Stormwater Management Plan – Project Application

Barangaroo South – R8 and R9 Residential Buildings

YN210079/12-0258

Prepared for
Lend Lease Project Management and Construction

18 October 2012

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1 Project Understanding

1.1 Introduction

This report supports a Project Application (MP11_0002) submitted to the Minister for Planning pursuant to Part 3A of the Environmental Planning and Assessment Act 1979 (EP&A Act). The Application seeks approval for construction of two residential flat buildings (known as Buildings R8 and R9) and associated works at Barangaroo South as described in the Overview of Proposed Development section of this report.

1.2 Background

The 22 hectare Barangaroo site has been divided into three distinct redevelopment areas (from north to south) – the Headland Park, Barangaroo Stage 2 (also known as Barangaroo Central) and Barangaroo Stage 1 (herein after referred to as Barangaroo South).

Lend Lease was successfully appointed as the preferred proponent to develop Barangaroo Stage 1 (otherwise known as Barangaroo South) on 20 December 2009.

1.3 Purpose of this Report

The R8 and R9 Project Application seeks approval for the construction and use of two residential flat buildings comprising 159 apartments, ground floor retail, allocation of car parking spaces from the Bulk Excavation and Basement Car Parking Project Application, and the construction of the surrounding ancillary temporary public domain and landscaping.

This report has been prepared to accompany the Project Application for the R8 and R9 residential buildings and associated works at Barangaroo South. It addresses the relevant Director-General Requirements for the project.

These Director-General Requirements are discussed in the Environmental Assessment Report (EAR) that has been prepared to support the application.

1.4 Planning History & Framework

On 9 February 2007 the Minister approved a Concept Plan for the site and on 12 October 2007 the land was rezoned to facilitate its redevelopment. The Approved Concept Plan allowed for a mixed use development involving a maximum of 388,300m^2 of gross floor area (GFA) contained within 8 blocks on a total site area of 22 hectares.

Modification No. 1 was approved in September 2007 which corrected a number of minor typographical errors.

On 25 February 2009 the Minister approved Modification No. 2 to the Concept Plan. The Approved Concept Plan as modified allowed for a mixed use development involving a maximum of 508,300m^2 of gross floor area (GFA) contained within 8 blocks on a total site area of 22 hectares.

On 11 November 2009 the Minister approved Modification No. 3 to the Concept Plan to allow for a modified design for the Headland Park and Northern Cove. The Approved Concept Plan as modified allows for a mixed use development involving a maximum of 489,500m^2 of gross floor area (GFA) across Barangaroo as a whole.

On 16 December 2010 the Minister approved Modification No. 4 to the Barangaroo Concept Plan. The Approved Concept Plan as modified allows for approximately 563,965m^2 Gross Floor Area of mixed use development across the entire Barangaroo site.

This Project Application forms one of a series of individual Project Applications that Lend Lease will be submitting to deliver Barangaroo South. This Project Application is consistent with the established planning framework for the site, including the approved Concept Plan (as modified).

A Project Application (MP10_0023) has been approved for the bulk excavation and construction of a basement car park to accommodate up to 880 car parking spaces and associated services and infrastructure to support the initial phases of the future development of Barangaroo South. A Section 75W Modification Application was subsequently submitted seeking to modify MP10_0023 to extend the area of the approved basement to the south. This modification was approved by the Minister for Planning on 3 March 2011.

A further Section 75W application has been submitted to the Department of Planning and Infrastructure (the Department) and is currently being assessed, which seeks the Minister's approval to modify the depth of the excavation and change the reduced levels of the basement structure, using the same construction methodology as detailed and approved as part of the original project application. This includes:

> reduced excavation and bulk earthworks;

> reduced structural works – foundations, basement levels, perimeter retention system etc; and

> installation of associated services and infrastructure to support the initial phases of the future development of Barangaroo South.

In addition to the above basement Project Application, additional Project Applications for the C3, C4 and C5 building have been lodged.

1.5 Project Summary Description

The R8 and R9 Project Application seeks approval for the construction and use of two residential flat buildings comprising 159 apartments, ground floor retail, allocation of car parking spaces from the Bulk Excavation and Basement Car Parking Project Application, and the construction of the surrounding ancillary temporary public domain and landscaping.

1.6 Site Location

Barangaroo is located on the north western edge of the Sydney Central Business District, bounded by Sydney Harbour to the west and north, the historic precinct of Millers Point (for the northern half), The Rocks and the Sydney Harbour Bridge approach to the east; and bounded to the south by a range of new development dominated by large CBD commercial tenants.

