Report

Frasers Property Pty. Ltd.

Telopea Urban Renewal Project

Integrated Water Management Plan

July 2021

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS
& PROJECT MANAGERS

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Version control

Issue	Author	Reviewer	Approver	Date approved
A – Draft Issue	Troy McLeod	Francis Lane	David Crompton	5/06/2020
B – First Issue	Troy McLeod	David Crompton	David Crompton	30/06/2020
C – Second Issue	Troy McLeod	David Crompton	David Crompton	7/08/2020
D – Third Issue	Troy McLeod	David Crompton	David Crompton	20/11/2020
E – SEARS Update	Troy McLeod	David Crompton	David Crompton	15/04/2021
F – Updated Stage 1A Layout	Troy McLeod	David Crompton	David Crompton	25/06/2021
G – Basin Amendments	Troy McLeod	David Crompton	David Crompton 	1/07/2021

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1. EXECUTIVE SUMMARY

J. Wyndham Prince has been engaged by Frasers Property Telopea Developer Pty Ltd (Frasers) to prepare an Integrated Water Management Plan to support the staged redevelopment of the Telopea 'Concept Plan Area' (CPA), as well as a detailed proposal for the first stage of development, known as 'Stage 1A'. This report will inform a Development Application (DA) submission for assessment by the relevant planning authority.

The Integrated Water Management Plan outlined in this document assesses both water quality and water quantity required to manage the proposed Stage 1A lots and the new road alignments being introduced into the concept masterplan. Devices have been designed to achieve Parramatta City Council (PCC) objectives. This report should be read in conjunction with the civil plan sets 110500-04-DA001-603 (concept masterplan) and 110500-04-DA1001-1601 (Stage 1A) which provide details of the stormwater infrastructure proposed to service the concept masterplan and Stage 1A respectively. We have undertaken a preliminary hydraulic assessment to inform the DA drainage design with further hydraulic assessments to form part of the Construction Certificate and detailed design in the future.

The investigation involved the following specific tasks:

- Review Parramatta City Council policies, requirements and site constraints;
- Review design assumptions and compliance or otherwise of the proposed development with Council's policy;
- Review Telopea Master Plan Flooding and Water Cycle Management study undertaken by Mott MacDonald (MM) in 2017 for NSW Land and Housing Corporation;
- Undertake on-site detention (OSD) sizing in accordance with the Parramatta City Council DCP and supporting guidelines;
- Undertake MUSIC modelling for WSUD to achieve stormwater quality targets required for the development in accordance with the Parramatta City Council DCP;
- Identify the location, size and configuration of stormwater treatment measures proposed for the development.

The investigation has concluded that:

- Six (6) detention basins will be located throughout the area to deliver the site discharge and storage requirements as outlined in the Upper Parramatta River Catchment Trust (UPRCT) Handbook (4th ed., 2005).
- StormFilter™ chambers containing 690 mm high Psorb cartridges will be co-located in each of the basins in order to deliver Council's stormwater pollutant reduction requirements.
- OceanGuard® pit filter inserts will be located throughout each of the Stage 1A development parcels to manage the anticipated gross pollutants.

The proposed Integrated Water Management Plan as outlined in the report is consistent with Parramatta City Council's requirements and provides a means to ensure the environmental outcome can be achieved, sets the framework for its construction and allows for the granting of a development consent.

2. INTRODUCTION

This report has been prepared by J. Wyndham Prince on behalf of Frasers Property Telopea Developer Pty Ltd (Frasers) and accompanies a State Significant Development application (SSDA) submitted to the NSW Department of Planning, Industry and Environment (DPIE). The SSDA seeks Concept Approval, in accordance with Division 4.4 of the Environmental Planning and Assessment Act 1979 (EP&A Act), for the staged redevelopment of the Telopea 'Concept Plan Area' (CPA), as well as a detailed proposal for the first stage of development, known as 'Stage 1A'.

The purpose of this report is to provide details of the Integrated Water Management Plan for the Telopea CPA. This report focuses on supporting the works required for new roads nominated within the "core" as well as the Stage 1A development.

2.1. Background

The Telopea CPA forms part of the Telopea Precinct Master Plan endorsed by City of Parramatta Council (March 2017), which was prepared by NSW Land and Housing Corporation (LAHC) and Parramatta City Council to facilitate the rezoning of the precinct which occurred in December 2018. The Master Plan seeks to revitalise the Telopea Precinct through the redevelopment of LAHC's social housing assets, as well as sites under private ownership, to deliver an integrated community with upgraded public domain and community facilities – and to capitalise on access to the new Parramatta Light Rail network.

The Telopea CPA is the land identified in Plate 2.1 and is currently owned by LAHC, Council and church. The proposed redevelopment of the CPA is part of the NSW Government Communities Plus program, which seeks to deliver new communities where social housing blends with private and affordable housing with good access to transport, employment, improved community facilities and open space. The program seeks to leverage the expertise and capacity of the private and non-government sectors.

In December 2019, the NSW Government announced that the Affinity consortium, comprising Frasers and Hume Community Housing, were awarded the contract to redevelop the Telopea CPA. The SSDA represents the first step in the delivery of the planned redevelopment of the Telopea CPA and the Stage 1A works will provide the first integrated social and market housing development on the site, as well as a new arrival plaza for the Parramatta Light Rail.

2.2. Site Description

Telopea is located in the Parramatta Local Government Area (LGA). It is approximately 4km north-east of the Parramatta Central Business District (CBD), 6km south-west of Macquarie Park Strategic Centre, and 17km from Sydney CBD.

The Telopea CPA site is approximately 13.4 ha and comprises 99 individual allotments (refer Plate 2.1). It currently accommodates 486 social housing dwellings, across a mix of single dwelling, townhouse, and 3-9 storey residential flat buildings as well as the Dundas Community Centre, Dundas Branch Library, Community Health Centre, and Telopea Christian Centre.

The immediate surrounds comprise predominantly residential properties within an established landscape setting. The broader Precinct contains the Telopea Public School, a neighbourhood centre known as the Waratah Shops, and two large Council parks known as Sturt Park and Acacia Park.

Plate 2-1 – Telopea CPA Site Plan (Source: Bates Smart and Hassell)

2.3. Proposed Development

The SSDA seeks Concept Approval for the staged redevelopment of the Telopea CPA, as well as a detailed proposal for the first stage of development (Stage 1A). The application sets out the maximum building envelopes and GFA that can be accommodated across the CPA, and identifies the land uses and public infrastructure upgrades to be provided including new roads throughout the core parcels. The application will establish the planning and development framework from which any future development application will be assessed against.

For further details of the proposed masterplan and Stage 1A development applications refer to civil plans 110500-04-DA001-603 and 110500-04-DA1001-1601 respectively.

