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Water Cycle Management Report

Gosford Gateway Centre

Prepared for: Jarre Pt Ltd

Document no: NSW200166

Issue no: B

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REVISIONS

Revision	Date	Purpose	Prepared By	Approved By
A	2/3/2020	For Client Review	JPR	UK
B	1/4/2020	For Approval	JPR	UK

Review Panel	
Division/Office	**Name**
Newcastle	Ulrika Knight

Unless otherwise advised, the parties who have undertaken the Review and Endorsement confirm that the information contained in this document adequately describes the conditions of the site located at "[Insert Client Site]"

Table of Contents

Appendices

1 SEARs References

1.1 General

Table 1 outlines the SEARs requirements as well as providing a reference to where they are discussed in the report.

Table 1: SEARs Requirements References

SEARs Item	Section Reference	Page
9. Flooding Assess the potential flooding impacts associated with the development and consider the relevant provisions of the NSW Floodplain Development Manual (2005), including the potential impacts of climate change, sea level rise and increase in rainfall intensity.	9	14
10. Stormwater and Drainage Prepare a preliminary stormwater management report demonstrating how stormwater would be appropriately managed in accordance with Council's requirements.	8	12
11. Water Quality • Assess water quality and hydrology impacts of the development, including any downstream impacts for both surface and groundwater and any impacts on natural processes and functions.	5,6,7	6,7

2 Introduction

2.1 General

ACOR Consultants have been engaged by Jarre Pty Ltd through ADG Architects to prepare a concept Water Cycle Management Plan report for the proposed Gosford Gateway Centre.

The Gosford Gateway Centre project consists of three mixed towers, basement parking and a piazza located on a site bounded by Mann, Faunce and Watt Streets Gosford.

As the project is defined as a state significant project, Development Approval will be provided by the NSW Planning, Industry and Environment Department. Items 9, 10 and 11 of the SEAR's letter from the department dated 17 January 2020 outlines the stormwater requirements to be addressed for the development. Gosford is in the Central Coast Council Local Government Area.

The Water Cycle Management Plan will address:

- Water Conservation
- Stormwater Retention
- Stormwater Quality
- Stormwater quantity, conveyance and detention/retention
- Flooding

3 Site

3.1 Location

The site is located at 8-16 Watt Street Gosford (Lot 112 in DP 1022614, Lot 1, 2 , 3 and 4 in DP 1191104). It is bounded by the Faunce Street to the north, Mann Street to the west, Watt Street to the East and existing development to the south.

The location of the site is shown in Figure 1.

3.2 Existing Development

The current site is densely developed and is close to 100% impervious. The site currently contains a mixed-use development including commercial buildings and multi-level car parking. Figure 2 shows an aerial image of the current site.

3.3 Topography

The current site drains to the west to Mann Street. The average slope of the site is 8%. Due to the significant development on the site, the current levels are likely to be significantly different to the predeveloped levels. Figure 3 shows the survey of the current site.

4 Development

4.1 Proposed Development

The proposed State Significant Development Application (SSD DA) seeks concept development approval for the redevelopment of the Gosford Gateway Centre. The concept development proposes three mixed use towers and a public plaza. The development will be constructed in stages.

The concept development application will be subject to subsequent Development Applications with development approvals required for each stage. Full details of the proposal are included in the Environmental Impact Statement prepared by Barker Ryan Stewart. Figure 4 shows the proposed development layout.

5 Water Conservation

5.1 General

The intention of the water conservation requirement for Central Coast Council is to reduce mains water consumption by 40%. This will be achieved by adopting best practice for the fit out of the kitchen and bathrooms in the development including:

- Using all fittings meeting the minimum standards defined by the Water Efficiency Labelling and Standards including:

- 4-star duel flush toilets
- 3-star shower heads
- 4-star taps
- 3-star urinals
- Water efficient washing machines and dishwashers
- Dual reticulation for toilet flushing (where possible) and irrigation

As the development will include housing, BASIX will also apply to two of the three towers. Water reuse will be used for toilet flushing, irrigation and washing hard stand areas.

6 Water Retention

6.1 General

Stormwater retention is required on new developments to mimic the natural catchment hydrology in terms of quantity, rate and response. The deemed to comply volume of retention for a development withing the Gosford CBD area is calculated by the formula:

$V = 0.01A(0.02F)^2$

where V = retention volume in (m^3), A = total site area (m^2) and F = fraction impervious of the site.

With a site are of approximately 10,422 m^2 and a fraction impervious of 85%, the required retention storage for the development is approximately 305 m^3.

The retention volume on site will comprise of rainwater tank storage as well as gardens in the proposed deep soil zone.

7 Stormwater Quality

7.1 General

A preliminary water quality design in accordance with Central Coast Council requirements was undertaken. Item 11.2.1 Stormwater Quality from the Central Coast Council Civil Works Specification, Design Guidelines 2018 notes the following Water quality objectives:

- Total Suspended Solids (TSS): 80% reduction
- Total Phosphorus (TP): 45% Reduction
- Total Nitrogen (TN): 45% Reduction
- Gross Pollutants

7.2 Methodology and Modelling

MUSIC modelling of the proposed water quality features was undertaken in MUSIC version 6.33.

Modelling was undertaken using the Central Coast Council MUSIC Link for High Land catchments (site grades over 5%).

Figure 5 shows the proposed water quality infrastructure for the development. Figure 6 shows a schematic of the MUSIC model.

7.3 Catchments

Catchment types adopted for the modelling were Roofs (for each of the three buildings), sealed roads (for the undercover car park entry) and mixed use for the remainder of the site. A catchment plan is shown in Appendix A

7.4 Rainfall Data

The rainfall data included as part of Central Coast Councils MUSIC link was adopted for the modelling. The rainfall data is from the Sydney Observatory (1974 to 1993).

7.5 Evapotranspiration Data

The default Evapotranspiration values from the Central Coast Council MUSIC link were adopted.

7.6 Source Parameters

The source node parameters were adopted from the MUSIC link model. They are shown below in Table 2.

Table 2: MUSIC Source Node Soil Properties

Soil Parameter	Value
Rainfall Threshold (mm/day)	1.00
Soil Storage Capacity (mm)	200
Initial Storage (% of Capacity)	30
Field Capacity	80
Infiltration Capacity Coefficient – a	200
Infiltration Capacity Coefficient – b	1.00
Groundwater Initial Depth (mm)	10
Groundwater Daily Recharge Rate (%)	0.5
Groundwater Daily Base Flow (%)	0.16
Groundwater Daily Deep Seepage Rate (%)	2.00

7.7 Catchments Pollutant Mean Concentrations

The catchment pollutant information for roof, sealed roads and mixed-use catchment types were adopted from the MUSIC Link. Details of the inputs for the baseflow and stormflow are shown in Tables 3,4 and 5.

Table 3: Base Flow and Storm Flow Pollutant Event Mean Concentration Values - Roofs

Catchment Type	TSS (log 10)		TP (log 10)		TN (log 10)	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Base Flow	1.100	0.170	-0.820	0.190	0.320	0.120
Storm Flow	1.300	0.320	-0.890	0.250	0.300	0.190

Table 4: Base Flow and Storm Flow Pollutant Event Mean Concentration Values – Sealed Roads

Catchment Type	TSS (log 10)		TP (log 10)		TN (log 10)	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Base Flow	1.200	0.170	-0.850	0.190	0.110	0.120
Storm Flow	2.430	0.320	-0.300	0.250	0.340	0.190

Table 5: Base Flow and Storm Flow Pollutant Event Mean Concentration Values - Mixed

Catchment Type	TSS (log 10)		TP (log 10)		TN (log 10)	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Base Flow	1.200	0.170	-0.850	0.190	0.110	0.120
Storm Flow	2.150	0.320	-0.600	0.250	0.300	0.190

7.8 Treatment Train

The proposed treatment train for the site consists of rainwater tanks, a GPT upstream of the detention tank to remove gross pollutants, sediment and attached nutrients and filter cartridges to be constructed inside the detention tank to further treat nutrient runoff from the site.