The Barangaroo site has been divided into three distinct redevelopment areas (from north to south) – the Headland Park, Barangaroo Central and Barangaroo South.

The R8 and R9 Project Application Site area is located within Barangaroo South as shown in Figure 1.1.

The Project Application Site extends over land generally known and identified in the approved Concept Plan as Block X.

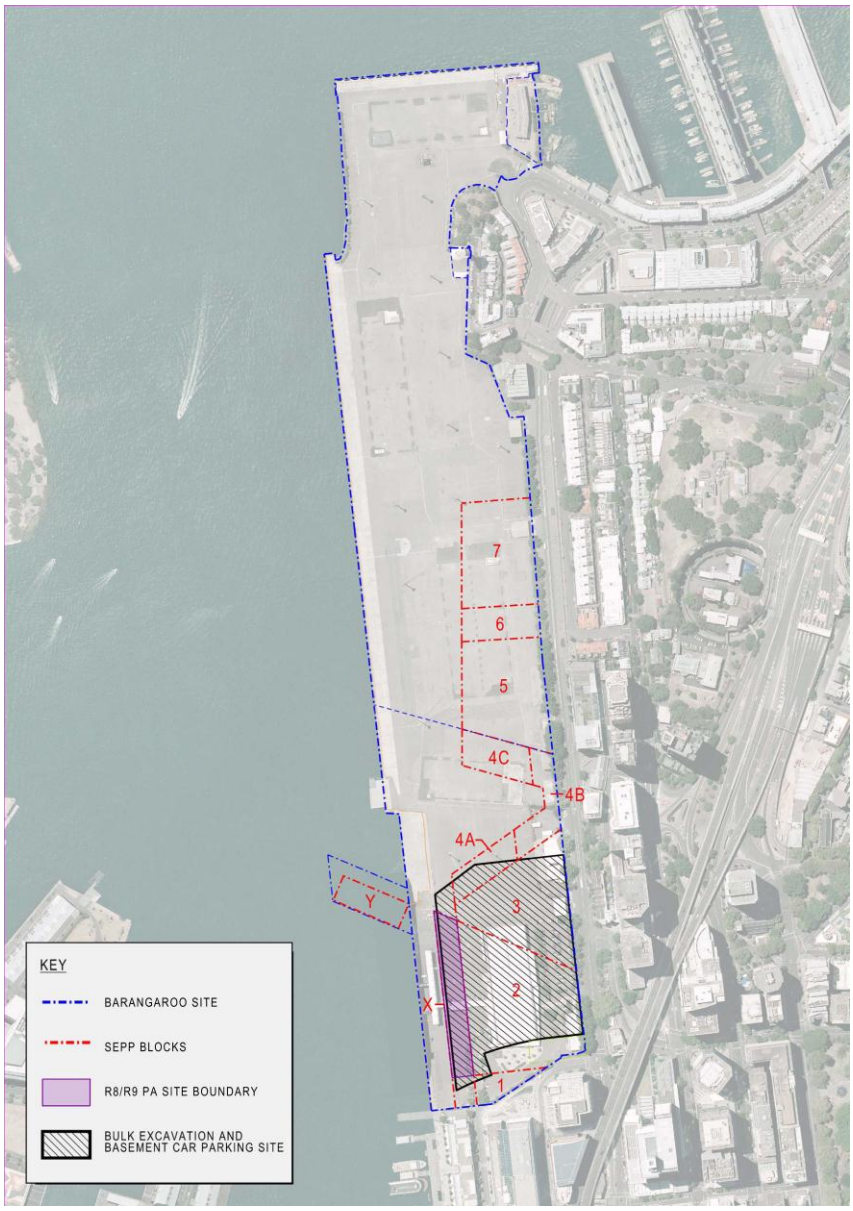

Figure 1-1 R8 and R9 Residential Building Project Application (MP11_0002) Aerial Site Location Plan

2 Integrated Water Strategy

Stormwater management is one aspect of the site-wide Barangaroo South water strategy. The objective of this strategy is to achieve a positive water balance based on exporting recycled water from the site in greater quantity than potable water is imported.

This objective will be achieved through a site wide approach that focuses on:

a. Potable water demand reduction including:

   i. Commitment to achieve a 35% reduction in potable water consumption compared to a standard practice development;

   ii. A 5 Star NABERS water rating will be targeted through:

      1. Reuse of recycled water, for non-potable uses, through rainwater capture and blackwater treatment; and

      2. Minimising irrigation requirements of landscaping.

b. Water balance modelling including:

   i. Review of potential sources of water;

   ii. Investigation of sewer mining;

   iii. Assessment of appropriate treatment measures; and

   iv. Further development of existing conceptual water balance model, refer to Figure 2.1.