The Telopea CPA proposal comprises:

- A mixed-use development including:
  - Approximately 4700 dwellings, including a mix of social, affordable and market dwellings
  - Inclusion of a new retail precinct with a new supermarket, food and beverage, and speciality retail
  - Proposed childcare facility

  - Proposed combined library and community centre
  - Proposed combined Church, Residential Aged Care Facility and Independent living unit's facility
- Delivery of new public open space, including:
  - A new light rail plaza
  - Hill top park
  - Eyles pedestrian link
  - Open space associated with the proposed library
- Retention of existing significant trees
- Road and intersection upgrades
- Cycle way upgrades
- Upgrade of utility services

The Telopea CPA is divided into four precincts known as Core, North, South and East incorporating a total of 29 development parcels. The proposal is further detailed in the Urban Design Report prepared by Bates Smart and Hassell.

This report focuses on the new roads nominated within the "core" as well as Stage 1A development. See the "Subject Site" in Plate 2.1.

The first stage of works to be delivered (known as 'Stage 1A') is located adjacent to the Parramatta Light Rail station and will include:

- Site establishment works, including demolition of all existing buildings and structures, tree removal, site preparation, excavation, and services augmentation
- Construction of a new arrival plaza for the Parramatta Light Rail, incorporating a Community Pavilion
- Construction of the Sturt Street extension, Light Rail crossing including Adderton Road intersection works and cycleway connection
- Part demolition and upgrade of Sturt and Shortland Streets including new kerb-realignment, new footpaths and landscaping, new parking bays, bus zones, line marking and crossing.
- Construction of a new public park surrounding the existing significant trees
- Construction of residential flat buildings, up to 10-storeys in height, including studio, one, two and three bedroom apartments
- Construction of two basement levels, with access / egress via Sturt Street and Winter Street, including waste and loading facilities
- Associated open space and landscaping works, including retention of existing significant trees, ground and rooftop communal open space, and a publicly accessible through site link.

The Stage 1A proposal is further detailed in the Urban Design Report prepared by Plus Architecture and Landscape Report prepared by Hassell.

3. RELEVANT DEVELOPMENT GUIDELINES

The following studies and control documents have been considered in the development of the Integrated Water Management Plan for the Telopea CPA:

- Parramatta Development Control Plan, City of Parramatta Council, 2011
- Development Engineering Design Guidelines, City of Parramatta Council, June 2018
- On-site Stormwater Detention Handbook, Upper Parramatta River Catchment Trust, Fourth Edition December 2005

3.1. Parramatta Development Control Plan (DCP) 2011

The City of Parramatta Council *Development Control Plan* (DCP, 2011) identifies the following objectives with regards to Water Sensitive Urban Design and Stormwater Drainage:

- To minimise the quantity of stormwater run-off including changes in flow rate and duration by disconnecting impervious areas.
- To protect and enhance existing natural or constructed drainage networks including channel bed and banks by controlling the magnitude and duration of erosive flows.
- To ensure that downstream flora and fauna are protected from stormwater impacts during and post construction.
- To minimise surcharge from the existing drainage systems.
- To minimise and control nuisance flooding and to provide for the safe passage of less frequent floods.
- To ensure that on-site stormwater management measures are operated and maintained in accordance with design specifications.

Importantly, the DCP outlines the stormwater treatment targets for developments in the Parramatta Local Government Area (LGA). See Table 3.1 below.

Table 3-1 – Stormwater Pollutant Reduction Targets

Pollutant	Performance Target reduction loads[1]
Gross Pollutants	90% reduction in the post development mean annual load of total gross pollutant load (greater than 5mm)
Total Suspended Solids	85% reduction in the post development mean annual load of Total Suspended Solids (TSS)
Total Phosphorus	60% reduction in the post development mean annual load of Total Phosphorus (TP)
Total Nitrogen	45% reduction in the post development mean annual load of Total Nitrogen (TN)

3.2. Development Engineering Design Guidelines 2018

The City of Parramatta Council *Development Engineering Guideline* (2018) sets guidelines for On-site Stormwater Detention (OSD) from urban developments within the Council Local Government Area. The guideline specifies the Stormwater Management requirements as specified in the Upper Parramatta River Catchment Trust (UPRCT) handbook (4th Edition, 2005). The guideline defines 10 separate catchments for which there are differing OSD (discharge and volume) parameters. The Telopea Development is situated in the Subiaco/Ponds Creek catchment. Plate 3.1 provides an overview of the site location within the Subiaco/Ponds Creek catchment.

