Warren Smith & Partners

17 October 2019

CIVIL ENGINEERING SERVICES

Seniors Living and RACF Development

Village Green Penrith

Development Application

DOCUMENT CONTROL

Rev #	Date	Description of Change	Status
05	17th October 2019	Re-Issue for Development Application	Current
04	14th October 2019	Re-Issue for Development Application	Superseded
03	26th June 2019	Re-Issue for Development Application	Superseded
02	7th June 2019	Re-Issue for Development Application	Superseded
01	7th December 2018	Issue for Development Application	Superseded

APPROVALS

Rev #	Author	Approver
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CONTENTS

SCHEDULES

CIVIL ENGINEERING SERVICES

1. INTRODUCTION

Warren Smith and Partners (WS+P) has been engaged by Greengate Property Group to prepare a Development Application report for the redevelopment of the Council owned carpark into an integrated Aged Care and Retirement Village located on Reserve Street, Penrith.

This report outlines a stormwater strategy plan associated with the proposed development and aims to address the following: -

- Proposed Stormwater Drainage Works
- On-Site Detention (OSD);
- Freeboard Requirements;
- Water Quality Requirements and Proposed Treatment System, and;
- Sediment and erosion control.

1.1 BACKGROUND

The existing site is a public council-owned on-grade carpark on Reserve Street, Penrith. The development site is bound by Derby Street to the north, Woodriff Street to the east, Reserve Street to the south, and residential properties to the west.

Please refer to Figure 1.1 which illustrates the extent within which the proposed works are to be undertaken.

Figure 1.1: Aerial View of Property Boundary (Source: Six Maps)

2. ABBREVIATIONS AND DEFINITIONS

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
DA	Development Application
DCP	Development Control Plan
DN	Diameter Nominal (mm)
EY	Exceedances per Year
IFD	Intensity-Frequency-Duration
IL	Invert Level
L/s	Litres per second
LGA	Local Government Area
m/s	Metres per second
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
OSD	On-Site Detention
PCC	Penrith City Council
RCP	Reinforced Concrete Pipe
RL	Reduced Level
RWT	Rainwater Reuse Tank
SID	Safety In Design
WSC	Water Services Coordinator
WS+P	Warren Smith and Partners
WSUD	Water Sensitive Urban Design

The Use of Must, Shall & Should:

In accordance with the International Organization for Standardisation (ISO) Directives, the word “shall” is used to state that a requirement is strictly to be followed in order to conform to a Performance Requirement. Consequently, there can be no deviation from that requirement, other than a specific tolerance.

It is noted that in legislation and specifications it is common to use the word “must” to express a requirement. The word “shall” in this document should be considered as equivalent to “must” in the legislation.

The word “should” introduces a suggestion or recommendation that is not a requirement. It is not necessary that such recommendations or suggestions be followed in order to comply with the Performance Requirement.

3. EXISTING STORMWATER DRAINAGE

A desktop review and a site inspection were undertaken on 8th November 2018 to determine the existing drainage infrastructure within the development area. The review revealed the following:-

- The north portion of the site grades to Derby St., the south portion grades to the neighbouring site to the west and to the Reserve St. and the east portion grades to Woodriff St.;
- There are two (2) pits located adjacent to the development, one of which is located on Woodriff Street and the other located on Reserve Street, and;
- There is no drainage system in Derby St. and within the existing carpark which currently experiences ponding in minor storm events.

Please refer to Figure 3.1 for an illustration of the existing stormwater infrastructure and site grading.

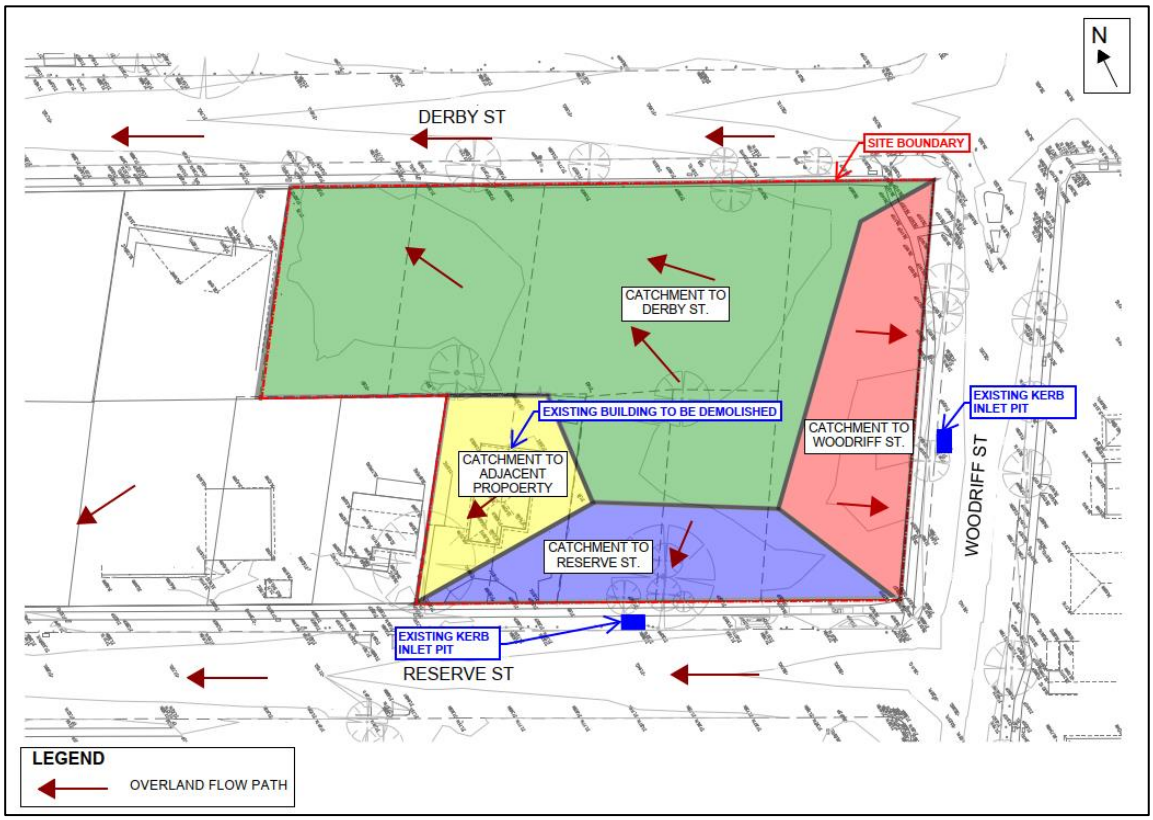

Figure 3.1: Existing Site Stormwater Network and Site Grading

4. AUTHORITY AND REGULATORY REQUIREMENTS

With reference to the Penrith City Council (PCC) Development Control Plan (DCP) 2014, PCC Stormwater Drainage Specification for Building Developments, dated November 2016, and PCC WSUD Technical Guidelines 2015, the Council requirements are as presented in the following sub-sections.

