not been included in the calculation.

Potable water back up will be required when output from the recycled water plan is not sufficient to meet on site demand. A 150mm metered supply shall extend from the Sydney Water mains to the recycled water storage tanks within the RWP. When water level in the recycled water storage tanks reaches critical low level automatic potable water top up shall be introduced into the recycled water storage tanks. The tank filling valves will have back flow prevention in accordance with AS3500.

Back-up potable water supply will not be provided for the proposed offsite export recycled water supply.

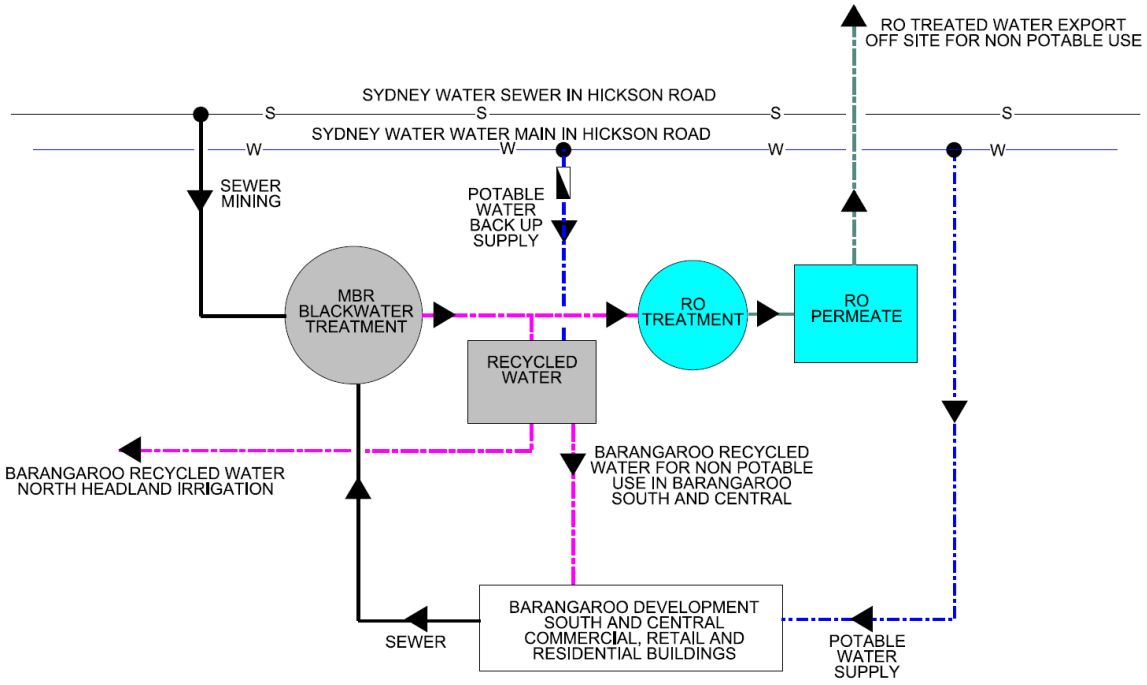


**Figure 10-1 Functional Water Flow Diagram**

Sewer mining as a supplementary source for wastewater will be required when the requirement for recycled water exceeds onsite sewage flows.

Discharge of sewage to Sydney Water network, as previously discussed under Section 8 of this report, will occur when:

1. The treatment plant is offline for maintenance or repair (see comments following), or
2. When onsite sewage flows exceed the demand for recycled water.

## 10.2 Recycled Water Ownership and Maintenance

The Lend Lease Recycled Water (Barangaroo South) company would own and operate the RWP and would charge for the supply of recycled water to buildings within the Barangaroo development and also to potential external customers. A suitably experienced operator will be employed by the Lend Lease Recycled Water (Barangaroo South) company.

Sydney Water will be advised of planned and emergency maintenance or shutdowns. However, two separate treatment modules will be installed such that one module can be shut down for maintenance while the other remains on line. Maintenance cycles are expected to occur every 5-7 years with proof testing in the order of 12 weeks after installation. The first module is scheduled for installation in 2015 and the second in 2018.

A location diagram showing position of the treatment plant within the development has been provided in Appendix E.

It is anticipated that the discharge of sewage from the site will be reduced during operation of the RWP and will include by-products of the treatment process. However, due to the requirement for maintenance and potential for down time of the RWP, Sydney Water has agreed to accept full site discharge to Sydney Water sewers as outlined in Section 7 of this document. As previously noted, this would require a trade waste discharge agreement between the Lend Lease Recycled Water (Barangaroo South) company and Sydney Water.

## 10.3 Recycled Water Quality and Approvals

The quality of the recycled water products will be in accordance with the Australian Guidelines for Water Recycling.

Sydney Water have agreed to assist LLPM&C where required in furtherance of the application for an IPART license under the WIC Act. This includes agreement for sewer mining between Sydney Water and LLPM&C.

The design intent is for the recycled water and potable water reticulation systems shall have a minimum pressure differential as required by Water Supply Code WSAA 03.

The export water supply is pressure boosted from pump system in the Barangaroo Basement. The export water reticulation, external to the Barangaroo development, shall be located in public roads. The design intent is to set the export recycled water systems at 5m lower head pressure when compared to the Sydney Water potable water mains. The pressure information will be based on Sydney Water pressure enquiry information. The design of the export water system is subject to detailed design and customer locations which have not yet been determined. This design requirement will be reassessed when the export reticulation network scope is known and the system detail design commences.