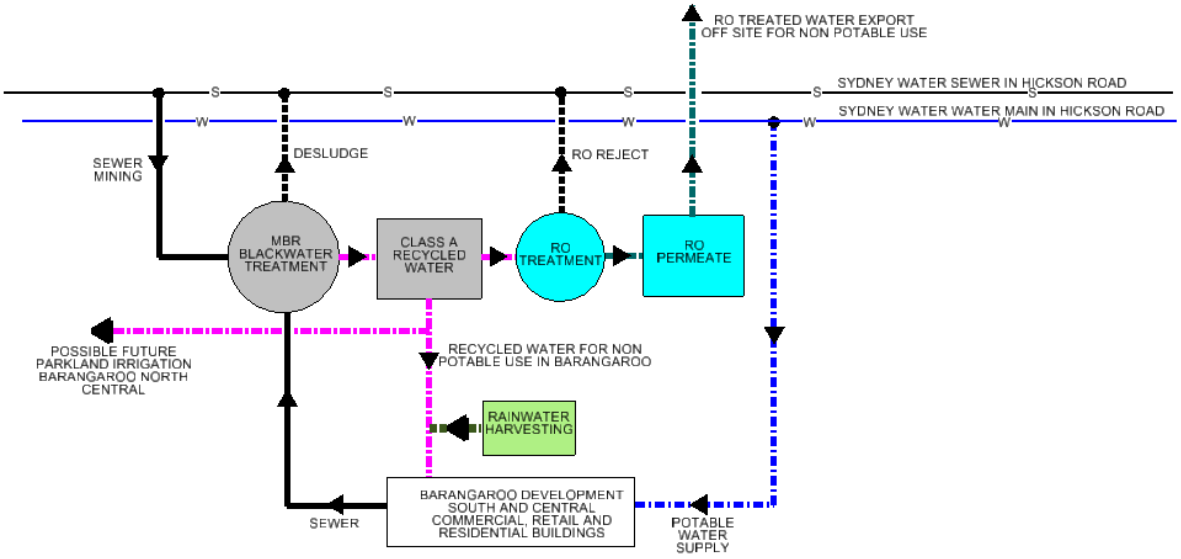

Figure 2-1 Barangaroo South Water flow diagram

Further development of this strategy will occur through detailed design and Water Balance modelling. Methods of drainage and treatment are discussed in the Building Services Report supporting the R8 and R9 application.

3 Stormwater Drainage

3.1 Catchments

3.1.1 Internal

There is no expected requirement for on-site detention (OSD) as the Barangaroo South site is adjacent to the Harbour and at the outlet from the catchment where attenuation would normally have little impact on upper catchment flows.

3.1.2 External

Based on interpretation of Area Laser Scan (ALS) data (as used by City of Sydney Council), the external catchment area draining to the Barangaroo South site is approximately 12.99Ha. See Catchments 1 to 4 as shown in Appendix A and details of the catchments as follows:

a. **Catchment 3:**

   i. This catchment has a total area of approximately 4.79Ha, which discharges to a 750mm diameter stormwater pipe via Hickson Road, then through a 1200mm diameter pipe through the development site;

b. **Catchment 1 and 4:**

   i. This catchment has a total area of approximately 7.39Ha, which discharges to a 900mm diameter pipe in Hickson Road connecting to the existing 1500/1650mm diameter pipe which runs in a north west direction through the site before joining with the 1200mm pipe noted from catchment 3, ultimately discharging to Darling Harbour via an 1800mm diameter stormwater pipe and box culvert.

c. **Catchment 2:**

   i. Connects to the existing 1200mm diameter pipe along Sussex Street before turning into Shelley Street, ultimately discharging to Darling Harbour adjacent to Bungalow 8.

The most prominent overland flow paths are generally:

a. **Catchment 3:**

   i. North along Hickson Road; and

   ii. Southern boundary defined by crest in Hickson Road approximately 30 metres north of the intersection of Hickson Road and Napoleon Street.

b. **Catchment 1 and 4:**

   i. South along Kent Street to the junction with Napoleon Street;

   ii. West along Napoleon Street;

   iii. South along Hickson Road to the existing low point approximately 50 metres north of the Sussex Hotel; and

   iv. Through the development site.

c. **Catchment 2:**

   i. West on Erskine Street; and

   ii. North on Sussex Street to the existing low point approximately 50 metres north of the Sussex Hotel.