4.1 STORMWATER DRAINAGE AND ON SITE DETENTION (OSD) REQUIREMENTS

- The minor, or piped, stormwater system shall be designed to cater for all storm events up to, and including, the 5% AEP storm event;
- The major stormwater system, or overland flow paths, shall be designed to cater for all storm events up to, and including, the 1% AEP storm event;
- OSD systems shall be designed to cater for all storm events up to, and including, the 1% AEP storm event;
- Discharge to kerb and gutter shall be limited to 25L/s in the 10% AEP storm event, and;
- Post development discharge rates shall not exceed pre-development discharge rates for all storm events up to, and including, the 1% AEP storm event.

4.2 FREEBOARD REQUIREMENTS

Refer to Table 4.1 for the freeboard requirements for developments requiring OSD.

Table 4.1: Freeboard Requirements

Type	Freeboard (mm)
Residential, Industrial or Commercial Floor Levels	300*
Garage Floor Levels for Residential Dwellings	100
Entry Crest to Basement Carparks	300

**May be reduced in exceptional circumstances where there is no risk to the development*

4.3 WATER SENSITIVE URBAN DESIGN (WSUD)

Minimum pollutant reduction targets adopted are in accordance with Penrith City Council DCP requirements for water quality. Refer to Table 4.2 for the pollutant reduction targets.

Table 4.2: WSUD Pollutant Reduction Targets

Pollutant Type	Percentage (%) Retention of Post Development Loads
Gross Pollutants (GP)	90%
Total Suspended Solids (TSS)	85%
Total Phosphorus (TP)	60%
Total Nitrogen (TN)	45%

5. PROPOSED STORMWATER DRAINAGE SYSTEM

The proposed site has a total development area of 0.4955 Ha. The majority of the site, consisting of roof and suspended areas, shall be captured via the hydraulic system. Rainwater captured from the hydraulic system shall reticulate to three (3) separate OSD tanks. One (1) tank is located along the south-eastern boundary of the site and two (2) OSD tanks will be located on the northern boundary of the site.

Roof area from Building 1 shall reticulate to a 12.3kL rainwater tank, with any overflows from the system discharging into OSD Tank 2. OSD Tank 2, on the south eastern site boundary shall be suspended within Basement Level 1 and will, discharge into a proposed kerb inlet pit in Reserve Street. The two (2) OSD tanks located on the northern site boundary line will be partially above ground. Both tanks will discharge to the kerb and gutter in Derby Street.

A separate grated drain located along the driveway ramp into the basement shall capture surface runoff from a small portion of the driveway and adjacent landscaped area, bypassing the OSD tanks, and shall reticulate via a pit and pipe network prior to discharging directly into a proposed kerb inlet pit on Reserve Street.

A swale located along the eastern boundary of the site shall capture surface runoff from the eastern portion of the site prior to discharging into the proposed kerb inlet pit in Reserve Street. A small area along the northern boundary of the site shall bypass the stormwater system and runoff into a buffer zone prior to flowing into Derby Street. The northern area of the court yard will bypass the OSD and be reticulated into a second 12.3kL rainwater tank, with any overflow discharging to the kerb and gutter in Derby Street.

Council has provided commentary in relation to the existing capacity restraints at Woodriff St and we have redesigned the system to take this into account.

The stormwater system has been re-designed to match the existing flow scenarios per council's advice. We have taken account of the lack of capacity in the Woodriff Street drainage system and removed any discharge to this network. In addition, we have also removed the existing overland flow regime through a private property at 11 Reserve Road.

There is no existing stormwater system in Derby Street which has resulted in the OSD system for this portion of the site to discharge to kerb and gutter to re-create the existing flow regime. This has resulted in the OSD tanks being partially above ground under planter beds which means that the drainage from the suspended deck cannot reticulate to the OSD as the system will overflow onto the deck prior to reaching it's 100-year ARI Tank HGL. The alternative is to reticulate this deck system to a basement pump-out, which would discharge to the OSD, which is not desirable due to the risks in flooding the basement.

This has resulted in the total site bypass exceeding the limit of 15% set by council. To assist in alleviating this issue 543 m^2 of the site will reticulate to an additional rainwater tank before discharging to the kerb and gutter on Derby Street.

It should be noted that even with the bypass included that the proposed development still complies with the overarching DCP requirements to keep post-development flows below pre-development flows. This is illustrated in Table 5.4 which shows a 38% reduction in flows in the 5% AEP storm event and a 40% reduction in the 1% AEP storm event.

Refer to Table 5.1 for a catchment breakdown. Refer to Figure 5.1 for the stormwater layout plan and stormwater catchment plan respectively.

Table 5.1: Catchment Breakdown

Catchment	Impervious Area (Ha)	Pervious Area (Ha)	Total Area (Ha)
OSD Tank 1			
Building 2 Roof to OSD Tank 1	0.0834	-	0.0834
		OSD Tank 1 Catchment	**0.0834**
OSD Tank 2			
Building 1 Roof to RWT 2	0.0350	-	0.0350
Building 1 Roof to OSD Tank 2	0.0862	-	0.0862
Suspended Area to OSD Tank 2	0.0566	0.0217	0.0783
		OSD Tank 2 Catchment	**0.1995**
OSD Tank 3			
Building 3 Roof to OSD Tank 1	0.0750	**-**	0.0750
		OSD Tank 3 Catchment	**0.0750**
Bypass			
Ground Area	0.0156	0.0677	**0.0833**
Ground Area Captured by Rainwater Tank	0.0364	0.0179	**0.0543**
Total Area (Ha)	**0.3882**	**0.1073**	**0.4955**