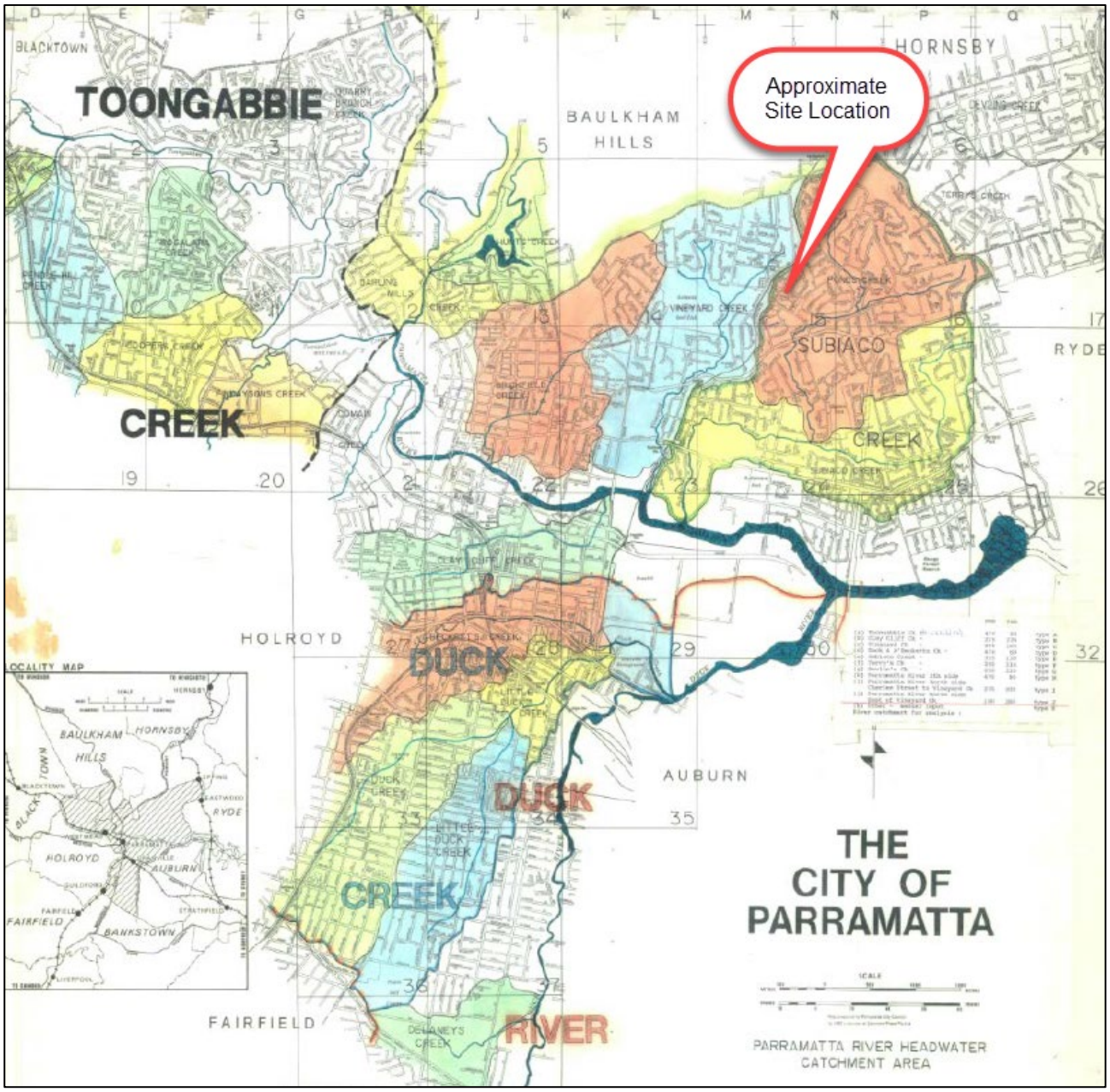

Plate 3-1 – OSD Catchments of former Parramatta City Council area

Table 3.2 provides details of the permissible site reference discharge (SRD) and site storage requirements (SSR) for the Subiaco/Ponds Creek catchment. SRD_L refers to the discharge from the (lower) extended detention storage while SSR_L refers to the minimum volume required for the lower extended detention storage when flows are restricted to the SRD_L. SRD_U refers to the flow from the discharge control pit when the volume exceeds the extended detention storage. SSR_T refers to the total volume required (extended detention storage plus flood detention storage).

Table 3-2 – Permissible Site Reference Discharge (SRD) and Site Storage Requirement (SSR)

Catchment	SRD_L (L/s/ha)	SSR_L (m^3/ha)	SRD_U (L/s/ha)	SSR_T (m^3/ha)
Subiaco Creek	40	284	150	438

4. ON-SITE DETENTION (OSD)

The On-site Detention (OSD) requirements for the Telopea CPA have been determined based on Council's Development Engineering Guidelines (PCC, 2018). Council's Development Engineering Guideline refers to UPRCT On-site Stormwater Detention Handbook (4th Ed., 2005) and is, therefore, the controlling document for development with the entire Parramatta River Catchment.

The Telopea CPA is located in the Subiaco/Ponds Creek catchment which is within the lower portion of the Parramatta River catchment and therefore needs to comply with the requirements for new development outside the UPRCT. The relevant details are provided in Appendix R of the Handbook, which uses the UPRCT OSD calculation sheet (received from Council) to determine the required detention needs for this development.

4.1. Sub-catchments

Sub-catchments in the subject area have been delineated based on the site grading development application (DA) design for the Telopea Masterplan and Stage 1A. These catchments are illustrated in Plate 4.1 below.

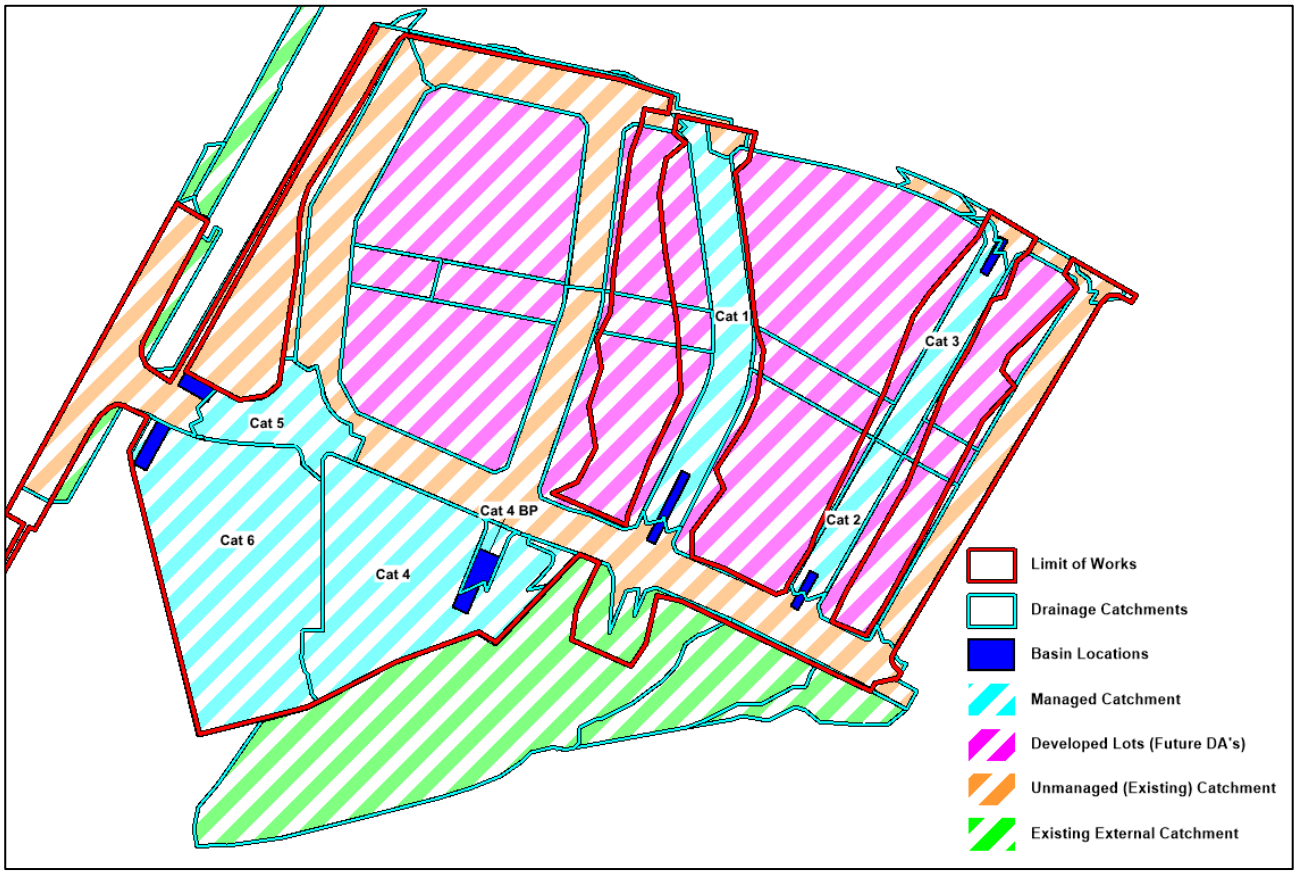

Plate 4-1 – OSD Catchments (Roads & Stage 1A)

It is important to note that OSD devices have only been proposed for the newly proposed roads within the Masterplan DA and the Stage 1A lots. Future modelling will be required to confirm OSD requirements for the core lot parcels ("Developed Lots" in Plate 4.1) external to the Stage 1A area.

A small portion of catchment downstream of Basin 4 (Cat 4 BP) has been assumed to bypass the device which has been reflected in the OSD calculation sheet for the basin. Therefore, this small bypassing area is compensated for within Basin 4.