3.2 Internal Stormwater Drainage

3.2.1 Design Criteria

The stormwater network is proposed to be designed to provide:

> Low flow storm drainage through tree pits and/or water quality measures;

> Internal site piped drainage for major storm event flows (1 in100 year); and

> Safe overland flow paths to convey emergency overland flows.

3.2.2 Design Standards

The stormwater drainage network will be designed generally in accordance with the following standards and guidelines:

> Australian Rainfall and Runoff Volume 1 and 2, 1997;

> NSW Floodplain Development Manual 2005;

> City of Sydney Council Policies;

> AS3500 – Stormwater and Drainage Design codes;

> AS3725 – Loads on Buried Concrete Pipes;

> Managing Urban Stormwater – Soils and Construction Volume 1, 4th edition; and

> WSUD best practice.

3.2.3 Proposed R8 and R9 Stormwater Strategy

3.2.3.1 Roofs and Awnings

It is proposed that all rainwater falling on roof and awning areas will be collected via a combination of traditional stormwater capture devices, water quality measures and WSUD principles prior to storage or discharge.

Roof drainage shall be based on rainfall intensity for a 1:100 year average recurrence interval for a storm event of 5 minute duration.

3.2.3.2 Internal Roads and Public Domain

It is proposed that all rainwater falling on roads or public domain will be collected via a combination of traditional stormwater capture devices, water quality measures and WSUD principles prior to storage or discharge.

The further design of the above systems will be the subject of design development.

3.3 External Stormwater Network

3.3.1 Network Data

Information regarding the location of existing services has been obtained from a number of documents including a Dial Before You Dig (DBYD) search and the Services Overview Report prepared by Cardno Limited (Report number 600062-R002 Nov 2005).

3.3.2 Existing External Stormwater Network

The existing stormwater network is characterised by a series of in ground piped stormwater systems (typically between 300mm to 1800mm in diameter) draining Hickson Road and other external catchments through the Barangaroo site directly to the Harbour.

Pipes crossing the Barangaroo site are generally between 1200mm and 1800mm in diameter. See Figure 3.1 for details.