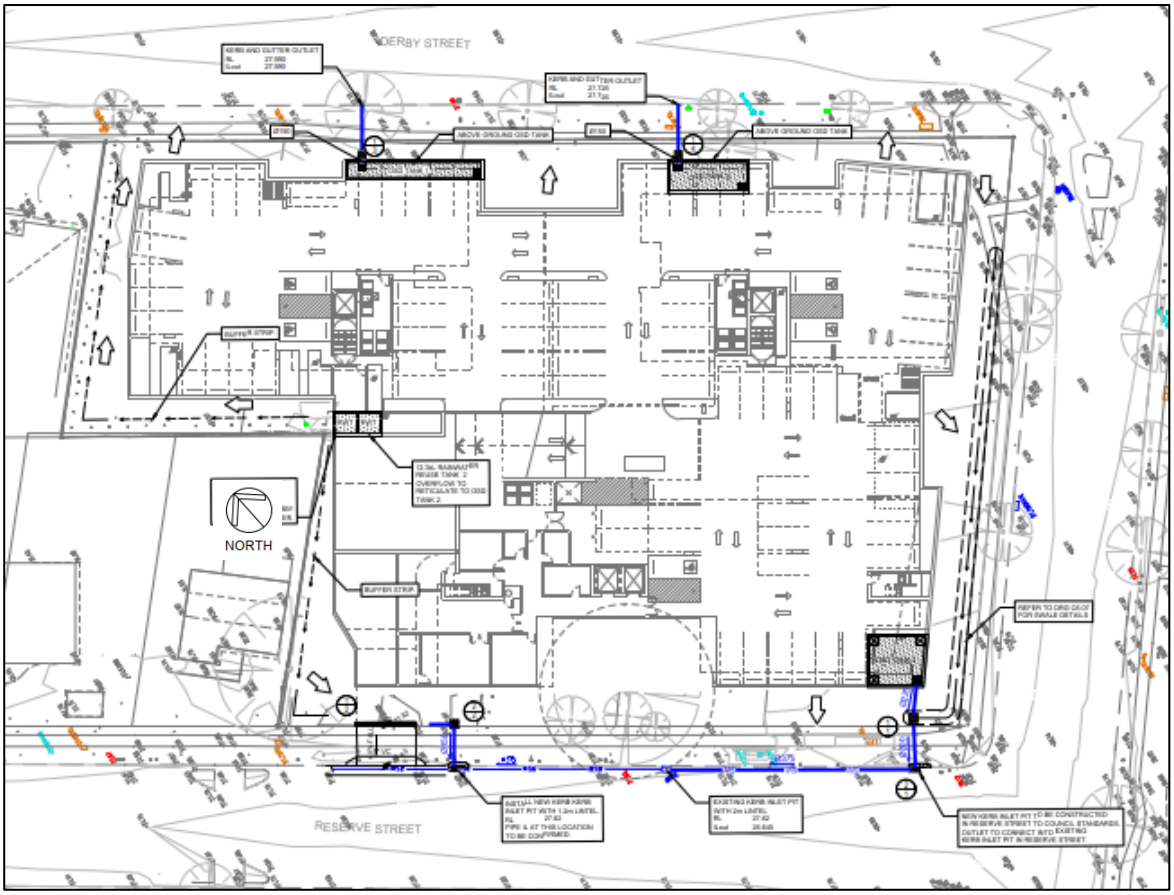

Figure 5.1: Proposed Stormwater Layout Plan

5.1 DRAINS INPUT PARAMETERS

The site discharges have been calculated using a DRAINS model, which is a stormwater drainage system design and analysis program. DRAINS performs hydraulic grade line analysis and generates flows that occur in a drainage system for a particular AEP storm event.

The catchment characteristic factor values for the development site used in the DRAINS model are listed below:-

- Soil Type – Normal 3.0
- Paved (Impervious) Area Depression Storage 1mm
- Supplementary Area Depression Storage 1mm
- Grassed (Pervious) Area Depression Storage 5mm
- Antecedent Moisture Condition 3.0
- Minimum Pit Blockage (Sag Pits) 0.5
- Minimum Pit Blockage (On-Grade Pits) 0.3
- Minimum Pit Freeboard 150mm

The rainfall data has been taken from the Bureau of Meteorology Rainfall IFD Data System using local coordinates. ARR 2016 procedures have been adopted for modelling purposes.

5.2 TAILWATER LEVEL

The tailwater level adopted in DRAINS is in accordance with the PCC Stormwater Drainage Specification for Building Developments. Where discharging to an existing kerb inlet pit, the tailwater level has been set at the grate level for all storm events up to, and including, the 10% AEP storm event. For storm events greater than the 10% AEP storm event up to, and including, the 1% AEP storm event, the tailwater level has been set at the top of kerb level.

5.3 SITE DISCHARGE RESULTS

In order to comply with the PCC's stormwater drainage requirements, the existing site and proposed development were both modelled in DRAINS. As the existing site is a gravel carpark, a conservative approach has been adopted when modelling the pre-development scenario, whereby the site has been assumed 50% pervious to account for infiltration of stormwater into the ground.

Refer to Table 5.2 for the pre-development and post development discharge flows.

Table 5.2: Total Site Discharge Results

Storm Event (% AEP)	Pre-Development Area Discharge (L/s)	Post Development Area Discharge (L/s)
50% AEP Event	69	61
20% AEP Event	124	87
10% AEP Event	165	106
5% AEP Event	199	109
2% AEP Event	232	127
1% AEP Event	270	140

The discharge results were also examined by comparing the pre vs post development catchment area for the site. The pre-development catchment area is shown in Table 5.3.

Table 5.3 Pre-Development Catchment Area

Catchment	Area (ha)
To Derby Street	0.2919
To Reserve Street	0.0780
To Woodriff Street	0.0752
To Adjacent Property	0.0504

Table 5.4 shows the pre vs post development of each storm event for each catchment area.

Table 5.4 Pre vs Post Catchment Discharge Results

	To Derby Street		To Reserve Street		To Woodriff Street		To Adjacent Property	
	Pre-Discharge (L/s)	Post Discharge (L/s)	Pre-Discharge (L/s)	Post Discharge (L/s)	Pre-Discharge (L/s)	Post Discharge (L/s)	Pre-Discharge (L/s)	Post Discharge (L/s)
50% AEP	40	45	11	16	11	0	7	0
20% AEP	73	54	20	33	19	0	13	0
10% AEP	97	65	26	41	25	0	17	0
5% AEP	117	73	31	36	30	0	20	0
2% AEP	137	86	37	41	35	0	24	0
1% AEP	159	95	78	45	41	0	27	0

The post development design eliminates the current discharge to the adjacent property and Woodriff Street, which we understand is currently designed for the 1 year ARI. There are some minor increases in discharge to Reserve Street in the minor event but this is attributed to removing discharge to Woodriff Street and to the private properties. OSD Tanks 1 and 3 have discharge rates of 21 L/s and 12 L/s to the kerb and gutter in Derby Street for the 10% AEP Storm event.

6. FREEBOARD REQUIREMENTS

In accordance with Penrith City Council's Stormwater Drainage Specification for Building Developments, a minimum freeboard shall be provided for developments requiring OSD. The minimum freeboard requirements have been specified in Section 4 of this report. As the existing site sits outside of the 1% AEP flood extent, the freeboard has been adopted from the existing ground level adjacent to the point of entry. However, the site is identified as a Flood Planning Area from the Penrith CBD Overland Flow 2015 Study. The Flood Planning Level for this development is RL 28.20m AHD.

