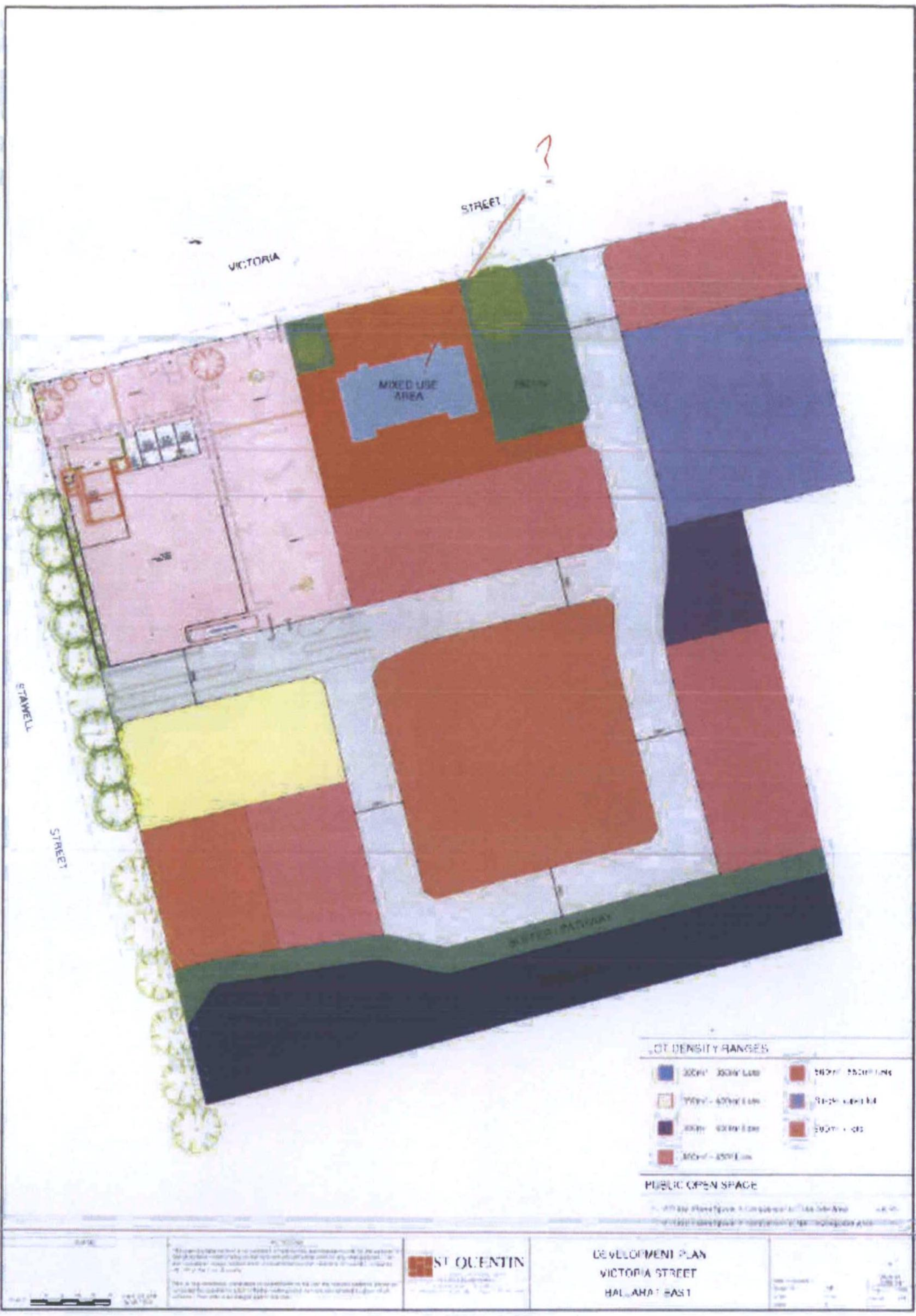
VICTORIA
STREET
STAWELL
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MIXED USE
AREA
LOT DENSITY RANGES
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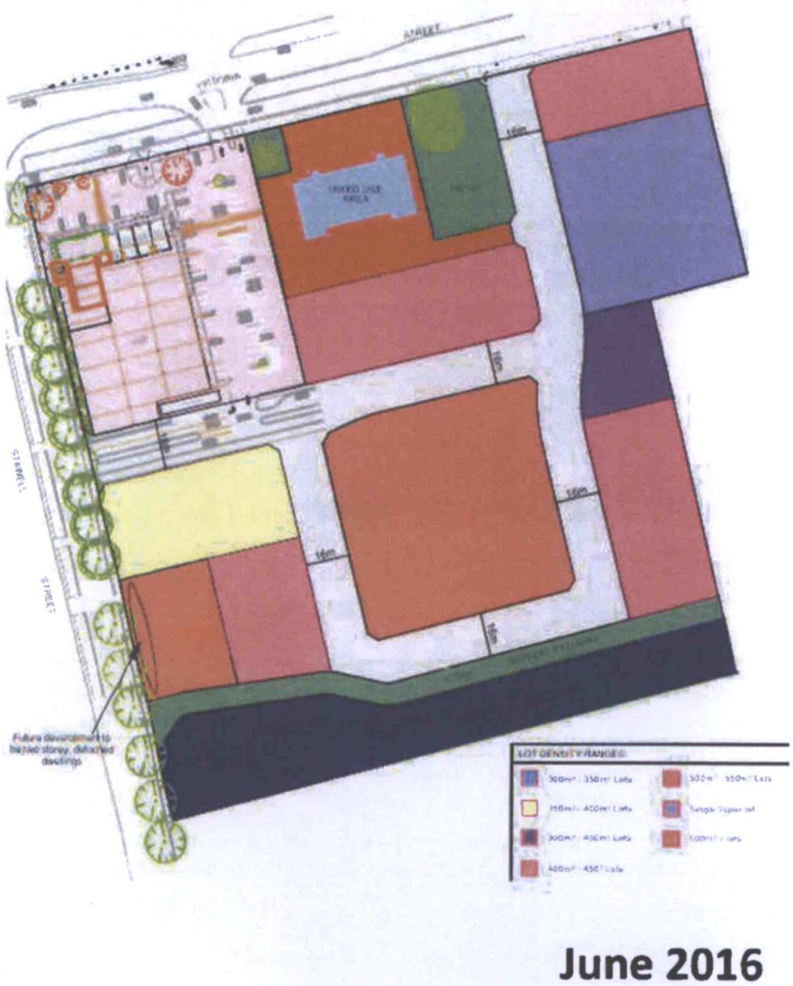
DEVELOPMENT PLAN
VICTORIA STREET
BALLARAT EAST

