PROPOSED COMMERCIAL DEVELOPMENT

St Kevin's College, Glendalough

WATER SENSITIVE URBAN DESIGN REPORT

FOR

ST KEVINS COLLEGE

29 July 2020

File 1433A

ark resources

CONTENTS

APPENDICES

Issue	Date	Prepared	Approved	Status
A	21 October 2019	MT	MR	Draft
B	25 October 2019	MT	MR	Draft
C	28 October 2019	MT	MR	Final
D	7 November 2019	MT	MR	Final
E	13 March 2020	MT	MR	ESD referral response
F	3 April 2020	MT	MR	ESD referral response
G	29 July 2020	MT	MR	ESD referral response

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1. Introduction

Ark Resources has been engaged by St Kevins College to provide advice in relation to water sensitive urban design (WSUD) opportunities for the proposed residential development at St Kevin's College, Glendalough.

We have reviewed the architectural plans prepared by Chandler Architecture and recommended a package of WSUD initiatives with the aim of meeting the objectives of Council's *Water Sensitive Urban Design* Policy (Clause 22.18) and the objectives of Clause 53.18 (*Stormwater Management in Urban Development*) of the Stonnington Planning Scheme.

Performance outcomes in this report are based on:

- Discussions and correspondence with:
  - Loris Rebeschini – Associate, Chandler Architecture
  - Sophie Jordan – Sophie Jordan Consulting
  - Mariano Lopez – Principal Landscape Architect, Tract
- Architectural plans prepared by Chandler Architecture set out below:

Description	Drawing No.	Revision	Date
Aerial View	TP00	B	1 November 2019
Locality Plan	TP01	B	1 November 2019
Site Context Plan	TP02	B	1 November 2019
DD03 Setback	TP03	B	1 November 2019
Site survey Plan	TP04	B	1 November 2019
Existing Site - Demolition Plan	TP05	C	6 March 2020
Ground Floor - Demolition Plan	TP06	C	6 March 2020
First Floor - Demolition Plan	TP07	C	6 March 2020
Streetscape Elevations	TP08	B	1 November 2019
Site Plan – Design Response	TP09	C	6 March 2020
Design Response Diagrams	TP10	B	1 November 2019
Staging Plan	TP11	B	1 November 2019
Proposed Ground Floor Plan	TP12	C	6 March 2020
Proposed First Floor Plan	TP13	B	1 November 2019
Proposed Roof Plan	TP14	C	6 March 2020
Proposed Lower Ground Plan	TP15	C	6 March 2020
Drop Off Zone	TP16	C	6 March 2020
Proposed Playground	TP17	C	6 March 2020
Proposed Elevations Building	TP18	C	6 March 2020
Proposed Elevations Car Park	TP19	B	1 November 2019
Propose Sections Building & Carpark	TP20	B	1 November 2019
Material Schedule	TP21	B	1 November 2019
Visual Impact Assessment	TP22A	B	1 November 2019
Visual Impact Assessment	TP22B	B	1 November 2019
Shadow Diagrams	TP23	B	1 November 2019
Proposed Fencing Plan	TP24	B	1 November 2019
Tree Protection Site Plan	TP25	C	6 March 2020

2. WSUD Initiatives

2.1. Water-efficient fixtures

In order to meet the City of Stonnington's WSUD policy objectives, water-efficient fittings and fixtures will be specified to the proposed extension in accordance with the following WELS star ratings:

- 4-star toilets;
- 5-star urinals; and
- 5-star basin taps.

2.2. Rainwater Harvesting

In order to meet water conservation and stormwater quality objectives, the following rainwater harvesting system will be installed:

- Collection from new roof area and playground (total catchment area approx. 850m^2)
- A total storage volume of 24,000 litres in rainwater tanks
- Re-use of water for toilet flushing
- Re-use of water for irrigation.

A computer simulation of rainwater supply and demand[1] has been undertaken to optimise the rainwater harvesting system design.

The model predicts that the rainwater harvesting system will reduce mains water consumption by an average of 152kL per year and provide an average supply reliability of 96% for toilet flushing and 98% for irrigation.

Rainwater storage is broken up into a 4,000 litre tank collecting rain water from part of the new roof to be used for the flushing of toilets in the new and refurbished building toilets. A 20,000 litre tank collection rain water from part of the new playground area to be used for landscape irrigation. Rainwater from the playground to be treated with a combination of:

- 100 micron screen filter
- 5 micron cartridge filter
- Ultra Violet disinfection unit

Please refer to Appendix 1 for details of the rainwater catchment areas and to Appendix 2 for details of the rainwater model outputs.

[1] Note that the rainwater simulation model utilises a daily rainfall interval and is based on Bureau of Meteorology daily rainwater data for Melbourne for a twelve-year period.

3. MUSIC Modelling

To assess the quality of stormwater runoff from the site, an analysis has been undertaken using the MUSIC 6.3.0 Software developed by eWater and the results are summarised in Figure 1 below.

Pollutant	MUSIC Model Results	Melbourne Water Targets	Green Star Targets (Column A)
Reduction in Total Suspended Solids (TSS)	88.2%	80.0%	80.0%
Reduction in Total Phosphorus (TP)	46.2%	45.0%	30.0%
Reduction in Total Nitrogen (TN)	45.1%	45.0%	30.0%
Reduction in Total Gross Pollutants	99.3%	70.0%	85.0%
Compliance with Melbourne Water targets		✓	✓

Figure 1: MUSIC Modelling Results

The MUSIC results confirm that, based on the proposed rainwater harvesting system described above, the development meets the objective of Clauses 22.18 and 53.18 of the Stonnington Planning Scheme by exceeding the pollutant load reduction targets set out in the Best Practice Environmental Management Guidelines (CSIRO 1999) for Total Suspended Solids (TSS), Total Phosphorous (TP), Total Nitrogen (TN) and Gross Pollutants (GP).

Please refer to Appendix 3 for details of the MUSIC assessment.

4. Site Management Plan & WSUD Maintenance Program

A construction phase stormwater pollution reduction plan will be implemented by the builder during construction to ensure that litter, sediments and other pollution are prevented from entering the stormwater system.

Please refer to Appendix 4 for the preliminary Site Management Plan.

4.1. Rainwater harvesting system

Once installed, a systematic maintenance program will be implemented by the landowner to ensure the rainwater harvesting system operates as designed and water quality is maintained.

The scope of the maintenance program will include inspection and rectification of issues associated with:

- Roof gutters and downpipes
- First flush screens and filtration devices
- Pumps
- Distribution pipework and reticulation systems
- Overflow systems

Inspections of the system and any maintenance works required will be undertaken on a quarterly basis.

The rainwater harvesting system will be installed in accordance with the guidelines set out in the Rainwater Design & Installation Handbook published by the National Water Commission[2]. An indicative schematic diagram of the rainwater tank installation is provided below.