Refer to the catchment plans in civil plan sets 110500-04-DA001-603 (concept masterplan) and 110500-04-DA1001-1601 (Stage 1A) for further details of catchments and gradings.

4.2. OSD Results

The site storage requirements for each of the managed catchments in the Telopea CPA are shown in Table 4.1 below. Further details of the OSD requirements can be seen in the UPRCT Calculation Sheets provided in Appendix A.

Table 4-1 – Total Site Storage Requirements (SSR)

Basin / Catchment ID	Catchment Area (ha)	Total Site Storage Requirement (m^3)
1	0.33	143
2	0.11	50
3	0.16	68
4	0.67	317
4 (Bypass)	0.05	
5	0.18	80
6	0.88	384

The above storages will ensure that peak flow management can be achieved for all catchments.

5. WATER QUALITY MANAGEMENT

The stormwater quality analysis for this study was undertaken using the Model for Urban Stormwater Improvement Conceptualisation (*MUSIC*). This water quality modelling software was developed by the Cooperative Research Centre (CRC) for Catchment Hydrology which is based at Monash University and was first released in July 2002. Version 6.3 was adopted for this study.

The model provides a number of features relevant for the development:

- It is able to model the potential nutrient reduction benefits of gross pollutant traps, constructed wetlands, grass swales, bio-retention systems, sedimentation basins, infiltration systems, ponds and it incorporates mechanisms to model stormwater re-use as a treatment technique.
- It provides mechanisms to evaluate the attainment of water quality objectives.

The *MUSIC* modelling was undertaken to demonstrate that the stormwater management system proposed will deliver the required pollutant reduction targets specified in Council's current guidelines. The pollutant reduction requirements are as follows.

- Total Suspended Solids (TSS) – 85%
- Total Phosphorus (TP) – 60%
- Total Nitrogen (TN) – 45%
- Gross Pollutants (GP) – 90%

Parramatta City Council requires the use of the 'NSW MUSIC Modelling Guidelines' (BMT, 2015) in the development of *MUSIC* models to represent the generation of various pollutants by different land uses in support of the future development.

5.1. Catchments

A MUSIC model was established to represent the treatment required for the proposed development as outlined in this application. It is noted that the future lots will provide their own on-lot treatment as part of future DA processes. The lots will be required to meet Council's annual pollutant load reduction requirements as shown above.

The MUSIC model layout is shown on Plate 5.1 with further details of the catchment breakup provided in Appendix B.

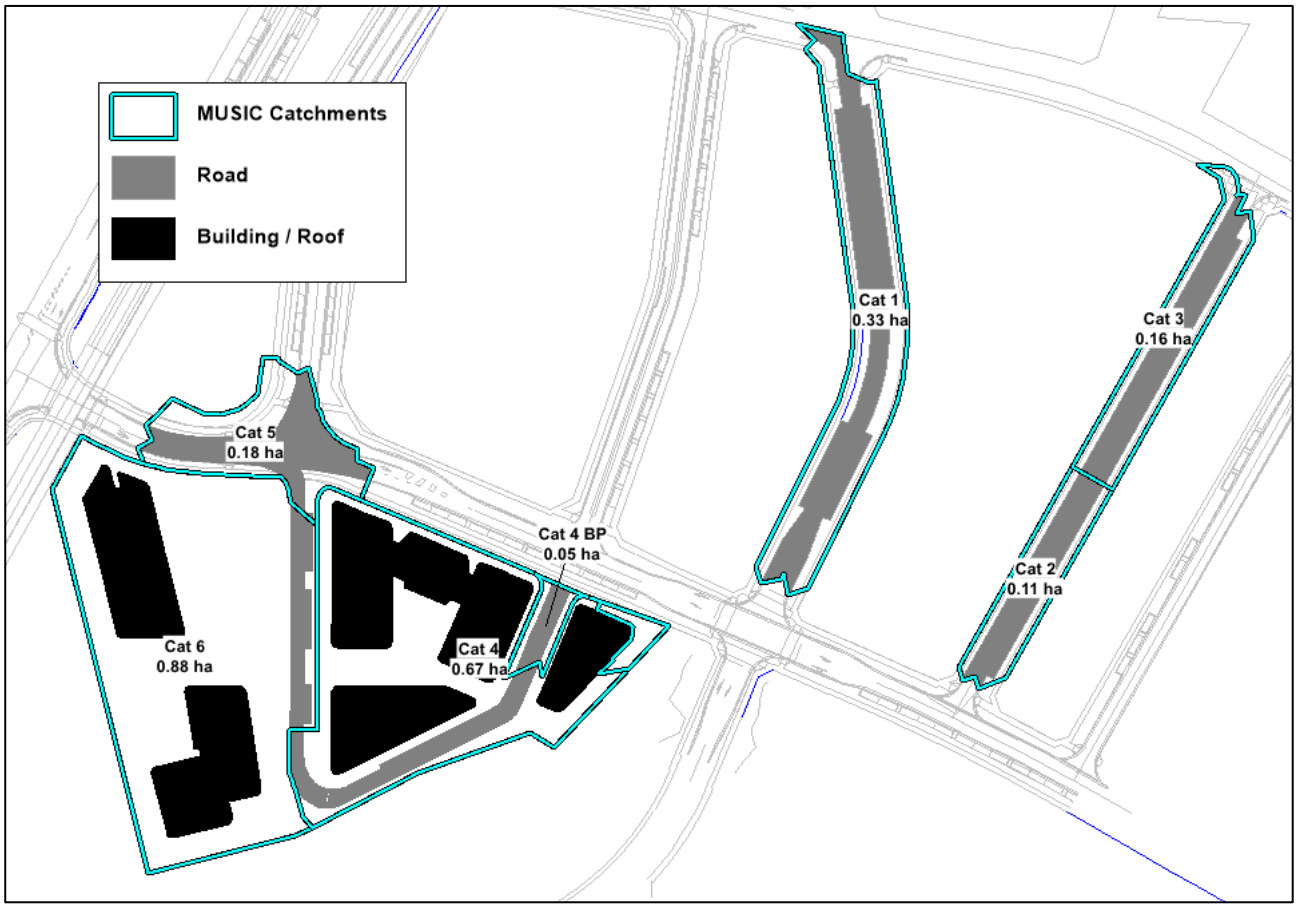

Plate 5-1 – MUSIC Catchments

A small portion of catchment downstream of Basin 4 (Cat 4 BP) has been assumed to bypass the device. This is compensated for within the treatment measures proposed in Catchment 4 (StormFilter cartridges and OceanGuard pit inserts).

5.2. Modelling Inputs and Assumptions

The following assumptions and parameters were adopted in the MUSIC models:

- Catchment areas have adopted the following overarching fraction impervious:
  - Road reserve catchments (Cat 1, 2, 3, & 5) – 95% impervious
  - Stage 1A lot catchments (Cat 4, 4 BP & 6) – 85% impervious
- Catchment areas in Plate 5-1 have been split into individual landuses based on the architectural building layouts and civil road designs. Landuses have adopted the following for MUSIC nodes impervious area:
  - Road (pavement) node = 100% impervious
  - Building / roof node = 100% impervious
  - Other impervious = 100% impervious
  - Pervious = 0% impervious

Further details of catchment areas and node parameters are detailed in Appendix B.