The internal water systems are generally boosted systems. The common recycled water reticulation systems located in the basement shall be set with a minimum 5m lower head pressure compared to the Sydney Water potable water mains.

Internal recycled and potable water systems serving Barangaroo customers shall be design and installed in accordance with AS3500.

# DESIGN INTENT CERTIFICATION

Warren Smith & Partners

35 YEARS OF SERVICE

Monday 3rd July, 2017

Project # 2017-3661064

Lend Lease Pty Ltd
Level 14, Tower Three, International Towers Sydney
Exchange Place, 300 Barangaroo Avenue
Barangaroo NSW 2000

Attention: Mr Demos Avramidis

Dear Demos

**RE: DIRECTOR GENERALS REQUIREMENTS**
**HYDRAULIC SERVICES CERTIFICATE OF DESIGN INTENT**

**SUBJECT PREMISES:** **BUILDING C1**
**BARANGAROO SOUTH**

**APPLICATION REFERENCE:** **SSD 8529**

Pursuant to the provisions of **Clause A2.2 of the Building Code of Australia,** we hereby certify that it is the intent of Warren Smith & Partner Pty Ltd to provide full design documentation for the above stated project, which shall be in accordance with normal engineering practice with the intent of meeting the requirements of the Building Code of Australia, the Environmental Planning and Assessment Regulation and relevant Australian Standards.

In particular the design is in accordance with the following:

| Title of Engineering Service | | Standard, Code or Authority Requirements |
|---|---|---|
| Gravitational Sewer Drainage | AS/NZS 3500.2 | National Plumbing and Drainage Code<br>Sanitary plumbing and drainage<br>NSW Code of Practice Plumbing and Drainage – July 2006 |
| Trade Waste Drainage | AS/NZS 3500.2 | National Plumbing and Drainage Code<br>Sanitary plumbing and drainage<br>NSW Code of Practice Plumbing and Drainage – July 2006 |
| Sanitary Plumbing | AS/NZS 3500.2 | National Plumbing and Drainage Code<br>Sanitary plumbing and drainage<br>NSW Code of Practice Plumbing and Drainage – July 2006 |
| Stormwater Drainage | AS/NZS 3500.3 | National Plumbing and Drainage Code<br>Stormwater drainage<br>Local Government requirements<br>NSW Code of Practice Plumbing and Drainage – July 2006 |
| Subsoil Drainage | AS/NZS 3500.3 | National Plumbing and Drainage Code<br>Stormwater drainage<br>Local Government requirements<br>NSW Code of Practice Plumbing and Drainage – July 2006 |

| Title of Engineering Service | | Standard, Code or Authority Requirements |
|---|---|---|
| Rainwater Downpipes and Roof Gutters | AS/NZS 3500.3 | National Plumbing and Drainage Code<br>Stormwater drainage<br>NSW Code of Practice Plumbing and Drainage – July 2006 |
| Hot Water Supply | AS/NZS 3500.4<br><br>BCA - 2016 | National Plumbing and Drainage Code<br>Heated Water Services<br>NSW Code of Practice Plumbing and Drainage – July 2006<br>Building Code of Australia – Vol 1, Section J, Clause 6.6 & 7.2 |
| Natural Gas Service | AG 501<br>AG 5601 | Code for Industrial and Commercial Gas Fired Appliances<br>Gas Installation Code |
| Cold Water Supply and Pressurisation | AS/NZS 3500.1 | National Plumbing and Drainage Code<br>Water supply<br>NSW Code of Practice Plumbing and Drainage – July 2006 |
| Thermostatic Mixing Valve Systems | AS/NZS 3500.4 | National Plumbing and Drainage Code<br>Heated Water Services<br>NSW Code of Practice Plumbing and Drainage – July 2006 |
| Sanitaryware | AS/NZS 3500.1<br>AS/NZS 3500.2 | National Plumbing and Drainage Code<br>Water supply<br>Sanitary plumbing and drainage<br>NSW Code of Practice Plumbing and Drainage – July 2006 |
| Taps, Water & Gas Outlets | AS/NZS 3500.1<br>AS/NZS 3500.4<br>AG 5601<br>AG 501 | National Plumbing and Drainage Code<br>Water supply<br>Heated Water Services<br>Gas Installation Code<br>Code for Industrial and Commercial Gas Fired Appliances<br>NSW Code of Practice Plumbing and Drainage – July 2006 |

Warren Smith & Partners Pty Ltd is an appropriately qualified and competent practice in this area and as such can certify that the design intent and performance of the design systems shall comply with the above.

Warren Smith & Partners Pty Ltd possesses Indemnity Insurance to the satisfaction of the building owner or our principal.

**Full Name of Designer:** **Grahame Barnes**
**Address of Designer:** **Level 1, 123 Clarence Street, SYDNEY NSW 2000**
**Business Telephone No:** **(02) 8234 8617** **Fax No: (02) 9290 1295**
**Name of Employer:** **Warren Smith & Partners Pty Limited**

**Signature:** Grahame Barnes **Date:** **3rd July 2017**