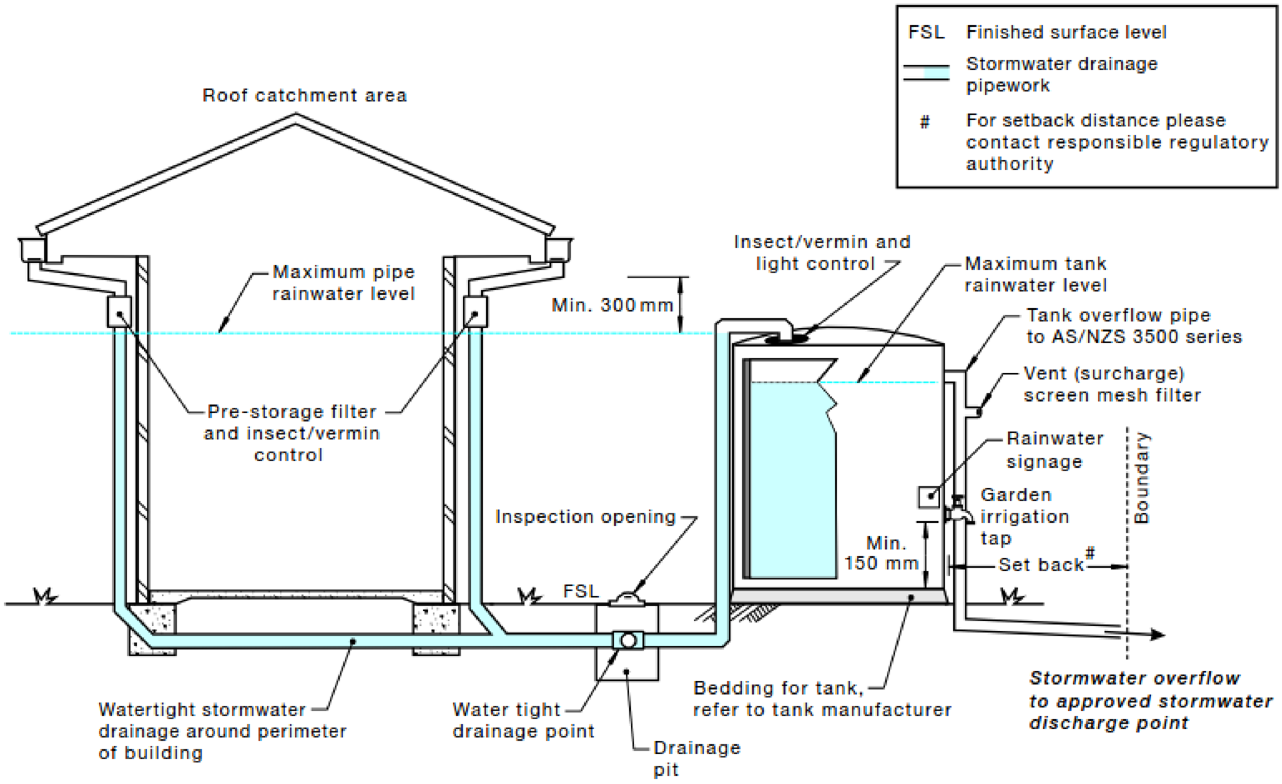


Figure 2: Rainwater Harvesting Schematic

[2] Rainwater Design & Installation Handbook, National Water Commission, 2008

4.2. Raingarden Maintenance Program

A systematic maintenance program will be implemented by the owner's corporation maintenance contractor to ensure the any installed raingardens operate as designed and water quality is maintained. The scope of the maintenance program will include inspection and rectification of issues associated with:

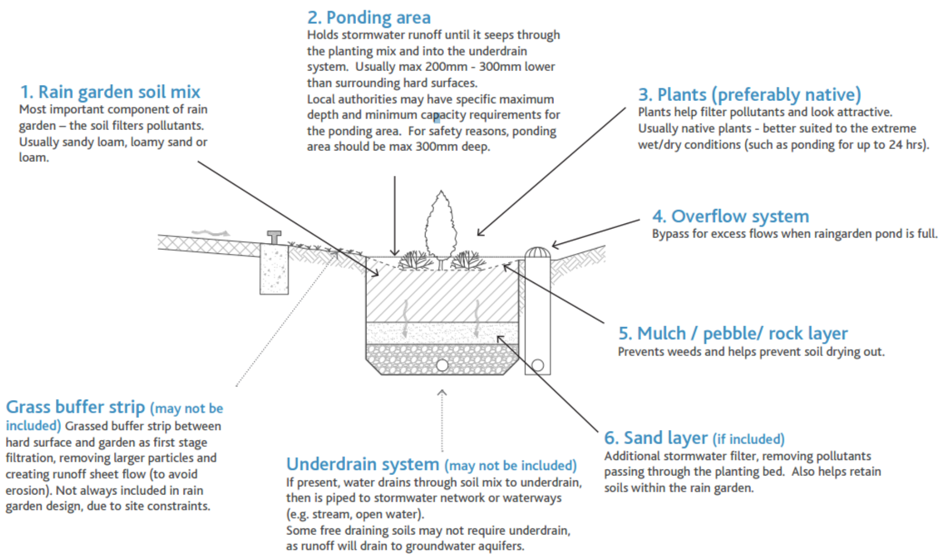
- Raingarden soil mix
- Ponding area
- Plants
- Overflow system
- Mulch/ pebble/ rock layer
- Underdrain system (where applicable)

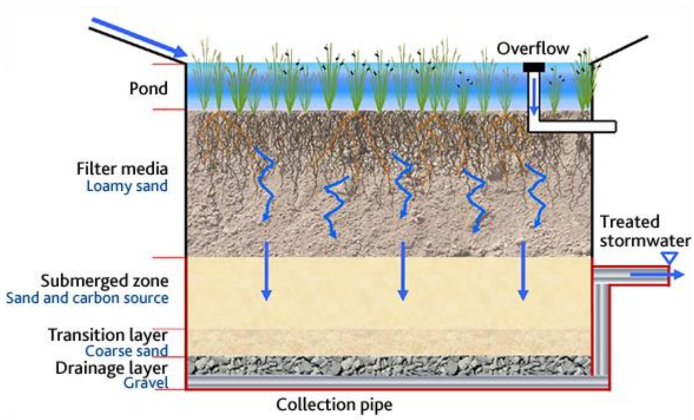
Inspections of the raingarden system and any maintenance works required will be undertaken as outlined in the maintenance schedule below.

Component	Maintenance Action
AFTER STORM EVENTS	
Ponding Area	• Check raingarden inlet for sediment, rubbish and leaves and remove as required. • Check for erosion or scour and repair. • Check and ensure that the garden is infiltrating effectively. • Check and re-profile topsoil as necessary – ensure level is below surrounding hard surface and overflow.
Kerb, Paved Area, or Grass Filter Strip (if included)	• Remove rubbish, leaves and other debris from surrounding areas
Mulch	• Check and redistribute/add mulch as necessary – particularly at the raingarden inlets.
3 MONTHLY	
Ponding area	• Check raingarden inlets for sediment build up, litter and leaves. • Check for erosion or scour and repair if necessary.
Mulch Layer	• Remove litter, leaves and other debris. • Redistribute/add mulch if necessary.
Overflow system	• Check for any blockages and remove as necessary.
Plants	• Check plant health and replace dead plants as necessary. • Remove weeds – do not use herbicides, pesticides and fertilisers as the chemicals may infiltrate through the rain garden and pollute the stormwater runoff.

Component	Maintenance Action
ANNUALLY	
Mulch Layer	• Check for sediment build up – remove and replace as required.
Ponding Area	• Check all water has drained 24 hours after heavy rain – remove and replace the crust from the top of raingarden if drainage not effective. • Check for litter, leaves and sediment build up and remove as necessary. • Check for erosion and gouging and repair where necessary.
Raingarden Soil Mix	• Check soil level is below surrounding hard surface level and the overflow
Underdrain System	• If underdrain present, flush underdrain and check for blockages – repair if necessary.

A cross-sectional diagram of a typical raingarden[3] is provided below.





[3] http://www.wsud.org

5. Conclusion

This report provides details of the water sensitive urban features which will be integrated into the design and specification of the proposed development in order to improve environmental outcomes during occupation.