WATER TECHNOLOGY

Damascus College Development

Preliminary Stormwater Management Strategy



June 2016

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v01	Draft Report	Cintia Dotto	Luke Cunningham	Chris Mason	15/06/2016
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PROJECT DETAILS

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Cover Photo: Development Plan, Victoria Street (Former Damascus College site), Ballarat East

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1. INTRODUCTION

This report sets out a recommended Stormwater Management Strategy for the former Damascus College site to serve the future urban development proposed for the area.

Water Technology understands the proposal involves sub-division of the site for private sale and residential development. The investigation identified on-site stormwater management solutions under developed conditions, and identified three concept drainage designs for the site that would achieve best practice targets and minimise impact of the development on river health values.

The recommended Stormwater Management Strategy for the site is founded on best practice principles and achieves compliance with the requirements of the Water Act 1989 and Best Practice Guidelines and Standards for water quality treatment.

It should be noted that flood risk assessment for the site was not within the scope of this study and will be addressed in a separate study.

2. SITE OVERVIEW

The subject site is located in Ballarat East and is bordered by Victoria Street to the north and Stawell Street South to the west. The site is located on a hillside with the lower, southern portions of the property located on a floodplain of Specimen Vale Creek.

The site consists of a former school. The lower portions of the site adjacent to Specimen Vale Creek are undeveloped and grassed. The site is currently zoned predominately General Residential with some areas of Commercial and Mixed Use Zone in the northern portion of the site.

