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DATE 21 OCTOBER 2015

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REFERENCE B14320CR001

Stormwater Management Plan

Proposed Mixed use Development at the Corner of Brunswick & Water Street, Fortitude Valley

For Metro (Brunswick) Pty Ltd

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Revision	Date	Description	Author	Signature	Verifier	Signature	Approver	Signature
A	17/09/2014	DRAFT	ND		AP		AP	
B	21/11/2014	UPDATE	ND		AP		AP	
C	25/03/2015	UPDATE FOR DA	ND		AP		AP	
D	16/10/2015	UPDATE FOR DA REVISION	BN		AP		AP	
E	21/10/2015	FINAL	BN	BN	AP		AP	

1.0 INTRODUCTION

Lambert & Rehbein (SEQ) Pty Ltd has been commissioned by Metro (Brunswick) Pty Ltd to develop a conceptual Stormwater Management Plan (SMP) (Quality and Quantity) for Phase 2 of the proposed mixed use development at corner of Brunswick and Water Street, Fortitude Valley.

Phase 2 of the proposed development comprises two (22 and 28 storey) residential towers and common podium levels containing retail space, car parking and public open space over basement car park levels. This development phase is split into two stages (Stages 4 & 5). The site is located within the Brisbane City Council (BCC) Local Government Area, however the site is located within a Priority Development Area identified by the Queensland Department of State Development, Infrastructure & Planning (DSDIP), Economic Development Queensland (EDQ).

It is the objective of this report to ensure that the principles of Water Sensitive Urban Design (WSUD) are applied as required. This report has been compiled to address the stormwater quality and quantity requirements of the Queensland Urban Drainage Manual (QUDM), the Queensland DSDIP State Planning Policy 2014, the Environmental Protection Act 1994 and the associated Environmental Protection (Water) Policy, 2009.

The aim of this Conceptual SMP is to identify any stormwater detention requirements (if necessary) and an appropriate level of stormwater quality improvement that achieves the Water Quality Objectives (WQOs) as detailed in this report.

This report presents the results of the site based SMP utilising the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) to model an appropriate stormwater treatment approach for the proposed development.

2.0 SITE DESCRIPTION

2.1 SITE LOCATION

The site is located on the corner of Brunswick and Water Street, Fortitude Valley and is located across several existing lots, including Lot 1 on RP10553, Lots 11 & 12 on RP10552, Lot 13 on RP81335, Lots 5, 6 & 94 on SP266307 and part of Lot 93 on SP266307. The site is irregular in shape and has a total area of approximately 5,379 m^2.

The subject site is located within a predominantly commercial area and is currently occupied by large commercial buildings. It is fronted by Brunswick Street to the west, Water Street to the south, Phase 1 of the Central Village Project to the east and existing commercial properties to the north. Figure 1 below displays the subject site's locality.

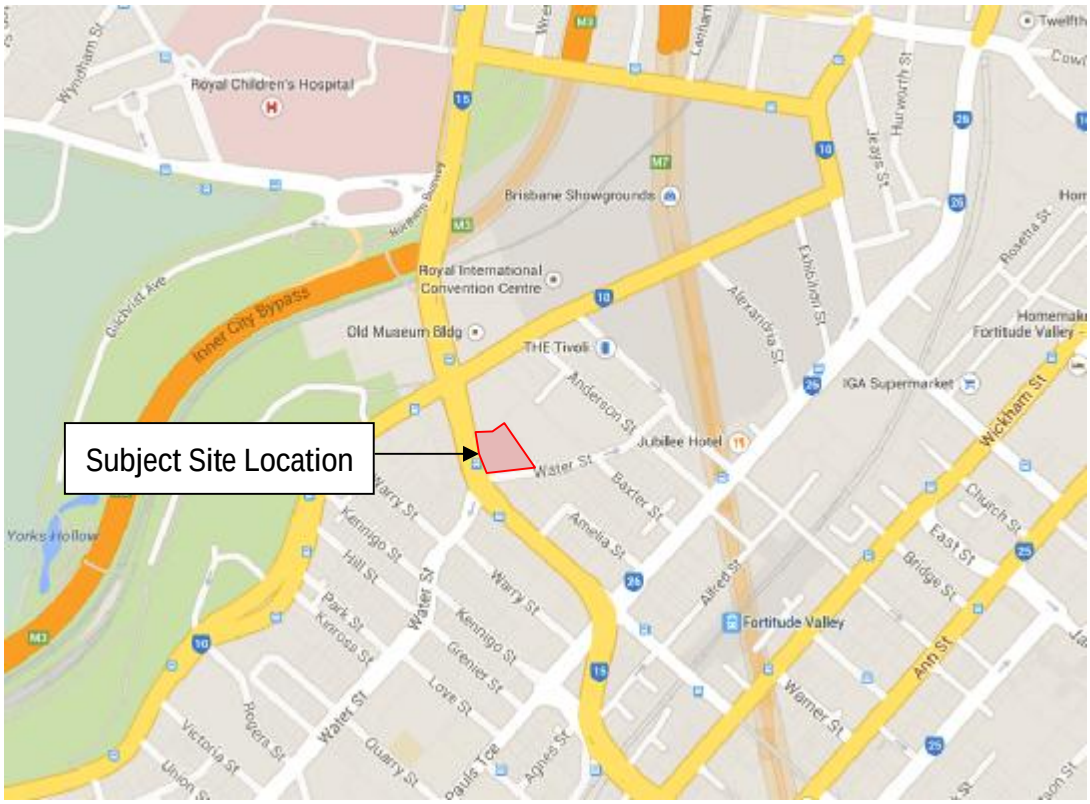

Figure 1 Site Locality Plan

Source: Google Maps 2014

2.2 TOPOGRAPHY

A search of BCC's eBimap indicates the Phase 2 site falls from approximately RL 20 m AHD in the northwest corner of the site to RL 12.5 m AHD in the south eastern corner.

2.3 EXISTING LAND USE

The majority of the existing site is occupied by commercial buildings and impervious carpark facilities with some small gardens areas spread throughout the site.

2.4 PROPOSED LAND USE

Phase 2 includes two (22 and 28 storey) residential towers and common podium levels containing retail space, car parking and public open space over two levels of basement car parking. This development phase is split into two stages (Stages 4 & 5). It is anticipated that Stage 4 construction will commence prior to Stage 5 however the timing of Stage 5 is yet to be determined. Should Stage 5 not commence construction prior to the completion of construction of Stage 4 then alternatives for the separate treatment of stormwater for each stage will need to be considered. Selected preliminary Phase 2 architectural plans by Bureau Proberts, Project Number 14037 are enclosed in Appendix A of this report.

2.5 RECEIVING ENVIRONMENT

Stormwater runoff from the site currently discharges to the Water Street BCC stormwater drainage infrastructure which flows to the lower reaches of Breakfast Creek which is located approximately one kilometre east of the site.

The Breakfast/Enoggera Creek catchment covers 89.2 square kilometres and includes the waterways of Enoggera, Ithaca, and Fish Creeks in Brisbane's north and west. Enoggera Creek meets the Brisbane River at Newstead as Breakfast Creek. (BCC, 2014)

3.0 STORMWATER QUANTITY

3.1 STORMWATER DETENTION REQUIREMENTS

The majority of the existing site includes roofed areas and hardstand areas. The proposed development will not increase the impervious area of the site from the existing condition. Therefore no worsening of flows is anticipated and subsequently no on site stormwater detention is proposed.

3.2 FLOODING

A review of the BCC Flood Overland Flow Flood Overlay Mapping indicates the proposed development is located in a flood overland flow area. A detailed hydraulic assessment is currently being prepared by Cardno (Qld) Pty Ltd to assess the flood immunity and the potential flooding impacts of the proposed development. Initial advice from Cardno indicates the Stages 4 & 5 buildings are located within the footprint of the existing building and hence will have minimal or no impact on the existing flood levels associated with the overland flow path. Development floor levels and vehicular basement access will be set to achieve the required flood immunity above the nominated floor levels detailed in the Cardno Report.

3.3 LAWFUL POINT OF DISCHARGE

It is proposed to discharge flows to an existing 1.275 m x 2.10 m brick arch drain located in the centre of the Water Street road reserve. To minimise the risk of undermining the structural integrity of this drain, the proposed lawful point of discharge is an existing stormwater manhole located on this drain approximately 40m to the east of Phase 2. The proposed discharge arrangement is displayed the Concept Stormwater Connection Layout Plan drawing B14320-CSK03 enclosed in Appendix B of this report.

4.0 STORMWATER QUALITY

4.1 STORMWATER QUALITY OBJECTIVES

In accordance with the Queensland DSDIP State Planning Policy (2014) the required operational phase Water Quality Objectives (WQOs) are provided in Table 1 below.

Table 1 Operational Phase Water Quality Objectives:

Pollutant	WQO Percentage Load Reductions
Total Suspended Solids (TSS)	80%
Total Phosphorous (TP)	60%
Total Nitrogen (TN)	45%
Goss Pollutants (GP)	90%

4.2 POTENTIAL WATER QUALITY IMPACTS

4.2.1 CONSTRUCTION PHASE

Potential exists during the construction phase of development for sediment (from exposed soil areas and stockpiles) to become mobilised by stormwater. This results in suspended solids entering waterways. Suspended solids can also potentially enter waterways as a result of spillages from construction and plant operations.

Table 2 overleaf details the typical stormwater pollutants which may be generated during the construction phase of a development.

Table 2 Typical Construction Phase Pollutants

Pollutant	Sources
Litter	Paper, construction packaging, food packaging, cement bags and off-cuts.
Sediment	Unprotected exposed soils and stockpiles during earthworks and building.
Hydrocarbons	Fuel and oil spills and leaks from construction equipment.
Toxic Materials	Cement slurry, asphalt prime, solvents, cleaning agents and wash waters.
pH altering substances	Cement slurry and wash waters.

Stormwater quality during the construction phase of the development should be addressed in an Erosion and Sediment Control Plan. The plan should address construction phase erosion and sediment control issues in accordance with the Institute of Engineers Australia (Qld) *Erosion and Sediment Control Guidelines*. The Erosion and Sediment Control Plan should also be in accordance with Brisbane City Council guidelines.

The following measures should be implemented prior to the commencement of construction:

- Education of all site workers in sediment and erosion procedures;
- Specified storage areas for construction materials and plant that are bunded to prevent any spillages from escaping; and
- Construction of silt fences and catch drains adjacent to the downstream boundaries to divert runoff to temporary sediment basins.

The following measures should be implemented during the construction phase of the project:

- Staging the development to minimise large exposed areas of soil;
- Silt fences should be erected downstream of all disturbed areas; and
- All erosion and sediment control devices should be regularly inspected and maintained following storm events.

However, the most effective course of action will be to minimise the construction footprint and stabilise the site as soon as possible with the ultimate building and landscaped furnishes.

4.2.2 OPERATIONAL PHASE

During the operational phase of the development, the following impacts have been identified in relation to stormwater runoff and water quality of the receiving waterways:

- Potential exists for gross pollutants, which include human derived litter, coarse sediment and vegetation, to affect the drainage capacity of stormwater systems. Gross pollutants may physically affect the downstream waterway habitats and organisms such as entangling birds and aquatic animals. Gross pollutants are also typically unsightly and reduce the visual amenity of the site;
- Sediment can become mobilised by stormwater as suspended solids from the erosion of exposed soil areas, un-mulched garden beds, sediment deposited on car park and hardstand areas by vehicles and by atmospheric deposition of sediment. Suspended solids can be used as a transport medium resulting in nutrients and heavy metals making their way into waterways. Suspended solids can block stormwater systems leading to local flooding and can also affect receiving waterways physically through smothering aquatic flora and fauna; and
- Nutrients can enter waterways in stormwater runoff through many sources including detergents used in car washing, fertilizers from landscaping and lawn areas, nitrous oxide deposition from vehicle exhausts, and organic waste. High nutrient levels can lead to eutrophication of the receiving waterways resulting in algal blooms (toxic in some cases) and excessive macrophyte growth.

Implementation of the appropriate SQIDs would ensure that stormwater discharge from the site would adhere to EDQ's requirements and objectives.

5.0 STORMWATER QUALITY ASSESSMENT

The potential impact and effectiveness of the proposed SQIDs was assessed using MUSIC Version 6.0.4. MUSIC is a software tool that simulates stormwater runoff quality from different sources and the effectiveness of SQIDs.

The MUSIC modelling program is able to simulate the quantity and quality of stormwater runoff from Catchment sizes which range from a single house lot up to 100 km^2. The program is able to report on the pollution uptake efficiencies of a wide range of treatment measures.

The model can be used to generate both pollutant concentrations and long term pollutant loads and is recognised as the most appropriate modelling software for the planning of stormwater treatment measures for urban catchments. The model can generate pollutant loads and event mean concentrations for TSS, TP and TN. Current versions are limited to modelling only these pollutants together with gross pollutants. Other pollutants can be substituted, such as heavy metals or oils and greases, however long term statistical data on the generation of these pollutants is required.