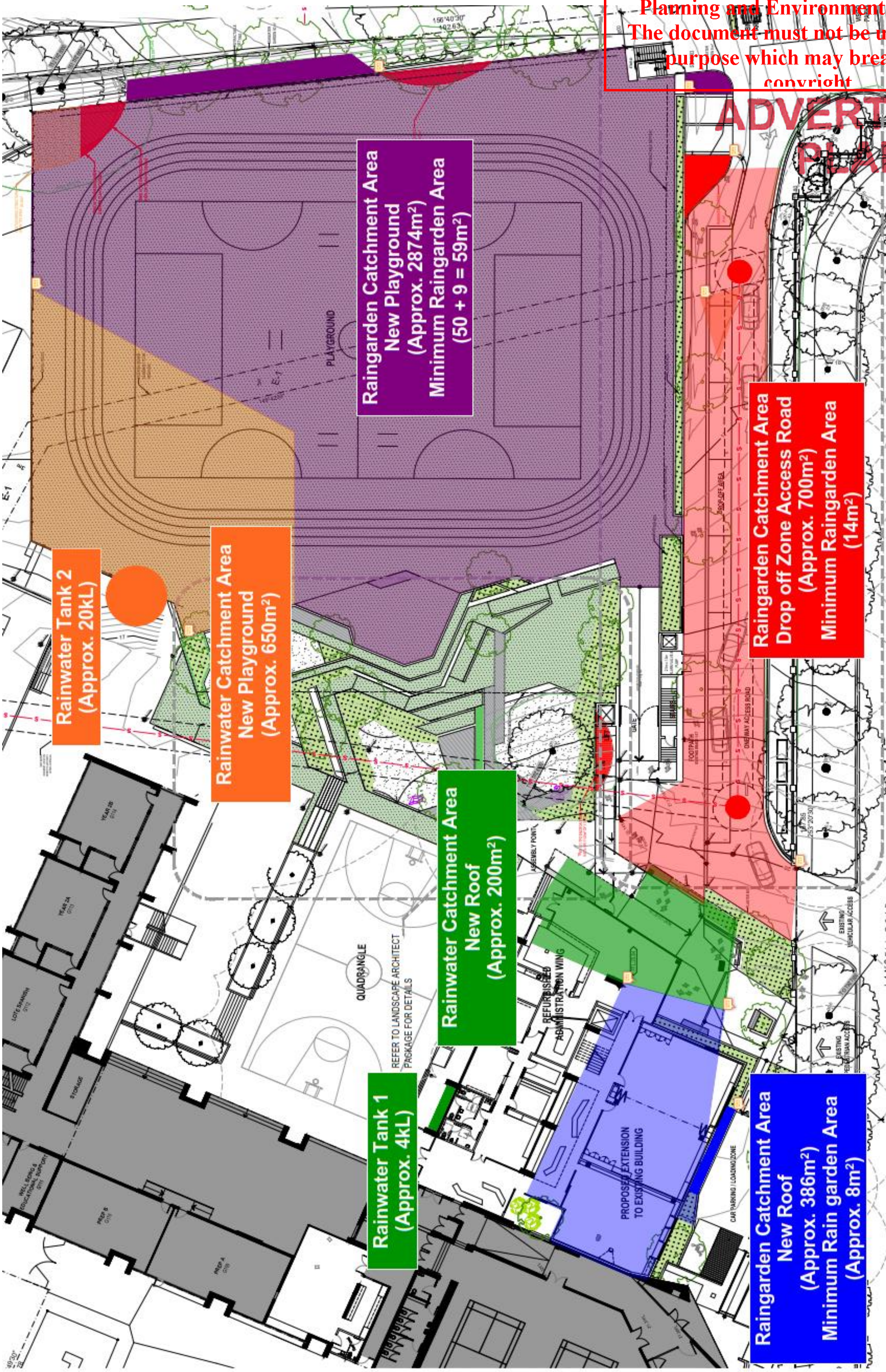
In terms of performance outcomes, the rainwater harvesting systems will significantly reduce the mains water demand and have been designed to achieve a high level of reliability. The rainwater supply and demand analysis confirms that there is very little additional reduction in mains water use from substantial increases in the size of the rainwater tank which indicates that the system strikes an appropriate balance.

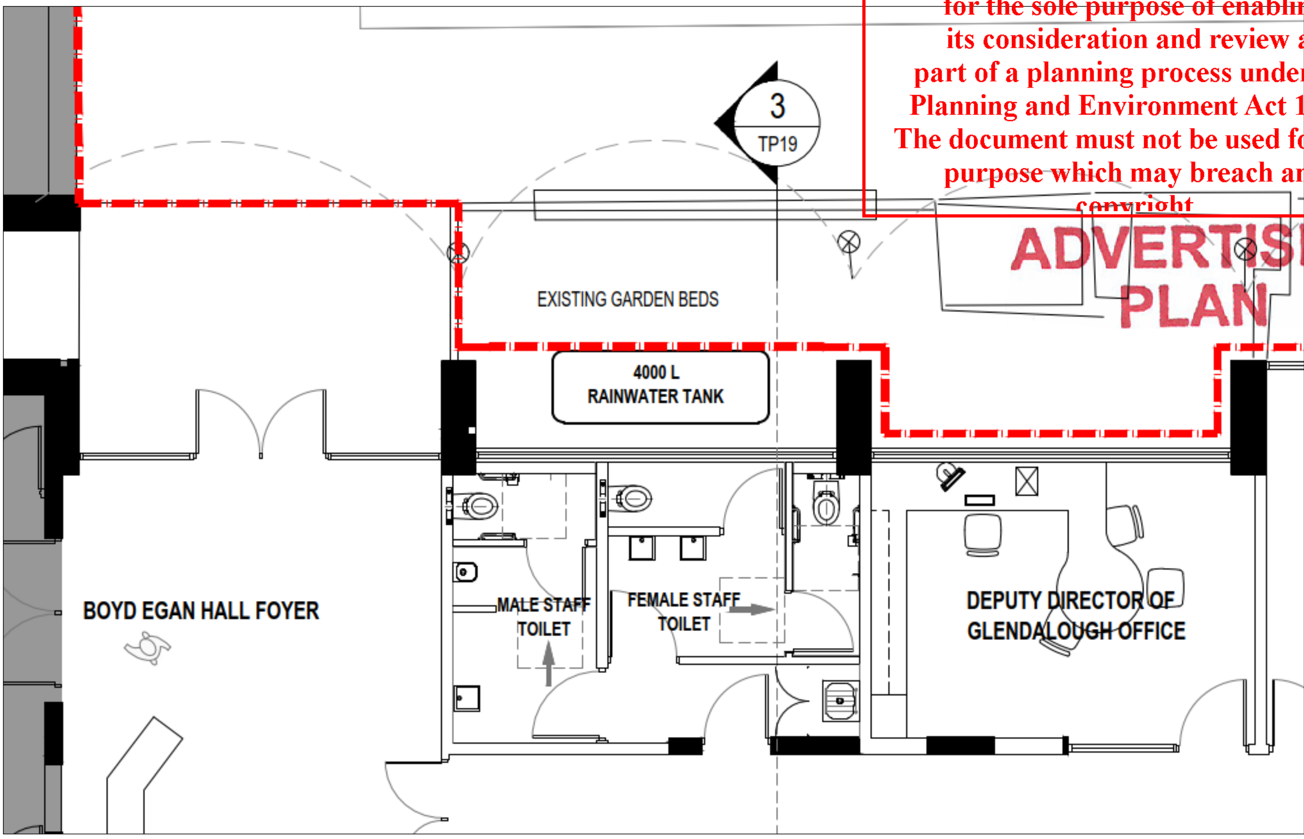
Furthermore, the project has areas of soft landscaping that will promote onsite infiltration of stormwater and therefore minimise runoff from the subject site into the stormwater system.