Specimen Vale Creek borders the property to the south and is piped through a 1,650 mm Reinforced Concrete Pipe (RCP) through that reach. An open pit is located at the south-east corner of the site where the underground network transitions from two 1,200 mm RCPs to the single 1,650 mm RCP. Downstream of the site the waterway passes under Stawell Street through a large box culvert and then into an open lined channel.

A map of the site illustrating the major features is shown in Figure 2-1.

Figure 2-1 **Site Features**

3. STORMWATER MODELLING

Stormwater modelling was carried out with regards to best practice industry methods, as well as Melbourne Water's latest guidelines.

The water quality treatment targets established by the Urban Stormwater Best Practice Guidelines (CSIRO, 1999) should be achieved as a minimum to protect river health values. The removal rate targets for key pollutants are as follows:

- 80% of total suspended sediments;
- 45% of total nitrogen;
- 45% total phosphorous; and,
- 70% gross pollutants.

A MUSIC model (Version 6.2) was constructed for a preliminary analysis of the water quality requirements for the development. A continuous 10-year MUSIC model with a 6-minute time interval was run. The Ballarat Aerodrome pluviograph station data was used in the MUSIC modelling for the period 1989-1999. This period was selected as the average mean annual rainfall for this period was equal to 626 mm, similar to its average rainfall (689.4mm)[1]. Monthly evapotranspiration data recorded at the same station was used.

3.1 Catchment analysis

A catchment analysis was undertaken based on the latest development plan, with fraction impervious areas assigned to each area based on latest development plan and proposed density ranges. A summary of sub-catchment parameters is shown in Table 3-1.

Table 3-1 Catchment delimitation and fraction effective impervious

Sub-Catchment	Type	Area (m^2)	Adopted percentage effective impervious (%)
Retail Site	Commercial	7,600	90
Child Care	Public Use Zone (Education)	5,290	65
Residential_A	Residential (13 lots)	5,470	75
Residential_B	Residential (9 lots)	2,820	75
Residential_C	Residential (10 x 600m²+ lots)	6,020	60
Residential_D	Residential (9 lots)	8,980	75
Road_North	Road	4,400	80
Road_South	Road	4,400	80

[1] http://www.bom.gov.au/climate/averages/tables/cw_089002.shtml

Three options were considered to treated stormwater runoff for the development area:

1. Option 1 - Swale + Sedimentation Basin + Wetland
2. Option 2 - Swale + Sedimentation Basin + Wetland + Rainwater Tanks
3. Option 3 - Swale + Sedimentation Basin + Wetland + Raingarden

Additional details for each option are given in the following sections.

3.1.1 Option 1 - Swale + Sedimentation Basin + Wetland

Option 1 is based on a single-site treatment with all proposed WSUD assets located along the south boundary of the site. Option 1 would consist of:

- A swale (grassed) along the southern boundary of the site to treat road runoff;
- A sedimentation basin located in the southwest corner of the site; and,
- A constructed wetland located in the southwest corner of the site.

Modelling parameters for these three assets are shown in Table 3-2. The sedimentation basin was sized to allow for a five-year clean-out frequency (minimum).

Table 3-2 Total area of modelled end-of-line WSUD Features – Option 1

System	Surface Area at the NWL (m^2)	Extended Detention Depth (m)	Permanent Pool Volume (m^3)
Swale	300 (60m long and 5m wide)	0.5	N/A
Sediment Pond	325	0.5	95
Wetland	675	0.5	255

The model layout for Option 1 is shown in Figure 3-1.