5.3. Modelling Results

Total annual pollutant load estimates were derived from the results of *MUSIC* model based on a stochastic assessment of the developed site incorporating the proposed water quality treatment system.

The proposed treatment train consists of:

- Catchment 1 (Basin 1)
  - 21 x 690 mm high StormFilter™ Cartridges
- Catchment 2 (Basin 2)
  - 7 x 690 mm high StormFilter™ Cartridges
- Catchment 3 (Basin 3)
  - 10 x 690 mm high StormFilter™ Cartridges
- Catchment 4 (Basin 4)
  - 6 x 690 mm high StormFilter™ Cartridges
  - 8 x OceanGuards® (pit filter inserts) (2 of which are proposed in the bypassing catchment)
- Catchment 5 (Basin 5)
  - 11 x 690 mm high StormFilter™ Cartridges
- Catchment 6 (Basin 6)
  - 7 x 690 mm high StormFilter™ Cartridges
  - 12 x OceanGuards® (pit filter inserts)

Each treatment device has been designed to achieve the necessary pollutant reductions in isolation. It is noted that the driving pollutant varies across different catchments which has resulted in the water quality solution exceeding the required pollutant reductions.

The estimated annual pollutant loads and reductions for TSS, TP, TN and Gross Pollutants across the whole model are presented in Table 5.1 below.

Table 5-1 – Summary of Estimate Mean Annual Pollutant Loads and Reductions

Pollutant	Total Developed Source Nodes	Minimum Reduction Required	Total Residual Load from Site	Total Reduction Achieved	Target Reduction Required	Total Reduction Achieved
	(kg/yr)	(kg/yr)	(kg/yr)	(kg/yr)	(%)	(%)
TSS	16000	13600	1820	14180	85.0%	88.6%
TP	11.1	6.7	3.4	7.8	60.0%	69.8%
TN	56.7	25.52	30.0	26.7	45.0%	47.1%
Gross Pollutants	586	527	0.0	586	90.0%	100.0%

The combination of treatment approaches detailed above will ensure that the minimum pollutant reductions are achieved.

6. REFERENCES

City of Parramatta Council, 2011, *Parramatta Development Control Plan.*

City of Parramatta Council, 2018, *Development Engineering Design Guidelines.*

Upper Parramatta River Catchment Trust 2005, *On-site Stormwater Detention Handbook 4th Edition.*

7. GLOSSARY

Term	Definition
Airborne Laser Survey (ALS)	Is a technique for obtaining a definition of the surface elevation (ground, buildings, power lines, trees, etc.) by pulsing a laser beam at the ground from an airborne vehicle (generally a plane) and measuring the time taken for the laser beam to return to a scanning device fixed to the plane. The time taken is a measure of the distance which, when ground truthed, is generally accurate to ± 150mm.
Annual Exceedance Probability (AEP)	Is the chance or probability of a natural hazard event (usually a rainfall or flooding event) occurring annually and is usually expressed as a percentage.
Australian Rainfall and Runoff (AR&R)	Refers to the current edition of Australian Rainfall and Runoff published by the Institution of Engineers, Australia.
Dam Safety Committee (DSC)	Is a NSW statutory body aligned with Department of Primary Industries. Its function is to ensure the safety of dams within NSW.
Digital Terrain Model (DTM)	Is a spatially referenced three-dimensional (3D) representation of the ground surface represented as discrete point elevations where each cell in the grid represents an elevation above an established datum.
Exceedances per Year (EY)	Is the number of times a year that statistically a storm flow will be exceeded.
Floodplain Planning Level (FPL)	The FPL is a height used to set floor levels for property development in flood prone areas. It is generally defined as the 1% AEP flood level plus 0.5m freeboard.
Floodplain Development Manual (FDM) and Guidelines (April 2005)	The FDM is a document issued by the Department of Environment Climate Change and Water (DECCW) that provides a strategic approach to floodplain management. The guidelines have been issued by the NSW Department of Planning (DoP) to clarify issues regarding the setting of FPL's. This document is also the framework for the development of Floodplain Risk Management Studies and Plans.
Floodplain Storage Areas	Parts of a floodplain that are important for the temporary storage of floodwaters during the passage of a flood. Loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation.
Floodway	Is the areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels.
Hyetograph	Is the distribution of rainfall over time.
Hydrograph	Is a graph that shows how the stormwater discharge changes with time at any particular location.
Hydrology	The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.

Term	Definition
J. Wyndham Prince Pty Ltd (JWP)	Consulting Civil Infrastructure Engineers and Project Managers undertaking these investigations
Peak Discharge	Is the maximum stormwater runoff that occurs during a flood event
Probable Maximum Flood (PMF)	Is the greatest depth of precipitation for a given duration meteorologically possible for a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends.
Triangular Irregular Network (TIN)	Is a technique used in the created DTM by developing a mass of interconnected triangles. For each triangle, the ground level is defined at each of the three vertices, thereby defining a plane surface over the area of the triangle
TUFLOW	Is a computer program that provides two-dimensional (2D) and one dimensional (1D) solutions of the free surface flow equations to simulate flood and tidal wave propagation. It is specifically beneficial where the hydrodynamic behaviour, estuaries, rivers, floodplains and urban drainage environments have complex 2D flow patterns that would be awkward to represent using traditional 1D network models.
XP-RAFTS	Is a runoff routing model that uses the Laurenson non-linear runoff routing procedure to develop a sub catchment stormwater runoff hydrograph from either an actual event (recorded rainfall time series) or a design storm utilising Intensity-Frequency-Duration data together with dimensionless storm temporal patterns as well as standard AR&R 1987 data.

APPENDIX A

UPRCT OSD Calculation Sheets

Project:	**Telopea**
Site Address	**Basin 1**
Job No:	**110500-04**
Designer:	**TM**
Telephone:	**(02) 4720 3392**

Site Data

OSD Area:	**Upper Parramatta River Catchment**						
L.G.A	**Parramatta City Council**						
Site Area	**0.326452**	ha	**3,265**	m^2			
Total Roof Area	**0**	ha	**0**	m^2			
Area of Site draining to OSD Storage	**0.326452**	ha	**3,265**	m^2	**Satisfactory**		
Residual Site Area (Lot Area - Roof Area)	**0.326**	ha					
Area Bypassing Storage	**0**	ha					
Area Bypassing / Residual Site Area	**0.0%**				**Satisfactory**		**30% Max**
No. of Dwellings on Site	**1**				**Satisfactory**		
Site Area per Dwelling	**0.326**	ha					
Roof Area per Dwelling	**0.000**	ha					