5.1.1 GENERAL MUSIC MODELLING APPROACH

Due to the proposed development's site constraints discussed in Section 5.2, Stormwater 360 was engaged to prepare a MUSIC model and size proprietary SQIDs to meet the WQOs. MUSIC modelling was conducted generally in accordance with the Healthy Waterways Water by Design "MUSIC Modelling Guidelines for South East Queensland, Version 1.0, 2010".

The MUSIC guidelines suggest that the timestep of each model should match the time of concentration of the smallest source node and the smallest detention time of any treatment devices. As WSUD principles are to be applied, a six (6) minute timestep should be adopted to match the range of treatments incorporated and the low time of concentrations expected from the Catchment.

Six (6) minute rainfall and mean monthly Potential Evapotranspiration (PET) data was sourced from the Bureau of Meteorology for Brisbane Regional Office (Central) Rainfall Station (Stn. Number: 40214) for 1980-1990 and was used for all modelling scenarios.

Table 3 below details the MUSIC parameters utilised in running the model.

Table 3 MUSIC Model Hydrological Parameters

Parameter	Description
Meteorological Data	Bureau of Meteorology for Brisbane Regional Office (Central) Rainfall Station (Stn. Number: 40214) for 1980-1990
Source Node	Commercial Urban – Road, Roof, Ground
Modelling Time Step	6 minute
Drainage Link	No Routing
Pollutant Concentration	Commercial Urban – Roof, Ground, Roads
Rainfall-Runoff Properties	Commercial Urban

The MUSIC model defaults of k and C* assist in the definition of treatment performance and are based on research and judgement by academics and industry leaders assisting the eWater Cooperative Research Centre (CRC). The k constant is used in a first order kinetic model to simulate the removal of pollutants within the treatment system. C* values represent the background concentrations of pollutants for end of line treatment measures. All modelling for this study has used the default values for k and C*.

5.1.2 DEVELOPED SITE CATCHMENTS

A review of selected preliminary Phase 2 architectural plans by Bureau Proberts, Project Number 14037 as enclosed in Appendix A was carried out to determine an appropriate stormwater quality modelling approach. The intent of the stormwater quality assessment is to provide an appropriate level of stormwater quality improvement for Phase 2 within the new boundaries of the developed site.

MUSIC models the rainfall-runoff and pollutant generation processes within a source node with unique pollutant export parameters for each different land use type. The following sub catchments were identified based on their relevance for each source node: Sub-catchments identified include

- Roof - Consisting of the entire roof of the proposed residential towers for each stage;
- Pavement – This consists of the pavement portions of the proposed development;
- Garden – This consists of the garden portions of the proposed development.

A breakdown of the proposed developed catchment is presented in Table 4 below:

Table 4: Proposed Developed Catchment Areas

	Area		
Catchment	Stage 4	Stage 5	TOTAL
Roof	1,072 m^2	1,692 m^2	2,764 m^2
Pavement	1,501 m^2	360 m^2	1,861 m^2
Garden	153 m^2	103 m^2	256 m^2
TOTAL	2,726 m^2	2,155 m^2	4,881 m^2

Note: 498 m^2 of land dedication along the Brunswick Street and Water Street frontages were excluded from the model.

Given the nature of the proposed development, the identified sub catchments were modelled with commercial urban source node parameters as per the Healthy Waterways Water by Design "MUSIC Modelling Guidelines for South East Queensland Version 1.0, 2010". These parameters presented in Table 5 and Table 6 below:

Table 5 MUSIC Rainfall-Runoff Parameters

Pollutant	Commercial Urban Land Use
Rainfall Threshold (mm)	1
Soil Storage Capacity (mm)	18
Initial Storage (%)	10
Field Capacity (mm)	80
Infiltration Capacity Coefficient a	243
Infiltration Capacity Exponent b	0.6
Initial Depth (mm)	50
Daily Recharge Rate (%)	0
Daily Baseflow Rate (%)	31
Daily Deep Seepage Rate (%)	0

Source: Water by Design "MUSIC Modelling Guidelines for South East Queensland", Version 1.0, 2010

Table 6 Pollutant Export Parameters Adopted in the MUSIC model

Pollutant			Commercial Urban Land Use	
			Mean	Standard Deviation
Total Suspended Solids	Roof	Base Flow	N/A	N/A
		Storm Flow	1.30	0.38
	Road	Base Flow	0.78	0.39
		Storm Flow	2.43	0.38
	Ground	Base Flow	0.78	0.39
		Storm Flow	2.16	0.38
Total Phosphorous	Roof	Base Flow	N/A	N/A
		Storm Flow	-0.89	0.34
	Road	Base Flow	-0.60	0.50
		Storm Flow	-0.30	0.34
	Ground	Base Flow	-0.60	0.50
		Storm Flow	-0.39	0.34
Total Nitrogen	Roof	Base Flow	N/A	N/A
		Storm Flow	0.37	0.34
	Road	Base Flow	0.32	0.30
		Storm Flow	0.37	0.34
	Ground	Base Flow	0.32	0.30
		Storm Flow	0.37	0.34

Note: Parameters are shown as Log_{10} of Concentration in mg/L

Source: Water by Design "MUSIC Modelling Guidelines for South East Queensland", Version 1.0 2010

5.2 ADOPTED STORMWATER TREATMENT TRAIN

As the proposed development is divided into two stages (Stages 4 & 5), and the timing for the construction of each stage is yet to be determined, two options are proposed. Option A proposes to treat the stormwater from Stages 4 & 5 separately, should construction not be concurrent. Option B proposes to treat the stormwater from Stages 4 & 5 together where construction is concurrent. These options will allow Stages 4 & 5 to be constructed together or independently as required.

Due to limited space available for traditional systems such as bioretention basins, mechanical treatment trains have been selected to treat stormwater flows generated from the site. Accordingly, Stormwater360, a manufacturer and supplier of a mechanical filtration systems known to be approved by BCC, were engaged to model an appropriate mechanical filtration systems. It should be noted, that an approved equivalent mechanical filtration system may be utilised.

Refer to Table 7 and Table 8 below for the proposed Stormwater360 mechanical filtration details for Option A and Option B respectively. The proposed stormwater quality treatment measures are illustrated on the Concept Stormwater Connection Layout Plan B14320-CSK03 enclosed in Appendix B of this report. It should be noted that this plan is preliminary only and will be subject to confirmation during detailed design.

Table 7 Stormwater360 Mechanical Filtration Device Details – Option A

Treatment Device Adopted	Details
Catchment: Stage 4	
• Stormwater360 EnviroPod (EP) Filter; • Stormwater 360 StormFilter Man Hole (SFMH)	• 3 by EnviroPod Series 200 filter fitted to field inlet or at inlet to SFMH; • 7 cartridge (690mm) 2290mm Manhole StormFilter system including pre-cast components by Stormwater360.
Catchment: Stage 5	
• Stormwater360 EnviroPod (EP) Filter; • Stormwater 360 StormFilter Man Hole (SFMH)	• 3 by EnviroPod Series 200 filter fitted to field inlet or at inlet to SFMH; • 5 cartridge (690mm) 2290mm Manhole StormFilter system including pre-cast components by Stormwater360.

Table 8 Stormwater360 Mechanical Filtration Device Details– Option B

Treatment Device Adopted	Details
Catchments: Stages 4 & 5	
• Stormwater360 EnviroPod (EP) Filter; • Stormwater 360 StormFilter Man Hole (SFMH)	• 6 by EnviroPod Series 200 filter fitted to field inlet or at inlet to SFMH; • 12-cartridge (690mm) 3100mm Manhole StormFilter system including pre-cast components by Stormwater360.

5.3 STORMWATER QUALITY MODELLING RESULTS

The predicted MUSIC pollutant concentrations for Option A and Option B are provided in Table 9 and Table 10 respectively.

Table 9 MUSIC Model Results – Option A

STAGE 4	Initial Pollutant Concentration	Residual Pollutant Concentration	Water Quality Objectives	Reduction Achieved
Total Suspended Solids (TSS)	394 kg/yr	50.2 kg/yr	80%	87.2 %
Total Phosphorous (TP)	1.14 kg/yr	0.397 kg/yr	60%	65.1 %
Total Nitrogen (TN)	9.01 kg/yr	4.96 kg/yr	45%	45 %
Gross Pollutants (GP)	64.2 kg/yr	0 kg/yr	90%	100%
STAGE 5	**Initial Pollutant Concentration**	**Residual Pollutant Concentration**	**Water Quality Objectives**	**Reduction Achieved**
Total Suspended Solids (TSS)	146 kg/yr	22 kg/yr	80%	85 %
Total Phosphorous (TP)	0.562 kg/yr	0.203 kg/yr	60%	63.9 %
Total Nitrogen (TN)	7.3 kg/yr	4.01 kg/yr	45%	45.1 %
Gross Pollutants (GP)	51.2 kg/yr	0 kg/yr	90%	100%

(Refer to Appendix C for MUSIC Model Output Details).

Table 10 MUSIC Model Results – Option B

	Initial Pollutant Concentration	Residual Pollutant Concentration	Water Quality Objectives	Reduction Achieved
Total Suspended Solids (TSS)	543 kg/yr	72.1 kg/yr	80%	86.7 %
Total Phosphorous (TP)	1.69 kg/yr	0.592 kg/yr	60%	64.9 %
Total Nitrogen (TN)	16.3 kg/yr	8.96 kg/yr	45%	45 %
Gross Pollutants (GP)	115 kg/yr	0 kg/yr	90%	100%

(Refer to Appendix C for MUSIC Model Output Details).

As shown above, MUSIC predicts that the proposed treatment trains will meet the DSDIP State Planning Policy Water Quality Objectives for key pollutants including TSS, TP, TN and GP. Electronic copies of the MUSIC models have been provided as part of this submission. Copies of the model outputs are also attached in Appendix C.

6.0 STATE PLANNING POLICY (JULY 2014) – WATER QUALITY

A single State Planning Policy (SPP) document came into effect in July 2014. The SPP replaces the SPP for Healthy Waters (SPP 4/10) and aims to ensure that the quality of Queensland waters are protected and enhanced.

The SPP has a Water Quality Code to ensure development is planned, designed, constructed and operated to manage stormwater in ways that support the protection of environmental values identified in the Environmental Protection (Water) Policy 2009 (DSDIP, 2014).

The SPP has developed Performance Outcomes to address Urban Stormwater Outcomes.

Table 11 includes a summary of the three (3) Performance Outcomes that are relevant to stormwater quality for the project and an assessment of this proposal against the Acceptable Outcomes.

Table 11: State Planning Policy Code: Water Quality

Performance Outcomes	Acceptable Outcomes
Performance outcome PO1 The development is planned and designed considering the land use constraints of the site for achieving stormwater design objectives.	Acceptable outcome AO1.1 A site stormwater quality management plan (SQMP) is prepared, and: a. is consistent with any local area stormwater water management planning; and b. provides for achievable stormwater quality treatment measures meeting design objectives listed in Table A (construction phase) and Table B ((post construction phase) of the SPP), or current best practice environmental management, reflecting land use constraints, such as: - erosive, dispersive and/or saline soil types; - landscape features (including landform); - acid sulfate soil and management of nutrients of concern; and - rainfall erosivity. Comment: - This proposal achieves the Acceptable Outcome. The quality of the treatable stormwater flow is treated through a mechanical filtration system prior to release from the site. This SQMP achieves both Point a. and Point b. above. As excavations on site may extend down to a RL of approximately 6.0 m AHD, it is not anticipated to encounter any potential acid sulphate soils on the site.

Performance Outcomes	Acceptable Outcomes
Performance outcome PO6 Construction activities for the development avoid or minimise adverse impacts on stormwater quality.	Acceptable outcome AO6.1 An erosion and sediment control plan (ESCP) demonstrates that release of sediment-laden stormwater is avoided for the nominated design storm, and minimised when the nominated design storm is exceeded, by addressing design objectives listed in Table A ((construction phase) of the SPP)) or local equivalent, for: a. drainage control; b. erosion control; c. sediment control; and d. water quality outcomes. Acceptable outcome AO6.2 Erosion and sediment control practices (including any proprietary erosion and sediment control products) are designed, installed, constructed, operated, monitored and maintained, and any other erosion and sediment control practices are carried out, in accordance with local conditions and appropriate recommendations from a suitably qualified person or Acceptable outcome AO6.3 The ESCP demonstrates how stormwater quality will be managed in accordance with an acceptable regional or local guideline so that target contaminates are treated to a design objective at least equivalent to Acceptable Outcome AO6.1. Comment: - This SMP deals in the main with the operational phase of the development. However the proposal achieves the Acceptable Outcome AO6.1, AO6.2 and AO6.3 as the SMP recommends the incorporation of comprehensive erosion and sediment control planning and implementation during the construction phase.