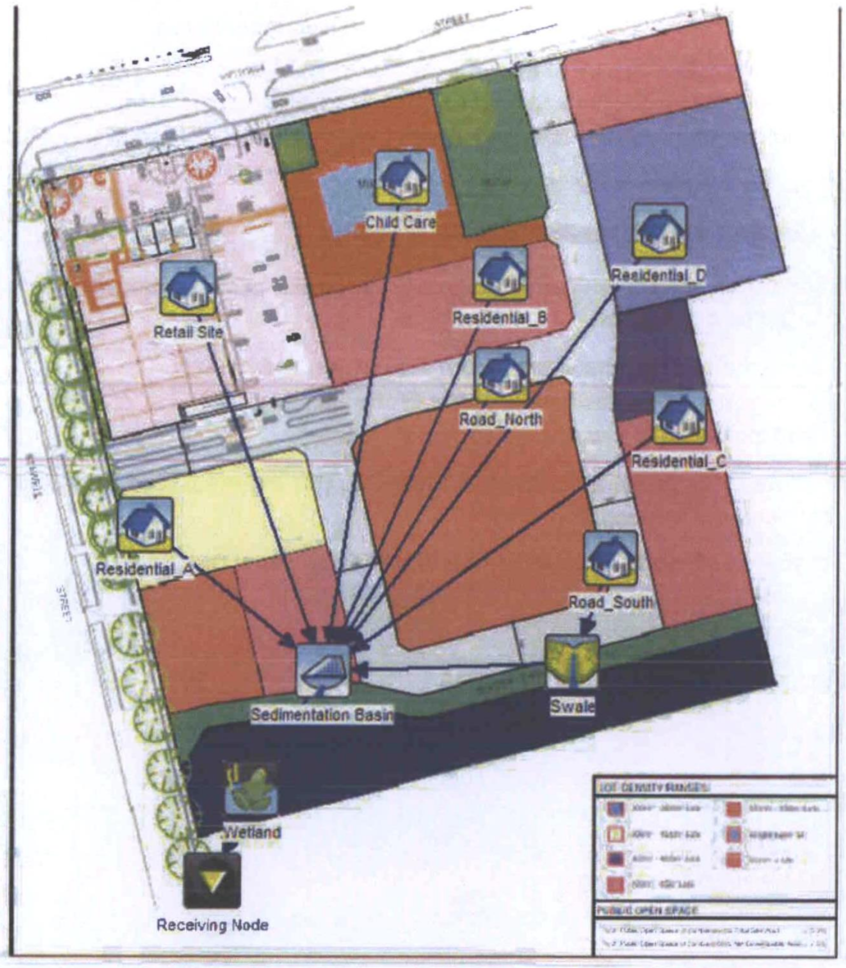

Figure 3-1 – Option 1 MUSIC Model Layout

3.1.2 Option 2 – Swale + Sedimentation Basin + Wetland + Rainwater Tanks

Option 2 integrated the same downstream end-of-line modelled in Option 1 with a reduced footprint for the wetland and with a 2.5kL rainwater tank installed on each individual property. It was assumed that each property would have an occupancy of 2, regardless of the size of the lot.

The roof areas for the retail site and the residential properties were differentiated from the total site area, to ensure only roofwater was captured by the modelled rainwater tanks. Roof areas were assumed to represent 30% of the total parcel areas for residential area, with a fraction imperviousness of 90%.

Table 3-3 Catchment delimitation and fraction effective impervious

Sub-Catchment	Total Area (m²)	Parcels minus roof area (m²)	Revised fraction effective impervious (%)	Roof area (m²)
Retail Site	7,600	5,355	85	2,245
Residential_A	5,470	3,830	65	1,640
Residential_B	2,820	1,974	65	846

Residential_C	6,020	4,210	43	1,810
Residential_D	8,980	6,280	65	2,700

Annual water usage for each dwelling was estimated to be 106L per day:

- toilet flushing (25 l per person per day[2]);
- cold water laundry (23 l per person per day[2]);
- external use (5 l per person per day[2])

A 10kL rainwater tank was also modelled for the retail centre. Annual water usage for the site was estimated to be 345kL/year, based on:

- Retail store area of 2,245m^2;
- 0.77kL/m^2/year water usage for commercial site[3]
- Toilet flushing would represent 20% of the water usage at the site.

Modelling parameters for the reduced-footprints for the sedimentation and wetland are shown in Table 3-4. The sedimentation basin was sized to allow for a five-year clean-out frequency (minimum).