7.9 Rainwater Tanks

Rainwater tanks will capture runoff from the roofs. Captured rainwater will be reused for toilet flushing for the rooms in the student accommodation (120), the aged care (50) and the hotel (120) and externally for irrigation and washing the hardstand areas on site. As Central Coast Council do not have reuse data for the above items, the reuse values from Blacktown Council have been adopted. For the internal reuse, the values were calculated assuming 0.1 kL/day per room for the student accommodation and the aged care while the same was adopted for the hotel rooms, assuming 75% occupancy. The external reuse for irrigation was calculated at 0.4 kL/year/m^2. The annual reuse from the rainwater tank is shown in Table 6.

Table 6: Rainwater Tank Reuse (per lot)

Rainwater Reuse	
Internal (kL/day)	26
External (kL/year)	794

7.10 Gross Pollutant Traps

A Gross Pollutant Trap (GPT) is proposed to be constructed upstream of the detention tank. Modelling includes an Ocean Protect OceanSave GPT. Details of the OceanSave were provided by Ocean Protect. The removal efficiencies of the unit are shown in Table 7.

Table 7: Ocean Protect OceanSave GPT Performance

Pollutant	Removal
TSS	70%
TP	30%
TN	0%
Gross pollutants	100%

7.11 Ocean Protect Filter Cartridges

Filter cartridges by Ocean Protect are proposed to be constructed upstream of the rainwater and detention tanks to remove nutrients from the incoming stormwater runoff. The filter cartridges remove TSS, TN and TP from the stormwater prior to flows leaving the tank. Ocean Protect provided the MUSIC treatment node of the filter cartridges. Details of the filter cartridge treatment node are shown in Table 8.

Table 8: Ocean Protect StormFilter Performance (based on node provided by Ocean Protect)

Pollutant	Performance
Treatable Flow Rate	9 l/s per cartridge
TSS	93% Reduction
TP	86% Reduction
TN	55% Reduction
Gross Pollutants	100%

7.12 Model Results

The results of the MUSIC modelling are shown below in Table 9.

Table 9: MUSIC Model Results

	Source Load	Residual Load	% Achieved Reduction	%Required Reduction
Flow (ML/yr.)	10.5	4.92	53.1	40%
TSS (kg/yr.)	718	94.5	86.8	80%
TP (kg/yr.)	2.01	0.452	77.5	45%
TN (kg/yr.)	23	7.88	65.8	45%
Gross Pollutants (kg/yr.)	242	0	100	90%

As can be seen form Table 9, the treatment measures proposed for the development reduce the pollutant concentrations from the development to below the reductions required for Central Coast Council. The MUSIC Link report can be found in Appendix B. The MUSIC model for the development has been provided for review.

7.13 Monitoring and Maintenance

7.13.1 General

A detailed water quality maintenance plan for the water quality infrastructure in the development will be provided as part of the detailed engineering design. Preliminary maintenance information is described below.

This will involve implementation of a regular inspection and maintenance schedule. As a minimum, the inspection and maintenance program is to follow the manufacturer's recommended time frame plus after any significant rain event. The inspection regime may be increased when housing construction commences to determine if a more frequent maintenance period is required.

Installation of the bioretention filtration media and vegetation will be delayed until a significant proportion of the contributing lots are built on and established.

7.13.2 Maintenance – GPT

Maintenance activities and frequencies will be in accordance with manufacturer's recommendations and Council's experience. Refer Appendix C for the maintenance manual for the Ocean Protect OceanSave.

7.13.3 Maintenance – Filter Cartridges

Refer to Appendix D for the maintenance manual for the Ocean Protect StormFilter cartridges.

8 Stormwater Quantity

8.1 Objectives

Stormwater quantity for the development will be addressed in two parts; conveyance and detention. The objective of the stormwater conveyance for the development is to provide a stormwater drainage system to control runoff from the site and safely discharge it to the nominated point of discharge. The objective of the stormwater detention is to ensure the peak flows from the developed site are equal to or below the predeveloped peak flows from the site. Each of these items are discussed further below.

8.2 Stormwater Conveyance

Stormwater conveyance for the site will be undertaken in accordance with Australian Rainfall and Runoff 2016's (ARR) major/minor philosophy. Minor storms (10% Annual Exceedance Probability(AEP)) will be conveyed through the site in a traditional pit and pipe system. Major flows (1% AEP) will be conveyed by a combination of the minor system and overland flow routes through the site. An indicative stormwater management plan is shown in Figure 5. A detailed design of the stormwater conveyance for the site will be undertaken in future design stages.

8.3 Stormwater Detention

Discussions with Central Coast Council Engineering Officers confirmed that the peak stormwater flows from the developed site are to be less than or equal to the predeveloped peak flows. Even though the current site is close to completely impervious, Gosford Council DCP 2013, Section 6.7.7.4.4 Demonstrated Compliance states that "Predeveloped coverage shall be taken as the natural vegetation that would normally occur on the entire site with no impervious areas". Preliminary modelling has been undertaken to determine the volume of detention required for the development.

8.4 Methodology and Modelling

Modelling was undertaken in the DRAINS program (Version 2020.012 (64 bit)- 5 February 2020) to determine the peak predeveloped and peak developed flows for the site. Models were run for AEP's ranging from 20% (5-year ARI) through to 1% (100-year ARI) for durations ranging from 5 minutes through to 3 hours. The 2016 ARR procedures were used for the modelling. The initial/Continuing loss model was adopted. Information was obtained from the BOM and the ARR Data Hub.

Pre-burst values were applied from the ARR Data Hub which offset the initial loss for each storm event. The continuing losses were reduced by 40% in accordance with the guidelines. The Initial and Continuing losses for Gosford and the reduced values adopted for the modelling are shown in Table 10.

Table 10: MUSIC Model Results

Loss	ARR Data Hub Loss	0.4 Reduced ARR Data Hub Loss
Initial Loss (mm)	**58**	**NA**
Continuing Loss (mm/hr)	**3.2**	**1.3**

The fraction impervious for the predeveloped model adopted 0% as per the Gosford DCP requirements. The developed fraction impervious adopted was 85%. This was calculated from the concept plans for the development.

8.5 Predeveloped Vs Developed Results, No Detention

The peak flows from the predeveloped site and the developed site, without detention, are shown in Table 11.

Table 11: Predeveloped Vs Developed Peak Flows (no detention)

AEP	Predeveloped Peak Flow	Developed Peak Flow	Increase	Increase
(%)	(m^3/s)	(m^3/s)	(m^3/s)	(%)
20%	0.241	0.363	0.122	51
10%	0.332	0.446	0.114	34
5%	0.425	0.532	0.107	25
2%	0.546	0.661	0.115	21
1%	0.707	0.775	0.068	10

As can be seen from the results in Table 11, detention is required for the development to reduce the developed peak flows to or below the predeveloped peak flows. A copy of the DRAINS model for the above assessment has been provided.

8.6 Detention Modelling

A DRAINS model was undertaken including stormwater detention. The proposed detention tank for the development will be located under the Piazza area adjacent to Mann Street. While not in the lowest level on the site, the peak flows from the roof areas of the three towers will discharge to the tank via a charged system. During the design approval process the location of the detention tank may change.