Refer to Figure 6.1 for an illustration of the proposed development location within the Penrith 1% AEP flood extent which has been taken from the Penrith CBD Detailed Overland Flow Flood Study, undertaken by Cardno in July 2015.

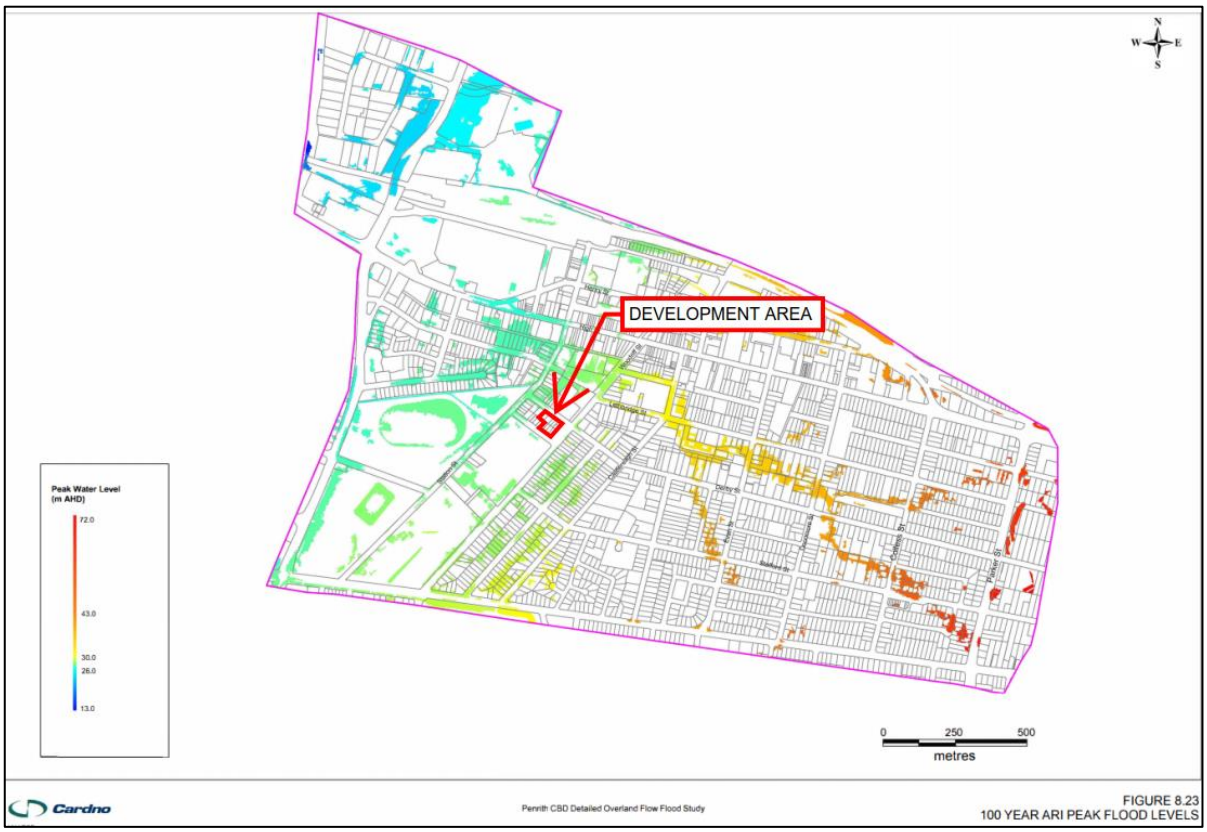

Figure 6.1: 1% AEP Flood Extent (Source: Cardno Penrith CBD Overland Flood Study)

The development currently satisfies the freeboard requirements for entry crests to basement carparks, with approximately 400mm provided for the kerb level to the carpark entry threshold. Additionally, the development complies with the minimum freeboard requirement of 300mm from the existing level to the proposed finished floor level. The minimum floor level is also set at 28.20m AHD, which complies with the Flood Planning Level. Refer to Figure 6.2 for difference between existing ground level and finished floor levels.

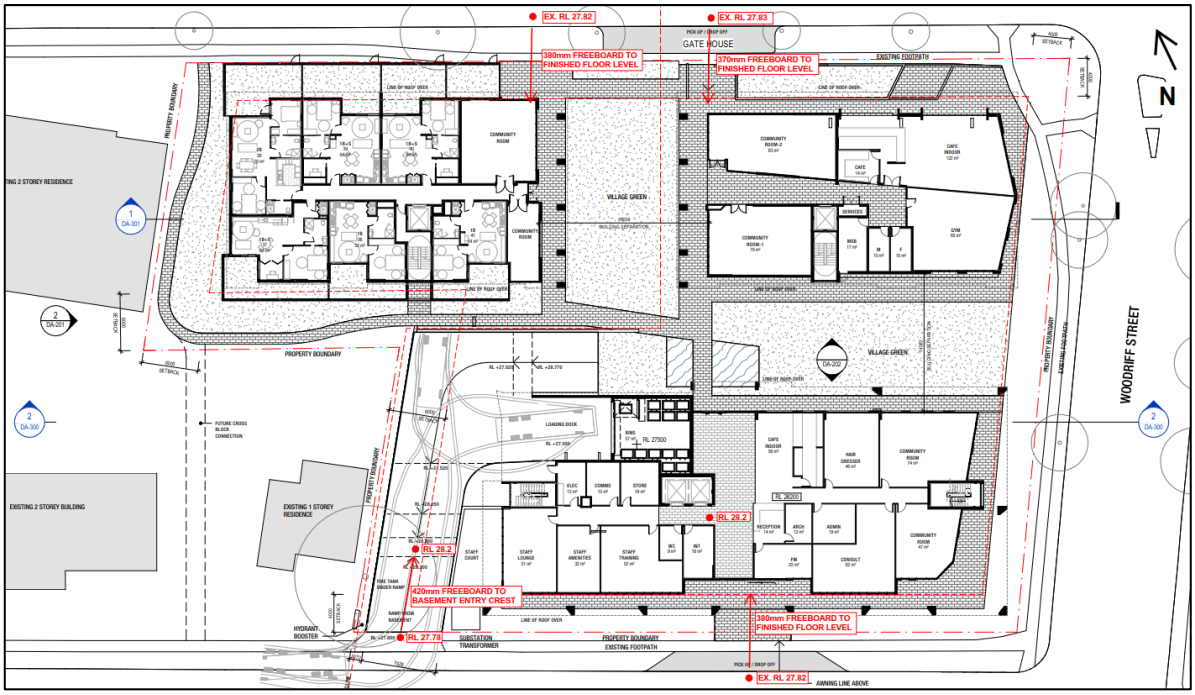

Figure 6.2: Freeboard Provided Across Development Site

7. WATER QUALITY REQUIREMENTS AND PROPOSED TREATMENT SYSTEM

In order to comply with the PCC requirements for the adequate treatment of stormwater runoff, treatment solutions have been provided to remove suspended solids, hydrocarbons, and nutrients prior to being discharged from site.