Table 3-4 Total area of modelled sedimentation and wetland – Option 2

System	Surface Area at the NWL (m^2)	Extended Detention Depth (m)	Permanent Pool Volume (m^3)
Sediment Pond	250	0.5	65
Wetland	440	0.5	165

The model layout for Option 2 is shown in Figure 3-2.

[2] Water by Design (December 2009) *Stormwater Harvesting Guidelines*
[3] City West Water Best Practice Guidelines for water efficiency https://www.citywestwater.com.au/documents/best_practice_guidelines.pdf

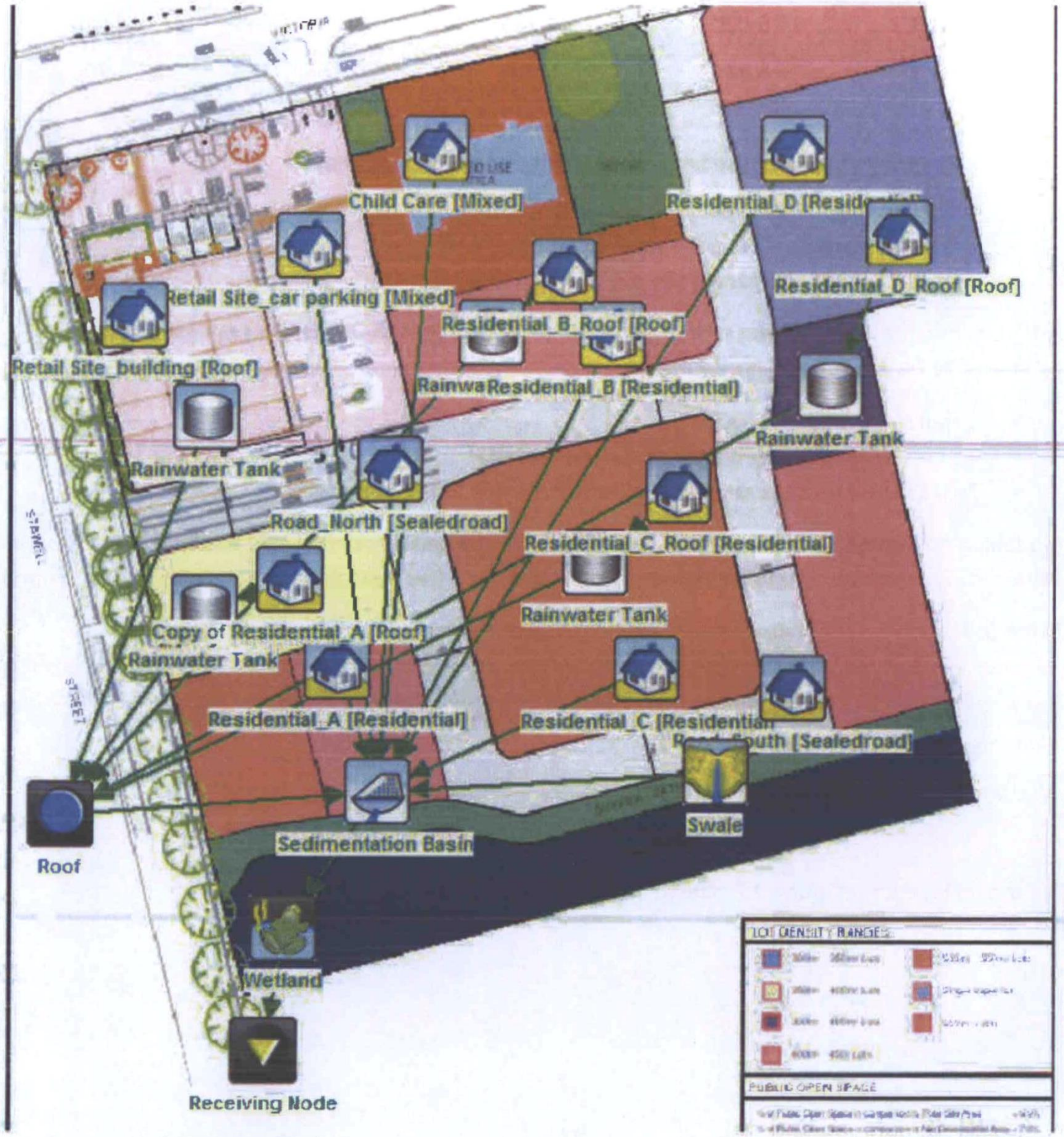

Figure 3-2 – Option 2 MUSIC Model Layout

3.1.3 Option 3 - Swale + Sedimentation Basin + Wetland + Raingarden

Option 3 integrated the same downstream end-of-line modelled in Option 2, with a 25m² raingarden system used to treat stormwater runoff from the site.