Basic OSD Parameters

		Extended Detention			Detention	
Basic SSR Vols	Ext Detention Storage	**284**	m^3/ha	Total Storage	**438**	m^3/ha
Basic SRDs	Primary Outlet	**40**	L/s/ha	Secondary Outlet	**150**	L/s/ha

OSD Tank Bypass

Residual Lot Capture in OSD Tank	**100%**				
Adjusted SRDs	**40**	L/s/ha		**150**	L/s/ha

OSD Calculations

		Extended Detention				Detention	
Basic SSR Volume	Ext Detention Storage	**92.71**	m^3		Total Storage	**142.99**	m^3
Total Rainwater Tank Credits		**#DIV/0!**	m^3			**#DIV/0!**	m^3
Storage Volume					Total	**#DIV/0!**	m^3
Storage Volume	Ext Detention Storage	**#DIV/0!**	m^3		Flood Detention Storage	**#DIV/0!**	m^3
OSD Discharges	Primary Outlet	**13.06**	L/s		Secondary Outlet	**48.97**	L/s
RL of Top Water Level of Storage		**44.090**	m			**44.600**	m
RL of Orifice Centre-line		**43.336**	m			**43.364**	m
Number of Orifices		**1**				**1**	
Estimated Downstream Flood Level		**43.23**	1.5 yr ARI			**43.29**	100 yr ARI
Downstream FL - RL of Orifice Cente-line		**-0.11**	**Satisfactory**		**Satisfactory**	**-0.07**	m
Design Head to Orifice Centre		**0.754**	m		TWL Ext Detn Storage - RL Orifice	**0.727**	m
Calculated Orifice Diameter		**85**	mm	**Satisfactory**	**Satisfactory**	**166**	mm

Overflow Weir & Freeboard Calculation

RL of Minimum Habitable Floor Level		**45.777**	m
RL of Minimum Garage Floor Level		**45.777**	m
Length of Overflow Weir		**1.00**	m
Site Runoff Coefficient	**Parramatta City Council**	**0.75**	
Storm Intensity (5 min 100 yr ARI)		**230**	mm/h
Peak Flow over Weir		**156.4**	L/s
Depth of Flow over Weir		**209**	mm
Freeboard to Habitable Floor	**Satisfactory**	**968**	mm
Freeboard to Garage Floor	**Satisfactory**	**968**	mm

Project:	**Telopea**
Site Address	**Basin 2**
Job No:	**110500-04**
Designer:	**TM**
Telephone:	**(02) 4720 3392**

Site Data

OSD Area:	**Upper Parramatta River Catchment**						
L.G.A	**Parramatta City Council**						
Site Area	**0.113367**	ha	**1,134**	m^2			
Total Roof Area	**0**	ha	**0**	m^2			
Area of Site draining to OSD Storage	**0.113367**	ha	**1,134**	m^2	**Satisfactory**		
Residual Site Area (Lot Area - Roof Area)	**0.113**	ha					
Area Bypassing Storage	**0**	ha					
Area Bypassing / Residual Site Area	**0.0%**				**Satisfactory**		**30% Max**
No. of Dwellings on Site	**1**				**Satisfactory**		
Site Area per Dwelling	**0.113**	ha					
Roof Area per Dwelling	**0.000**	ha					

Basic OSD Parameters

		Extended Detention			Detention	
Basic SSR Vols	Ext Detention Storage	**284**	m^3/ha	Total Storage	**438**	m^3/ha
Basic SRDs	Primary Outlet	**40**	L/s/ha	Secondary Outlet	**150**	L/s/ha

OSD Tank Bypass

Residual Lot Capture in OSD Tank	**100%**				
Adjusted SRDs	**40**	L/s/ha		**150**	L/s/ha

OSD Calculations

		Extended Detention				Detention	
Basic SSR Volume	Ext Detention Storage	**32.20**	m^3		Total Storage	**49.65**	m^3
Total Rainwater Tank Credits		**#DIV/0!**	m^3			**#DIV/0!**	m^3
Storage Volume					Total	**#DIV/0!**	m^3
Storage Volume	Ext Detention Storage	**#DIV/0!**	m^3		Flood Detention Storage	**#DIV/0!**	m^3
OSD Discharges	Primary Outlet	**4.53**	L/s		Secondary Outlet	**17.01**	L/s
RL of Top Water Level of Storage		**38.690**	m			**38.980**	m
RL of Orifice Centre-line		**38.118**	m			**38.138**	m
Number of Orifices		**1**				**1**	
Estimated Downstream Flood Level		**38.02**	1.5 yr ARI			**38.05**	100 yr ARI
Downstream FL - RL of Orifice Cente-line		**-0.10**	**Satisfactory**		**Satisfactory**	**-0.09**	m
Design Head to Orifice Centre		**0.572**	m		TWL Ext Detn Storage - RL Orifice	**0.552**	m
Calculated Orifice Diameter		**54**	mm	**Satisfactory**	**Satisfactory**	**105**	mm

Overflow Weir & Freeboard Calculation

RL of Minimum Habitable Floor Level		**40.490**	m
RL of Minimum Garage Floor Level		**40.490**	m
Length of Overflow Weir		**2.00**	m
Site Runoff Coefficient	**Parramatta City Council**	**0.75**	
Storm Intensity (5 min 100 yr ARI)		**230**	mm/h
Peak Flow over Weir		**54.3**	L/s
Depth of Flow over Weir		**65**	mm
Freeboard to Habitable Floor	**Satisfactory**	**1445**	mm
Freeboard to Garage Floor	**Satisfactory**	**1445**	mm

Project:	**Telopea**
Site Address	**Basin 3**
Job No:	**110500-04**
Designer:	**TM**
Telephone:	**(02) 4720 3392**

Site Data

OSD Area:	**Upper Parramatta River Catchment**						
L.G.A	**Parramatta City Council**						
Site Area	**0.155385**	ha	**1,554**	m^2			
Total Roof Area	**0**	ha	**0**	m^2			
Area of Site draining to OSD Storage	**0.155385**	ha	**1,554**	m^2	**Satisfactory**		
Residual Site Area (Lot Area - Roof Area)	**0.155**	ha					
Area Bypassing Storage	**0**	ha					
Area Bypassing / Residual Site Area	**0.0%**				**Satisfactory**	**30% Max**	
No. of Dwellings on Site	**1**				**Satisfactory**		
Site Area per Dwelling	**0.155**	ha					
Roof Area per Dwelling	**0.000**	ha					

Basic OSD Parameters

		Extended Detention			Detention	
Basic SSR Vols	Ext Detention Storage	**284**	m^3/ha	Total Storage	**438**	m^3/ha
Basic SRDs	Primary Outlet	**40**	L/s/ha	Secondary Outlet	**150**	L/s/ha

OSD Tank Bypass

Residual Lot Capture in OSD Tank	**100%**				
Adjusted SRDs	**40**	L/s/ha		**150**	L/s/ha