A detention tank with the following criteria was modelled:

- Surface area: 115m^2
- Depth: 1.2 m
- Low Level Outlet Invert: Base of Tank
- Low Level Orifice size: 420 mm diameter
- Weir outlet (pit at downstream end of tank): 2 x 900 mm square grates (5.4 m perimeter)

8.7 Predeveloped Vs Developed Results, with Detention

The peak flows from the predeveloped site and the developed site, with detention, are shown in Table 12.

Table 12: Predeveloped Vs Developed Peak Flows (with detention)

AEP	Predeveloped Peak Flow	Developed Peak Flow	Reduction	Reduction
(%)	(m^3/s)	(m^3/s)	(m^3/s)	(%)
20%	0.241	0.223	0.018	7
10%	0.332	0.275	0.057	17
5%	0.425	0.322	0.103	24
2%	0.546	0.53	0.016	3
1%	0.707	0.658	0.049	7

As can be seen from Table 12, by having a detention facility with the above noted elements, the peak flows from the development will be reduced to below the predeveloped peak flows. This satisfies the requirements of the SEARs.

More detailed information relating to the detention on site will be provided for future project approvals. A copy of the DRAINS model for the developed site with detention has been provided for review.

9 Flooding

9.1 Objectives

The objective of the flooding review for the development is to assess the flooding impacts with the development including the potential impacts of climate change, sea level rise and increased rainfall

9.2 Flooding Review

To assess the risk of flooding to the site, a review of the Gosford CBD Local Overland Flow Flood Study by Cardno Lawson Treloar, dated 18 September 2013 was undertaken. Figure 4.29 of the report shows the 1% AEP flood extents with a 30% increase in rainfall intensity and 0.9 m sea level rise. The flooding shown around the site is limited to the Mann Street frontage. Figure 4.3 of the report shows 1% peak flood depths for the catchment area. The Mann Street frontage shows a peak depth between 0 and 0.19 m for the 1% AEP storm. This depth is within the road reserve. The flood waters do not encroach on the site itself, therefore there is no flooding impacts on the site. Figure 7 shows the 1% flood extent, noting a 30% increase in rainfall intensity and 0.9 m sea level rise.

10 Conclusion

A stormwater management plan was undertaken for the proposed Gateway Centre Development located at 8-16-Watt Street, Gosford. The report covers stormwater quantity (conveyance and detention), water quality, water retention and flooding. By undertaking the measures for each of these items proposed in this preliminary analysis the requirements of the SEARS and Central Coast Council have been achieved. Further detailed design will be undertaken during future assessment milestones.

11 References

- Central Coast Council , Civil Works Design Guideline – Volume 1, August 2018
- Gosford Development Control Plan 2013
- Gosford CBD Local Overland Flow Flood Study, Cardno Lawson Treloar, September 2013
- Concept Proposal for Mixed Use Development at 8-16 Watt Street, Gosford (SSD-10414) Planning Secretary's Environmental Assessment Requirements (SEARs), Department of Planning, industry and Environment, 17 January 2020

12 Figures

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Project
GOSFORD GATEWAY CENTRE
STORMWATER REPORT

8-16 WATT STREET, GOSFORD NSW 2250

Drawing Title
LOCAILTY PLAN

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JER	FEB 2020	N.T.S		
Designed	**Project No.**		**Dwg. No.**	**Issue**
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Drawing Title
EXISTING AERIAL IMAGE

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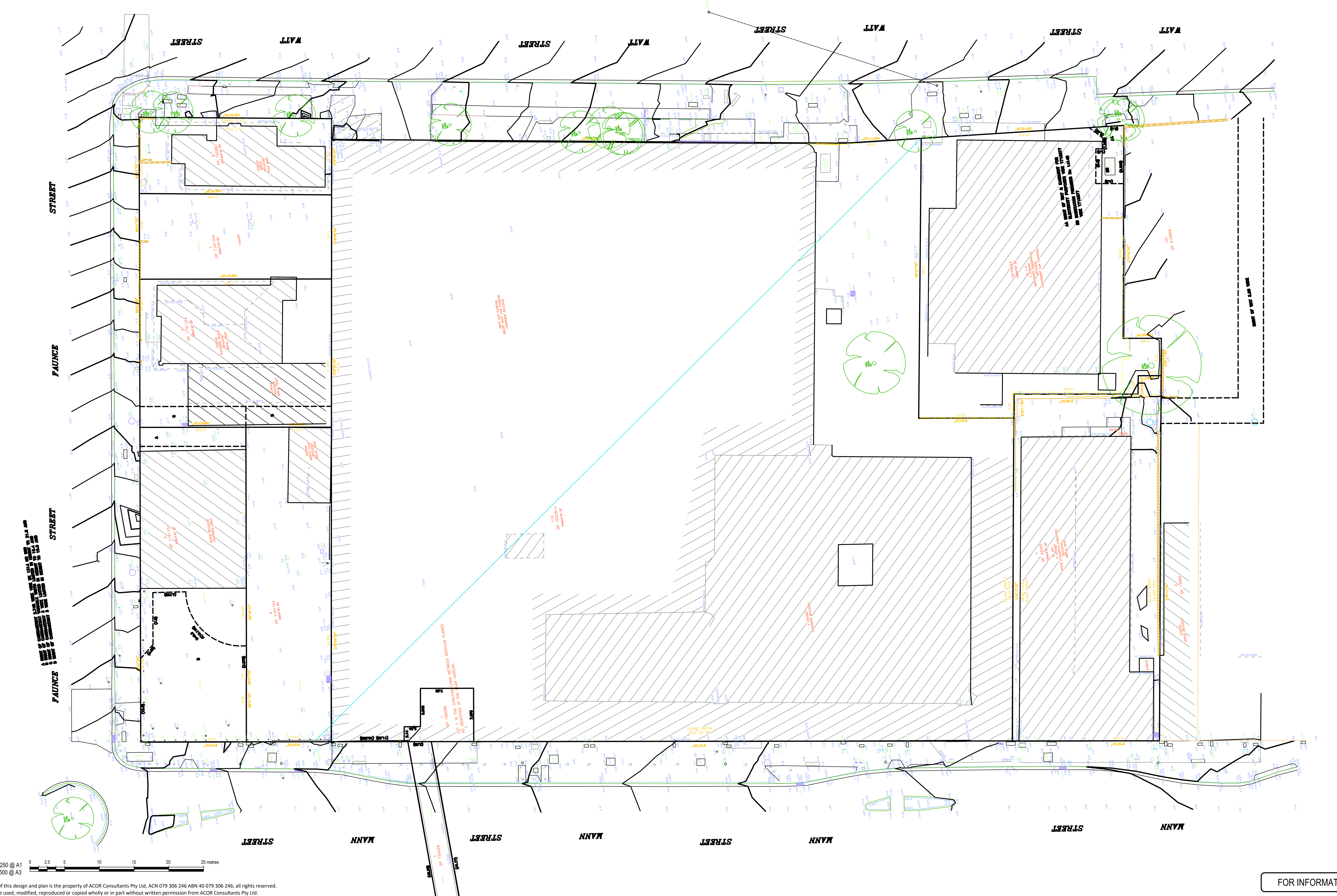

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Drawing Title
EXISTING SITE SURVEY

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Drawing Title
PROPOSED DEVELOPMENT LAYOUT