Modelling parameters for this bio-filtration asset are shown in

Table 3-5 and Table 3-6. The sedimentation basin was sized to allow for a five-year clean-out frequency (minimum).

Table 3-5 Total area of modelled Raingarden – Option 3

System	Surface & Filter Areas (m^2)	Extended Detention Depth (m)	Hydraulic Conductivity (mm/hr)	Filter Depth (m)	Submerged Zone
Raingarden	25	0.2	150	0.4	Yes (0.45m)

Table 3-6 Total area of modelled end-of-line WSUD Features – Option 3

System	Surface Area at the NWL (m^2)	Extended Detention Depth (m)	Permanent Pool Volume (m^3)
Swale	250 (50m long and 5m wide)	0.5	N/A
Sediment Pond	325	0.5	95
Wetland	575	0.5	230

The model layout for Option 3 is shown in Figure 3-3Figure 3-1.

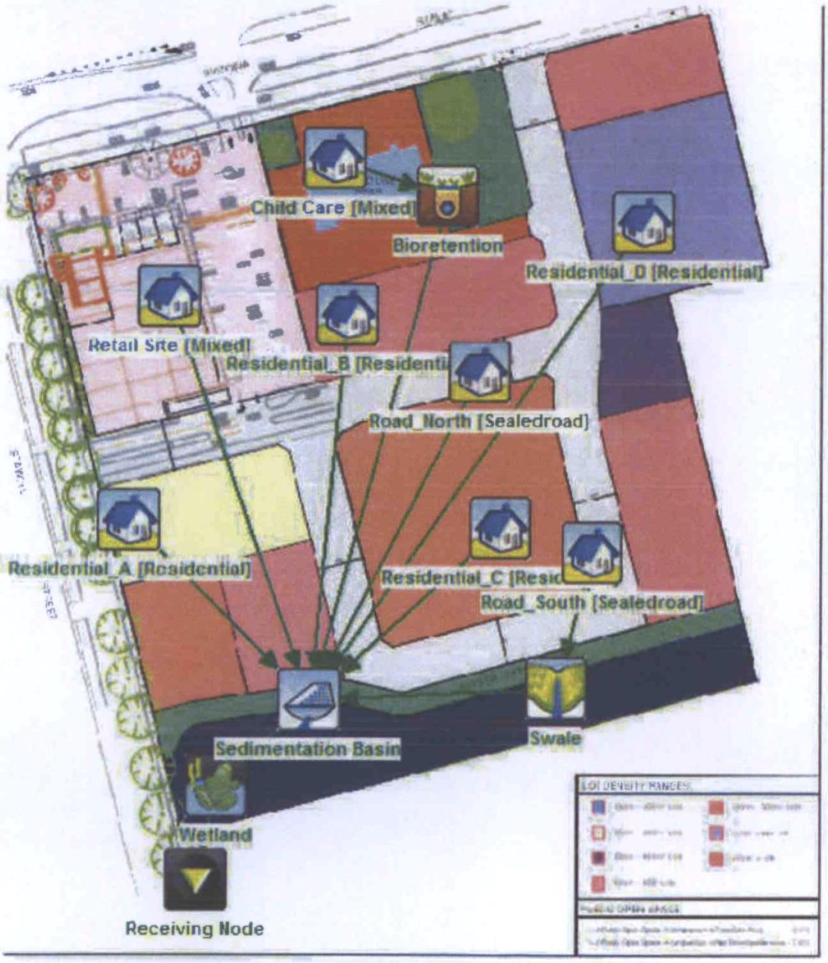

Figure 3-3 – Option 3 MUSIC Model Layout

4. RECOMMENDED STORMWATER MANAGEMENT STRATEGY

4.1 Water Quality

All three treatment trains ensure best practice stormwater management targets are met and exceeded at the site, as shown in Table 4-1.