Accordingly, the analysis set out in this report confirms that the development meets the objectives of Clause 22.18 (WSUD Policy) and Clause 53.18 (Stormwater Management) of the Stonnington Planning Scheme.

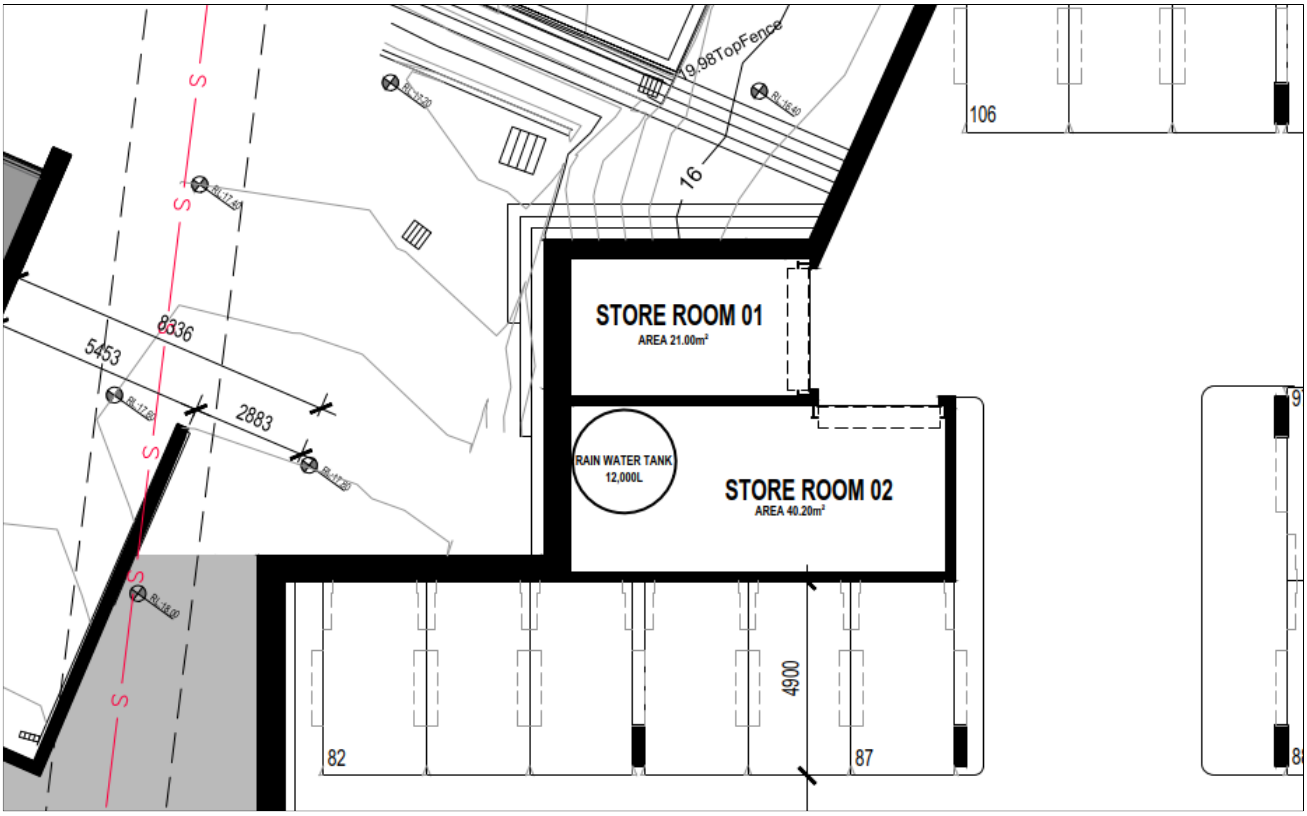
Jan Talacko
Director

Appendix 1: Rainwater Collection Areas for Re-use & Treatment

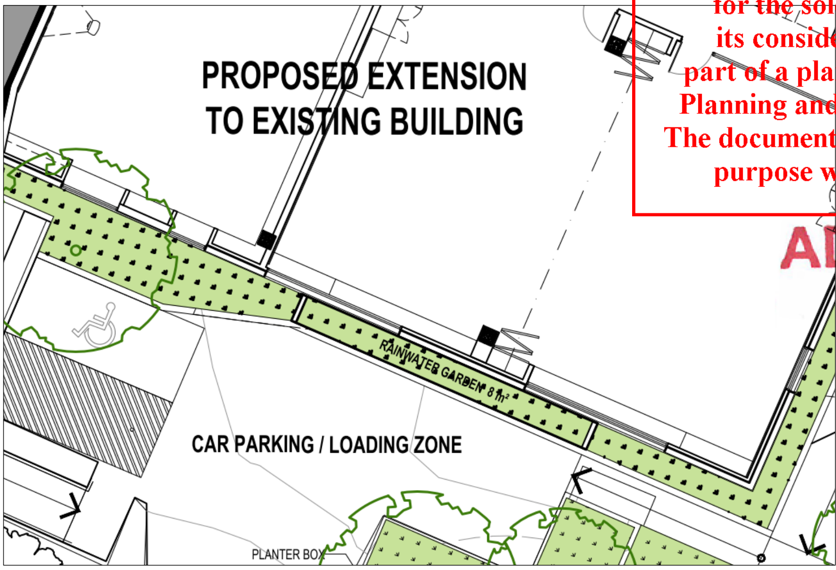




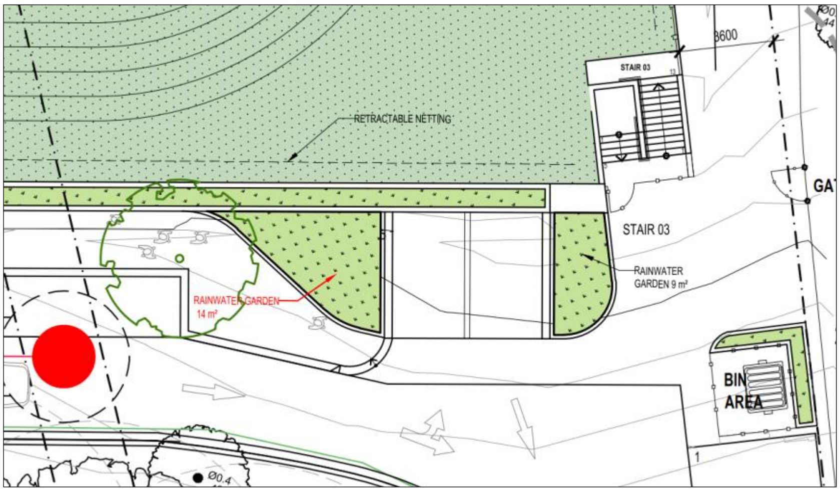
Location of 4,000 Litre rainwater tank.