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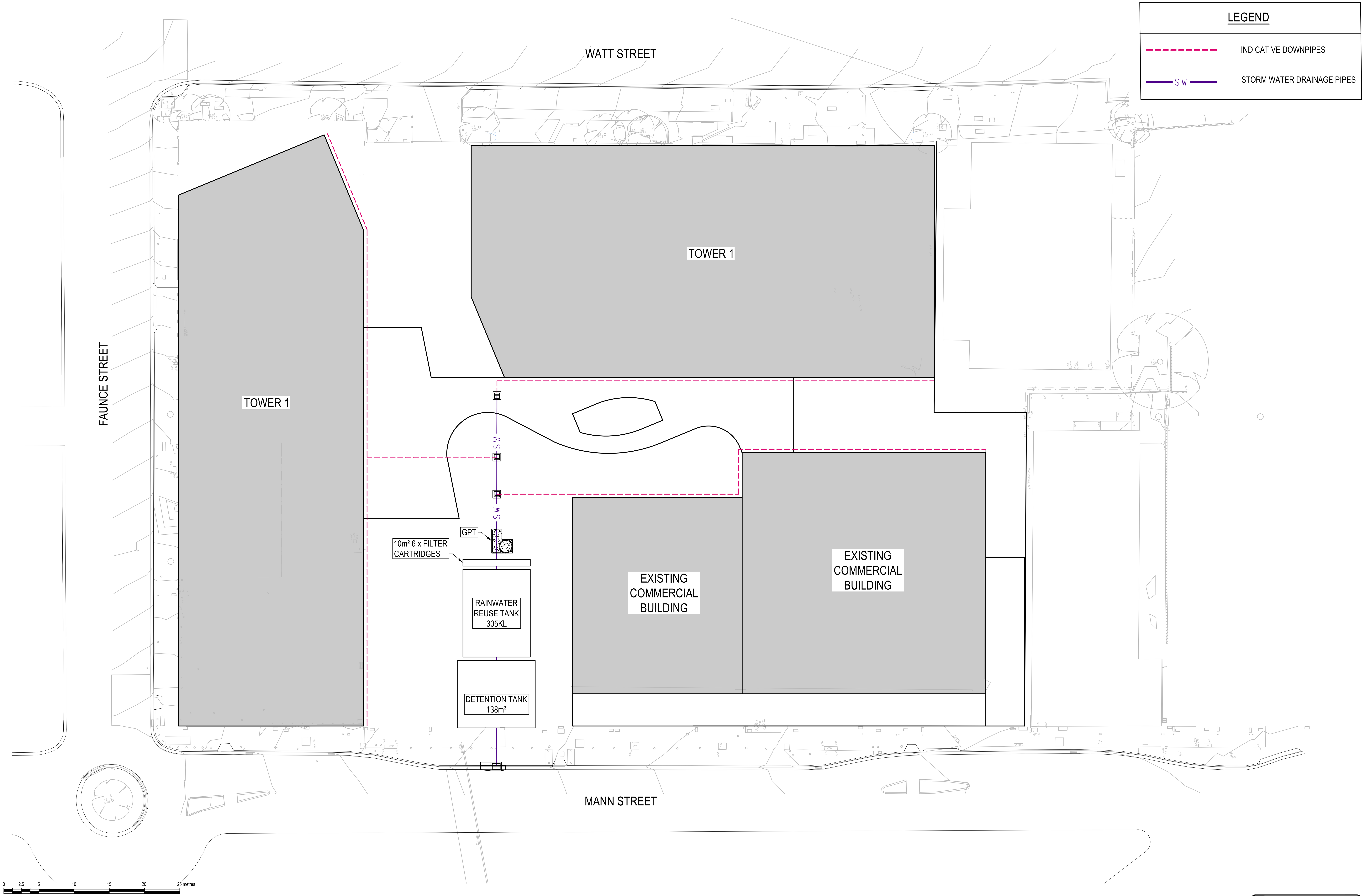

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Drawing Title: STORMWATER MANAGEMENT PLAN

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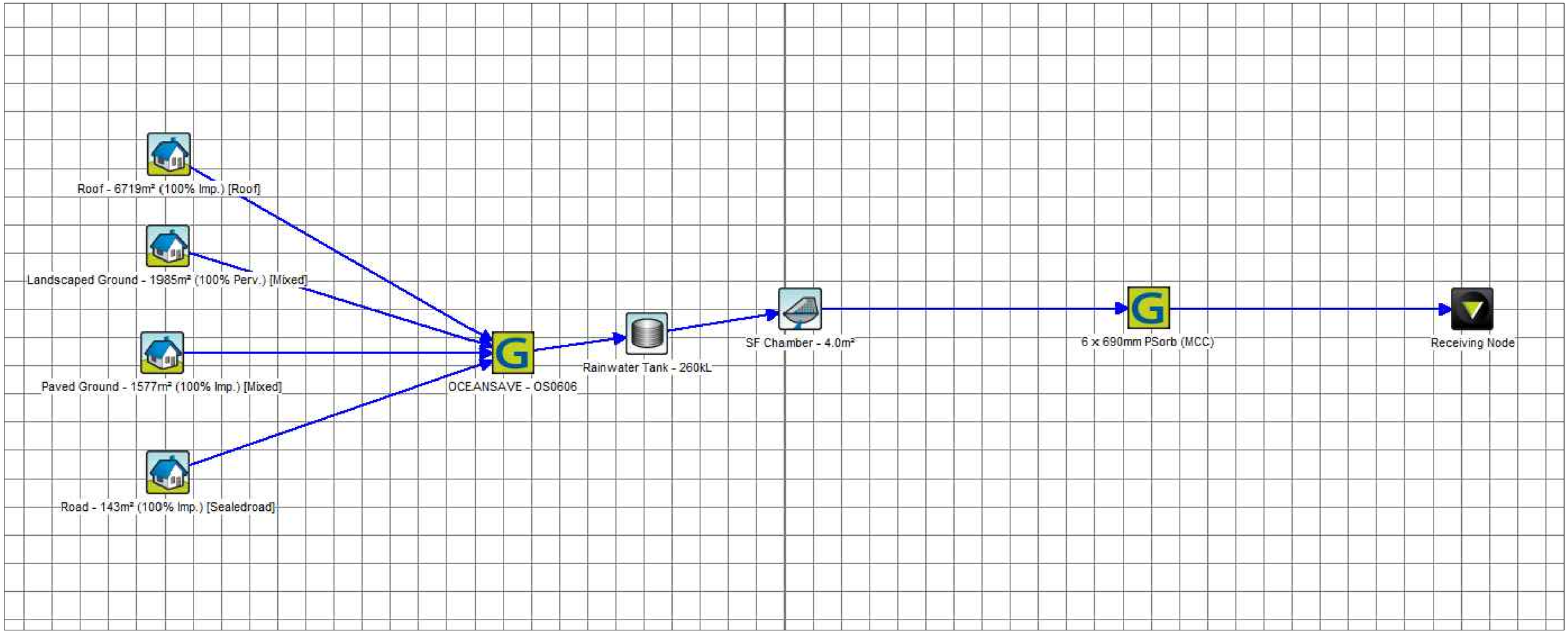

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8-16 WATT STREET, GOSFORD NSW 2250