Table 4-1 MUSIC Modelling Results

Option 1 - Swale + Sedimentation Basin + Wetland			
Component	Source Load	Residual Load	Reduction
Total Suspended Solids (kg/yr)	3,850	341	91.2%
Total Phosphorus (kg/yr)	6.79	1.59	76.6%
Total Nitrogen (kg/yr)	42.7	23.4	45.3%
Gross Pollutants (kg/yr)	754	2.65	99.6%
Option 2 - Swale + Sedimentation Basin + Wetland + Rainwater Tanks			
Component	Source Load	Residual Load	Reduction
Total Suspended Solids (kg/yr)	3,180	367	88.5%
Total Phosphorus (kg/yr)	6.05	1.63	73.0%
Total Nitrogen (kg/yr)	41.4	22.6	45.3%
Gross Pollutants (kg/yr)	740	1.41	99.8%
Option 3 - Swale + Sedimentation Basin + Wetland + Raingardens			
Component	Source Load	Residual Load	Reduction
Total Suspended Solids (kg/yr)	3,850	338	91.2%
Total Phosphorus (kg/yr)	6.78	1.6	76.5%
Total Nitrogen (kg/yr)	42.7	23.4	45.2%
Gross Pollutants (kg/yr)	754	2.28	99.7%

Option 1 relies on a single site treatment train. This approach has 'obvious maintenance advantage'[4], as it centralises the WSUD assets in one location, minimising time loss to travel during maintenance operations. The WSUD assets are also located in public open spaces and are integrated as water features, they therefore add amenity value to the site's reserves. The swale may also minimise the need for underground pipes to intercept and convey road runoff to the sedimentation basin and wetland.

[4] From http://www.melbournewater.com.au/wsud

The rainwater tanks (Option 2) are located on private property and provide an alternative water source for non-drinking use, such as flushing toilets, with a reliability exceeding 80% for non-potable use. Our model assumed that rainwater tanks would be installed for all newly developed residential properties and the associated benefits would need to be scaled down depending on uptake by new residents.

The proposed raingarden would provide treatment to the runoff from the childcare centre as well as providing an asset that can be used for educational purpose. With a footprint of 25m², it could easily be accommodated within the child care centre or on the adjacent park reserve.

Both these options require a smaller footprint for the wetland compared to Option 1. On the other hand, the rainwater tanks will be located on private parcels and water quality treatment may not be achieved if tanks are not maintained and/or disconnected. It may also require approval from Council as an acceptable form of treatment.

4.2 Construction Stage

It is understood that the development of the Damascus site will be staged in four phases, as shown in Figure 4-1:

1. Stage A (9,170m²)– Construction of the retail centre and road network;
2. Stage B (16,795m²)– Development of the Mixed Used Area (child care) and residential properties;
3. . Stage C (15,330m²)– Construction of residential properties; and
4. Stage D (10,545m²)– Construction of final residential lots.

Figure 4-1– Proposed Construction Phases

A developing catchment can be expected to discharge between 50 m^3 and 200 m^3 of sediment per hectare each year during construction. Sedimentation resulting from construction sites can, if unmitigated, result in significant adverse impacts on the downstream waterways, including (but not limited to):

- Bank erosion and channel instabilities;
- Detrimental impacts on aquatic life and habitats; and,
- Increased flood risk.

Sedimentation basins capable of treating stormwater runoff from each construction phase have been sized to capture anticipated sediment discharge (assumed at 100m^3 per ha per year) and yearly clean-up operations. Calculations indicate that a sedimentation basin with a footprint of 1,000m^2 would be required (Stages B and C) and could be located in the southwest corner of the site.

This area is where the proposed sedimentation basin and constructed wetland will be located. The maximum footprint required for the sedimentation basin matches the footprint area required for the permanent sedimentation basin and wetland (Option 1). It will therefore be possible to size and shape the sedimentation basin with consideration of the final permanent treatment waterbodies design and minimise earthworks required during the construction of the wetland.