Performance Outcomes	Acceptable Outcomes
Performance outcome PO7 Operational activities for the development avoid or minimises changes to waterway hydrology from adverse impacts of altered stormwater quality and flow.	Acceptable outcome AO7.1 Development incorporates stormwater flow control measures to achieve the design objectives set out in Table A and Table B (of the SPP (construction phase)). Both the construction and operational phases for the development comply with design objectives in Table A (construction phase) and Table B (post construction phase), or current best practice environmental management, including management of frequent flows, peak flows, and construction phase hydrological impacts. Comment: - This SMP deals in the main with the operational phase of the development. However the proposal achieves the Acceptable Outcome AO7.1 as this Stormwater Management Plan suggests that stormwater detention is not required, incorporates mechanical treatment measures and recommends the incorporation of comprehensive erosion and sediment control planning and implementation during the construction phase. The proposal also meets the operational phase reduction requirements in mean annual load from TSS, TP, TN and GP.

Source: DSDIP, State Planning Policy, effective July 2014.

7.0 MAINTENANCE

The primary purpose of the proposed mechanical stormwater treatment train is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the system to its full efficiency and effectiveness. Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site.

A typical maintenance plan for the proposed mechanical treatment measures is enclosed in Appendix D of this report. Maintenance of the Stormwater360 StormFilter and EnviroPod systems will be undertaken in accordance with the manufacturer's specification, which is expected to be on an annual basis subject to ongoing monitoring.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Lambert & Rehbein (SEQ) Pty Ltd was commissioned by Metro (Brunswick) Pty Ltd to develop a conceptual Stormwater Management Plan (SMP) (Quality and Quantity) for Phase 2 of the proposed mixed use development at corner of Brunswick and Water Street, Fortitude Valley.

Phase 2 includes two (22 and 28 storey) residential towers and common podium levels containing retail space, car parking and public open space over basement car park levels. The aim of this conceptual SMP was to identify any stormwater detention requirements and to appropriately achieve the operational phase WQOs.

The proposed development will not increase the imperviousness of the site from the existing condition, therefore no on site stormwater detention is proposed.

As the development is divided into two stages (Stages 4 & 5), two stormwater treatment options are proposed. Option A proposes to treat the stormwater from Stages 4 & 5 separately, whilst Option B proposes to treat the stormwater from Stages 4 & 5 together. These options will allow Stages 4 & 5 to be constructed together or independently as required.

Mechanical filtration systems are proposed to achieve the stormwater quality treatment requirements for both Options A and B for the development. MUSIC modelling results indicate that the proposed treatment trains of SQIDs will adequately achieve the operational phase WQOs to EDQ's requirements. Proposed SQIDs are illustrated on Concept Stormwater Connection Layout Plan B14320-CSK03 enclosed in Appendix B of this report.

Adherence to the maintenance measures detailed in Section 7 will ensure the ongoing effectiveness and longevity of the proposed SQIDs.

Lambert and Rehbein considers that the proposed stormwater treatment and detention methods detailed in this report will satisfy EDQ's requirements for stormwater quality treatment and stormwater detention for the proposed mixed use development located at the corner of Brunswick and Water Street, Fortitude Valley.

9.0 REFERENCES

Brisbane City Council (BCC) (2014) *Infrastructure Design Planning Scheme Policy* Queensland Government, Brisbane.

Brisbane City Council (BCC) (2014) *Know Your Creek Breakfast/Enoggera Creek Catchment* Queensland Government, Brisbane.

Department of Energy and Water Supply (2013). *Queensland Urban Drainage Manual Third Edition 2013,* Queensland Government, Brisbane.

Department of Infrastructure and Planning (2014). State Planning Policy, 2014. Queensland Government, Brisbane.

Healthy Waterways (2010) Water by Design Draft MUSIC Modeling Guidelines for South East Queensland, Version 1.

LAMBERT & REHBEIN

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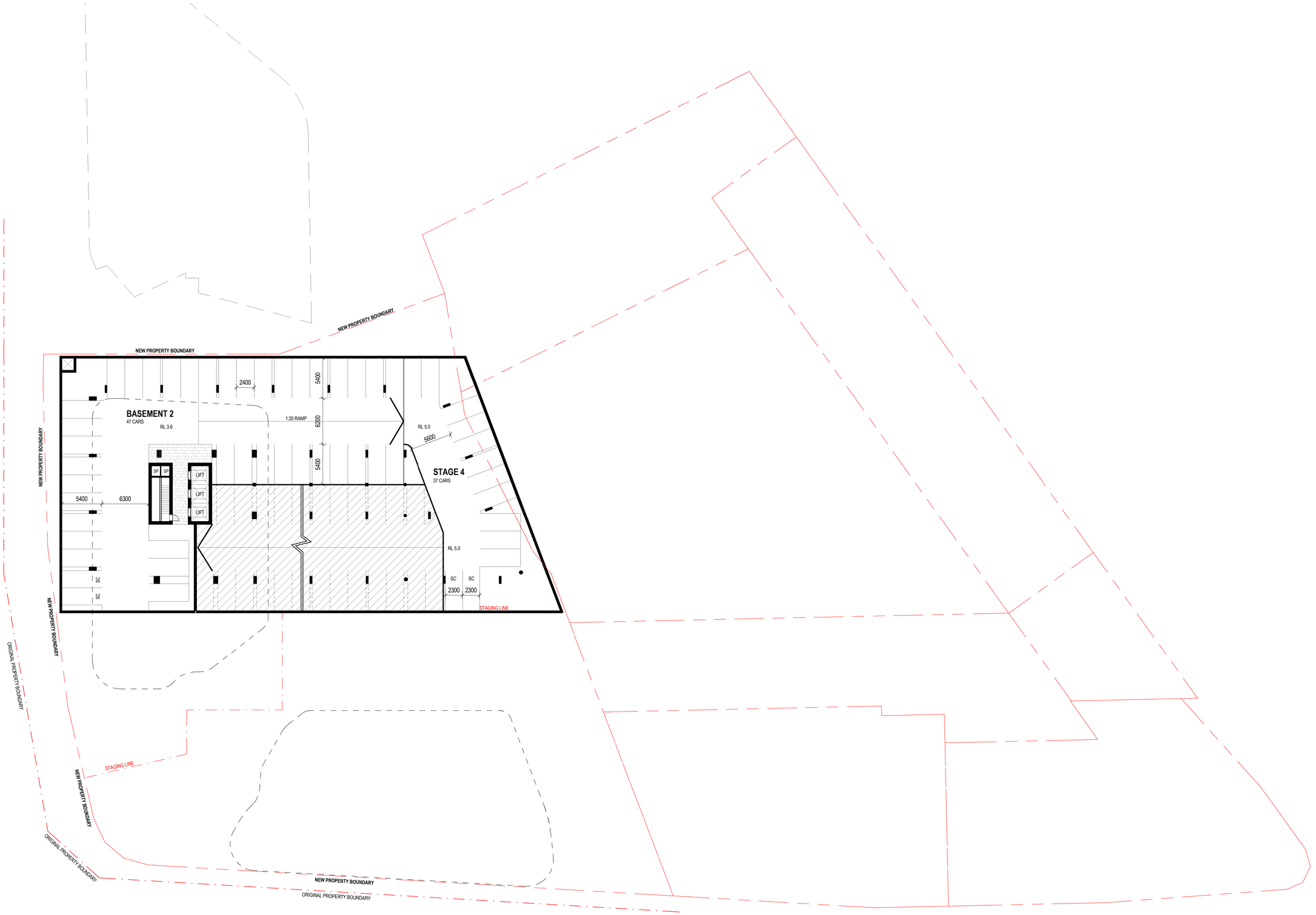
APPENDIX A

SELECTED PRELIMINARY ARCHITECTURAL PLANS PREPARED BY BUREAU PROBERTS – PROJECT NUMBER 14037



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REV	DESCRIPTION	DATE
21	PRELIMINARY DA ISSUE	20.10.15
20	CIVIL COORDINATION	20.10.15
16	EDQ PACKAGE	12.10.15
15	Co-ordination Issue	12.10.15
11	Client Issue	02.10.15
10	QS Issue	02.10.15
9	Preliminary Co-ordination	24.09.15

BASEMENT 2

CLIENT: METRO PROPERTY DEVELOPMENT
PROJECT: CENTRAL VILLAGE STAGE 4 AND 5
ADDRESS: CORNER OF WATER AND BRUNSWICK STREET

SCALE: 1 : 250 [A1]
DATE: 20.10.15
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NORTH:
6
PROJECT NO: 14037
PHASE: DA
DRAWING NUMBER: 20.01
REVISION: 21
20/10/2015 7:28:30 PM

BASEMENT 1

REV	DESCRIPTION	DATE
21	PRELIMINARY DA ISSUE	20.10.15
20	CIVIL COORDINATION	20.10.15
16	EDQ PACKAGE	12.10.15
15	Co-ordination Issue	12.10.15
11	Client Issue	02.10.15
10	QS issue	02.10.15
9	Preliminary Co-ordination	24.09.15

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CLIENT: METRO PROPERTY DEVELOPMENT
PROJECT: CENTRAL VILLAGE STAGE 4 AND 5
ADDRESS: CORNER OF WATER AND BRUNSWICK STREET

SCALE: 1 : 250 [A1]
DATE: 20.10.15
DRAWN: AE
NORTH:
6

PROJECT NO: 14037
PHASE: DA
DRAWING NUMBER: 20.02
REVISION: 21

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PODIUM 1

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REV	DESCRIPTION	DATE
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20	CIVIL COORDINATION	20.10.15
16	EDQ PACKAGE	12.10.15
15	Co-ordination Issue	12.10.15
11	Client Issue	02.10.15
10	QS issue	02.10.15
9	Preliminary Co-ordination	24.09.15

CLIENT: METRO PROPERTY DEVELOPMENT
PROJECT: CENTRAL VILLAGE STAGE 4 AND 5
ADDRESS: CORNER OF WATER AND BRUNSWICK STREET

SCALE: 1 : 250 [A1]
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DRAWN: AE
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REV	DESCRIPTION	DATE
21	PRELIMINARY DA ISSUE	20.10.15
20	CIVIL COORDINATION	20.10.15
16	EDQ PACKAGE	12.10.15
15	Co-ordination Issue	12.10.15
11	Client Issue	02.10.15
10	QS issue	02.10.15
9	Preliminary Co-ordination	24.09.15

CLIENT:
METRO PROPERTY DEVELOPMENT
PROJECT:
CENTRAL VILLAGE STAGE 4 AND 5
ADDRESS:
CORNER OF WATER AND BRUNSWICK STREET

PODIUM 2

SCALE: 1 : 250 [A1]
DATE: 20.10.15
DRAWN: AE
NORTH:
PROJECT NO: 14037
PHASE: DA
DRAWING NUMBER: 20.04
REVISION: 21
20/10/2015 7:28:45 PM

bureau proberts

REV	DESCRIPTION	DATE
21	PRELIMINARY DA ISSUE	20.10.15
16	EDQ PACKAGE	12.10.15
15	Co-ordination Issue	12.10.15
11	Client Issue	02.10.15
10	QS issue	02.10.15
9	Preliminary Co-ordination	24.09.15
4	Preliminary Co-ordination	17.09.15

PODIUM 3

CLIENT: METRO PROPERTY DEVELOPMENT
PROJECT: CENTRAL VILLAGE STAGE 4 AND 5
ADDRESS: CORNER OF WATER AND BRUNSWICK STREET

SCALE: 1 : 250 [A1]
DATE: 20.10.15
DRAWN: JC
NORTH:
6

PROJECT NO: 14037
PHASE: DA
DRAWING NUMBER: 20.05
REVISION: 21

20/10/2015 7:28:52 PM

REV	DESCRIPTION	DATE
21	PRELIMINARY DA ISSUE	20.10.15
16	EDQ PACKAGE	12.10.15
15	Co-ordination Issue	12.10.15
11	Client Issue	02.10.15
10	QS issue	02.10.15
9	Preliminary Co-ordination	24.09.15
4	Preliminary Co-ordination	17.09.15

bureau proberts

LEVEL 1

CLIENT: METRO PROPERTY DEVELOPMENT
PROJECT: CENTRAL VILLAGE STAGE 4 AND 5
ADDRESS: CORNER OF WATER AND BRUNSWICK STREET

SCALE: 1 : 250 [A1]
DATE: 20.10.15
DRAWN: JC
NORTH:
PROJECT NO: 14037
PHASE: DA
DRAWING NUMBER: 20.06
REVISION: 21

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REV	DESCRIPTION	DATE
21	PRELIMINARY DA ISSUE	20.10.15
16	EDQ PACKAGE	12.10.15
15	Co-ordination Issue	12.10.15
11	Client Issue	02.10.15
10	QS issue	02.10.15
9	Preliminary Co-ordination	24.09.15
4	Preliminary Co-ordination	17.09.15