Drawing Title: MUSIC MODEL SCHEMATIC

Drawn	Date	Scale A1	Q.A. Check	Date
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Designed	Project No.		Dwg. No.	Issue
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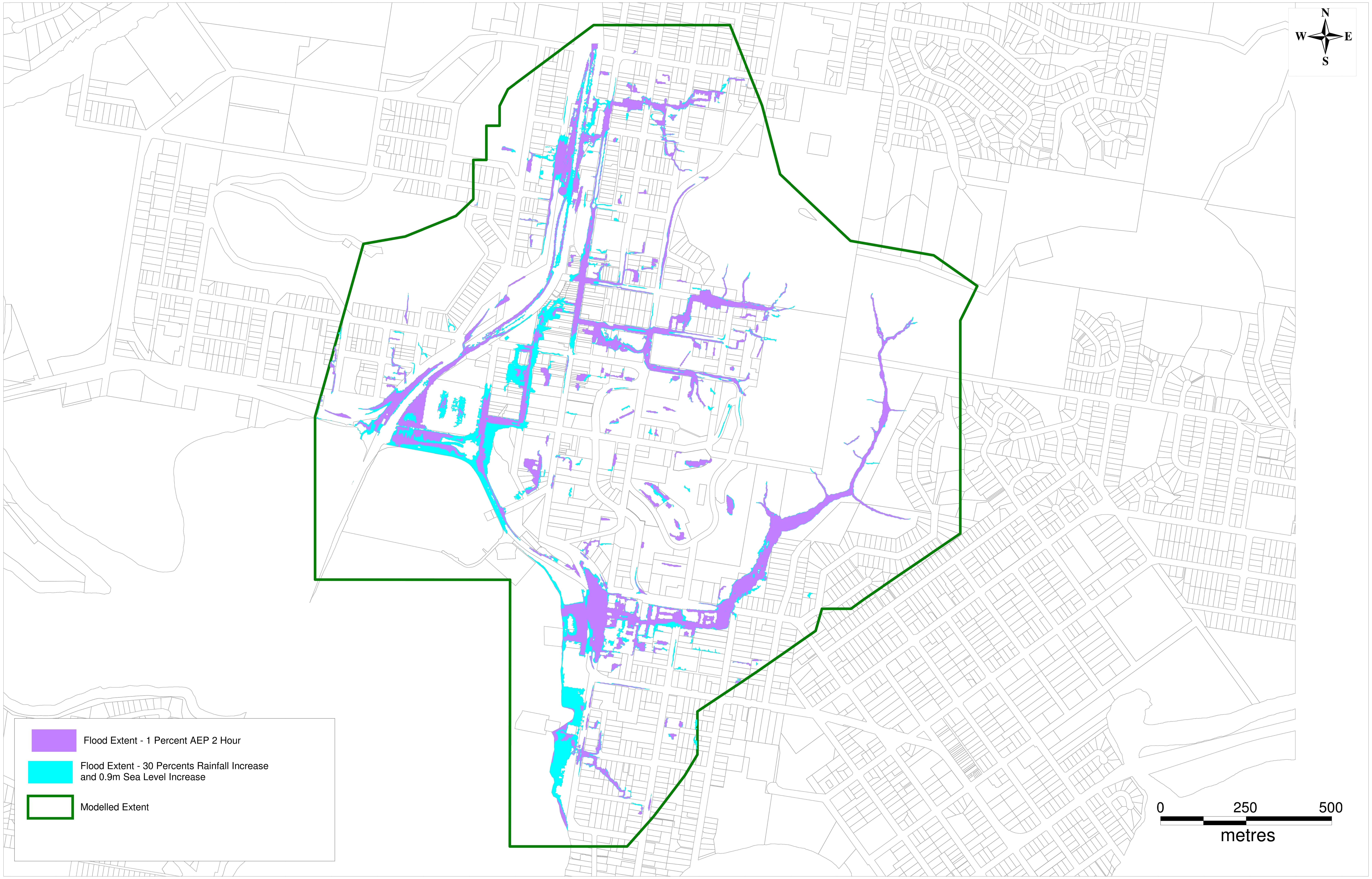

Gosford CBD Local Overland Flow Flood Study

FIGURE 4.29
CLIMATE CHANGE EXTENT COMPARSION GOSFORD CBD
1% AEP 2 HOURS SCENARIO 3- RAINFALL INCREASED BY 30%
AND SEA LEVEL INCREASED BY 0.9m

Cardno Lawson Treloar

W4816/V4
January 2011

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STORMWATER REPORT

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Drawing Title
FLOODING EXTENT

Drawn	Date	Scale A1	Q.A. Check	Date
JER	FEB 2020	XXX		

Designed	Project No.	Dwg. No.	Issue
CD	NSW200116	FIG-07	A

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Appendix A - Catchment Plan

LEGEND

CATCHMENT AREAS

WATT STREET

FAUNCE STREET

AREA ROAD 143m²

AREA ROOF 2162m²

TOWER 1

AREA HARDSTAND (MIXED) 1577m²

TOWER 1

AREA ROOF 2263m²

LANDSCAPED AREA (MIXED) 1985m²

EXISTING COMMERCIAL BUILDING

AREA ROOF 2293m²

EXISTING COMMERCIAL BUILDING

MANN STREET

SCALE 1:250 @ A1
SCALE 1:500 @ A3

0 2.5 5 10 15 20 25 metres

FOR INFORMATION

This drawing has been assigned an electronic code that signifies the drawing has been checked and approved by:

Issue	Description	Date	Drawn	Approved
A	ISSUED FOR INFORMATION	03.03.20	JER	JPR

1cm at full size

North

Client
JARRE PTY LTD

ACOR Consultants Pty Ltd
Level 1, 54 Union Street
Cooks Hill, Newcastle NSW 2300
T +61 2 4926 4811

ACOR CONSULTANTS ENGINEERS | MANAGERS | INFRASTRUCTURE PLANNERS | DEVELOPMENT CONSULTANTS

Project
GOSFORD GATEWAY CENTRE
STORMWATER REPORT
8-16 WATT STREET, GOSFORD NSW 2250

Drawing Title
STORMWATER MANAGEMENT PLAN

Drawn	Date	Scale A1	Q.A. Check	Date
JER	FEB 2020	1:250		
Designed	Project No.		Dwg. No.	Issue
CD	NSW200116		SKC-01	A

Mar 03, 2020 - 11:01am
I:\192.168.2.1\Synergy\Projects\NSW\NSW200116\Drawings\CIVIL\Drawings\NSW200116_SKC-01_A.dwg

Appendix B - MUSIC Link Report

MUSIC-*link* Report

Project Details		Company Details	
Project:	Gateway Centre Gosford	**Company:**	ACOR Consultants
Report Export Date:	2/03/2020	**Contact:**	Josh Rhodes
Catchment Name:	13960 - 249 Mann St	**Address:**	Level 1, 5 Union Street, Cooks Hill
Catchment Area:	1.043ha	**Phone:**	02 49264811
Impervious Area*:	80.92%	**Email:**	jrhodes@acor.com.au
Rainfall Station:	66062 SYDNEY		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1974 - 31/12/1993 11:54:00 PM		
Mean Annual Rainfall:	1297mm		
Evapotranspiration:	1261mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.33		
Study Area:	Upland		
Scenario:	Central Coast Development		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness

Node: Receiving Node	Reduction
Flow	53.1%
TSS	87%
TP	77.5%
TN	65.7%
GP	100%

Treatment Nodes

Node Type	Number
Sedimentation Basin Node	1
Rain Water Tank Node	1
Generic Node	2