The pollutants that could potentially be generated as a result of the development are as follows:-

- Litter;
- Sediments, and;
- Nutrients (Phosphorus and Nitrogen).

The development has been modelled to demonstrate the performance of the stormwater treatment system utilising a program called MUSIC. MUSIC models the proposed stormwater treatment devices and estimates their respective performance against the performance targets of the project. The pollutants modelled in MUSIC are Gross Pollutants (GP), Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN).

7.1 RAINFALL

The rainfall data to be used in the MUSIC model will be based on the Bureau of Meteorology data from a Sydney rainfall station. Refer to Table 7.1 and Table 7.2 for the rainfall and potential evapotranspiration data (PET) data respectively.

Table 7.1: Rainfall Data for MUSIC Modelling

Rainfall Station	Rainfall Period	Rainfall Period Dates	Time Step
067113 Penrith Lakes AWS	10 years	Jan 1999 – Dec 2008	6 minutes

Table 7.2: Monthly Evapotranspiration Data for MUSIC Modelling

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PET (mm)	159	122	115	77	50	39	41	57	81	122	142	152

7.2 RAINFALL RUNOFF PROPERTIES

In accordance with the NSW MUSIC Modelling Guidelines, August 2010, Table 7.3 and Table 7.4 present the rainfall runoff properties which have been used in the MUSIC model.

Table 7.3: Soil Properties for MUSIC Source Nodes

Parameter	Units	Urban
Impervious Area Parameters		
Rainfall Threshold	mm	1.4mm
Pervious Area Parameters		
Soil Capacity	mm	105
Initial Storage	%	30
Field Capacity	mm	70
Infiltration Capacity Coefficient – a		150
Infiltration Capacity Coefficient – b		3.5
Groundwater Properties		
Initial depth	m	10
Daily Recharge Rate	%	25
Daily Baseflow Rate	%	10
Deep Seepage	%	0

Table 7.4: Stormwater Water Quality Parameters for MUSIC Source Nodes

Land-Use Category		Log_{10}TSS (mg/L)		Log_{10}TP (mg/L)		Log_{10}TN (mg/L)	
		Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow
General Urban	Mean	2.15	1.20	-0.60	-0.85	0.30	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12
Roof Areas	Mean	1.30	*	-0.30	*	0.34	*
	Std Dev	0.32	*	0.25	*	0.19	*

**Base flows are only generated from pervious areas; therefore these parameters are not relevant to impervious areas*

7.3 STORMWATER TREATMENT PLAN

The MUSIC model's total catchment area to be treated is 0.4955 Ha. The proposed site treatment shall utilise two products by Ocean Protect. The first level of treatment shall include OceanGuard, which intercepts surface runoff at the pit grates and filters the runoff prior to entering the piped stormwater system. It is proposed that two (2) proposed grated stormwater pits on-site be fitted with OceanGuard filter baskets. It is also proposed that an OceanGuard filter basket be installed immediately upstream of each OSD tank to reduce the gross pollutants and total suspended solids entering the system. The OceanGuard is fitted with a monofilament 200 micron pore size filter bag that removes gross pollutants such as sediment, trash and debris as well as suspended solids; please refer to Figure 7.1 for an illustration of a typical OceanGuard.

Figure 7.1: Typical OceanGuard Filter

The second treatment device which shall be incorporated into the system is a stormfilter system. To achieve the reduction targets, each OSD tank shall be fitted with six (6) 460mm phosphorous absorption cartridges. A Psorb Stormfilter cartridge system is provided to remove any remaining suspended sediments and nutrients which have entered the stormwater system, please refer to Figure 7.2 for an illustration of a typical Psorb Stormfilter.

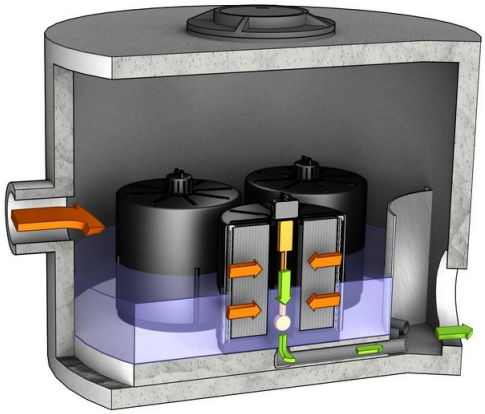

Figure 7.2: Typical PSorb Stormfilter

In addition to the above mentioned proprietary devices, it is proposed that a swale be installed along the eastern boundary of the site to capture and treat the majority of the eastern bypass. The swale will significantly reduce the nutrient content within the stormwater prior to being discharged from site. A buffer strip shall also be located along the western boundary of the site to treat bypass from the western portion of the site. Please refer to Table 7.5 and Table 7.6 for the swale and buffer strip details respectively.

Table 7.5: Swale Details

Length (m)	Bed Slope (%)	Base Width (m)	Top Width (m)	Depth (m)
52.5	1.00	0.40	1.60	0.15

Table 7.6: Buffer Strip Details

Percentage of Upstream Area Buffered (%)	Upstream Impervious Area (m^2)	Buffer Area (m^2)	Buffer Area (% of Upstream Impervious Area)	Exfiltration Rate (mm/hr)
100	66	69	50	0.00

7.4 MUSIC MODEL TREATMENT RESULTS

The stormwater quality treatment system has been modelled using the MUSIC software. Please refer to Figure 7.3 for the treatment plan, and Table 7.7 and Schedule 1 for the treatment results.