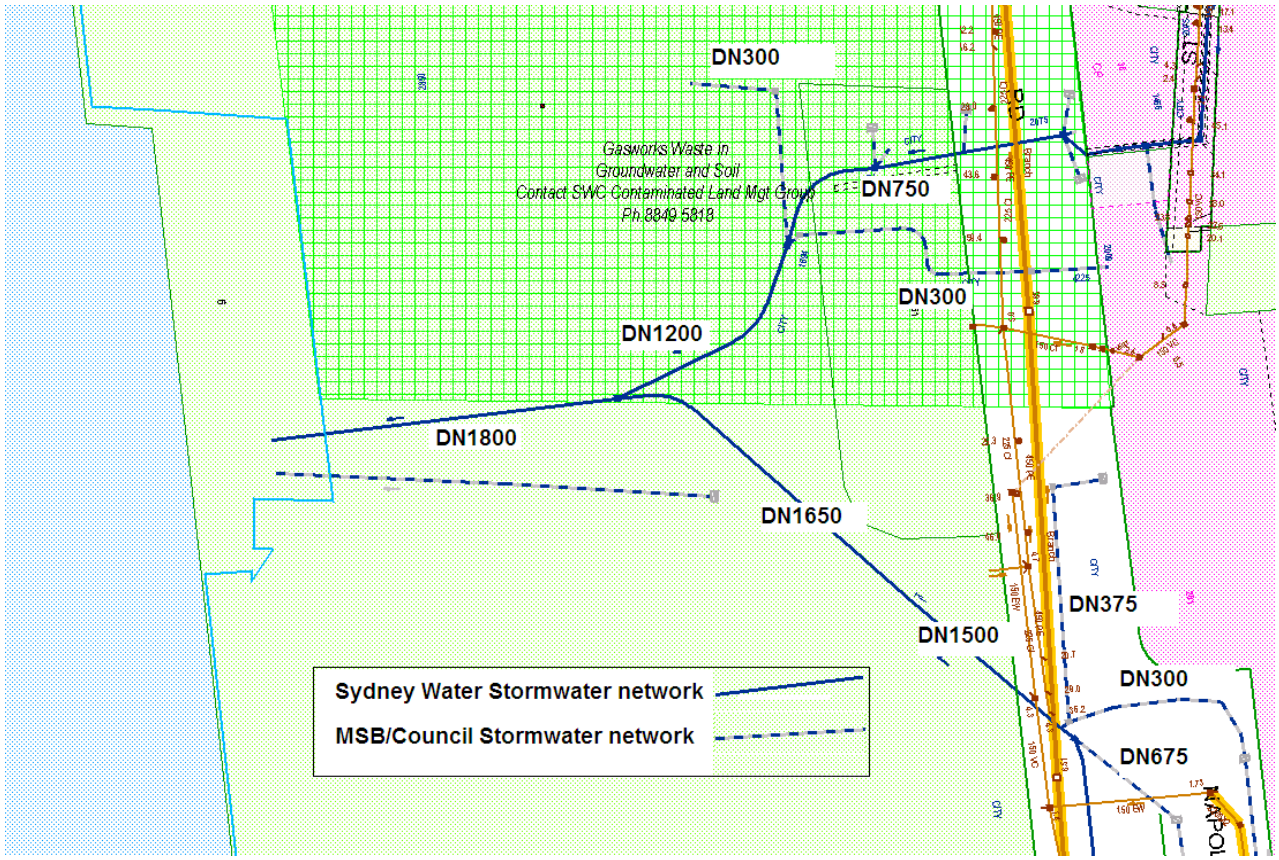

Figure 3-1 Existing Stormwater Network

The proposed changes to this network are covered in the separate Bulk Excavation and Basement Car Parking Project Application (MP10_0023). Arrangements are included for completeness in this application as depicted in Appendix B.

3.3.3 Proposed External Stormwater Strategy

Diversion of the existing stormwater assets traversing the Barangaroo South site has been considered. Drawings have been approved by Sydney Water and the diversion is supported by BDA, Transport for NSW and RMS.

The diversion as proposed would require:

> Temporary diversion of the existing system north along Hickson Road and then suspended within the basement heading west along the inside northern face of the diaphragm wall;

> Permanent diversion to the south of the development and generally along the line of the existing Shelley Street and then towards the harbour outlet.

This diversion would maintain existing conveyance capacity in the temporary case and at completion of the permanent diversion would improve the conveyance capacity of the external drainage network by raising Hickson Road. This diversion would also cater for future harbour water level increases due to climate change. Provision has also been made for low flow take off (ARI < 1 year) for supply to Headland Park for future irrigation.

4 Overland Flows and Flooding

4.1 Historic Flood Data

The City of Sydney Council has confirmed that there is no available historical flood data for the Barangaroo site or the external catchments to the site.

4.2 Impact of Proposed Development

The key changes to overland flow paths and effects on existing stormwater infrastructure are as follows:

> The existing stormwater pipes for the external catchment that traverse the site are to be relocated due to the construction of the basement and are addressed in the Project Application for the basement, as previously discussed.

> 2100 forecasts recommend adoption of harbour water level at RL 1.975. An allowance for surge of 600mm gives a minimum site level of 2.575 at the foreshore area.

> The above site level precludes overland flow through the site from the existing low point in Hickson Road.

> Considering existing levels on Hickson Road, it has been proposed to capture and pipe the 1% AEP event. An emergency overland flow route along Shelley Street (west) and then to the harbour will be provided for events exceeding the design capacity.

The design of the overland flow path is subject to further investigation and development and shall result in no negative impact on surrounding neighbours relating to the overland flow paths through and around the perimeter of the R8 and R9 building area.

5 Climate Change Adaptation

The risk and likely magnitude of climate change induced sea level rise is addressed in detail in the Climate Change and Sea Level Rise Report prepared by Arup.

The above report recommends adoption of 2100 Harbour level of RL 1.975. It is noted that this level is 25mm lower than the existing low point in Hickson Road.

It is likely that in the coming years, the existing local drainage systems in the area surrounding the development will reduce in capacity and effectiveness as the outlets to the harbour become increasingly submerged.

These risks are addressed at this stage through:

> Locating site based stormwater discharge points at a high level within the new sea wall to allow gravity flow of the run-off to the Harbour;

> Design of stormwater transport systems to incorporate partial inundation from tide flows;

> Specification of materials to marine grade to prevent accelerated degradation;

> Use of tidal flaps on stormwater discharge points; and

> Provision of local overland flow paths within the development site should the discharge point become obstructed.

It is also noted that the recommended minimum seawall level for the proposed Barangaroo South development is RL 2.575. This raises concerns with respect to levels of road and properties along Hickson Road. However, this is likely to be a city wide issue and a holistic, risk based mitigation approach will be required, by others, that is beyond the scope of this Project Application.