5. SUMMARY

This Stormwater Management Plan (SWMP) outlines three concept designs available for the water quality treatment for the urban development of the former Damascus College Site in accordance with industry best practices.

Water quality management is achieved through a number of WSUD assets, including a swale, a sediment pond and a wetland located along the south boundary. These have been sized based on land availability and the concept designs include appropriate normal water levels to allow for operation and drainage outfall. The pollutant load reduction resulting from the water quality strategy meets or exceeds best management practice targets.

Further benefits can be obtained by promoting the use of rainwater tanks on each property and the inclusion of a raingarden for the proposed child care centre. The integration of these assets will also reduce the footprint of the wetland systems.

Secondly, a 1,000m^2 sedimentation basin would be required during construction to intercept sediments emanating from construction activities during a four phases construction stage. This sedimentation basin will also be located in the south west corner of the site.

The results obtained with the investigations in this study showed that the three options proposed are consistent with best practice stormwater management (and guidelines) in terms of stormwater quality and that the proposed development can minimise its impact of the development on river health values. The study was developed upon the latest best practice guidelines for water quality treatment as well as industry best practice for overall stormwater management of greenfield developments.

6. REFERENCES

CSIRO (1999). Best Practice Environmental Management Guidelines.

Melbourne Water (2015). Constructed Waterways in New Developments Guidelines (in progress).

Melbourne Water (2015). Design, Construction and Establishment of Constructed Wetlands: Design Manual, Draft, 2015

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2nd August 2017

Attention: Leanne Wilson
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City of Ballarat
PO Box 655
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Dear Leanne

RE: Revised Development Plan – 200 Victoria Street, Ballarat East
Stormwater Management Strategy & Flood Investigation

This brief report accompanies the revised Development Plan with an assessment overview of the Stormwater Management Strategy and Flood Investigation reports previously prepared for the previous Development Plan of the site at 200 Victoria Street, Ballarat East.

We have reviewed and assessed the preliminary Stormwater Management Strategy (SWMS) prepared by Water Technology (4099-01 R2, V02 - 21/06/2016) in reference to the revised proposed Development Plan. Whilst the general layout arrangement and yield of the revised proposed Development Plan are not identical, in consideration of the SWMS analysis the proposed catchments and impervious percentages adopted in the Water Technology report are uniquely similar.

Consequently we are satisfied that the potential options (3No.) developed within the Water Technologies preliminary SWMS report will be reliable concepts on which the platform for the detailed design delivering the objectives of Urban Stormwater Best Practice (CSIRO, 1999) in reference to the revised Development Plan can be structured.

The Flood Investigation report prepared by Water Technology (4099-01 R01, V02 – 21/6/2016) has been analyzed in consideration of the revised proposed Development Plan. The existing conditions hydraulic modelling results and subsequent inundation mapping of the 1% AEP flood event will be consistent and provide the 'base-case' comparison. Whilst the general layout arrangement and yield of the revised proposed Development Plan are not identical, the developed conditions catchment assumptions are considered to be representative of the proposed revised Development Plan.

The revised proposed Development Plan is consistent with the Water Technology Flood Investigation report (Section 5.1) whereby sufficient space is provided along the southern boundary to allow for the passage of overland flow. The revised proposed Development Plan is considerate of the key facets of Figure 5.4 of the Water Technology Flood Investigation report. Subsequently we advise that the revised proposed Development Plan will have no adverse off-site impacts in the 1% AEP flood event.

Whilst the proposed revised Development Plan layout and yield is not identical to the initial Development Plan proposal the general arrangement and subsequent staging of the project is considerate to be commensurate.

We trust this brief assessment meets with your approval and look forward to continuing to work together with you on this project. If you have any queries with this proposal please don't hesitate to contact me on 5330 8888 or 0408 031421.

TGM GROUP PTY LTD
Ballarat Office
per:

DARREN J. TRIGG
General Manager – Business Development
Civil Engineer – BECivil, MIE Aust., CPEng. (Member No. 456606)