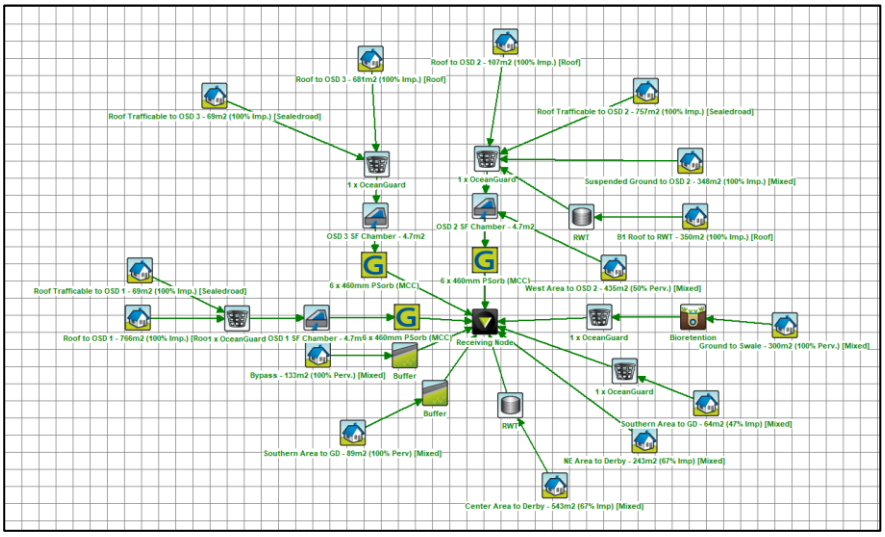

Figure 7.3: MUSIC Model Treatment Plan

Table 7.7: Percentage Based Load Reduction in Pollutant Results

Pollutant Type	Source (kg/yr)	Residual Load (kg/yr)	Reduction % Achieved	DCP Target Reduction (%)
Gross Pollutants (GP)	66.2	3.10	95.4	90
Total Suspended Solids (TSS)	193	28.3	85.6	85
Total Phosphorus (TP)	0.467	0.138	76.8	60
Total Nitrogen (TN)	4.95	2.35	57.3	45

7.5 STORMWATER TREATMENT MAINTENANCE MEASURES

In order to ensure the effective operation of treatment measures, regular maintenance must be undertaken for all of the systems. The following maintenance procedures are proposed for the proposed stormwater treatment measures.

The rainwater tank should be regularly monitored so as to minimise the amount of debris, litter and sediment within the tank. The gutter guards, leaf diverter and first flush diverters should be inspected generally every three (3) or four (4) months, while the tanks should be monitored and cleaned of sediment every one (1) or two (2) years. Tanks should also be examined for accumulation of sludge every two (2) or three (3) years, and desludged. Additionally, sections of pipework that are not self-draining should be drained.

The OceanGuard filter baskets are to undergo two (2) separate levels of maintenance, in accordance with Ocean Protect's recommendations; these being the inspection/minor maintenance, and the major maintenance. Minor maintenance, an inspection, is recommended to be undertaken twelve (12) times a year (monthly) and after major storm events, particularly during the first year of operation. Major maintenance is to be undertaken two (2) to six (6) times a year, with the frequency being adjusted to accommodate variable rainfall patterns; i.e. inspections are undertaken on a more frequent basis in months where higher volumes of rainfall are expected. It is recommended that the filter baskets are no more than two-thirds full when emptied as it may cause blockages of the overflow sections. For more details on maintenance requirements, refer to Ocean Protect's Operations and Maintenance Manual for OceanGuard.

The Psorb stormfilter cartridges, similarly to the OceanGuard filter baskets, are to undergo both minor maintenance and major maintenance. Minor maintenance is to be undertaken twice a year and after major storm events, and generally involve a visual inspection of the system and removal of vegetation and debris, as required. Major maintenance is to be undertaken once a year, and generally involves cartridge recharging and disposal of materials that require consideration of regulatory guidelines. For more details on maintenance requirements and factors influencing maintenance, refer to Ocean Protect's Operation, Design, Maintenance and Performance Manual for stormfilters.

The maintenance for the OceanGuard filter baskets and Psorb stormfilter cartridges are to be undertaken by a qualified and licenced Cleaning Contractor.

The swale and buffer strip, located along the eastern and western boundaries of the site respectively, must be monitored and inspected routinely, primarily during the first two (2) years of establishment. Weeds may require removal, replanting of vegetation may be required and sedimentation may impact on the growth of plants. Debris and sediment removal is an ongoing maintenance requirement which must be undertaken regularly in order to minimise obstructions to the flow path and blockages of the system. Long term maintenance requirements include the removal and replacement of dead vegetation within the swale/buffer strip, and repair of any damage to the swale profile, as a result of scour, erosion and potential vehicle damage. Inlet pits within the swale will also require routine inspections to ensure that they are clear of blockages and to maintain the structural integrity of the structure. General considerations that should be taken into account are whether mowing is required, whether there is evidence of ponding, or whether soil additives or amendments are required.

8. SEDIMENT & EROSION CONTROL

The Contractor for the works is required to provide Sedimentation and Erosion Control in accordance with the guidelines set out in Landcom's Managing Urban Stormwater Soils & Construction Guidelines and the general requirements outlined below.

8.1 SITE PROTECTION MEASURES

The Contractor for the works is required to provide Erosion and Sedimentation Control in accordance with the requirements outlined below to inhibit the movement of sediment off the site during demolition and construction phases.

8.1.1 SITE ACCESS

Site access shall be established from Reserve Street. Construction vehicles leaving the site shall be required to pass over a Temporary Construction Vehicle Entry consisting of a 1.5m long by 3m wide 'cattle rack'.

8.1.2 SEDIMENT CONTROL

All exposed earth areas where it may be possible for runoff to transport silt down slope shall be protected with a sediment and erosion control silt fence generally installed along the boundaries of the site.

The fence will be constructed in accordance with details provided by the Department of Conservation and Land Management incorporating geotextile fabric which will not allow suspended particles greater than 50mg/L non-filterable solids to pass through, and as such comply with the appropriate provisions of the Clean Waters Act 1970.

The construction of the silt fence will include the following: -

- Geotextile fabric buried to a maximum of 150mm below the surface.
- Overlapping any joins in the fabric;
- Turning up on the ends for a length of 1 metre in order to prevent volumes of suspended solids escaping in a storm event;
- Any Council owned road kerb entry and or gully pits will be protected by Atlantis Filter Bales and EcoSock. Additional protection will be provided by inserting Water Clean Filter Cartridges into the gully opening, and;
- Internal site drainage pits shall be protected by Sediment Traps consisting of hay bales.

Refer to Figure 8.1, Figure 8.2, Figure 8.3 and Figure 8.4 for details.