6 Building Floor Levels

Minimum floor levels within the proposed development site are driven by three factors:

> Tie in to existing and proposed levels surround the development site;

> Future Harbour water levels; and

> Overland flow from upstream catchments.

6.1 Minimum Building Floor Level – Main Buildings

Main building floor levels are driven primarily by future harbour water levels. As discussed above, future harbour level is predicted to rise to RL1.975 by the year 2100. It is recommended that the proposed seawall be constructed at RL2.575 to allow 300mm for each of storm surge and wave action.

As per Section 3.2.3, the internal roof, podium and internal road drainage network will be designed for the 1% AEP event. To ensure that an emergency overland flow path exists for internal development areas, it is proposed to grade at 0.25% from the top of the proposed new seawall. Based on a freeboard of 200mm and local emergency flow depth of 100mm this would result in a floor level of RL3.35.

It is recommended that minimum floor levels for the main building should be set at RL3.35.

7 Erosion and Sediment Control

7.1 Construction Phase

The Erosion and Sedimentation Control measures proposed to be utilised during the construction phase are discussed in detail in the Environmental Construction and Site Management Plan, prepared by Cardno in conjunction with Lend Lease Project Management & Construction for Lend Lease (Millers Point) Pty Limited (Report number 10-0347 September 2011).

7.2 Operational Phase

The prevention of erosion is achieved by protecting soils from the erosive forces of water and/or by controlling the flow of water to reduce erosive forces.

During the operational phase, erosion and sediment control will be achieved through:

> Selection of appropriate vegetation for swales and bio-retention areas where appropriate;

> Selection of appropriate filter media for bio-retention systems;

> Incorporating multiple drainage entry points to bio-retention systems to avoid concentration of flow where appropriate;

> Incorporating energy dissipaters at drainage outfalls where necessary;

> Selection and sizing of appropriate GPT's;

> Regular maintenance by authorities of all water quality measures to remove built-up sediment;

> Separation of construction drainage and operational drainage during phase delivery if appropriate; and

> Adopting landscaped batter slopes appropriate to the soil type used.

8 Water & Stormwater Management Plan

8.1 Plan Details

In line with previous Project Applications, Lend Lease commits to the preparation of a detailed Water and Stormwater Management Plan, prior to issue of Construction Certificate that addresses water quality and water monitoring matters specific to the Barangaroo site. The Water and Stormwater Management Plan will include the following information.

8.1.1 Water Volumes

> Water volume management;

> Anticipated volumes of water generated on-site including potential volumes of groundwater and stormwater discharges;

> Volumes of wastewater to be treated on site;

> Volumes of recycling/reuse; and

> Volumes to be discharged to sewer.

8.1.2 Water Monitoring

> Criteria for nominating areas and different sources of site water as clean or contaminated;

> Water monitoring protocols and decision criteria for whether site water will be directed to stormwater, a water treatment plant, to sewer or to a liquid waste facility;

> Water discharge criteria and monitoring frequency for parameters listed in the 'Water Quality Monitoring Requirements' document prepared as part of the Environmental Assessment;

> An initial more intensive monitoring program for sediment basins, stormwater discharges, reused water and ambient waters to help determine potential water quality impacts and ongoing monitoring protocols;

> Specific discharge and monitoring points for on-site generated water including for collected groundwater seepage into excavations, sediment basins for clean or contaminated areas, discharge points to stormwater drains, and confirmation of ambient monitoring locations in Darling Harbour and Johnstons Bay;

> Suitability of chosen reference site(s) based on turbidity data from a proposed monitoring program;

> Consideration of tidal currents, circulation patterns in Darling Harbour and the position of stormwater discharge points with regard to the positioning of monitoring location(s) outside the turbidity (silt) curtain. The location will not be a fixed point so that it can account for potential plume movement under different conditions. Alternatively, more than one location may be needed; and

> The development of criteria for wastewater discharges that would trigger a review of water management systems. These criteria will trigger operational responses that help in ensuring licence conditions are not exceeded. It is noted that this element may fall under approval of the site recycled water/treatment devices and may be separated from the R8 and R9 approval.

8.1.3 Stormwater and Sediment Controls

> A detailed description of measures for stormwater and sediment control for specific locations on the site; and

> Silt curtain arrangements for the protection of Darling Harbour as a secondary protection control.

8.1.4 Operational Procedures

> An operational plan detailing how contaminated water and sediment control systems will be implemented, operated and maintained;

> A description of the operation and maintenance of environmental protection structures such as (not limited to) silt curtains, bunding and filtration systems, dewatering plant and methodology etc.; and

> Details of the prevention of contaminated water being discharged to Darling Harbour.