Source Nodes

Node Type	Number
Urban Source Node	4

Comments

Treatment nodes supplied by Ocean Protect

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Receiving	Receiving Node	% Load Reduction	None	None	53.1
Receiving	Receiving Node	GP % Load Reduction	90	None	100
Receiving	Receiving Node	TN % Load Reduction	45	None	65.7
Receiving	Receiving Node	TP % Load Reduction	45	None	77.5
Receiving	Receiving Node	TSS % Load Reduction	80	None	87
Sedimentation	SF Chamber - 4.0m^2	Exfiltration Rate (mm/hr)	0	0	0
Sedimentation	SF Chamber - 4.0m^2	Extended detention depth (m)	0.25	1	0.77
Sedimentation	SF Chamber - 4.0m^2	High Flow Bypass Out (ML/yr)	None	None	0
Urban	Landscaped Ground - 1985m^2 (100% Perv.)	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Landscaped Ground - 1985m^2 (100% Perv.)	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Landscaped Ground - 1985m^2 (100% Perv.)	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Landscaped Ground - 1985m^2 (100% Perv.)	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Landscaped Ground - 1985m^2 (100% Perv.)	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Landscaped Ground - 1985m^2 (100% Perv.)	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Paved Ground - 1577m^2 (100% Imp.)	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Paved Ground - 1577m^2 (100% Imp.)	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Paved Ground - 1577m^2 (100% Imp.)	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Paved Ground - 1577m^2 (100% Imp.)	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Paved Ground - 1577m^2 (100% Imp.)	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Paved Ground - 1577m^2 (100% Imp.)	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Road - 143m^2 (100% Imp.)	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Road - 143m^2 (100% Imp.)	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Road - 143m^2 (100% Imp.)	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Road - 143m^2 (100% Imp.)	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Road - 143m^2 (100% Imp.)	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Road - 143m^2 (100% Imp.)	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Roof - 6719m^2 (100% Imp.)	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Roof - 6719m^2 (100% Imp.)	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Roof - 6719m^2 (100% Imp.)	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Roof - 6719m^2 (100% Imp.)	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Roof - 6719m^2 (100% Imp.)	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Roof - 6719m^2 (100% Imp.)	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3

Only certain parameters are reported when they pass validation

Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Sedimentation	SF Chamber - 4.0m	Notional Detention Time (hrs)	8	12	0.0902
Sedimentation	SF Chamber - 4.0m	Total Nitrogen - k (m/yr)	500	500	1
Sedimentation	SF Chamber - 4.0m	Total Phosphorus - k (m/yr)	6000	6000	1
Sedimentation	SF Chamber - 4.0m	Total Suspended Solids - k (m/yr)	8000	8000	1

Only certain parameters are reported when they pass validation

Appendix C - Ocean Protect Ocean Save GPT Maintenance Manual

OCEAN PROTECT

OceanSave

Operations & Maintenance Manual

Table of Contents

Rev: *1* ***Last Updated:*** *Feb 2020*

Introduction

The primary purpose of stormwater treatment devices is to capture and prevent pollutants from entering waterways, maintenance is a critical component of ensuring the ongoing effectiveness of this process. The specific requirements and frequency for maintenance depends on the treatment device and pollutant load characteristics of each site. This manual has been designed to provide details on the cleaning and maintenance processes as recommended by the manufacturer.

The OceanSave is a vortex type engineered stormwater management device designed to remove litter, gross pollutants, sediment and associated pollutants from stormwater runoff. It removes all particles 5 mm and greater from stormwater flows, including neutrally buoyant material. It also removes some suspended solids and free-floating oil and grease via the internal baffle.

The OceanSave is a system that effectively captures and retains a broad range of pollutants.

Why do I need to perform maintenance?

Adhering to the maintenance schedule of each stormwater treatment device is essential to ensuring that it works properly throughout its design life.

During each inspection and clean, details of the mass, volume and type of material that has been collected by the device should be recorded. This data will assist with the revision of future management plans and help determine maintenance interval frequency. It is also essential that qualified and experienced personnel carry out all maintenance (including inspections, recording and reporting) in a systematic manner.

Maintenance of your stormwater management system is essential to ensuring ongoing at-source control of stormwater pollution. Maintenance also helps prevent structural failures (e.g. prevents blocked outlets) and aesthetic failures (e.g. debris build up).

Health and Safety

Access to an OceanSave unit requires removing heavy access covers/grates, additionally it might become necessary to enter into a confined space. Pollutants collected by the OceanSave will vary depending on the nature of your site. There is potential for these materials to be harmful. For example, sediments may contain heavy metals, carcinogenic substances or objects such as broken glass and syringes. For these reasons, all aspects of maintaining and cleaning your OceanSave require careful adherence to Occupational Health and Safety (OH&S) guidelines.

It is important to note that the same level of care needs to be taken to ensure the safety of non-work personnel, as a result it may be necessary to employ traffic/pedestrian control measures when the device is situated in, or near areas with high vehicular/pedestrian activity.

Personnel health and safety

Whilst performing maintenance on the OceanSave, precautions should be taken in order to minimise (or when possible prevent) contact with sediment and other captured pollutants by maintenance personnel. In order to achieve this the following personal protective equipment (PPE) is recommended:

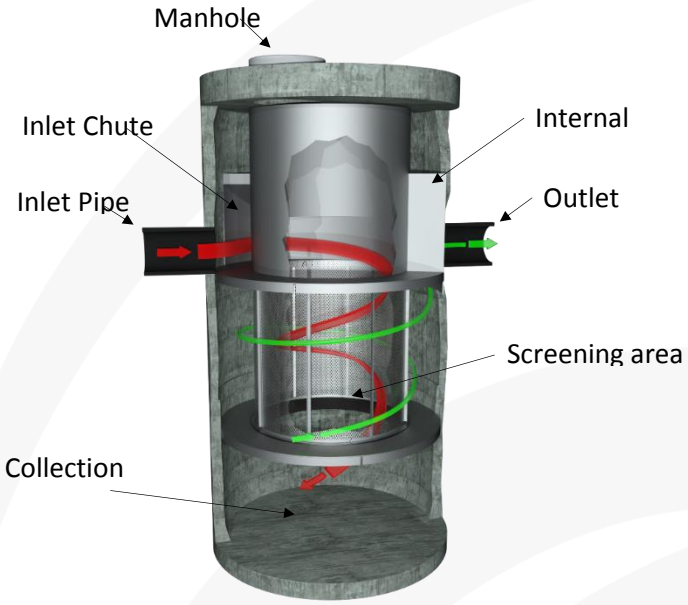
- Puncture resistant gloves
- Steel capped safety boots,
- Long sleeve clothing, overalls or similar skin protection
- Eye protection
- High visibility clothing or vest

During maintenance activities it may be necessary to implement traffic control measures. Ocean Protect recommend that a separate site specific traffic control plan is implemented as required to meet the relevant governing authority guidelines.

Whilst the minor maintenance for the OceanSave can be performed from surface level, there will be a need to enter the pit (confined space) during major services. It is recommended that all maintenance personnel evaluate their own needs for confined space entry and compliance with relevant industry regulations and guidelines. Ocean Protect maintenance personnel are fully trained and carry certification in confined space entry requirements.

How does it Work?

The OceanSave employs a unique screen design that maximizes hydraulic capacity and pollutant removal whilst simultaneously cleaning the screen surface. During operation, a tangential inlet causes stormwater to swirl in the circular treatment chamber. Buoyant materials migrate to the centre of the treatment chamber and rise above the screen while non-floating pollutants are trapped in the storage sump below.



During a storm, pipe flow enters the inlet structure where it is directed tangentially to the circular screen. The system builds driving head and forces water down into the screening area. This creates a vortex action with high tangential velocities across the face of the screen relative to the normal velocities through the screen. This indirect screening feature simultaneously cleans the screen surface whilst removing debris from stormwater. Floatable material is captured in the screening zone. There is also a baffle wall outside the screening zone that allows for the storage of hydrocarbons. Sediment and settable material fall into the sump below the screening area with treated stormwater exiting through the screen to the outlet pipe.