OSD Calculations

		Extended Detention			Detention	
Basic SSR Volume	Ext Detention Storage	**44.13**	m^3	Total Storage	**68.06**	m^3
Total Rainwater Tank Credits		**#DIV/0!**	m^3		**#DIV/0!**	m^3
Storage Volume				Total	**#DIV/0!**	m^3
Storage Volume	Ext Detention Storage	**#DIV/0!**	m^3	Flood Detention Storage	**#DIV/0!**	m^3
OSD Discharges	Primary Outlet	**6.22**	L/s	Secondary Outlet	**23.31**	L/s
RL of Top Water Level of Storage		**37.280**	m		**37.700**	m
RL of Orifice Centre-line		**36.496**	m		**36.517**	m
Number of Orifices		**1**			**1**	
Estimated Downstream Flood Level		**36.48**	1.5 yr ARI		**36.52**	100 yr ARI
Downstream FL - RL of Orifice Cente-line		**-0.02**	**Satisfactory**	**Raise Orifice Level*** **	**0.00**	m
Design Head to Orifice Centre		**0.785**	m	TWL Ext Detn Storage - RL Orifice	**0.763**	m
Calculated Orifice Diameter		**58**	mm	**Satisfactory**	**113**	mm

Overflow Weir & Freeboard Calculation

RL of Minimum Habitable Floor Level		**38.800**	m
RL of Minimum Garage Floor Level		**38.800**	m
Length of Overflow Weir		**1.00**	m
Site Runoff Coefficient	**Parramatta City Council**	**0.75**	
Storm Intensity (5 min 100 yr ARI)		**230**	mm/h
Peak Flow over Weir		**74.5**	L/s
Depth of Flow over Weir		**127**	mm
Freeboard to Habitable Floor	**Satisfactory**	**973**	mm
Freeboard to Garage Floor	**Satisfactory**	**973**	mm

***Final orifice level subject to future detailed modelling and design

Project:	**Telopea**
Site Address	**Basin 4**
Job No:	**110500-04**
Designer:	**TM**
Telephone:	**(02) 4720 3392**

Site Data

OSD Area:	**Upper Parramatta River Catchment**						
L.G.A	**Parramatta City Council**						
Site Area	**0.72356**	ha	**7,236**	m^2			
Total Roof Area	**0.34326356**	ha	**3,433**	m^2			
Area of Site draining to OSD Storage	**0.669581**	ha	**6,696**	m^2	**Satisfactory**		
Residual Site Area (Lot Area - Roof Area)	**0.380**	ha					
Area Bypassing Storage	**0.053979**	ha					
Area Bypassing / Residual Site Area	**14.2%**				**Satisfactory**	**30% Max**	
No. of Dwellings on Site	**1**				**Satisfactory**		
Site Area per Dwelling	**0.724**	ha					
Roof Area per Dwelling	**0.343**	ha					

Basic OSD Parameters

		Extended Detention			Detention	
Basic SSR Vols	Ext Detention Storage	**284**	m^3/ha	Total Storage	**438**	m^3/ha
Basic SRDs	Primary Outlet	**40**	L/s/ha	Secondary Outlet	**150**	L/s/ha

OSD Tank Bypass

Residual Lot Capture in OSD Tank	**86%**				
Adjusted SRDs	**36**	L/s/ha		**122**	L/s/ha

OSD Calculations

		Extended Detention				Detention	
Basic SSR Volume	Ext Detention Storage	**205.49**	m^3	Total Storage		**316.92**	m^3
Total Rainwater Tank Credits		**0.01**	m^3			**0.00**	m^3
Storage Volume				Total		**316.91**	m^3
Storage Volume	Ext Detention Storage	**205.49**	m^3	Flood Detention Storage		**111.43**	m^3
OSD Discharges	Primary Outlet	**25.86**	L/s	Secondary Outlet		**87.99**	L/s
RL of Top Water Level of Storage		**54.687**	m			**55.114**	m
RL of Orifice Centre-line		**53.900**	m			**53.900**	m
Number of Orifices		**1**				**1**	
Estimated Downstream Flood Level		**50.87**	1.5 yr ARI			**50.97**	100 yr ARI
Downstream FL - RL of Orifice Cente-line		**-3.03**	**Satisfactory**		**Satisfactory**	**-2.93**	m
Design Head to Orifice Centre		**0.787**	m	TWL Ext Detn Storage - RL Orifice		**0.787**	m
Calculated Orifice Diameter		**118**	mm	**Satisfactory**	**Satisfactory**	**218**	mm

Overflow Weir & Freeboard Calculation

RL of Minimum Habitable Floor Level		**56.900**	m
RL of Minimum Garage Floor Level		**56.900**	m
Length of Overflow Weir		**1.00**	m
Site Runoff Coefficient	**Parramatta City Council**	**0.75**	
Storm Intensity (5 min 100 yr ARI)		**230**	mm/h
Peak Flow over Weir		**320.8**	L/s
Depth of Flow over Weir		**339**	mm
Freeboard to Habitable Floor	**Satisfactory**	**1447**	mm
Freeboard to Garage Floor	**Satisfactory**	**1447**	mm

Project:	**Telopea**
Site Address	**Basin 5**
Job No:	**110500-04**
Designer:	**TM**
Telephone:	**(02) 4720 3392**

Site Data

OSD Area:	**Upper Parramatta River Catchment**						
L.G.A	**Parramatta City Council**						
Site Area	**0.18375**	ha	**1,838**	m^2			
Total Roof Area	**0**	ha	**0**	m^2			
Area of Site draining to OSD Storage	**0.18375**	ha	**1,838**	m^2	**Satisfactory**		
Residual Site Area (Lot Area - Roof Area)	**0.184**	ha					
Area Bypassing Storage	**0**	ha					
Area Bypassing / Residual Site Area	**0.0%**				**Satisfactory**		**30% Max**
No. of Dwellings on Site	**1**				**Satisfactory**		
Site Area per Dwelling	**0.184**	ha					
Roof Area per Dwelling	**0.000**	ha					

Basic OSD Parameters

		Extended Detention			Detention	
Basic SSR Vols	Ext Detention Storage	**284**	m^3/ha	Total Storage	**438**	m^3/ha
Basic SRDs	Primary Outlet	**40**	L/s/ha	Secondary Outlet	**150**	L/s/ha

OSD Tank Bypass

Residual Lot Capture in OSD Tank	**100%**				
Adjusted SRDs	**40**	L/s/ha		**150**	L/s/ha

OSD Calculations

		Extended Detention				Detention	
Basic SSR Volume	Ext Detention Storage	**52.19**	m^3		Total Storage	**80.48**	m^3
Total Rainwater Tank Credits		**#DIV/0!**	m^3			**#DIV/0!**	m^3
Storage Volume					Total	**#DIV/0!**	m^3
Storage Volume	Ext Detention Storage	**#DIV/0!**	m^3		Flood Detention Storage	**#DIV/0!**	m^3
OSD Discharges	Primary Outlet	**7.35**	L/s		Secondary Outlet	**27.56**	L/s
RL of Top Water Level of Storage		**52.090**	m			**52.970**	m
RL of Orifice Centre-line		**51.555**	m			**51.555**	m
Number of Orifices		**1**				**1**	
Estimated Downstream Flood Level		**51.52**	1.5 yr ARI			**51.54**	100 yr ARI
Downstream FL - RL of Orifice Cente-line		**-0.03**	**Satisfactory**		**Satisfactory**	**-0.02**	m
Design Head to Orifice Centre		**0.535**	m		TWL Ext Detn Storage - RL Orifice	**0.535**	m
Calculated Orifice Diameter		**69**	mm	**Satisfactory**	**Satisfactory**	**134**	mm