CLIENT: METRO PROPERTY DEVELOPMENT
PROJECT: CENTRAL VILLAGE STAGE 4 AND 5
ADDRESS: CORNER OF WATER AND BRUNSWICK STREET

LEVEL 1 RECREATION

SCALE: 1 : 250 [A1]
DATE: 20.10.15
DRAWN: JC
NORTH:
PROJECT NO: 14037
PHASE: DA
DRAWING NUMBER: 20.07
REVISION: 21
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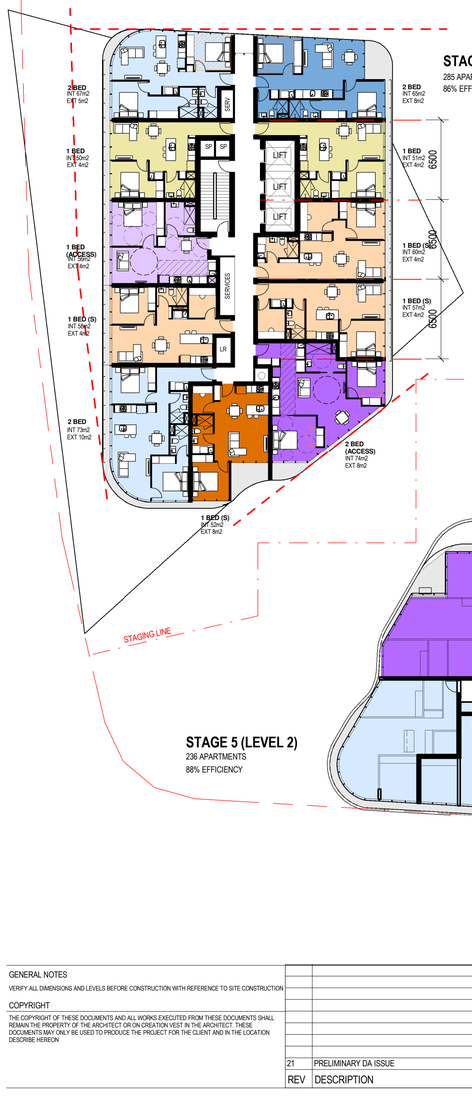

STAGE 4 (LEVEL 2)
285 APARTMENTS
86% EFFICIENCY

STAGING LINE

STAGING LINE

STAGE 5 (LEVEL 2)
236 APARTMENTS
88% EFFICIENCY

GENERAL NOTES

VERIFY ALL DIMENSIONS AND LEVELS BEFORE CONSTRUCTION WITH REFERENCE TO SITE CONSTRUCTION

REV	DESCRIPTION	DATE
21	PRELIMINARY DA ISSUE	20.10.15

KEY PLAN:

bureau proberts

bureau*proberts PTY LTD
ABN 53 073 087 993 ACN 073 087 993
GROUND LEVEL, 233A ADELAIDE STREET, BRISBANE QLD 4001 GPO Box 3204
P: 07 3221 0672 F: 07 3221 0683 EMAIL: mail@bureauproberts.com.au www.bureauproberts.com.au

CLIENT:
METRO PROPERTY DEVELOPMENT
PROJECT:
CENTRAL VILLAGE STAGE 4 AND 5
ADDRESS:
CORNER OF WATER AND BRUNSWICK STREET

DRAWN BY:	Author
CHECK BY:	Checker
PROJECT ARCHITECT	
DESIGN ARCHITECT	Designer

NORTH:

SCALE: 1 : 250 [A1]

DRAWING TITLE:
LEVEL 2

CAD FILE NO: C:\Users\chwong\.FPA\Documents\14037_CVS4_DA_Central EDQ_chwong.rvt

PROJECT NO:	PHASE:	DRAWING NUMBER:	REVISION:
14037	DA	20.08	21

DATE: 20.10.15

20/10/2015 7:29:15 PM

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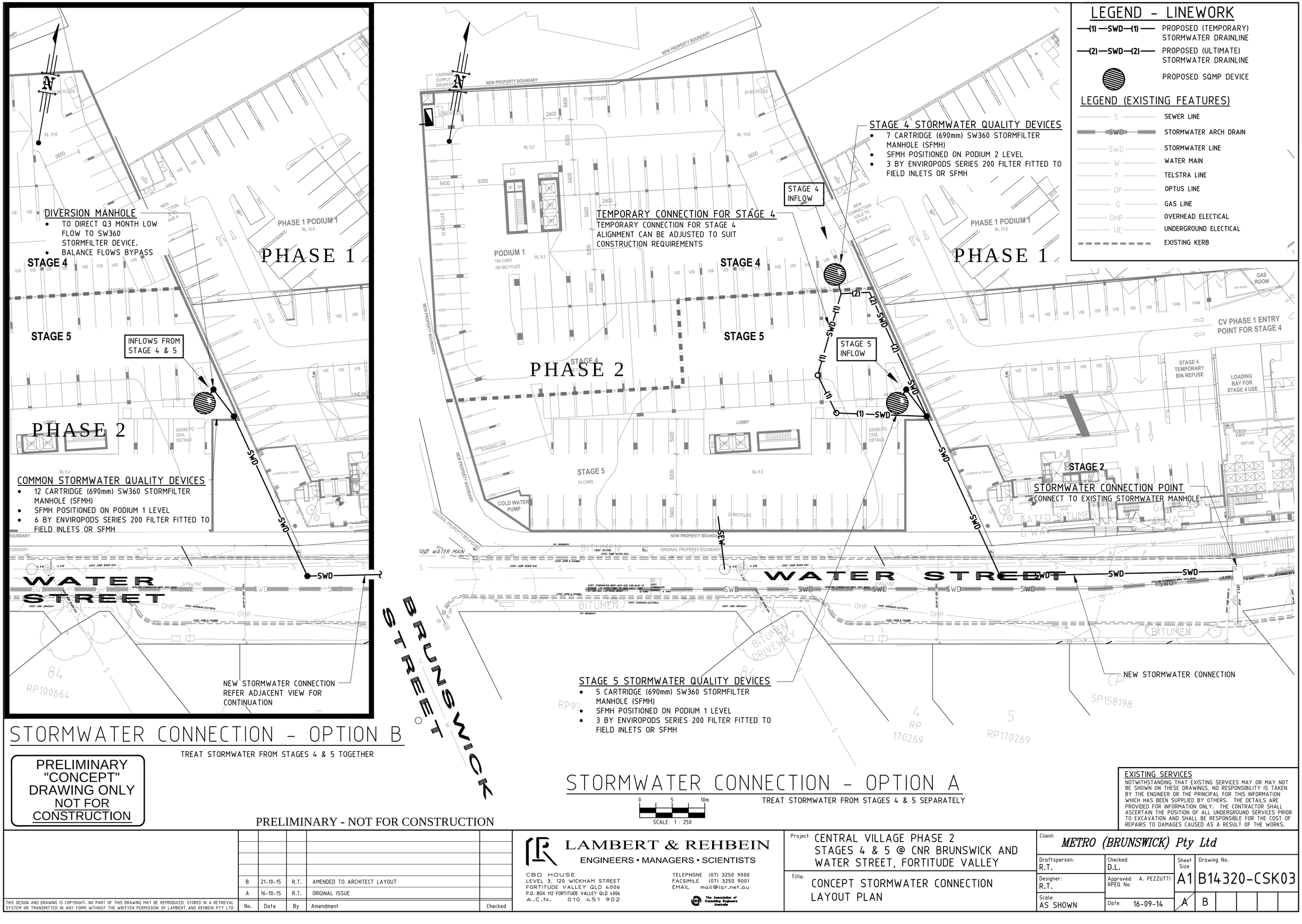
APPENDIX B

CONCEPT STORMWATER CONNECTION LAYOUT PLAN B14320-CSK03



STORMWATER CONNECTION - OPTION B

TREAT STORMWATER FROM STAGES 4 & 5 TOGETHER

PRELIMINARY "CONCEPT" DRAWING ONLY NOT FOR CONSTRUCTION

STORMWATER CONNECTION - OPTION A

TREAT STORMWATER FROM STAGES 4 & 5 SEPARATELY

0 5 10m

SCALE 1 : 250

PRELIMINARY - NOT FOR CONSTRUCTION

EXISTING SERVICES

NOTWITHSTANDING THAT EXISTING SERVICES MAY OR MAY NOT BE SHOWN ON THESE DRAWINGS, NO RESPONSIBILITY IS TAKEN BY THE ENGINEER OR THE PRINCIPAL FOR THIS INFORMATION WHICH HAS BEEN SUPPLIED BY OTHERS. THE DETAILS ARE PROVIDED FOR INFORMATION ONLY. THE CONTRACTOR SHALL ASCERTAIN THE POSITION OF ALL UNDERGROUND SERVICES PRIOR TO EXCAVATION AND SHALL BE RESPONSIBLE FOR THE COST OF REPAIRS TO DAMAGES CAUSED AS A RESULT OF THE WORKS.

No.	Date	By	Amendment	Checked
B	21-10-15	R.T.	AMENDED TO ARCHITECT LAYOUT	
A	16-10-15	R.T.	ORGINAL ISSUE	

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The Association of Consulting Engineers Australia

Project: CENTRAL VILLAGE PHASE 2
STAGES 4 & 5 @ CNR BRUNSWICK AND WATER STREET, FORTITUDE VALLEY

Title: CONCEPT STORMWATER CONNECTION LAYOUT PLAN

Client: *METRO (BRUNSWICK) Pty Ltd*

Draftsperson: R.T.	Checked: D.L.	Sheet Size	Drawing No.
Designer: R.T.	Approved: A. PEZZUTTI RPEQ No:	A1	B14320-CSK03
Scale: AS SHOWN	Date: 16-09-14	A / B	

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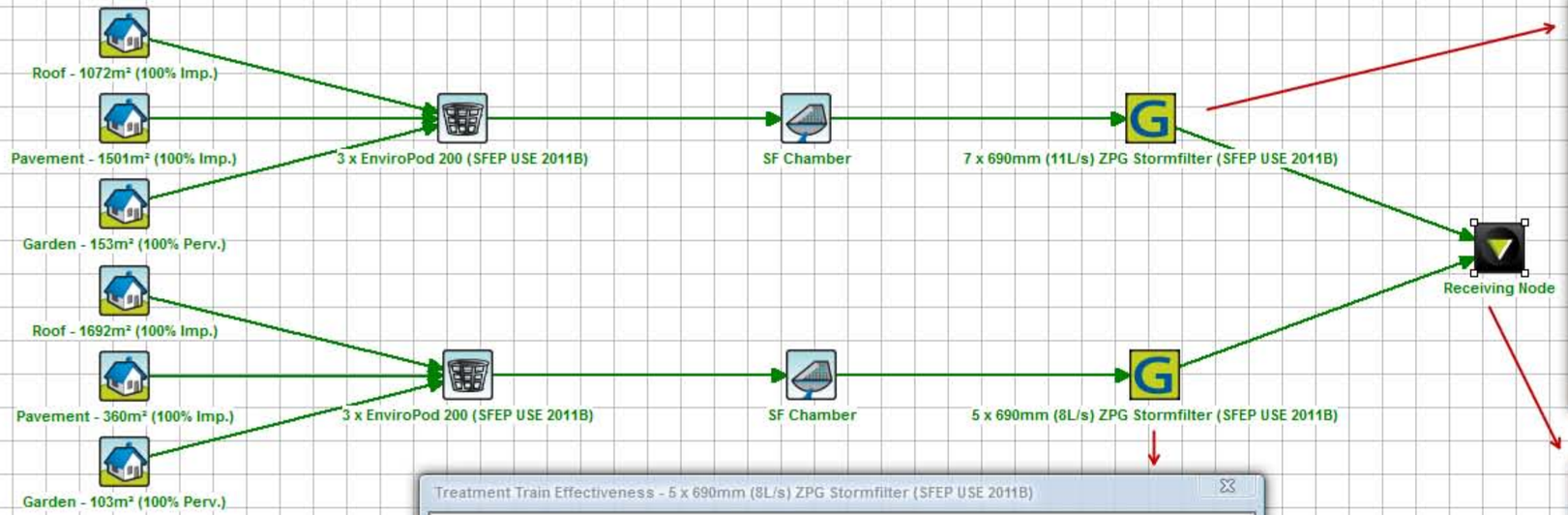
APPENDIX C

MUSIC MODELLING RESULTS



Treatment Train Effectiveness - 7 x 690mm (11L/s) ZPG Stormfilter (SFEP USE 2011B)