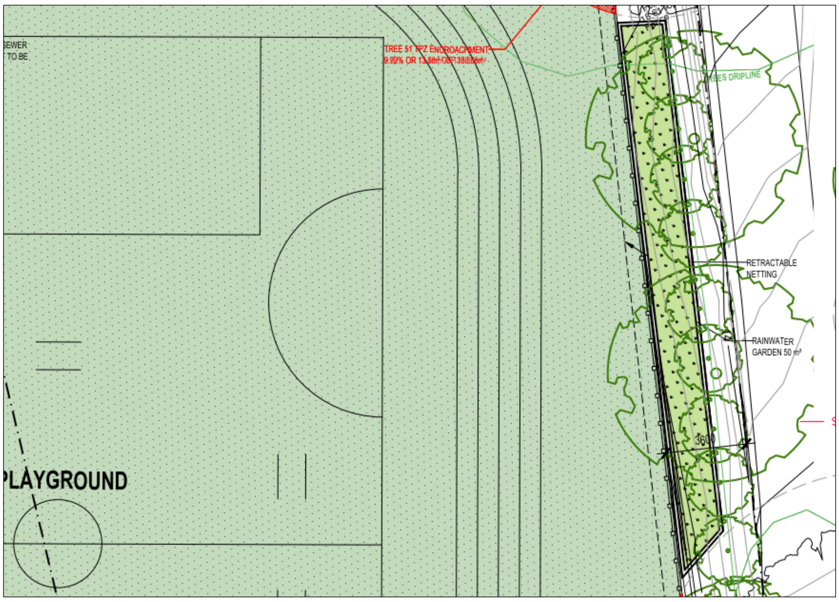
Location of 20,000 Litre rainwater tank.



Location of 8m^2 rainwater garden.



Location of 14m^2 and 9m^2 rainwater gardens.



Location of 50m^2 rainwater garden.

Appendix 2: Rainwater Modelling

Tank 1 – Toilet Flushing

Property St Kevin's College, Toorak (4kL)
Version

box 1

Inputs:

Commercial	Floor Area - NLA (m2)	131	
	PPL [M / F]	13	13
	Flush/Person/Day [M - Urinal]	2	
	Flush/Person/Day [M / F - WC]	0.3	2.3
	Litres/Flush [Urinal / WC]	1	3.3
	Total Daily usage (litres)	138.6	
Residential	PPL	0	
	Flush/Person/Day	5	
	Litres/Flush	3.3	
	Total Daily usage (litres)	0	
Development	Total Daily usage (litres)	139	
	Roof area (m2)	200	
	Collection Evaporation	5%	
	Tank Capacity (litres)	4,000	

Recalc, update pivots, table and graphs

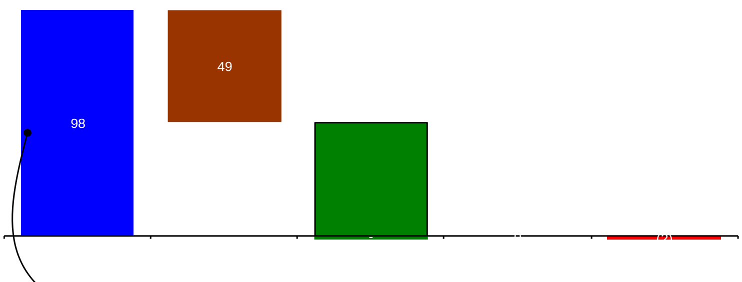
Irrigation Schedule

	l /m2	S	M	T	W	Th	Fr	S
Jan	10		y			y		
Feb	10		y			y		
Mar	10		y			y		
Apr	5		y					
May	5			y				
Jun	5			y				
Jul	5				y			
Aug	5				y			
Sep	5					y		
Oct	5					y		
Nov	10						y	
Dec	10		y				y	

Irrigation Area (m2) 0
T'off if Total Rain (mm) 10
in the last 5 days

box 2

System components (kls per year)



box 3

System components (kls per year) based on 12 years of actual historical daily rainfall

12 years of Averages
(kl)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rain Run off	6	9	6	9	8	7	7	9	8	10	10	10	98
Overflow	(2)	(5)	(2)	(4)	(4)	(3)	(2)	(4)	(4)	(6)	(6)	(6)	(49)
Rain Water saved	4	3	4	5	4	4	4	4	4	4	4	4	49
Toilet	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(51)
(Shortfall)/Surplus before Irrigation	0	(1)	(1)	1	(0)	(0)	0	0	(0)	(0)	0	(1)	(1)
Irrigation	-	-	-	-	-	-	-	-	-	-	-	-	-
Unsatisfied Demand	0	(1)	(1)	1	(0)	(0)	0	0	(0)	(0)	0	(1)	(1)

Actual Years
(kl)

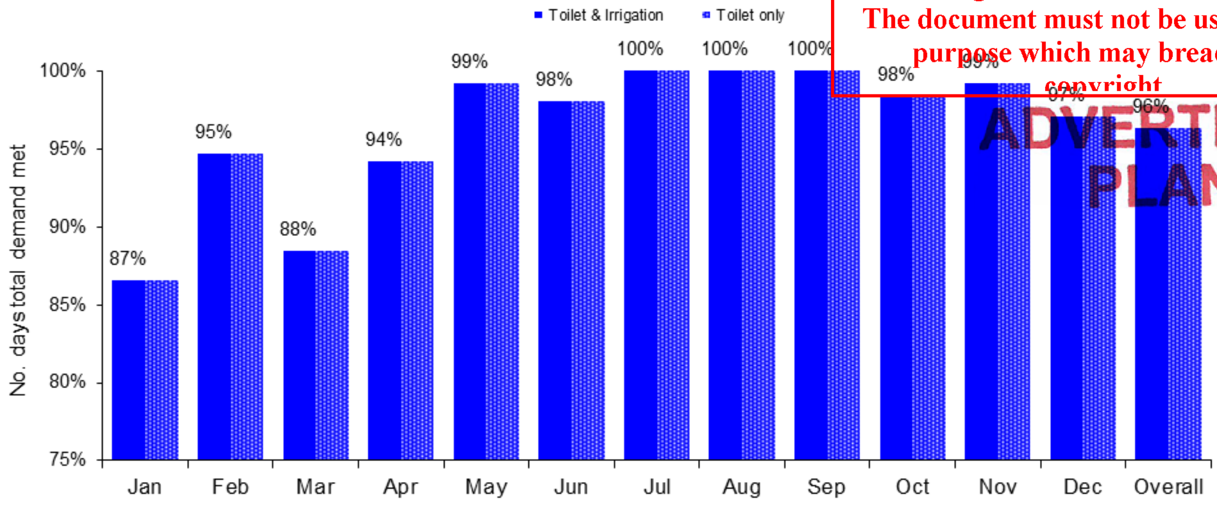
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Rain Run off	68	111	116	120	115	75	94	118	112	83	80	80	1,173
Overflow	(22)	(59)	(65)	(70)	(67)	(27)	(45)	(68)	(66)	(35)	(29)	(30)	(583)
Rain Water saved	46	52	51	50	48	48	49	50	46	48	51	49	590
Toilet	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(607)
(Shortfall)/Surplus before Irrigation	(4)	2	1	(1)	(2)	(3)	(1)	(1)	(4)	(2)	0	(1)	(17)
Irrigation	-	-	-	-	-	-	-	-	-	-	-	-	-
Unsatisfied Demand	(4)	2	1	(1)	(2)	(3)	(1)	(1)	(4)	(2)	0	(1)	(17)