At higher flow rates, a portion of the runoff spills over the weirs located on either side of the inlet structure without affecting the treatable flow rate of the OceanSave. At the end of the storm water drains down to the pipe inverts further promoting the settling of fine suspended debris into the storage sump.

Given the unique component design the device can have multiple inlet/outlet pipes coming at a range of angles generally up to 270 degrees between inlet and outlet. Furthermore, any debris that accumulates behind the screen can be cleaned at time of routine maintenance without dismantling of the screen itself. The refined design of the OceanSave technology utilises the proven performance of the indirect vortex style gross pollutant traps whilst improving characteristics such as configuring and associated installation and maintenance.

Maintenance Procedures

To ensure optimal performance, it is advisable that regular maintenance is performed. Typically, the OceanSave requires a minor service every 6 months and a major service every 12 to 24 months.

Primary Types of Maintenance

The table below outlines the primary types of maintenance activities that typically take place as part of an ongoing maintenance schedule for the OceanSave.

	Description of Typical Activities	Frequency
Minor Service	Visual inspection of inlet aperture Removal of large floatable pollutants Measuring of sediment depth	At 6 Months
Major Service	Removal of accumulated sediment and gross pollutants. Inspection of screening element and cleaning every 2 years	At 12 Months

Maintenance requirements and frequencies are dependent on the pollutant load characteristics of each site. The frequencies provided in this document represent what the manufacturer considers to be best practice to ensure the continuing operation of the device is in line with the original design specification.

Minor Service

This service is designed to assess the condition of the device and record necessary information that will inform the activities to be undertaken during a major service.

1. Establish a safe working area around the access point
2. Remove access cover
3. Visually inspect the inlet aperture
4. Remove large floatable pollutants with a net
5. Measure and record sediment depth
6. Replace access cover

Major Service

This service is designed to return the OceanSave device back to optimal operating performance.

1. Establish a safe working area around the access point
2. Remove access cover
3. Using a vacuum unit remove any floatable pollutants
4. Decant water until water level reaches accumulated sediment
5. Remove accumulated sediment and gross pollutants with vacuum unit (if required)
6. Enter the device to inspect the screening element (every 2 years on larger units)
7. Use high pressure water to clean screen and sump area (if required)
8. Replace access cover

When determining the need to remove accumulated sediment from the OceanSave unit, the specific sediment storage capacity for the size of unit should be considered (see table below).

OceanSave Model	Unit Diameter (m)	Total Capacity (m^3)	Sump Storage Capacity (m^3)
OS-0606	1.2	1.5	0.8
OS-0809	1.5	2.8	0.8
OS-1112	2.2	8.0	2.5
OS-1515	2.2	11.0	4.4
OS-2318	3.2	28.0	11.9
OS-2324	3.2	33.0	9.5

Additional Types of Maintenance

The standard maintenance approach is designed to work towards keeping the OceanSave system operational during normal conditions. From time to time events on site can make it necessary to perform additional maintenance to ensure the continuing performance of the device.

Hazardous Material Spill

If there is a spill event on site, the OceanSave unit that potentially received flow should be inspected and cleaned. Specifically all captured pollutants from within the unit should be removed and disposed in accordance with any additional requirements that may relate to the type of spill event.

Blockages

The OceanSave internal high flow bypass functionality is designed to minimise the potential of blockages/flooding. In the unlikely event that flooding occurs around or upstream of the device location the following steps should be undertaken to assist in diagnosing the issue and determining the appropriate response.

1. Inspect the inlet aperture, ensuring that it is free of debris and pollutants
2. Decant water from OceanSave unit in preparation for confined space entry
3. Inspect the screen and flume as well as both inlet and outlet pipes for obstructions, if present remove any built up pollutants or blockages.

Major Storms and Flooding

In addition to the scheduled activities, it is important to inspect the condition of the OceanSave after a significant major storm event. The focus is to inspect for higher than normal sediment accumulation that may result from localised erosion, where necessary accumulated pollutants should be removed and disposed.

Disposal of Waste Materials

The accumulated pollutants found in the OceanSave must be handled and disposed of in a manner that is in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. If the system has been exposed to any hazardous or unusual substance, there may be additional special handling and disposal methods required to comply with relevant government/authority/industry regulations.

Maintenance Services

With over a decade and a half of maintenance experience Ocean Protect has developed a systematic approach to inspecting, cleaning and maintaining a wide variety of stormwater treatment devices. Our fully trained and professional staff are familiar with the characteristics of each type of system, and the processes required to ensure its optimal performance.

Ocean Protect has several stormwater maintenance service options available to help ensure that your stormwater device functions properly throughout its design life. In the case of our OceanSave system we offer long term pay-as-you-go contracts and pre-paid once off servicing.

For more information please visit www.OceanProtect.com.au

Appendix D - Ocean Protect StormFilter Maintenance Manual

OCEAN PROTECT

StormFilter

Operations & Maintenance Manual

Table of Contents

Introduction

The primary purpose of stormwater treatment devices is to capture and prevent pollutants from entering waterways, maintenance is a critical component of ensuring the ongoing effectiveness of this process. The specific requirements and frequency for maintenance depends on the treatment device and pollutant load characteristics of each site. This manual has been designed to provide details on the cleaning and maintenance processes for the StormFilter as recommended by the manufacturer.

The StormFilter is designed and sized to meet stringent regulatory requirements. It removes the most challenging target pollutants (including fine solids, soluble heavy metals, oil, and soluble nutrients) using a variety of media. For more than two decades, StormFilter has helped clients meet their regulatory needs and, through ongoing product enhancements, the design continues to be refined for ease of use and improved performance.

Why do I need to perform maintenance?

Adhering to the inspection and maintenance schedule of each stormwater treatment device is essential to ensuring that it functions properly throughout its design life.

During each inspection and clean, details of the mass, volume and type of material that has been collected by the device should be recorded. This data will assist with the revision of future management plans and help determine maintenance interval frequency. It is also essential that qualified and experienced personnel carry out all maintenance (including inspections, recording and reporting) in a systematic manner.

Maintenance of your stormwater management system is essential to ensuring ongoing at-source control of stormwater pollution. Maintenance also helps prevent structural failures (e.g. prevents blocked outlets) and aesthetic failures (e.g. debris build up), but most of all ensures the long term effective operation of the StormFilter.

Health and Safety

Access to a StormFilter unit requires removing heavy access covers/grates, and it is necessary to enter into a confined space. Pollutants collected by the StormFilter will vary depending on the nature of your site. There is potential for these materials to be harmful. For example, sediments may contain heavy metals, carcinogenic substances or objects such as broken glass and syringes. For these reasons, all aspects of maintaining and cleaning your StormFilter require careful adherence to Occupational Health and Safety (OH&S) guidelines.

It is important to note that the same level of care needs to be taken to ensure the safety of non-work personnel. As a result, it may be necessary to employ traffic/pedestrian control measures when the device is situated in, or near areas with high vehicular/pedestrian activity.