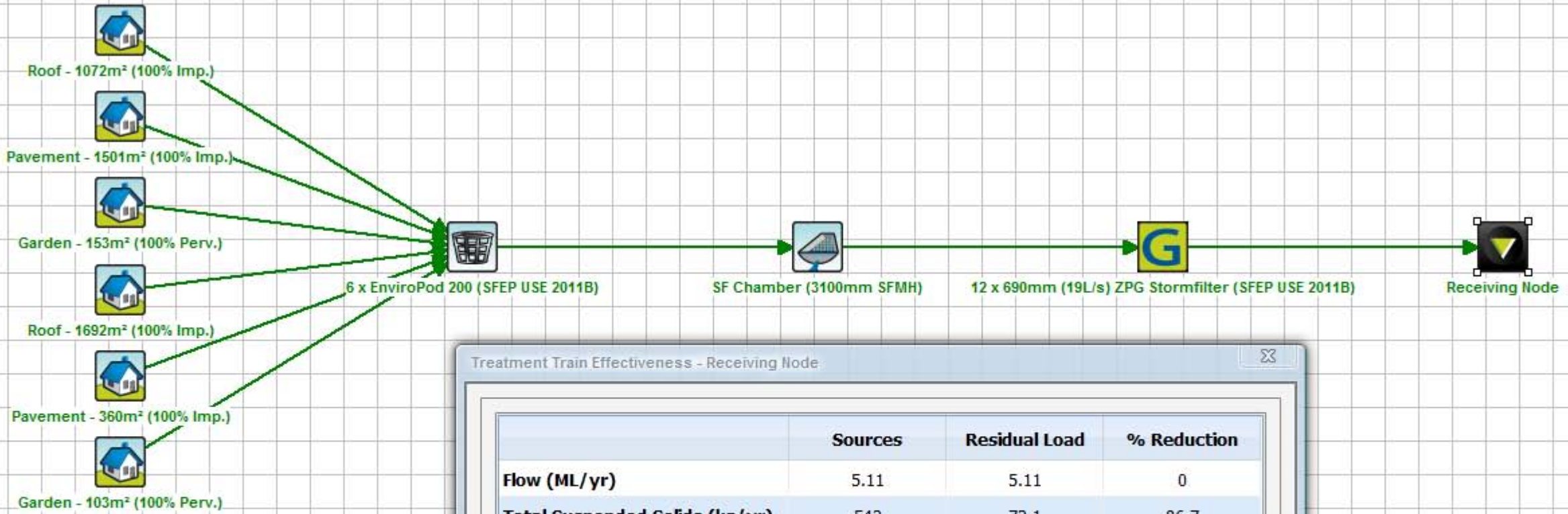
	Sources	Residual Load	% Reduction
Flow (ML/yr)	2.85	2.85	0
Total Suspended Solids (kg/yr)	394	50.2	87.2
Total Phosphorus (kg/yr)	1.14	0.397	65.1
Total Nitrogen (kg/yr)	9.01	4.96	45
Gross Pollutants (kg/yr)	64.2	0	100

Treatment Train Effectiveness - 5 x 690mm (8L/s) ZPG Stormfilter (SFEP USE 2011B)

	Sources	Residual Load	% Reduction
Flow (ML/yr)	2.26	2.26	0
Total Suspended Solids (kg/yr)	146	22	85
Total Phosphorus (kg/yr)	0.562	0.203	63.9
Total Nitrogen (kg/yr)	7.3	4.01	45.1
Gross Pollutants (kg/yr)	51.2	0	100

Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	5.11	5.11	0
Total Suspended Solids (kg/yr)	540	72.2	86.6
Total Phosphorus (kg/yr)	1.7	0.6	64.7
Total Nitrogen (kg/yr)	16.3	8.97	45
Gross Pollutants (kg/yr)	115	0	100



Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	5.11	5.11	0
Total Suspended Solids (kg/yr)	543	72.1	86.7
Total Phosphorus (kg/yr)	1.69	0.592	64.9
Total Nitrogen (kg/yr)	16.3	8.96	45
Gross Pollutants (kg/yr)	115	0	100

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APPENDIX D

STORMWATER360 OPERATIONS AND MAINTENANCE INFORMATION

Operations and maintenance

StormFilter® EnviroPod Treatment Train

Stormwater360
AUSTRALIA

Device details			
Location of Device			
GPS Coord	N:	E:	D P Number:
Relevant Council			
Company			
Contact		Email	Ph
Engineer			
Contact		Email	Ph

SFEP Treatment
1
2

Frequency of Inspection/Maintenance	Inspections (time/year)	Major Maintenance
StormFilter		
EnviroPod		

Maintenance Estimated Annual Cost
StormFilter
EnviroPod
TOTAL

Contents

Maintaining the EnviroPod® Stormwater Gully Pit Insert

Maintenance is as integral to every stormwater management system as it is to any other item of machinery or equipment.

The primary purpose of the EnviroPod® Stormwater Gully Pit insert is to filter out and remove pollutants from entering our waterways. To ensure that the EnviroPod® continues to function effectively, it is important that the pollutants it captures are periodically removed, and the filtration components properly cleaned.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site, as well as the occurrence of events such as chemical spills or excessive sediment loading due to site erosion or extreme storms. Similarly, the system should be inspected after all major storm events.

Treatment Train Specifications

Performance Specification

The stormwater filtration treatment train shall consist of x 200 micron gully pit basket/s and x 460/690mm passive, siphon-actuated, radial flow, self cleaning media filtration cartridge system/s operating at a specific flow rate of not more than 1.5L/s/m^2.

The gully pit basket system shall consist of the following components;

- Removable 200 micron Nylon monofilament Precision woven Filtration Bag
- Fixed Galvanised Mesh Cage (no greater than 80mm x 80mm) around the Filtration Bag
- Recycled modified ABS plastic to seal the unit into the pit
- By-pass mechanism above the Filter with no moving parts
- System rigidly fixed to the walls of the pit.

The media filtration system shall be located within the following structure.

- Manhole
- DownPipe
- Linear
- Vault
- Large Box
- Detention.

Regardless of the system type, the media filtration system shall consist of the following components;

- Inlet energy dissipation
- Cartridge section
- Outlet section to bypass storm flows and convey treated stormwater
- Access Lids in roof slab for access to Cartridges
- Siphon actuated cartridges filled with proprietary ZPG™ filter media
- Specific flow rate of each individual cartridge limited not to exceed 1.5L/s/m^2
- Air Lock Cap complete with one way Air Valve Flap
- Outer Hood complete with Scrubbing Regulators
- Automated high-energy turbulence on the screen face (only) at the end of storm flows to flush pollutants from the cartridge
- Centre Drainage Tube complete with Buoyancy Float
- Individual Cartridge Flow Restrictor Disc
- ¼ Turn Bayonet Fittings
- Under drain manifold to convey treated stormwater to the receiving environment.

Components of any proposes treatment train or technology

The components of any proposed the treatment train or technology, including a gully pit basket upstream of a radial flow cartridge filtration system, must be evaluated for a range of pollutants and these performance expectations must comply with current best practice guidelines, i.e. Water by Design "MUSIC Modeling Guidelines version 1.0 2010" for South East Queensland.

In short, the performance evaluation of any system must show:

1. Any reduction efficiencies are justified by rigorous scientific testing as determined by an independent peer reviewer and the results further peer reviewed and published in a credible scientific journal. Any potential or perceived conflicts of interest should be disclosed within the published article.
2. Published article providing insight into the pollutant composition (e.g. soluble vs particulate for nitrogen) and the mean concentration of inflow and outflow to compare to local and or regional conditions.
3. Performance evaluation undertaken in dry weather conditions or a method to take into account any potential leaching of nutrients that may occur in the system(s).
4. Evaluation is conducted using full-scale systems with details of treatable flow rates sampled and how they correlate to discrete removal efficiencies and comparisons to the designed treatable flow rates of the device. A comparison should also be made to the climatic conditions especially where un-restricted filters are used.

Maintenance Overview

The primary purpose of the Stormwater Treatment Train is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the system to its full efficiency and effectiveness.

* Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance must be performed in accordance with the Treatment Trains Operation and Maintenance Guidelines.

Introduction

This manual has been designed to assist you with cleaning and maintaining the EnviroPod Stormwater Gully Pit Insert, using the methods recommended by the manufacturer.

The cleaning process and methods described cover all aspects of the system, including:

- Removing the grate
- Cleaning the filter bag
- Inspecting the unit
- Rejuvenating the filter bag
- Re-installing the filter bags.

The manual should be used in conjunction with your site's traffic management and safety plans, as well as other appropriate Stormwater360 (IES) documents such as the IES Employee Health and Safety Manual. We also recommend that maintenance and cleaning contractors, or device owners, develop their own site-specific health and safety activity plans to ensure a safe work environment.

Please note: This manual consists primarily of the processes and tasks associated with the hand maintenance and inductor maintenance procedures. It does not include details of the site's traffic management or occupational health and safety requirements. Contractors or IES staff should utilise their own Employee Health and Safety Manual, which details the policies and procedures for safe work.

Why cleaning and maintenance are so vitally important

Adhering to the inspection and maintenance schedule of each stormwater treatment device is essential to ensuring that it works properly throughout its estimated 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's also essential that qualified and experienced personnel carry out all maintenance (including inspections, recording and reporting) in a systematic manner. To ensure consistency, we recommend that one person be responsible for overseeing the management of the maintenance and cleaning process.

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

The EnviroPod has been designed to trap and retain pollutants in stormwater runoff, helping to maintain the quality of water entering our aquatic ecosystems. Depending on the nature of your site, pollutants can range from organic material such as leaves and sticks through to debris such as broken glass, syringes or other potentially harmful materials.

Access to gully pits containing EnviroPods may require removing heavy protective grates, while cleaning such pits may entail working in confined spaces. For these reasons, all aspects of maintaining and cleaning your EnviroPod require careful adherence to Occupational Health and Safety (OH&S) guidelines. Doing so will ensure that all maintenance personnel are adequately protected and have been properly trained before taking part in any specialist activities. The same level of care needs to be taken to protect non-work personnel in and around the site, while appropriate traffic control measures must be put in place where collection pits are situated in, or adjacent to, roadways or car parks.

* The procedures indicated in the Operations section of this manual are recommended as the safest and most efficient manner of conducting the maintenance of EnviroPod units (Section 2), however contractors and cleaning staff may vary the procedure in response to the site conditions; varying work practices; or general preferences in the cleaning techniques. Please note that procedures outlined in this manual are not exhaustive, and that any changes made should always comply with general safe work practices.

Cleaning of EnviroPod filters and StormFilters is a specialist activity. The material collected by the devices can be harmful, and needs to be handled correctly. For example, sediments may contain heavy metals and carcinogenic substances as well as harmful objects such as broken glass and syringes. It is essential that Occupational Safety and Health guidelines are followed at all times, and that the following steps are carried out to ensure safe and successful maintenance operations.

In addition to the dangers associated with the cleaning and handling of material in the filter bags, precaution needs to be taken with activities such as removing the grate as well as with managing the traffic, pedestrians and other non-worker personnel at the site. The general workplace hazards associated with working outdoors also need to be taken into account.

2.1 Personnel health and safety

All contractors and staff must comply with all current workplace health and safety legislation and take all practicable steps to:

- Comply with all applicable laws, regulations and standards
- Ensure that all employees, contractors and visitors are informed of and understand their obligations in respect of current workplace health and safety legislation
- Ensure that employees understand and accept their responsibility to practice and promote a safe and healthy work environment.

* Take proper care. Pollutants can range from organic materials such as leaves and sticks through to debris such as broken glass, syringes or other potentially harmful materials.

While cleaning and maintaining filters, all relevant precautions must be taken to prevent contact with sediment and litter. This includes wearing the following personal protective and safety equipment:

- Puncture resistant gloves
- Steel capped safety boots
- Fluorescent safety vest
- Overalls or similar skin protection
- Safety apron (if necessary)*
- Eye protection (if necessary)*.

* Higher personal safety conditions may be required when maintaining units that may contain more hazardous material, for example pits where syringes have been observed or pits located in areas associated with such activities.

2.2 Traffic control

Stormwater collection pits are typically situated either in or on roads and car parks, or adjacent to roads in a footpath or swale. Traffic control requirements across all such locations differ with most of the state and local road authorities requiring the same controls to be implemented whether the work is to be conducted on the road or on the road reserve.

As traffic requirements differ depending on road usage and the specific road configuration, separate traffic control plans should be prepared for each site. Given that maintenance is typically a quick process, the contractor should liaise with the relevant road authority to determine the specific road safety requirements for each location to ensure that on site workers can conduct the cleaning operations safely and efficiently, while complying with all laws and regulations.

State government publications such as the NSW RMS *Traffic Control at Work Sites* safety manual outline the signage requirements, placement of barricades or witches hats and the positioning of traffic control personnel that's required when working on public roads. For increased safety, IES recommends that the maintenance vehicle be used to shield the work area from oncoming traffic.