box 4

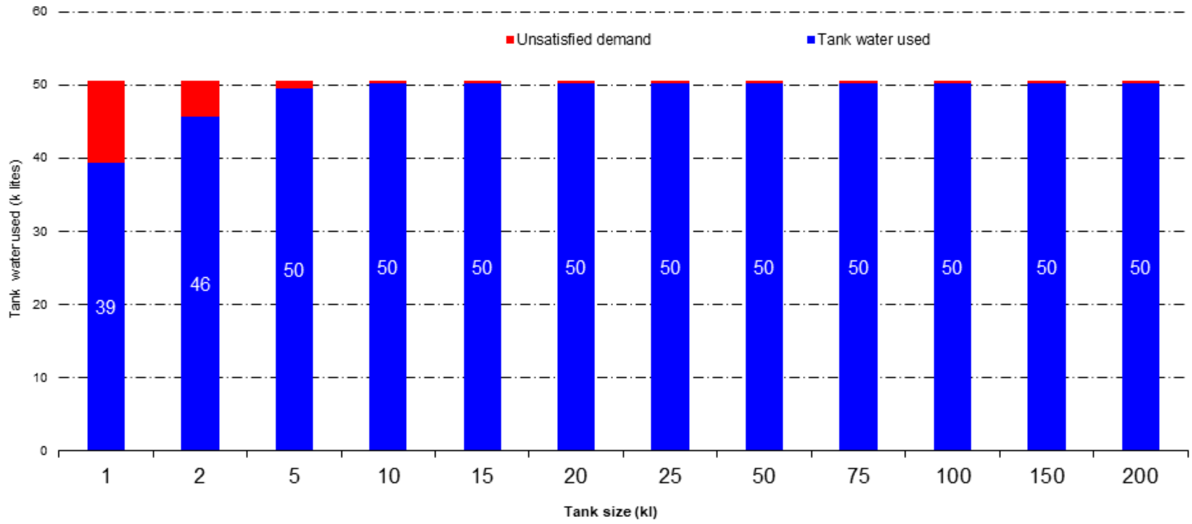
Reliability of supply (daily demand met)- Tank size what ifs

Tank	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
1k	57%	71%	55%	73%	76%	80%	84%	85%	80%	84%	76%	69%	74%
2k	75%	89%	71%	88%	92%	92%	95%	98%	91%	91%	96%	85%	89%
5k	91%	96%	92%	97%	100%	99%	100%	100%	100%	100%	100%	98%	98%
10k	95%	100%	96%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%
20k	95%	100%	96%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%
50k	95%	100%	96%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%
100k	95%	100%	96%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%
200k	95%	100%	96%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%

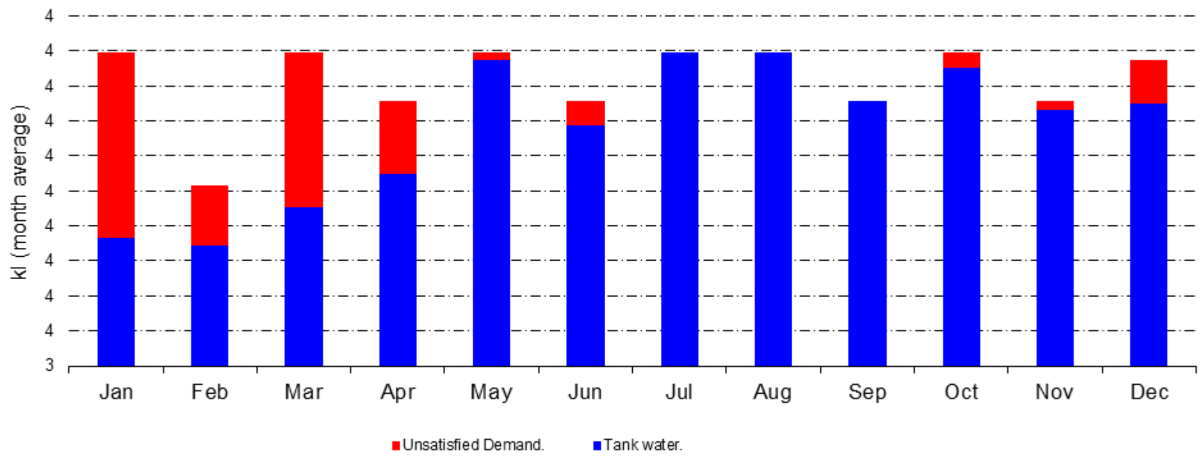
Graph 2 - Reliability of supply from tank (average across 12 years)



Graph 3 -Tank water used (per year) V Tank size
Kls per year



Graph 4 - Tank water used v unsatisfied demand
by month (kls per month)



Tank 2 – Irrigation

Property St Kevin's College, Toorak (20kL)
Version

box 1

Inputs:

Commercial	Floor Area - NLA (m2)	0	
	PPL [M / F]	0	0
	Flush/Person/Day [M - Urinal]	2	
	Flush/Person/Day [M / F - WC]	0.3	2.3
	Litres/Flush [Urinal / WC]	1	3.3
	Total Daily usage (litres)	0	
Residential	PPL	0	
	Flush/Person/Day	5	
	Litres/Flush	3.3	
	Total Daily usage (litres)	0	
Development	Total Daily usage (litres)	0	
	Playground area (m2)	650	
	Collection Evaporation	5%	
	Tank Capacity (litres)	20,000	
	Irrigation Area (m2)	277	
	T'off if Total Rain (mm)	10	
	in the last	5	days

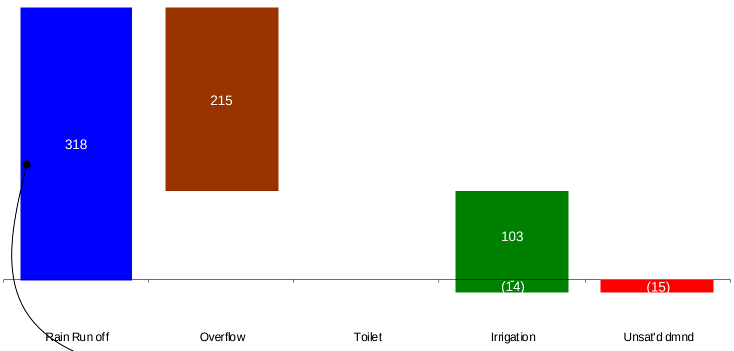
Recalc, update pivots, table and graphs

Irrigation Schedule

	l /m2	S	M	T	W	Th	Fr	S
Jan	10		y			y		
Feb	10		y			y		
Mar	10		y			y		
Apr	5		y					
May	5			y				
Jun	5			y				
Jul	5				y			
Aug	5				y			
Sep	5					y		
Oct	5					y		
Nov	10						y	
Dec	10		y				y	

box 2

System components (kls per year)



box 3

System components (kls per year) based on 12 years of actual historical daily rainfall

12 years of Averages
(k l)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rain Run off	21	28	18	29	27	23	22	29	24	32	32	33	318
Overflow	(5)	(16)	(6)	(16)	(21)	(18)	(17)	(24)	(20)	(27)	(25)	(20)	(215)
Rain Water saved	16	12	12	14	6	5	5	4	4	5	7	13	103
Toilet	-	-	-	-	-	-	-	-	-	-	-	-	-
(Shortfall)/Surplus before Irrigation	16	12	12	14	6	5	5	4	4	5	7	13	103
Irrigation	(20)	(17)	(21)	(5)	(5)	(5)	(5)	(5)	(4)	(5)	(8)	(18)	(117)
Unsatisfied Demand	(4)	(5)	(9)	9	2	0	0	(0)	0	0	(1)	(5)	(14)

Actual Years
(k l)