8.1.5 Wastewater and Effluent Reuse on site

> Criteria for wastewater or effluent reuse for either contaminated or clean sources of water;

> Management practices for reuse of treated wastewater from contaminated areas; and

> As above, it is noted that this element may fall under separate approval of the site recycled water/treatment devices and may be separated from the R8 and R9 approval.

9 Conclusion

This report has been prepared to describe the stormwater management strategy for the R8 and R9 Building development, to accompany the Project Application (MP11_0002) under Part 3A of the Environmental Planning and Assessment Act.

The strategy includes maximising stormwater reuse via:

> Water quality and WSUD measures;

> Building a rainwater harvesting system for non-potable reuse;

> Blackwater treatment;

> Diversion of minor event external storm flows to future stages for irrigation of headland park; and

> Diversion of major event external storm flows around the development site.

The completed design will aim to result in no negative impact on surrounding neighbours due to adjusted overland flow paths around the Barangaroo South site area. Details are to be developed and integrated into the ground plane design and detailed in the design development phase.

The climate change induced sea level rise predicted for 2100 poses a risk to the effectiveness of the existing local stormwater drainage system in the Barangaroo area. However, the proposed diversion seeks to improve the capacity and allow for future climate change driven increases in harbour water levels.

Lend Lease commits to entering into the necessary arrangements and obtaining the necessary approvals for water supply, sewer and stormwater connections from the relevant authorities, as required. Relevant external agents, for example a Water Servicing Coordinator, will be appointed as required.

Barangaroo South – R8 and R9
Residential Buildings

APPENDIX A

CATCHMENT PLAN – EXTERNAL CATCHMENTS

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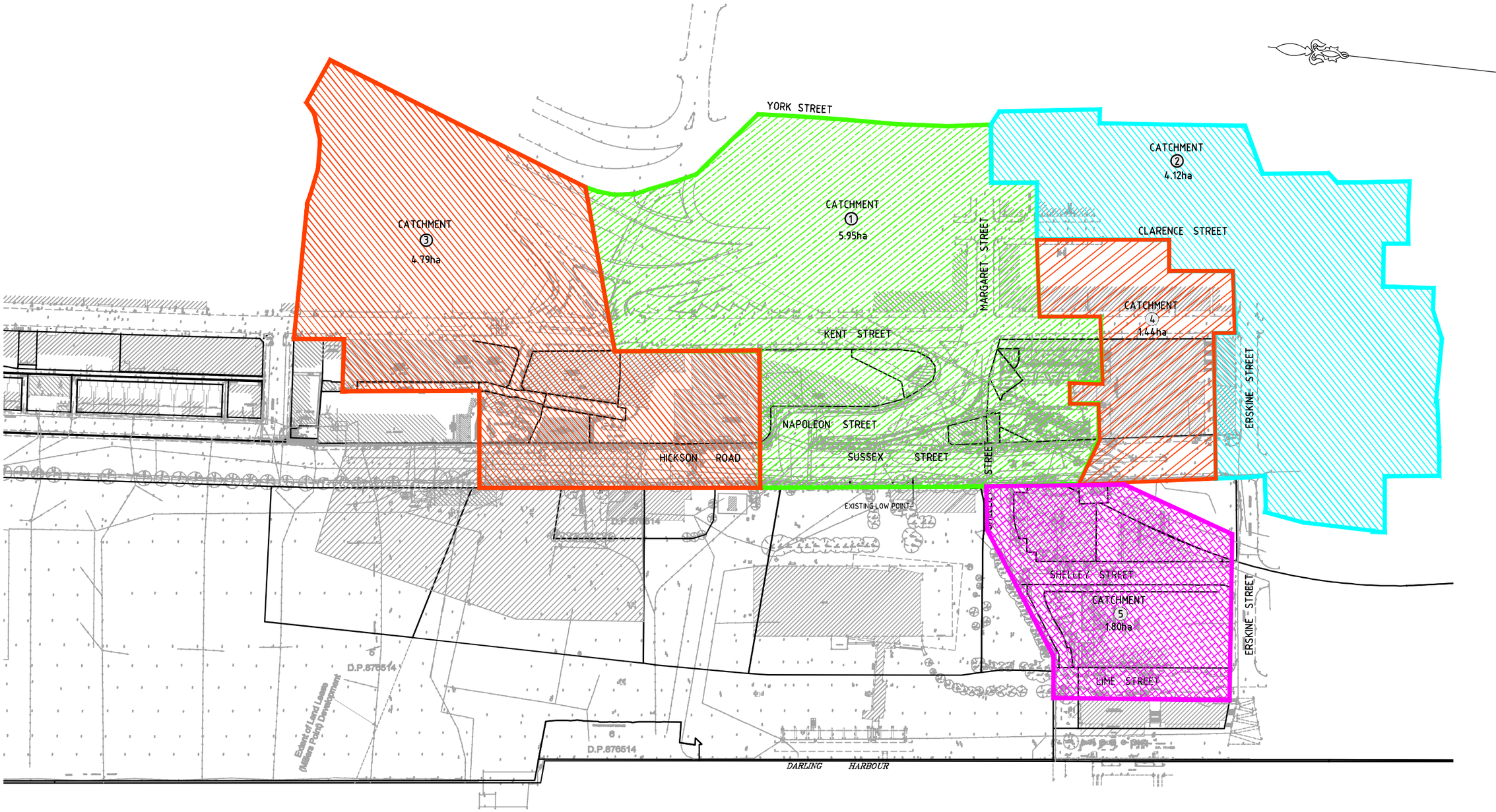
A1F