Photo 1 shows the maintenance vehicle with cones placed around and positioned to shield the work area. **Photo 2** shows the head-on view, note the vehicle is positioned to allow access to the drive, whilst still blocking the pit from on-coming traffic. The vehicle has a flashing light on the roof and the hazard lights switched on.

2.3 Confined spaces

Confined space entry procedures are not included as part of this manual. For IES employees these procedures are included as part of the IES Safety Manual. It is recommended that all contractors evaluate their own needs for confined space entry and compliance with Occupational Health and Safety regulations.

When repairs or maintenance activities cannot be conducted from the surface, and there is a need to enter and work in a confined space, only staff with current confined space training are permitted to operate in a confined space. Appropriate measures and controls must be put in place to meet confined space entry requirements. At all times the necessary safety equipment must be worn, and where gas or oxygen hazards occur, only staff trained in its use will use breathing apparatus gear. **Non-trained staff must not go into confined spaces.**

* Confined spaces pose a serious safety hazard for all personnel; however during the normal maintenance procedures there should be no reason to enter a confined space and all maintenance procedures are able to be conducted from the surface.

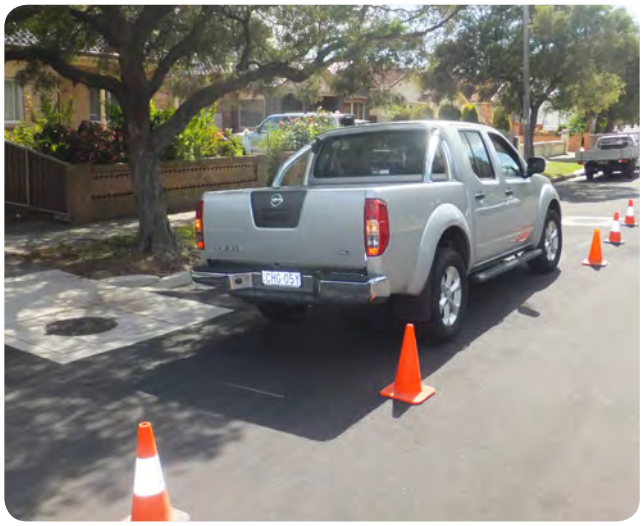

Photo 1 Vehicle positioned near pit, preventing traffic from passing close to the pit.

Photo 2 Head-on view, indicating the placement of the vehicle near the pit.

Operations

EnviroPod units need to be regularly inspected to determine whether they require maintenance or cleaning. This process involves several steps, and may require two or more maintenance personnel working together, as well the use of specialised equipment such as a hydraulic lifting arm or an inductor truck with a vacuum hose.

As gully pit grates are usually quite heavy, it is important that correct lifting procedures are adopted, and that the area surrounding the opened pit is shielded from access to non-work personnel.

If inspection reveals that the filter bag needs to be emptied and rejuvenated, the entire unit should also be examined to ensure that all connections and joints are sound. Any material that has accumulated in the overflow diversion channels or outlet pipes also needs to be removed, with those areas then being flushed. Where required, filter bags may need to be cleaned or repaired, and all waste material must be disposed of according to local guidelines at either an approved disposal site or transfer station.

This section outlines the procedures for cleaning the EnviroPod units. It has been written so that someone who has never previously encountered a stormwater pit or an EnviroPod unit can carry out such maintenance by simply following the outlined steps.

3.1 Maintenance and monitoring of EnviroPod filters

To ensure that each EnviroPod unit achieves optimal performance, the material collected by the filter bag should be emptied when the level of material is no more than approximately **half to two thirds** of the total bag depth or when there is evidence of material overflow. While the bag has a greater storage capacity, it is recommended that it is not left to fill completely prior to emptying, for the following reasons:

- the bags are capable of retaining a heavy mass of material (in excess of 50kg), which will make them more difficult to lift and empty
- material near the top of the bag can be re-suspended during high to extreme rainfall events
- blockage of the overflow sections can occur, when material is allowed to build up above the filter bag.

It is also recommended that additional monitoring is conducted following moderate to extreme rainfall events, especially when preceding months have had little or no rainfall. This increased frequency of monitoring is necessary as there is a greater accumulation of surface contamination during low rainfall periods, which will then enter the unit with the higher volumes of runoff generated during a major rainfall event. It is also important to ensure that the units have not been damaged due to high pipe velocities.

3.2 Stormwater pit cover removal

3.2.1 Hinged pit grates

These are the steps for opening a hinged pit grate:

1. Insert the lifting hooks beneath the grate. (Position indicated in **Photo 3**)
2. Check hinge point is not damaged and debris is not caught in the hinge area.
3. Fully open pit grate, ensuring that the grate will stay in the open position without any external forces applied. Grates that do not remain open without being held should be removed or secured during cleaning or maintenance activities. **Photo 4** indicates the grate being opened and grate resting freely in the open position, respectively.

Please note: Many cast iron hinges are not hinged securely (to enable the removal of the grate). This may result in the pit grate not being able to sit in an open position. Additionally the hinge pins may also be damaged or corroded, which may allow the grate to fall into the pit. Such pit grates can be removed using the method indicated below for non-hinged grates.

Photo 3 Lifting the grate

Photo 4 Fully open grate

Photo 5 Lowering grate

3.2.2 Non-hinged pit grates

To remove a non-hinged pit grate:

1. Place lifting hooks beneath grate, where possible in the four corners of the grate (see **Photo 6**). Concrete lids may have Gatic lifting points, a key arrangement or holes in the lid, which may require special equipment such as Gatic lifters
2. Position each person either side of the grate (see **Photo 7**)
3. Lift the grate, ensuring that good heavy lifting posture is used at all times
4. Place the grate on an angle on the gutter, to allow for the lifting hooks to be removed (see **Photo 8**)
5. For extremely heavy one-piece grates and concrete Gatic covers, insert the lifters in place and slide the lids back. Note some lids may still require two people

Photo 6 Insert hook near edge of grate

Photo 7 Position each lifter either side of the grate

Photo 8 Lift grate and move grate to one side

Photo 9 Lift grate above the support frame

Photo 10 Reinstated non hinged grate

3.3 Cleaning methods

One of the following maintenance methods should be used for servicing EnviroPod Filters:

3.3.1 Cleaning using an inductor truck

Follow these steps to safely and efficiently clean the EnviroPod using an inductor truck:

1. Open gully pit (See Section 3.2)
2. Place the inductor hose over the material collected in the filter bag and switch on the inductor
3. Using the inductor hose, suck out all of the sediment, organic leaf material, litter etc. collected in the filter bag
4. Allow the filter bag to be sucked up into the inductor hose for a few seconds to allow for the filter mesh pores to be cleaned. Care is to be taken that there are no sharp edges on the inductor hose that can damage the filter bag
5. If material has built up around the overflows, use the inductor hose to clear the accumulated material
6. Remove filter bag from the pit
7. Sediment retained in the gully pit grate is to be removed
8. Back-opening channels are to be cleared of any debris to ensure flow is not hindered. This debris can also be collected using the inductor truck
9. All gully pit waste is to be removed from the pit
10. Check the EnviroPod unit (Section 3.4)
11. Check filter bag (Section 3.4)
12. Reinstate filter bag and gully pit lids

Photo 11 Cleaning an EnviroPod using the inductor method

3.3.2 Hand maintenance

To clean the EnviroPod manually by hand, follow these steps:

1. Open gully pit (See Section 1)
2. Place the lifting hooks in the lifting loops of the filter bag (See **Photo 12**)
3. For extremely heavy and overfilled bags either use a hydraulic lifting arm to lift the bag, or remove excess material using a shovel or similar piece of equipment. IES prefers the use of a post hole shovel, due to the reduced strain on the back when digging and the ability of the shovel to grab material vertically
4. Lift the bag vertically off the supporting frame, ensuring that no undue pressure is placed on the filter bag. (See **Photo 13**)
5. Lift the bag clear of the stormwater pit (See **Photo 14**)
6. Position the bag over the truck or other collection vehicle, taking hold of the loops at the base of the bag (See **Photo 15** and **Photo 16**)
7. Lift and empty the filter bag by holding the bottom lifting loops only (See **Photo 17**)
8. Completely empty the filter bag (See **Photo 18**)
9. Brush the filter bag with a stiff brush to remove bound sediment from the filter pores
10. Check the EnviroPod unit (Section 3.4)
11. Check the filter bag (Section 3.5)
12. Reinstate filter bag, ensuring bag is installed the correct way (See **Photo 19** and **Photo 20**)
13. Reinstate gully pit lids (See **Photo 21** and **Photo 22**)

Photo 12 Place the lifting hooks through the bag loops

Photo 13 Lift the bag from the cage and support frame

Photo 14 Lift the bag from the stormwater pit

Photo 15 Lift the bag onto the collection vehicle

Photo 16 Grab the bottom lifting loops

Photo 17 Lifting the bottom bag loops empty the filter bag

Photo 18 Completely empty the contents of the filter bag

Photo 19 Reinstall filter bag

Photo 20 Ensure that the unit is positioned correctly, with the lifting loops on the inside

Photo 21 Correctly installed filter bag

Photo 22 Installed filter bag and sealed pit

Please note: Under no circumstances are gully pit sediments to be backwashed into the gully pit.

Photo 23 Check seals are pushed against the pit walls

Photo 24 Check joining rivets (two piece unit shown above)

3.4 Unit inspection

After the EnviroPod filter bag has been removed, emptied and cleaned, the following should be checked to ensure that the unit has not been damaged:

- All connections and joints should be checked and broken rivets replaced (See **Photo 23**)
- The plastic pit seals should be inspected for unit movement or damage (See **Photo 24**)
- The cage should be inspected for damage or movement.

The overflow diversion channels, and the area between the EnviroPod cage and pit wall should also be inspected for any accumulated debris. Any observed debris should be removed and disposed of off-site. Accumulated material within the outlet pipe may also need to be flushed.

If spare parts are required, Stormwater360 is able to provide these at a cost to the owner of the EnviroPod unit, although these parts may also be obtained from other suppliers.

Please note: If the units are not cleaned regularly, the mobilisation of material collected in the EnviroPod unit may occur. As such, cleaning of the units in accordance with this management plan is required. As this plan is based on observations and data collected during the monitoring period, ongoing adjustment of the cleaning frequency is generally required to improve the overall efficiency in the removal of collected material and prevent material overflow.

3.5 Filter bag inspection and rejuvenation

After the filter bags have been emptied and cleaned, they should be inspected to evaluate their condition. Given the nature of stormwater, the filter bag may become considerably clogged with fine sediment or damaged by various objects in stormwater as well as fauna. Sharp material such as sticks, combined with high velocity water and a large mass in the filter bag, can cause small tears in the filter material. Animals such as rats have also been known to chew through fine mesh filter bags located in gully pits near takeaway food outlets.

3.5.1 Clogged filters

Clogged filter bags can be cleaned using several different methods. If the techniques described in the general maintenance sections above do not adequately clean the filter bags, the following options should be considered:

- Using a stiff brush and a bucket of soapy water, scrub the filter bag surface.
- Remove filter bags from the pit and wash the bags using a high pressure water spray, taking care not to transfer the contamination elsewhere. Wastewater from the process should be collected and disposed of correctly.
- Remove the filter bags from the pits and the support rings and wash the bags in an industrial washing machine.

This final option typically results in the bags appearing like new, with no visible stain or pore clogging within the filter mesh.

Photo 25 Slightly clogged filter bag, indicated by the brown stain on in the centre of the bag

Photo 26 A clean used filter bag

3.5.2 Damaged filters

Damaged filter bags can often be repaired, provided the damage is small. Small tears in the fabric may occur due to several reasons, however the overall strength and structure of the nylon fabric typically prevents small tears becoming much larger. Although the bag is unlikely to tear further, care must be used when cleaning torn bags so as not to spill the collected material into the pit.

Small tears may be repaired by either sewing the tear back together with additional fabric to increase the strength of the stitching, or by sewing a patch of the filter material onto the filter bag. If large tears are present, the filter bag may need to be replaced as it is no longer able to function as intended.

3.6 Disposal of material

All gully pit wastes are to be taken off site and disposed of at a transfer station or similar approved disposal site. Stormwater sediments can contain lead, copper, zinc, mercury, hydrocarbons and PCBs, which are harmful to both humans and the receiving environment. Appropriate sampling and laboratory analysis may be required to classify the material as suitable for reuse, or disposal under appropriate local guidelines.

Emergency procedures

Spills and blockages can have an immediate impact on the performance of a stormwater management system, and can potentially result in serious damage to built infrastructure as well as the surrounding waterways and wetlands.

In these types of emergencies, it is important to act quickly to remediate the problem by removing affected sediment or clearing the cause of the blockage, so that the system can resume normal and effective functioning as soon as possible.