Personnel health and safety

Whilst performing maintenance on the StormFilter, precautions should be taken in order to minimise (or, if possible, prevent) contact with sediment and other captured pollutants by maintenance personnel. The following personal protective equipment (PPE) is subsequently recommended:

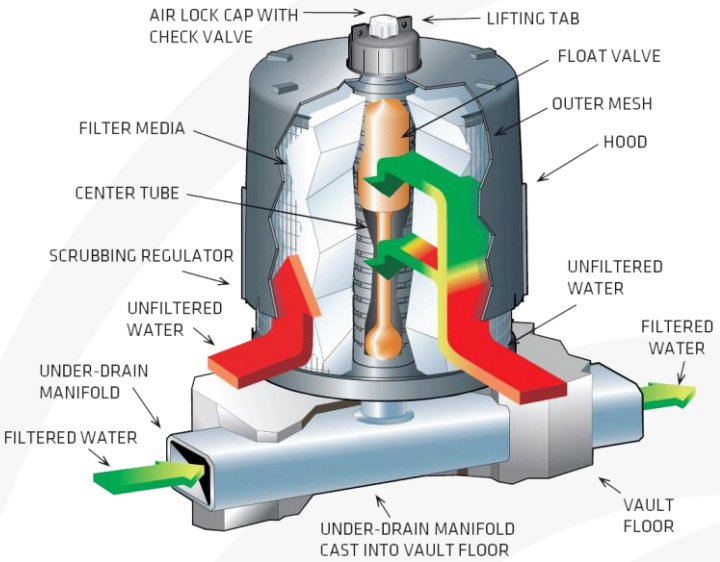
- Puncture resistant gloves
- Steel capped safety boots
- Long sleeve clothing, overalls or similar skin protection
- Eye protection
- High visibility clothing or vest

During maintenance activities, it may be necessary to implement traffic control measures. Ocean Protect recommend that a separate site-specific traffic control plan is implemented as required to meet the relevant governing authority guidelines.

Whilst some aspects of StormFilter maintenance can be performed from surface level, there will be a need to enter the StormFilter system (confined space) during a major service. It is recommended that all maintenance personnel evaluate their own needs for confined space entry and compliance with relevant industry regulations and guidelines. Ocean Protect maintenance personnel are fully trained and carry certification for confined space entry applications.

How does it Work?

Stormwater enters the cartridge chamber, passes through the filtration media and begins filling the cartridge center tube. When water reaches the top of the cartridge the float valve opens and filtered water is allowed to drain at the designed flow rate. Simultaneously, a one-way check valve closes activating a siphon that draws stormwater evenly throughout the filter media and into the center tube. Treated stormwater is then able to discharge out of the system through the underdrain manifold pipework.



As the rain event subsides, the water level outside the cartridge drops and approaches the bottom of the hood, air rushes through the scrubbing regulators releasing the water column and breaking the siphon. The turbulent bubbling action agitates the surface of the cartridge promoting trapped sediment to drop to the chamber floor. After a rain event, the chamber is able to drain dry by way of an imperfect seal at the base of the float valve.

Maintenance Procedures

To ensure optimal performance, it is advisable that regular maintenance is performed. Typically, the StormFilter requires an inspection every 6 months with a minor service at 12 months. Additionally, as the StormFilter cartridges capture pollutants the media will eventually become occluded and require replacement (expected media life is 1-3 years).

Primary Types of Maintenance

The table below outlines the primary types of maintenance activities that typically take place as part of an ongoing maintenance schedule for the StormFilter.

	Description of Typical Activities	Frequency
Inspection	Visual Inspection of cartridges & chamber Remove larger gross pollutants Perform minimal rectification works (if required)	Every 6 Months
Minor Service	Evaluation of cartridges and media Removal of accumulated sediment (if required) Wash-down of StormFilter chamber (if required)	Every 12 Months
Major Service	Replacement of StormFilter cartridge media	As required

Maintenance requirements and frequencies are dependent on the pollutant load characteristics of each site. The frequencies provided in this document represent what the manufacturer considers to be best practice to ensure the continuing operation of the device is in line with the original design specification.

Inspection

The purpose of the inspecting the StormFilter system is to assess the condition of the StormFilter chamber and cartridges. When inspecting the chamber, particular attention should be taken to ensure all cartridges are firmly connected to the connectors. It is also an optimal opportunity to remove larger gross pollutants and inspect the outlet side of the StormFilter weir.

Minor Service

This service is designed to ensure the ongoing operational effectiveness of the StormFilter system, whilst assessing the condition of the cartridge media.

1. Establish a safe working area around the access point(s)
2. Remove access cover(s)
3. Evaluate StormFilter cartridge media (if exhausted schedule major service within 6 months)
4. Measure and record the level of accumulated sediment in the chamber
   (if sediment depth is less than 100 mm skip to step 9)
5. Remove StormFilter cartridges from the chamber
6. Use vacuum unit to removed accumulated sediment and pollutants in the chamber
7. Use high pressure water to clean StormFilter chamber
8. Re-install StormFilter cartridges
9. Replace access cover(s)

Major Service (Filter Cartridge Replacement)

For the StormFilter system a major service is reactionary process based on the outcomes from the minor service, specifically the evaluation of the cartridge media.

Trigger Event	Maintenance Action
Cartridge media is exhausted[1]	Replace StormFilter cartridge media[2]

[1] Multiple assessment methods are available, contact Ocean Protect for assistance
[2] Replacement filter media and components are available for purchase from Ocean Protect.

This service is designed to return the StormFilter device back to optimal operating performance

1. Establish a safe working area around the access point(s)
2. Remove access cover(s)
3. By first removing the head cap, remove each individual cartridge hood to allow access to the exhausted media.
4. Utilise a vacuum unit to remove exhausted media from each cartridge
5. Use vacuum unit to remove accumulated sediment and pollutants in the chamber
6. Use high pressure water to clean StormFilter chamber
7. Inspect each empty StormFilter cartridges for any damage, rectify damage as required
8. Re-fill each cartridge with media in line with project specifications
9. Re-install replenished StormFilter cartridges
10. Replace access cover(s)

Additional Types of Maintenance

Occasionally, events on site can make it necessary to perform additional maintenance to ensure the continuing performance of the device.

Hazardous Material Spill

If there is a spill event on site, the StormFilter unit should be inspected and cleaned. Specifically, all captured pollutants and liquids from within the unit should be removed and disposed in accordance with any additional requirements that may relate to the type of spill event. Additionally, it will be necessary to inspect the filter cartridges and assess them for contamination, depending on the type of spill event it may be necessary to replace the filtration media.

Blockages

In the unlikely event that flooding occurs upstream of the StormFilter system the following steps should be undertaken to assist in diagnosing the issue and determining the appropriate response.

1. Inspect the upstream diversion structure (if applicable) ensuring that it is free of debris and pollutants
2. Inspect the StormFilter unit checking the underdrain manifold as well as both the inlet and outlet pipes for obstructions (e.g. pollutant build-up, blockage), which if present, should be removed.

Major Storms and Flooding

In addition to the scheduled activities, it is important to inspect the condition of the StormFilter after a major storm event. The focus is to inspect for damage and higher than normal sediment accumulation that may result from localised erosion. Where necessary damaged components should be replaced and accumulated pollutants should be removed and disposed.

Disposal of Waste Materials

The accumulated pollutants found in the StormFilter must be handled and disposed of in a manner that is in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. If the filter media has been contaminated with any unusual substance, there may be additional special handling and disposal methods required to comply with relevant government/authority/industry regulations.

Maintenance Services

With over a decade and a half of maintenance experience Ocean Protect has developed a systematic approach to inspecting, cleaning and maintaining a wide variety of stormwater treatment devices. Our fully trained and professional staff are familiar with the characteristics of each type of system, and the processes required to ensure its optimal performance.

Ocean Protect has several stormwater maintenance service options available to help ensure that your stormwater device functions properly throughout its design life. In the case of our StormFilter system we offer long term pay-as-you-go contracts, pre-paid once off servicing and replacement media for cartridges.

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