FILE LOCATION: YN210079/NORWEST SYDNEY WATER/121137SW12 DESIGNED: M. HODGES DRAFTED: J. BEZZINA VERIFIED: D. WILLIAMSON REVIEWED: S. LAM APPROVED: D. WILLIAMSON ISSUED: MAY 2012

DEVELOPER CONTRACT PLAN



STORMWATER DRAINAGE SUMMARY

CATCHMENT No.	FLOW (100yr ARI) (m^3/s)	AREA (Ha)	DESCRIPTION
1	$Q_{100} = 3.03 m^3/s$	5.95	CATCHMENT DISCHARGES TO EXISTING LOW POINT WITHIN SUSSEX STREET AND THEN CONVEYED TO DARLING HARBOUR VIA PROPOSED 2400Φ STORMWATER PIPE.
2	$Q_{100} = 0.73 m^3/s$	4.12	CATCHMENT DISCHARGES TO EXISTING DRAINAGE NETWORK ALONG ERSKINE STREET, OVERLAND FLOWS DISCHARGE THROUGH CATCHMENT 4 TO EXISTING LOW POINT WITHIN SUSSEX STREET.
3	$Q_{100} = 2.34 m^3/s$	4.79	NORTHERN CATCHMENT DISCHARGES TO 750Φ STORMWATER PIPE VIA HICKSON ROAD, THEN INTO 1200Φ THROUGH DEVELOPMENT SITE.
4	$Q_{100} = 1.88 m^3/s$	1.44	CATCHMENT DISCHARGES TO 1200Φ STORMWATER PIPE IN LIME STREET, OVERLAND FLOWS DISCHARGE TO EXISTING LOW POINT WITHIN SUSSEX STREET.
5	$Q_{100} = 0.92 m^3/s$	1.80	CATCHMENT DISCHARGES TO PROPOSED 2400Φ STORMWATER PIPE AND OVERLAND FLOWS DISCHARGE DIRECTLY TO DARLING HARBOUR.

No.	AMENDMENT DESCRIPTION	BY	DATE
10	RE-ISSUED FOR APPROVAL	M.D.H	11.10.12
9	RE-ISSUED FOR APPROVAL	S.J.P	12.09.12
8	RE-ISSUED FOR APPROVAL	M.K.H	26.07.12
7	RE-ISSUED FOR APPROVAL	M.K.H	09.07.12
6	RE-ISSUED FOR APPROVAL	M.K.H	06.06.12
5	RE-ISSUED FOR APPROVAL	M.K.H	23.05.12
2	ISSUED FOR APPROVAL	M.K.H	14.05.12
1	TENDER ISSUE	M.K.H	03.11.11

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210079-PP-1070 BARANGAROO SOUTH CATCHMENT PLAN

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WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER .....
W.S.C. .....
CONSTRUCTOR .....
COMPLETED .....
W.A.C. PREPARED .....

DESIGNER .....

I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS

Sydney WATER SYDNEY WATER CORPORATION

Case No. 126589SW | SHT 17 OF 19 SHTS.

CITY OF SYDNEY DRAINAGE
CITY AREA SWC 29
MARGARET STREET BRANCH 29N
& SUSSEX STREET NORTH BRANCH 29S

PLAN DRAWN DATE: 11.10.12 VERSION: 10 SHEET 17 OF 19 SHEETS