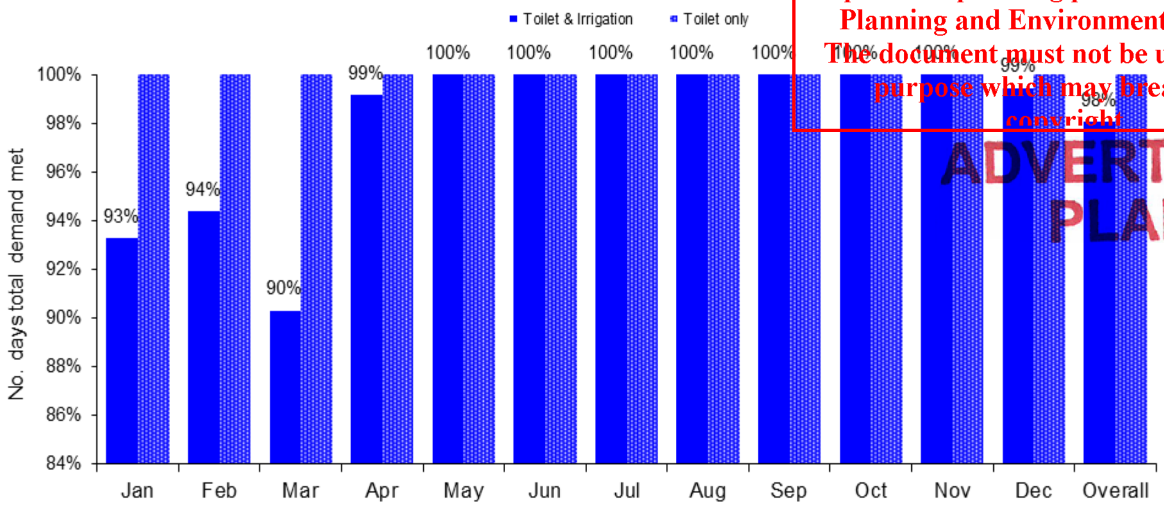
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Rain Run off	222	361	377	389	374	245	304	384	364	271	261	259	3,811
Overflow	(131)	(257)	(279)	(282)	(281)	(143)	(200)	(279)	(266)	(170)	(140)	(148)	(2,575)
Rain Water saved	91	104	98	107	93	102	104	106	98	101	122	111	1,236
Toilet	-	-	-	-	-	-	-	-	-	-	-	-	-
(Shortfall)/Surplus before Irrigation	91	104	98	107	93	102	104	106	98	101	122	111	1,236
Irrigation	(132)	(100)	(98)	(109)	(119)	(118)	(123)	(114)	(122)	(105)	(136)	(133)	(1409)
Unsatisfied Demand	(41)	5	-	(3)	(26)	(16)	(19)	(8)	(24)	(5)	(14)	(22)	(172)

box 4

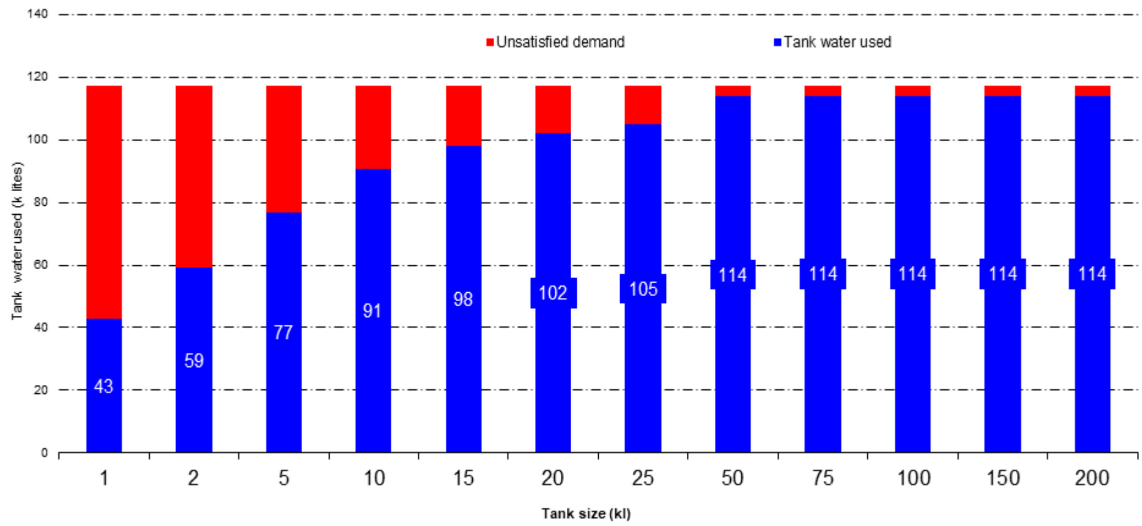
Reliability of supply (daily demand met)- Tank size what ifs

Tank	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
1k	77%	79%	76%	91%	92%	90%	92%	91%	91%	91%	91%	79%	87%
2k	78%	79%	77%	97%	98%	98%	99%	98%	98%	98%	92%	79%	91%
5k	83%	85%	81%	99%	100%	100%	100%	100%	100%	100%	99%	87%	94%
10k	89%	91%	85%	99%	100%	100%	100%	100%	100%	100%	100%	94%	97%
20k	**93%**	**94%**	**90%**	**99%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**99%**	**98%**
50k	98%	99%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
100k	98%	99%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
200k	98%	99%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

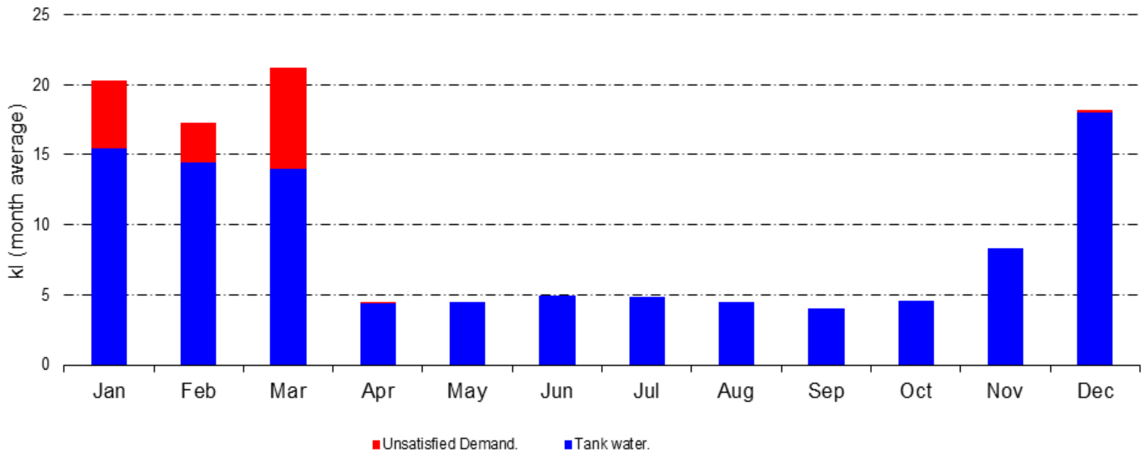
Graph 2 - Reliability of supply from tank (average across 12 years)



Graph 3 -Tank water used (per year) V Tank size
Kls per year



Graph 4 - Tank water used v unsatisfied demand
by month (kls per month)



Appendix 3: MUSIC Modelling

MUSIC Model Results

Assumptions	
Area Name	**Area [m²]**
Total Roof Areas to RWT	200
Total Playground Areas to RWT	650
Permeable Areas	171
Planters over basement car park Areas	138
Total Raingarden Catchment Areas	3,960
Playground Area	2,874
Part New Roof Area	386
Drop Off Area	700
Other impervious areas	2,269
Total Site Area	**7,388**

MUSIC Model 29/07/2020	
Treatment Devices Features	
RWT	4 + 20 kL
Total RWT Capacity	24 kL
Toilets connected to RWT for TF	All toilets in new/refurbished building (3 x toilets & 1 x urinal)
Daily water demand for TF (all toilets connected to RWT only)	0.211 kL/day
Annual water demand for TF (all toilets connected to RWT only)	0.211 x 240 = 51 kL/yr
Annual water demand for Irrigation	117 kL/yr
*Total RG surface area	81 m^2
Rain garden Fliter media depth	**600 mm**
Rain garden Extended detention depth	**300 mm**
**Primary Treatment System 1 (GPT)	Rocla CDS 0708 (or equivalent)
Results	
Reduction in Total Suspended Solids (TSS)	88.2%
Reduction in Total Phosphorus (TP)	46.2%
Reduction in Total Nitrogen (TN)	45.1%
Reduction in Total Gross Pollutants	99.3%

NOTES:
* RGs vegetated with Effective Nutrient Removal Plants. Further specification to be undertaken in Detailed Design.
**Nutrient reduction (Phosphorous and Nitrogen) not attributed to GPT as per Melbourne Water MUSIC guidelines.