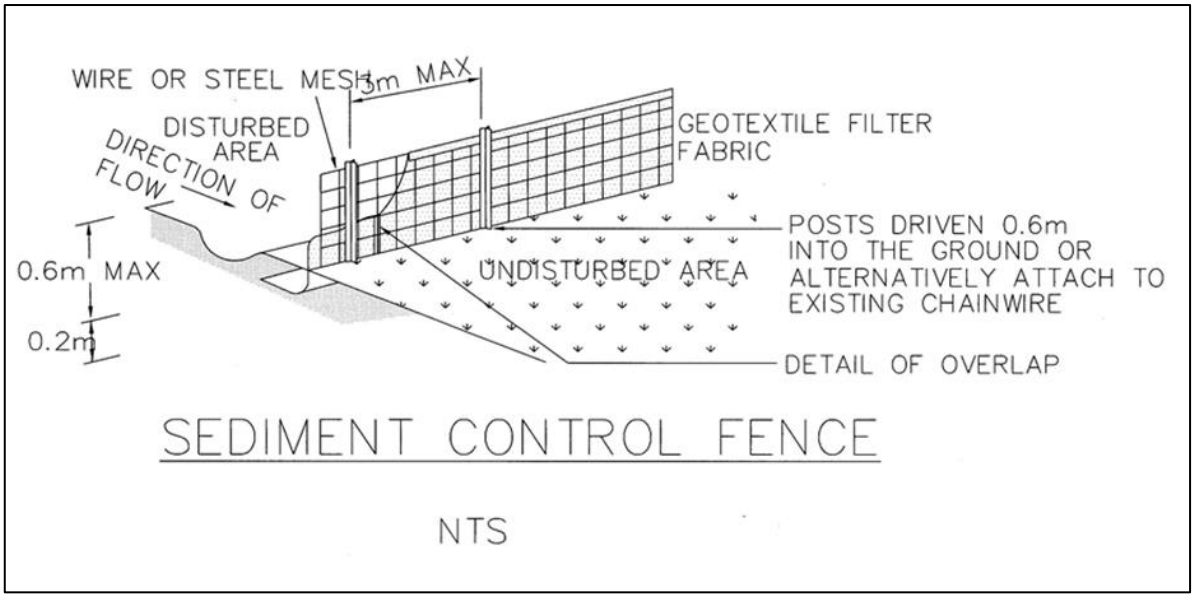

Figure 8.1*:* Sediment Control Fence Detail

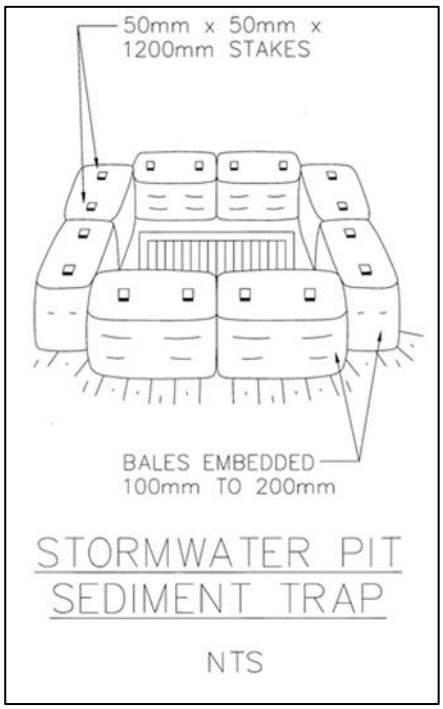

Figure 8.2: Stormwater Pit Sediment Trap Detail

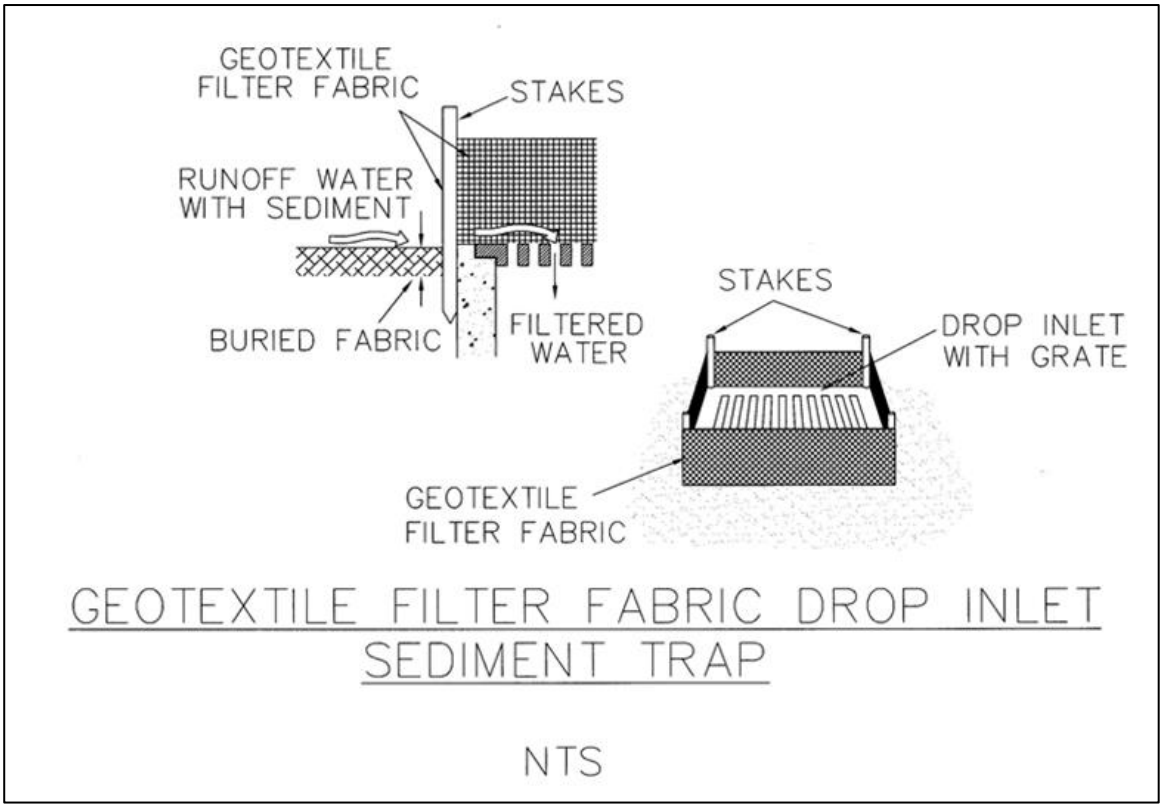

Figure 8.3: Geotextile Filter Fabric Drop Inlet Sediment Trap Detail

Atlantis Sediment Control Filter Bales

What are FilterBales?

Water Clean FilterBales are a unique new patented 7 stage sediment filter device developed to substantially reduce the migration of sediment and contaminants into drainage systems while allowing filtered water to easily pass through. FilterBales reduce customers' time and money by providing solutions to comply witht environmental and regulatory requirements.

Durable, Dependable, Reusable.
Replacing hay bales and other inadequate attempts to stop sediment run-off, FilterBales are durable and re-useable, effectively stopping your money from "pouring down the drain". They are also lightweight and easy to handle. Replaceable Water Clean Filter Cartridges guarantee peak performance is maintained.