Overflow Weir & Freeboard Calculation

RL of Minimum Habitable Floor Level		**55.400**	m
RL of Minimum Garage Floor Level		**55.400**	m
Length of Overflow Weir		**1.00**	m
Site Runoff Coefficient	**Parramatta City Council**	**0.75**	
Storm Intensity (5 min 100 yr ARI)		**230**	mm/h
Peak Flow over Weir		**88.0**	L/s
Depth of Flow over Weir		**142**	mm
Freeboard to Habitable Floor	**Satisfactory**	**2288**	mm
Freeboard to Garage Floor	**Satisfactory**	**2288**	mm

Project:	**Telopea**
Site Address	**Basin 6**
Job No:	**110500-04**
Designer:	**TM**
Telephone:	**(02) 4720 3392**

Site Data

OSD Area:	**Upper Parramatta River Catchment**						
L.G.A	**Parramatta City Council**						
Site Area	**0.877112**	ha	**8,771**	m^2			
Total Roof Area	**0.236268**	ha	**2,363**	m^2			
Area of Site draining to OSD Storage	**0.877112**	ha	**8,771**	m^2	**Satisfactory**		
Residual Site Area (Lot Area - Roof Area)	**0.641**	ha					
Area Bypassing Storage	**0**	ha					
Area Bypassing / Residual Site Area	**0.0%**				**Satisfactory**		**30% Max**
No. of Dwellings on Site	**1**				**Satisfactory**		
Site Area per Dwelling	**0.877**	ha					
Roof Area per Dwelling	**0.236**	ha					

Basic OSD Parameters

		Extended Detention			Detention	
Basic SSR Vols	Ext Detention Storage	**284**	m^3/ha	Total Storage	**438**	m^3/ha
Basic SRDs	Primary Outlet	**40**	L/s/ha	Secondary Outlet	**150**	L/s/ha

OSD Tank Bypass

Residual Lot Capture in OSD Tank	**100%**				
Adjusted SRDs	**40**	L/s/ha		**150**	L/s/ha

OSD Calculations

		Extended Detention				Detention	
Basic SSR Volume	Ext Detention Storage	**249.10**	m^3	Total Storage		**384.18**	m^3
Total Rainwater Tank Credits		**0.02**	m^3			**0.02**	m^3
Storage Volume				Total		**384.16**	m^3
Storage Volume	Ext Detention Storage	**249.08**	m^3	Flood Detention Storage		**135.08**	m^3
OSD Discharges	Primary Outlet	**35.08**	L/s	Secondary Outlet		**131.57**	L/s
RL of Top Water Level of Storage		**52.223**	m			**53.136**	m
RL of Orifice Centre-line		**50.540**	m			**50.540**	m
Number of Orifices		**1**				**1**	
Estimated Downstream Flood Level		**50.53**	1.5 yr ARI			**50.64**	100 yr ARI
Downstream FL - RL of Orifice Cente-line		**-0.01**	**Satisfactory**	**Raise Orifice Level*** **		**0.10**	m
Design Head to Orifice Centre		**1.683**	m	TWL Ext Detn Storage - RL Orifice		**1.683**	m
Calculated Orifice Diameter		**114**	mm	**Satisfactory**	**Satisfactory**	**220**	mm

Overflow Weir & Freeboard Calculation

RL of Minimum Habitable Floor Level		**55.900**	m
RL of Minimum Garage Floor Level		**55.900**	m
Length of Overflow Weir		**1.00**	m
Site Runoff Coefficient	**Parramatta City Council**	**0.75**	
Storm Intensity (5 min 100 yr ARI)		**230**	mm/h
Peak Flow over Weir		**420.3**	L/s
Depth of Flow over Weir		**406**	mm
Freeboard to Habitable Floor	**Satisfactory**	**2358**	mm
Freeboard to Garage Floor	**Satisfactory**	**2358**	mm

***Final orifice level subject to future detailed modelling and design

APPENDIX B

MUSIC Breakdown & Parameters

Table C1 –Catchment Area Breakdown

Catchment	Area	Landuse				% Imp
		Roof	Road	Other Impervious	Pervious	
Cat 1	0.326		0.173	0.137	0.016	0.95
Cat 2	0.113		0.067	0.041	0.006	0.95
Cat 3	0.155		0.088	0.060	0.008	0.95
Cat 4	0.670	0.343	0.065	0.161	0.100	0.85
Cat 4 BP	0.054		0.019	0.033	0.003	0.95
Cat 5	0.184		0.100	0.075	0.009	0.95
Cat 6	0.877	0.236	0.048	0.462	0.132	0.85

Table C2 – Rainfall-Runoff Parameters for Telopea

Property	Units	Value
Rainfall Threshold (mm/day)	mm/day	0.3 for roof, 1.5 for road and 1.0 for all other
Pervious Area Properties		
Soil Storage Capacity	mm	100
Initial Storage*	% of Capacity	30
Field Capacity	mm	87
Inifiltration Capacity Coefficient - a		250
Inifiltration Capacity Coefficient - b		1.3
Groundwater Properties		
Initial Depth*	mm	10
Daily Recharge Rate	%	60
Daily Baseflow Rate	%	45
Daily Deep Seepage Rate	%	0

Table C3 – Source Node Parameters

Surface / Landuse Type	TSS		TP		TN	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Base Flow						
General Urban, Residential, Commercial, Industrial	1.2	0.17	-0.85	0.19	0.11	0.12
Storm Flow						
General Urban, Residential, Commercial, Industrial	2.15	0.32	-0.6	0.25	0.3	0.19
Road	2.43	0.32	-0.3	0.25	0.34	0.19
Roof	1.3	0.32	-0.89	0.25	0.3	0.19

Table C4 – Psorb StormFilter Cartridge Input Parameters

Pollutant	Input	Output
Gross Pollutants (kg/ML)	0	0
	14.9393	0
Total Suspended Solids (mg/L)	0	0
	1000	66
Total Phosphorus (mg/L)	0	0
	10	1.39
Total Nitrogen (mg/L)	0	0
	100	44.1

Table C5 – OceanGuard Input Parameters

High flow bypass = 20 L/s per OceanGuard		
Pollutant	**Input**	**Output**
Gross Pollutants (kg/ML)	0	0
	14.7808	0
Total Suspended Solids (mg/L)	0	0
	20.8	8
	40.3	14.1
	60.6	19.3
	79.3	23.4
	99.9	26.9
	121	30
Total Phosphorus (mg/L)	0	0
	10	7
Total Nitrogen (mg/L)	0	0
	50	39.5