Acronyms
RWT: Rain Water Tank
RG: Rain Garden
TF: Toilet Flushing
GPT: Gross Pollutant Trap

Rainwater Use and Reliability calculations assume demand for 365 day per year. The demand for this project is limited to school office operating days. Therefore, the demand for a school environment has been averaged over 365 day of the year for the reliability calculations.

$$0.211 \times \frac{240}{365} = 0.138 \text{ kL/day}$$

MUSIC Model Parameters

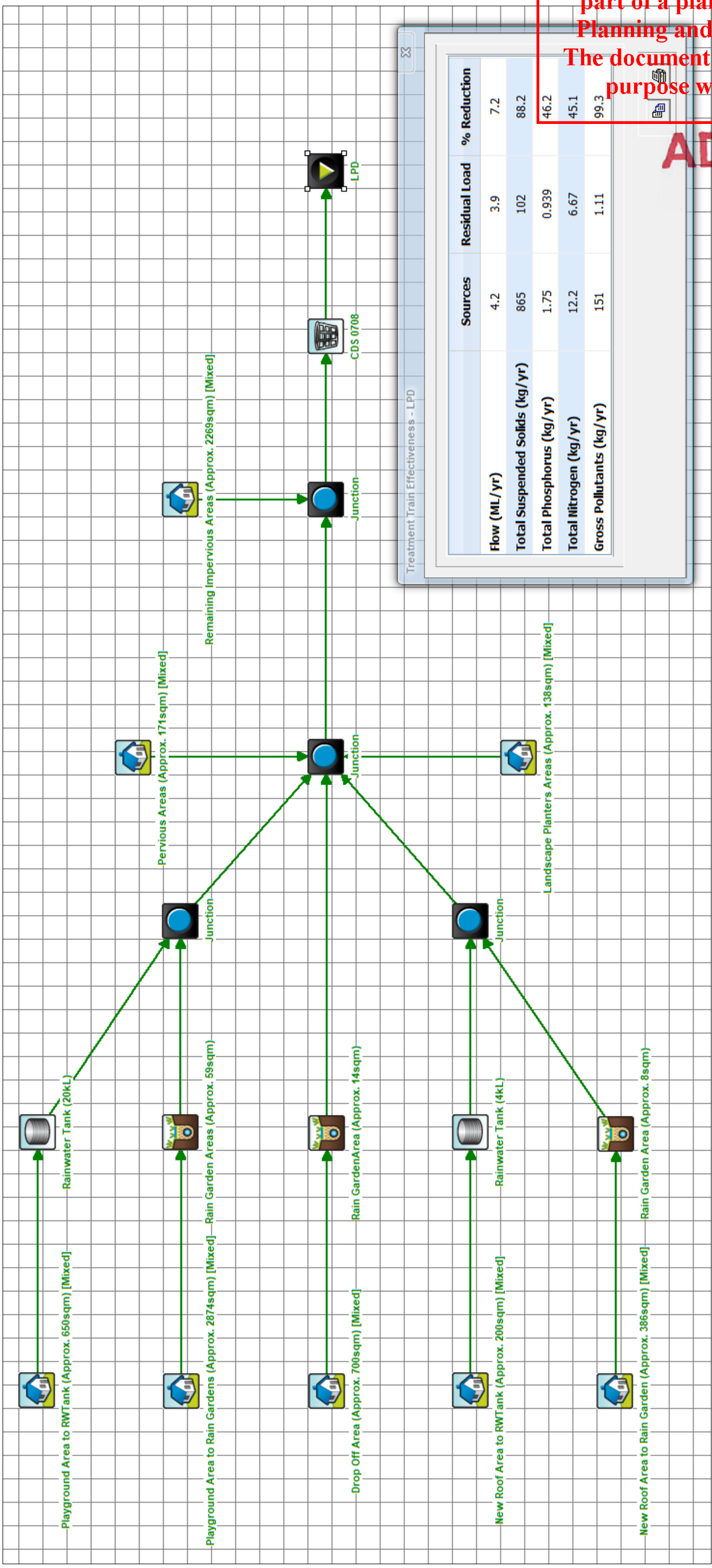
MUSIC v6.3.0 Input Parameters	
Rainfall data	
Rainfall Range & Station Name	C - Melbourne City (650-750mm)
10 Year Period	C - 1952-1961
Mean annual rainfall	C - 708mm
Evapotranspiration	C - 995
Time step	6 minutes
Estimation method	Stochastically generated

Soil properties - Melbourne	
Soil store capacity	120mm
Field capacity	50mm

Rain Garden	
Saturated Hydraulic Conductivity	100mm/hour
Underdrain present?	Yes

GPT Pollutant Removal Rates	
Total Suspended Solids	70%
Total Nitrogen	0%
Total Phosphorous	0%
Gross Pollutants	98%
Validation report	CRC for Catchment Hydrology

MUSIC Model Schematic



Appendix 4: Slimline Water Tank Options

Appendix 5: Site Management Plan

The objective of this Site Management Plan is to minimise the risks and impacts of stormwater pollution on nearby waterways during construction works.

The key pollutants at risk of entering the stormwater system during the construction phase include:

- Sediments such as soil, sand, gravel, mud and concrete washings;
- Oil, foam, scum, grease, and other chemicals; and
- Litter, stones, debris etc.

These pollutants arise from several factors such as dirt from construction vehicles, stockpiles located close to surface runoff flow paths, surface runoff from disturbed areas during earthmoving and construction works. It is therefore important to have measures that either prevent or minimise the pollutant loads entering stormwater system during construction.

In order to mitigate the impacts of the above pollutants on the stormwater system, the following stormwater management strategies will be implemented during the construction phase (as appropriate):

- Establish a single stabilised entry/exit point to the site;
- Ensure any stockpiles are on the project site and not on footpaths, roadways, and neighbouring land;
- Only clear those lands that must be disturbed during the building works;
- Where necessary, put up barrier fences around areas where vegetation or topsoil is not to be disturbed;
- Installation of onsite erosion and sediment control measures. Such measures may include (but not limited to):
  - Silt fences
  - sediment traps
  - hay bales
  - geotextile fabrics
- Ensure that all installed control measures are regularly inspected & maintained to ensure their effectiveness; and
- Where possible, waste bins or skips with a lid will be used to prevent litter from getting blown away and potentially entering stormwater drains.

Additionally, the following work practices shall be adopted to reduce stormwater pollution:

- Site induction by the head contractor/ builder to make personnel aware of stormwater management measures in place
- Employ suitable measures to reduce mud being carried off-site into the roadways such as installing a rumble grid/ gravel/ crushed-rock driveway (or equivalent measure) to provide clean access for delivery vehicles, removing mud from vehicle tyres with a shovel etc.
- Safe handling and storage of chemicals, paints, oils and other elements that could wash off site to prevent them from entering stormwater drains.
- Where practicable, stockpiles will be covered, located within the site's fence and away from the lowest point of the site where surface runoff will drain to. This initiative will minimise erosion.

Accordingly, the measures presented above are considered appropriate for the proposed development at this stage of the project. The measures will reduce the pollutants entering stormwater system from the site during construction works thereby protecting waterways.