4.1 Spill procedures

In the event of a spill discharging into any gully pit, all sediment is to be extracted and the filter bags are to be removed and replaced with rejuvenated filter bags. Normal operation procedures apply to additional cleaning as a result of spills.

4.2 Blockages

In the unlikely event of surface flooding around a gully pit fitted with an EnviroPod the following steps should be carried out:

1. Check EnviroPod overflow bypass. The EnviroPod filter has been designed with an overflow mechanism built into the filter box. If surface flooding still exists, check the overflow slots underneath the rubber seal. If debris is lodged in the overflow slots it can be easily cleared by hand or a steel rod.
2. If overflow is clear and surface flooding still exists remove EnviroPod and check outlet pipe for blockages.
3. Removal of the EnviroPod may be difficult if the filter is clogged and the EnviroPod is holding water. If the filter is clogged, brush the sidewalls of the filter with a yard broom or similar. This will dislodge particles trapped at the interface allowing contained water to flow through the filter.
4. If the outlet pipe is blocked, it is likely that a gully sucker truck will be required to unblock it. Debris should be removed from the EnviroPod with the gully sucker truck before removal of the EnviroPod filter. If a gully sucker truck is not available and the EnviroPod needs to be removed by hand, follow the steps below:

a. Remove excess debris by hand or brush the side of the filter.
b. Lift and place filter ring through the filter box and into cage.
c. Remove Filter box.
d. Lift cage containing filter bag and ring out of the pit.
e. Unblock outlet pipe.

The Stormwater Management StormFilter®

For almost two decades the Stormwater Management StormFilter® has helped meet the most stringent stormwater quality requirements.

The system has been continually tested and refined, to ensure it achieves maximum reliability and performance.

As a best management practice (BMP) system, it removes the most challenging target pollutants – including fine solids, soluble heavy metals, oils and total nutrients (including soluble) – by using a variety of media to achieve site-specific pollutant removal objectives.

StormFilter® overview

1.1 Description

StormFilter is a passive, flow-through stormwater filtration system consisting of vaults that house rechargeable cartridges filled with a variety of filter media, and is installed in-line with storm drains. The StormFilter works by passing stormwater through media-filled cartridges, which trap particulates and adsorb materials such as dissolved metals and hydrocarbons. After being filtered through the media, the treated stormwater flows into a collection pipe or discharges into an open channel drainage way. StormFilter is offered in three different configurations: cast-in-place, precast and linear. The precast and linear models utilise pre-manufactured vaults. The cast-in-place units are customised for larger flows and may be either covered or uncovered underground units.

1.2 Operation

1.2.1 Purpose

The StormFilter is a passive stormwater filtration system designed to improve the quality of stormwater runoff from the urban environment before it enters receiving waterways.

Through independent third party studies, it has been demonstrated that the StormFilter is highly effective for treatment of first flush flows, and fast-paced flows, during the latter part of a storm. In general, StormFilter's efficiency is highest when pollutant concentrations are highest. The primary target pollutants for removal are: sediments (TSS), soluble metals, soluble phosphorus, nitrates, and oil and grease.

1.2.2 Sizing

The StormFilter is typically sized to meet design water quality objectives, which are subject to legislation regulated by local government authorities and other relevant environmental bodies. MUSIC modelling software is used to determine pollutant loads from a site, influenced by a number of factors such as site area, imperviousness and land use. Pollutant load reduction capabilities, based on third party testing, allows the number of StormFilter cartridges required to achieve the relevant objectives to be established. Cartridges are designed to treat a peak flow between 0.7 and 1.6 litres/second, depending on the cartridge size used. For example, 10 standard sized cartridges (460mm) are able to treat 11 L/s, as each filter can treat 1.1 L/s.

Because of the highly porous nature of the granular filter media, the flow through a newly installed cartridge is restricted to 1 L/s (average 460mm), using a restrictor disc, to ensure adequate pollutant-media contact time.

Photo 27 Filter cartridge

1.2.3 Basic function

The StormFilter is designed to siphon stormwater runoff through a filter cartridge containing media. The variety of media available can be designed to act as a mechanical filter to remove sediments, as an ion exchanger to remove dissolved heavy metals, and as an absorber to remove oils and greases.

1.2.4 Priming system function

The treated stormwater collects in the centre tube of the cartridge, which is equipped with a self-priming siphon system. (Figure 1 illustrates this system.) The key component of the system is the plastic float, consisting of a ball located at the base leading up to a larger portion, which provides increased buoyancy. Initially the ball rests in a seat, effectively closing off the port to the drainage manifold.

As a result, the filter fills the centre drainage tube until the water level has risen high enough to purge the air from the filter cartridges and displaces the float. At a water depth of 22 inches the float pulls loose and allows the filtered water to drain out through the manifold. This effectively “primes” a siphon within the drainage tube and greatly increases the potential across the filter. The priming system increases StormFilter’s ability to be loaded with sediment. A related feature is the cartridge “hood”. This hood maintains the siphon effect by preventing air from being drawn into the cartridge until the external water level drops below the bottom of the hood.

Cartridges are connected to the manifold with a plastic connector. These can be either quarter turn connectors or in the older systems, threaded connectors.

StormFilter is also equipped with flow spreaders that trap floating debris and surface films, even during overflow conditions. Depending on individual site characteristics, some systems are equipped with high and/or low flow bypasses. High flow bypasses are installed when the calculated peak storm event generates a flow that overcomes the overflow capacity of the system. This is especially important for precast systems. Low flow bypasses are sometimes installed to bypass continuous inflows caused by ground water seepage, which usually do not require treatment. All StormFilter units are designed with an overflow. The overflow operates when the inflow rate is greater than the infiltration capacity of the filter media.

1.2.5 Maintenance overview

The primary purpose of the StormFilter is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, these pollutants must be removed periodically to restore the StormFilter to its full efficiency and effectiveness. Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. To assist the owner with maintenance issues, Stormwater360 provides detailed Operation and Maintenance Guidelines with each unit.

Stormwater360 can provide maintenance services completely, or in part. Available services include tracking of installed systems, advising the system’s owner of maintenance needs, and notification of the regulatory agency once the system has been maintained.

Maintenance is usually performed in the dryer periods to rejuvenate the filter media and prepare the system for the next rainy period. Maintenance activities can also be required in the event of a chemical spill or excessive sediment loading due to site erosion or extreme storms. It is good practice to inspect the system after severe storm events.

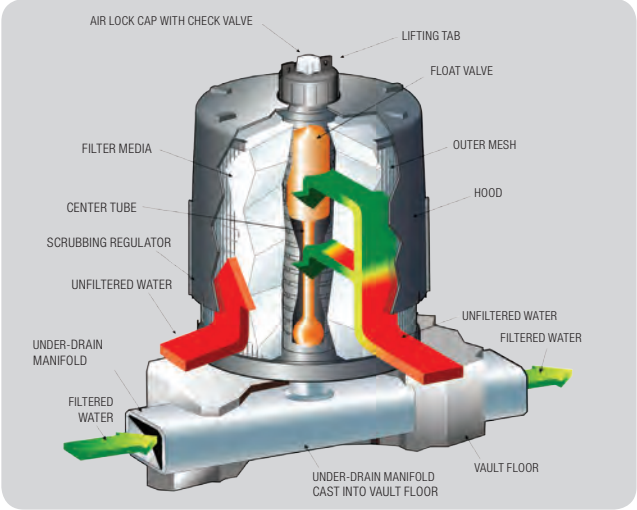

Figure 1 Filter cartridge

StormFilter® maintenance and performance expectations

To ensure the optimal and ongoing performance of the StormFilter, the system requires systematic inspection, cleaning and maintenance. This maintenance regime falls into two categories – ongoing minor inspection and maintenance, and major cleaning and maintenance. The maintenance frequency is largely determined by the conditions of each site, and the amount of sedimentation in the stormwater runoff that flows through the system. Unexpected events such as chemical spills, erosion or extreme storm activity require immediate inspection of the system, together with removal of debris or contaminated sediment, and where appropriate, replacement of the media cartridges.

While some maintenance activities can be completed by hand, others require specialised equipment such as an inductor truck with a vacuum hose. In all cases, it is important that maintenance staff are properly trained in the functioning of the StormFilter system and have a good knowledge of the correct procedures for disposing contaminated sediment as well as the methods for removing and installing StormFilter media cartridges.

At all times, appropriate safety equipment must be used, and Occupational Health And Safety (OH&S) guidelines adhered to.

2.1 Types of maintenance

Presently, procedures have been developed for two levels of maintenance:

- Inspection and/or minor maintenance
- Major maintenance.

Inspection/minor maintenance activities are combined since the minor maintenance does not require special equipment and typically little or no materials are in need of disposal.

Inspection/minor maintenance typically involves opening the flow restricting valves (to pre-set levels) and cleaning up vegetation and debris. Major maintenance typically includes cartridge recharging. Major maintenance may involve disposal of materials that require consideration of regulatory guidelines. Depending on the particular unit configuration and equipment used, major maintenance may require an understanding of OSHA rules. **Table 1** summarises the primary activities associated with StormFilter maintenance.

Table 1: StormFilter

Facility component requiring maintenance	Maintenance activity	When maintenance activity is required	Expected facility performance after maintaining
StormFilter cartridges and containment structure	Litter and debris removal	Floatable objects or other litter is present in the filter. Remove to avoid hindrance of filtration and eliminate unsightly debris and litter.	Permanent removal from storm system.
StormFilter cartridges and containment structure	Cartridge replacement and sediment removal	Media has been contaminated by high levels of pollutants, such as after a spill.	New media is able to effectively treat stormwater.
Drainage system piping	Flushing with water	Drainage system is obstructed by debris or sediment.	Outflow is not restricted.

2.2 Maintenance activities

2.2.1 Maintenance activity timing

Two scheduled inspections/maintenance activities should take place during the year. During the minor maintenance activities (routine inspection, debris removal), the type of major maintenance required is determined and, if required for disposal, samples of the sediments and media are obtained.

The next scheduled date is to perform major maintenance activities (replacement of the filter cartridges and associated sediment removal). In addition to the scheduled activities, it is important to check the condition of the filter after major storms to check for damage caused by high flows and to check for high sediment accumulation, which may be caused by localised erosion in the drainage area. It may be necessary to adjust maintenance activity scheduling depending on the actual operating conditions encountered by the system.

2.2.2 Maintenance activity frequency

The primary factor controlling timing of maintenance for the StormFilter is sedimentation. A properly functioning system will remove solids from water by trapping these particulates within the porous structure of the media. The flow through the system will naturally decrease as more and more solids are trapped. Eventually the flow through a system will be low enough to require replacement of the cartridges. Sediment should be removed from upstream trapping devices on an as-needed basis to prevent material from being re-suspended and discharged to the system.

Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction should be inspected and maintained more often than those in fully established areas. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after large storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual filter.

2.3 Maintenance crew requirements

Table 2 lists the anticipated crew requirements for maintenance operations. Removal of water and sediments during major maintenance activities can be accomplished using either a pump and water truck or a vacuum truck. All applicable occupational health and safety (OH&S) and disposal regulations should be followed. A general description of the maintenance activities follows.

Table 2 Anticipated Crew Requirements

	Inspection/Minor Maintenance	Major Maintenance: Sediment Removal	Major Maintenance: Cartridge Replacement
Labourer	1		1
Skilled Worker	1	1	1
Vacuum/Water Truck Operator		1	0/1
Total	**2***	**2***	**2/3***
Special Requirements	Knowledge of Proper StormFilter Function	Knowledge of Disposal Requirements	Knowledge of Cartridge Removal and Installation Procedures

* May require OH&S trained person if/when vault entry occurs.

2.4 Maintenance methods

2.4.1 Minor maintenance/inspection (twice a year)

Minor maintenance typically will involve the steps below, however if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately.

Steps for Minor Maintenance/Inspection

1. Maintenance to be performed by a skilled worker familiar with StormFilter units.
2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open access covers. Also set up appropriate safety equipment for work near roadways.
3. Inspect the external condition of the unit and take notes concerning defects/problems.
4. Open the access covers to the vault and allow the system to air out for 5-10 minutes.
5. **Without entering the vault,** inspect the inside of the unit, including components.
6. Take notes about the external and internal condition. This includes inspecting pit penetrations, walls, lids, ladders and grates etc.
7. Give particular attention to recording the level of sediment build-up on the floor of the vault and on top of the internal components. If flow is occurring, note the level of water and estimate the flow rate per drainage pipe. Record all observations.
8. Remove large loose debris and litter using a pole with a grapple or net on the end.
9. Close and fasten the access cover, and remove safety equipment.
10. Finally, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loadings of other materials to the system.

* In the case of a spill, workers should abort maintenance activities until the proper guidance has been obtained.