Ask your local FilterBales stockist about replacement frequencies in your area. Cartridges and filter covers should be changed when the infiltration rate decreases. Water Clean FilterBales are suitable for a wide range of sediment and water management situations and can be easily secured in place for long term use. The unique multi-directional filter system allows you to position Water Clean FilterBales in any direction without reducing performance.

Water Clean FilterBales can be fixed to concrete or bitumen surfaces using an epoxy mortar-binder or fixed to earth surfaces using 6-10 mm pegs or stakes. When positioning, the side with the red reflective marker should be facing traffic.

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1. FilterBales frames are a perforated plastic structure made from recycled wheelie bins, battery cases, milk bottles etc.

2. Filter medium (bio engineered soil media) used in the filter cartridges is made from a special blend of recycled organic (RO) materials from kerbside and vegetation drop off centres. The RO hosts enhanced naturally occurring micro-organisms. The blend also contains natural minerals to capture nutrients. The filter medium is as safe as normal soil.

3. FilterBales have a seven (7) stage filtration system:

1. **In through the filter bag**
2. **Through the perforated plastic structure wall**
3. **In through the filter cartridge bag**
4. **Through the bio engineered filter medium**
5. **Out through the filter cartridge bag**
6. **Out through the perforated plastic structure wall**
7. **Out through the filter bag**

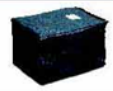
4. The filter bag is made from 300-micron (one third of a millimetre) pore size geotextile. This is the first stage that filters much of the sediment and other suspended solids from the run-off water. The geotextile is designed to stop sediment and reduce clogging but allow water to pass through easily. The filter cartridge bags are made from a similar geotextile.

5. FilterBales work effectively up to "a one-in-one-year 48 hours, 100 mm "storm events". This is the largest storm event experienced since the commercialisation of FilterBales. Having handled this easily, Filter Bales are considered capable of handling much greater "storm events". During these storm events FilterBales were used inside gully pits in one application and on the ground surrounding the gully pit in another application.

6. EcoSocks are made from a similar geotextile to the filter cartridge bags and contain the same bio engineered soil media as the FilterBales. They appear able to stand up to as much wear and tear as a sandbag.

7. FilterBales are much lighter (at around 15 kgs dry weight) than hay bales. This reduces exposure to Occupational Health and Safety problems

Product Range

Item No.	Description	
HFB001	**High FilterBale,** suitable for high flow situations and higher retention time applications. Contains two standard size WaterClean Filter Cartridges in upright formation to treat contaminated waters. (605mm x 485mm x 460mm)	
LFB002	**Low FilterBale,** suitable for low flow situations and kerb & gutter applications. Multi-directional module containing two standard size WaterClean Filter Cartridges. (605mm x 485mm x 220mm)	
ESF004	**Directional EcoSock,** can be used in conjunction with FilterBales to direct water. Will also provide some sediment filtration from seepage through bio-remediating media contained within the EcoSock (1135mm x 160mm x 30mm)	

Accessories

Item No.	Description	
FCR004	**WaterClean Filter Cartridges** contain a unique blend of fixating and bio-remediating products that treat common pollutants. To achieve maximum performance, each FilterBale uses two WaterClean Filter Cartridges. (440mm x 400mm x 100mm)	
HBC005 (High bale)	**Replaceable FilterBale covers,** made from specially designed geotextile. FilterBale covers have a standard aperture of 300 microns.	
HBC006 (Low bale)	**Replaceable FilterBale covers,** made from specially designed geotextile. FilterBale covers have a standard aperture of 300 microns.	

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Atlantis Water Management

V3-20/06/01

Figure 8.4: Atlantis Sediment Control Filter Bale Detail

8.1.3 TEMPORARY STORMWATER SYSTEM (WHERE REQUIRED)

Site runoff within the zones of the excavation will be drained into a central holding well within the excavation. Runoff will be allowed to settle out suspended particles and debris, and an acceptable water of 50mg per litre of Non-Filterable Residues (NFR) is required to be achieved prior to discharge.

8.1.4 DUST CONTROL

The following dust control procedures will be adhered to:

- Loose loads entering or leaving the site will be securely covered by a tarpaulin or like material in accordance with RMS and local Council Guidelines;
- Soil transport vehicles will use the single main access to the site;
- There will be no burning of any materials on site;
- Water sprays will be used across the site to suppress dust. The water will be applied either by water sprinklers or water carts across ground surfaces whenever the surface has dried out and has the potential to generate visible levels of dust either by the operation of equipment over the surface or by wind. The watercraft will be equipped with a pump and sprays;
- Spraying water at the rate of not less than three (3) L/s and not less than 700kPa pressure. The area covered will be small enough that surfaces are maintained in a damp condition and large enough that runoff is not generated. The water spray equipment will be kept on site during the construction of the works;
- During excavation all trucks/machinery leaving the site will have their wheels washed and/or agitated prior to travelling on Council Roads, and;
- Fences will have shade cloth or similar fabric fixed to the inside of the fence.

8.1.5 MAINTENANCE

Generally, the following maintenance measures shall be adhered to during construction:-

- It will be the responsibility of the site foreman for the building contractor to ensure sediment and erosion control devices on site are maintained. The devices shall be checked daily and the appropriate maintenance undertaken as necessary;
- Prior to the closing of the site each day, the road shall be swept and materials deposited back onto the site;
- Gutters and roadways will be kept clean regularly to maintain them free of sediment;
- Appropriate covering techniques, such as the use of plastic sheeting will be used to cover excavation faces, stockpiles and any unsealed surfaces;
- If dust is being generated from a given surface, and water sprays fail;
- If fugitive emissions have the potential to cause the ambient as quality to foul the ambient air quality;
- The area of soils exposed at any one time will be minimised wherever possible by excavating in a localised progressive manner over the site,;
- Materials processing equipment suitable comply with regulatory requirements. The protection will include the covering of feed openings with rubber curtains or socks, and;
- Suitable and approved bins shall be utilised for the containment of hard waste, including concrete slurries, building waste and litter. In the case of accidental spills, particularly within the public reserve, the material shall be swept and contained, and not washed into a gutter or waterway.

It is considered that by complying with the above, appropriate levels of protection are afforded to the site and the adjacent public roads, footpaths and environment.

SCHEDULE 1 MUSIC MODEL TREATMENT RESULTS

Receiving Node

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Treatment Train Effectiveness

	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	Gross Pollutants (kg/yr)
Sources	2.49	378	0.746	5.57	71.3
Residual Load	2.24	54.4	0.173	2.38	3.27
% Reduction	10.1	85.6	76.8	57.3	95.4