2.4.2 Major maintenance inspection (once a year)

The primary goal of the major maintenance inspection is to assess the condition of the cartridges relative to the level of sediment loading. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, large amounts of sediments should be present and very little flow will be discharging from the drainage pipes. It is likely that the cartridges need to be replaced. Major maintenance inspection will typically involve the steps below. However, if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained.**

Steps for Pre-Major Maintenance Inspection

1. Maintenance to be performed by a skilled worker familiar with StormFilter units.
2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open doors. Also, set up appropriate safety equipment for work near roadways.
3. Inspect the external condition of the unit and take notes concerning defects/problems.
4. Open the access covers to the vault and allow the vault to air out for 5-10 minutes.
5. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
6. Take notes about the external and internal condition.
7. Give particular attention to recording the level of sediment build-up on the floor of the vault, and on top of the internal components.
8. Remove large loose debris and litter using a pole with a grapple or net on the end.
9. If the visit is during a storm, make the flow observations discussed above.
10. Close and fasten the access cover, and remove safety equipment.
11. Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
12. Review the condition reports from the previous minor and major maintenance visits and schedule for cartridge replacement if needed.

2.4.3 Major maintenance: sediment removal and cartridge replacement (and emergency)

Major maintenance/filter cartridge replacement typically involves the steps below. However, if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained.**

Depending on the configuration of the particular system, a worker may be required to enter the vault to perform some tasks. If vault entry is required, OH&S rules for general confined space entry must be strictly adhered to. Filter cartridge replacement should occur during dry weather and it may be necessary to plug the filter inlet pipe if base flows exist. Standing water present in the vault should be regarded as polluted and contained during this operation by temporarily capping the manifold connectors.

> **Please note:** Confined space entry may be required on StormFilter systems. In this case, please ensure that appropriate Confined Space entry training and subsequent certification has been undertaken and is valid, and work procedures are strictly adhered to. If you are unsure, do not enter the vault and contact Stormwater360 immediately.

Steps For Cartridge Replacement Maintenance

1. Depending on the particular unit, one or two utility workers and a hauling truck operator will deliver the replacement cartridges to the site. Information concerning how to obtain the replacement cartridges is available from Stormwater360.
2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open doors. Also, set up appropriate safety equipment for work near roadways.
3. Inspect the external condition of the unit and take notes concerning defects/problems.
4. Open the doors to the vault and allow the system to air out for 5-10 minutes.
5. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
6. Make notes about the external and internal condition.
7. Give particular attention to recording the level of sediment build-up on the floor of the vault and on top of the internal components.
8. Ensuring safe working procedures are met, off load the replacement cartridges (16-39kgs each) and set aside.
9. Remove the top cap (threaded), upper seal and float from the cartridge. Repeat procedure for every cartridge within StormFilter vault. Place items in a large plastic container to be lifted form the vault.
10. Using a cordless drill and 8mm hex head, remove the three screws located around the top perimeter of the cartridge hood. Place screws in the large plastic container and, once full or completed, remove plastic container from vault.
11. Move the vacuum truck near the StormFilter vault on the down-wind side. Be sure that the truck is not too close to the vault so that fumes will not enter the vault. Make sure that the last 500mm of the nozzle is approximately 100-125mm in outside diameter.
12. Feed vacuum nozzle into cartridge bay and start vacuum truck. Remove cartridge hood and place nozzle directly onto filter media. Completely remove media from each cartridge and repeat process for every cartridge in vault.
13. Once completed disconnect cartridges from vault floor and place hood back on cartridges
14. Using the appropriate lifting cap, attach the cable and remove the cartridge (up to 10kgs. each) from the vault. It is strictly prohibited to have personnel standing under suspended cartridges. Care must also be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner unless Stormwater360 is performing maintenance activities and damage is not related to discharges to the system.
15. Set the used cartridge aside or load onto the hauling truck.
16. Repeat steps 14 to 15 until all cartridges have been removed.
17. Remove deposited sediment from the floor of the vault. This can be accomplished by using the vacuum truck
18. Once the sediments are removed, it is necessary to assess the condition of the vault, particularly the manifold and the connectors. These are short sections of 2-inch schedule 50 PVC, or threaded schedule 80 PVC that should protrude above the floor of the vault. If required, apply a light coating of FDA approved silicon grease to the outside of the exposed portion of the connectors. This ensures a watertight connection between the cartridge and the drainage pipe. Replace any damaged connectors.
19. Using the boom, crane, or tripod, lower and install the new cartridges (typically 30kg for standard 460 cartridges). Once again, take care not to damage connectors.
20. Close and fasten the access cover, and remove safety equipment.
21. Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loadings of other materials to the system.
22. Finally, dispose of the residual materials in accordance with applicable regulations. Make arrangements to return the used cartridges to Stormwater360.

2.4.4 Related maintenance activities (performed on an as-needed basis)

StormFilter units are often just one of many components in a more comprehensive stormwater drainage and treatment system. The entire system may include catch basins, detention vaults, sedimentation vaults and manholes, detention/retention ponds, swales, artificial wetlands, and other miscellaneous components. In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities. In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil and grease loading, and discharges of inappropriate materials.

2.5 Typical equipment required for maintenance activities

Typical equipment required for conducting maintenance is shown in Table 3. Some of the materials listed are suggestions rather than requirements. It should be noted that there is more than one way to accomplish some tasks. Owners with available labour and equipment resources may desire to use alternative methods. However, it is advisable that guidance from Stormwater360 be obtained prior to using alternative techniques.

Table 3 Maintenance Equipment Requirements

Maintenance equipment required		
Minor maintenance	**Pre-major maintenance inspection**	**Major maintenance cartridge replacement**
• Safety equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats • Work clothes: Rubber boots, overalls, and gloves • Door bolt, wrench, proprietary lifters (e.g. Gatic) and miscellaneous Tools • Tape measure • Flashlight • Grapple or net pole • Record keeping forms • Litter/debris container	• Safety equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats • Work clothes: Rubber boots, overalls, and gloves • Door bolt, wrench, proprietary lifters (e.g. Gatic) and miscellaneous Tools • Tape measure • Flashlight • Grapple or net pole • Record keeping forms • Litter/debris container	• Safety equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats • Work clothes: Rubber boots, overalls, and gloves • Door bolt, wrench, Pentasocket and miscellaneous Tools • Tape measure • Flashlight • Grapple or net pole • Record keeping forms • Vacuum truck • Replacement cartridges • Cartridge hauling truck • Crane, tripod and hoist, or other lifting device (150kg minimum capacity) • Shovels • Extra 50mm PVC cartridge connectors • Spare flow restrictor discs • Litter/debris container • Vault inlet pipe plug • Dolly • PVC Pipe cutter • Ladder • Cartridge installation and removal sling

*Confined space equipment may be required for vault entry. This equipment must be used by personnel with the appropriate OH&S training. This equipment typically includes: Atmospheric testing devices, atmospheric purging and ventilating devices, and entry, exit, and rescue assisting devices.

2.6 Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in a manner that will not allow the material to affect surface or ground water. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily travelled roads. Sediments and water must be disposed of in accordance with all applicable waste disposal regulations.

It is not appropriate to discharge these materials back to the stormwater drainage system. Part of arranging for maintenance to occur should include coordination of disposal of solids (landfill coordination) and liquids (municipal vacuum truck decant facility, local wastewater treatment plant, on-site treatment and discharge). Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals. Stormwater360 will determine disposal methods or reuse of the media contained in the cartridges. If the material has been contaminated with any unusual substance, the cost of special handling and disposal will be the responsibility of the owner.

SFEP StormFilter & Enviropod Maintenance Data Sheet

Stormwater360 AUSTRALIA

Date:	Location:	GPS COORD:
System size:	Type: ◯ Cast-in-place ◯ Precast ◯ Linear	
Number of Cartridges:	Type of Cartridge: ◉ 460mm ◯ 690mm ◯ 310mm	
Filter Media: ◯ ZPG ◯ Perlite		
Type of EnviroPods:		Number of EnviroPods:
Personnel:		

STORMFILTER SYSTEM OBSERVATIONS

Last service:
Sediment Depth on Vault Floor:
Structural Damage:
Cartridges submerged: ◯ Yes ◯ No How deep:
Comments:

ENVIROPOD SYSTEM OBSERVATIONS

Last service:
Amount of Sediment in Basket:
Structural Damage:
Comments:

DRAINAGE AREA REPORT

Excessive Oil and Grease Loading	◯ Yes	◯ No	Source:
Sediment Accumulation on Pavement	◯ Yes	◯ No	Source:
Erosion of Landscaped Areas	◯ Yes	◯ No	Source:
Comments:			

STORMFILTER CARTRIDGE MAINTENANCE ACTIVITIES

Remove Litter and Debris	◯ Yes	◯ No	Details:
Sediment Removed from Vault Floor	◯ Yes	◯ No	Details:
Quantity of Sediment Removed (estimate?):			
Replace Cartridges	◯ Yes	◯ No	Details:
Minor Structural Repairs	◯ Yes	◯ No	Details:
Residuals (debris, sediment) Disposal Methods:			
Notes/Problems:			

ENVIROPOD MAINTENANCE ACTIVITIES

Number of Bags Replaced:	Clogged EnviroPods/Bags: ◯ Yes ◯ No
Comments:	

SFEP Treatment Train Inspection Data Sheet

Stormwater360 AUSTRALIA

It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, large amounts of sediments should be present, very little flow will be discharging from the drainage pipes, and it is likely that the cartridges need to be replaced during major maintenance.

Date:	Location:	GPS COORD:
System size:	Type: ◯ Cast-in-place ◯ Precast ◯ Linear	
Number of Cartridges:	Type of Cartridge: ◯ 460mm ◯ 690mm ◯ 310mm	
Filter Media: ◯ ZPG ◯ Perlite		
Type of EnviroPods:		Number of EnviroPods:
Personnel Attending Inspection:		

STORMFILTER SYSTEM OBSERVATIONS

Last service:
Sediment Depth on Vault Floor:
Structural Damage:
Cartridges submerged: ◯ Yes ◯ No How deep:
Comments:

ENVIROPOD SYSTEM OBSERVATIONS

Last service:
Amount of Sediment in Basket:
Structural Damage:
Comments:

DRAINAGE AREA REPORT

Excessive Oil and Grease Loading	◯ Yes	◯ No	Source:
Sediment Accumulation on Pavement	◯ Yes	◯ No	Source:
Erosion of Landscaped Areas	◯ Yes	◯ No	Source:
Comments:			

Next steps

Learn more

For more detailed technical information about Stormwater360 products and solutions, visit **www.stormwater360.com.au**

Connect with us

With more than 12 years experience in developing, installing and maintaining innovative and efficient site-specific stormwater management solutions, Stormwater360's highly qualified engineers and consultants can assist you with every aspect of your stormwater project.

Whether it's an initial in-house technical presentation, a request to inspect and clean your existing facility, or assistance with designing a specific stormwater management solution for your site, simply complete the enquiry form at **stormwater360.com.au** or call **1300 354 722** to speak to a Stormwater360 consultant.

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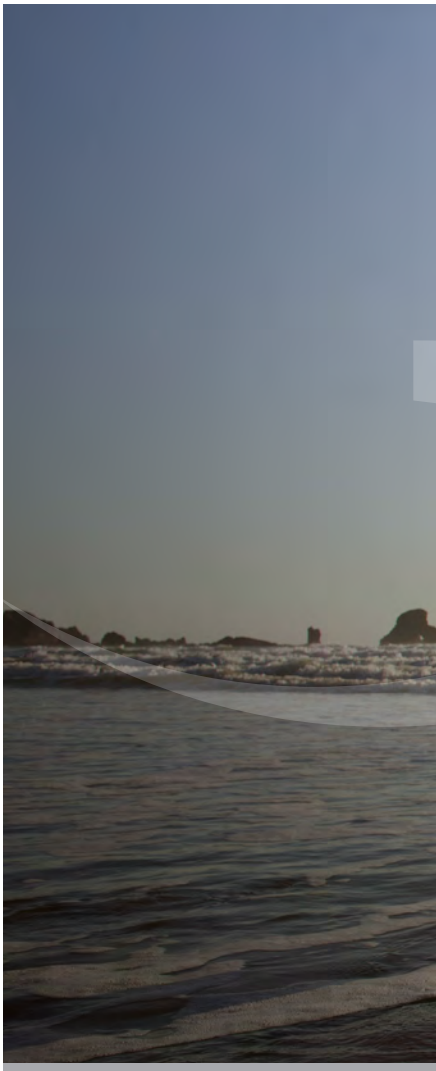
If you are ready to begin a project, our engineering team will provide you with everything you need, from a free preliminary design to MUSIC modelling, CAD drawings to maintenance frequency and associated costs schedules. To find out more, simply visit **www.stormwater360.com.au/custom-solutions** and complete the Design Information Request form.

Stormwater360 supplies and maintains a complete range of filtration, hydrodynamic separation, screening and oil/water separation technologies.

Call 1300 354 722



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