STORMWATER MANAGEMENT STRATEGY

275 Manchester Road, Chirnside Park

Summerset

May 2022

Document history

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1 Introduction

Alluvium Consulting Australia Pty Ltd (Alluvium) has been engaged by Summerset Group Holdings limited (Summerset) to prepare a Stormwater Management Strategy (SWMS) for Lot S4 at 275 Manchester Road, Chirnside Park.

The purpose of this SWMS is to propose management strategies for:

- Stormwater quantity
- Stormwater quality

Through meeting these objectives, this SWMS acts as a critical component of the development servicing strategy and ensures stormwater is managed in accordance with Melbourne Water's and Council's requirements. The strategy will directly inform the local drainage design for the site and will include appropriate mitigation measures to protect the local environment values.

2 Site Overview

Lot S4 at 275 Manchester Road, Chirnside Park (the subject site) covers an area of approximately 9.3 ha, of which 5.2ha is proposed for a Retirement Village Precinct and 4.1 ha is proposed for a Residential Precinct. The Site forms part of the East Ridge Development Plan and is titled as 'Lot S4' under the Plan of Subdivision PS 544666H. The Site locality is identified by the red boundary presented below in Figure 1.

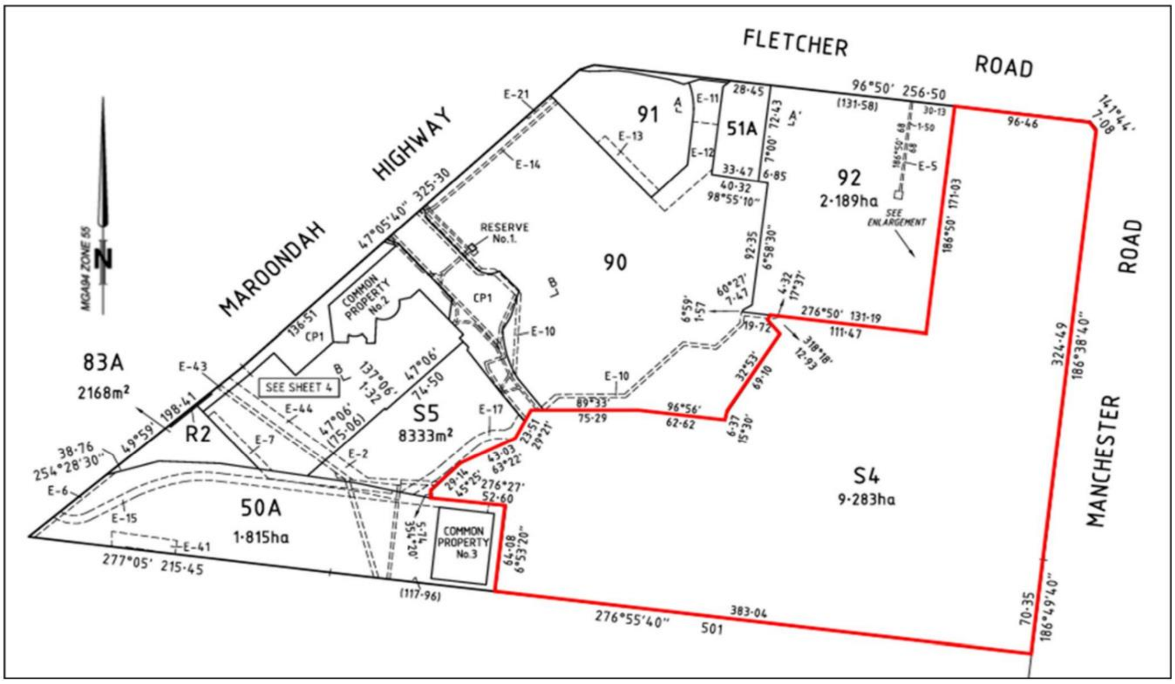

Figure 1. *Plan of Subdivision PS 544666H - site location (subject site shown in red)*

The subject site is situated in Chirnside Park and is surrounded by developed residential and commercial land. The site is generally bound by Fletcher Road to the north, Manchester Road to the east and Maroondah Highway to the west (refer to Figure 2). Historically the site was used for agricultural use. Currently the site is greenfield. Based on the current land use, the subject site is assumed to have an existing fraction imperviousness of 0.1. The proposed development is not located in a Melbourne Water Development Services Scheme (DSS) or council Precinct Structure Plan (PSP).

Figure 2. *Site location (subject site shown in red)*

The subject site is now proposed to be divided into two precincts, a Retirement Village Precinct and a Residential Precinct (refer to Figure 3). The residential precinct is a public development with roads, reserves and proposed stormwater assets being owned and managed by Council. Meanwhile the retirement village precinct will be a private development, with ownership and management of assets on the precinct being the responsibility of Summerset Group Holdings.

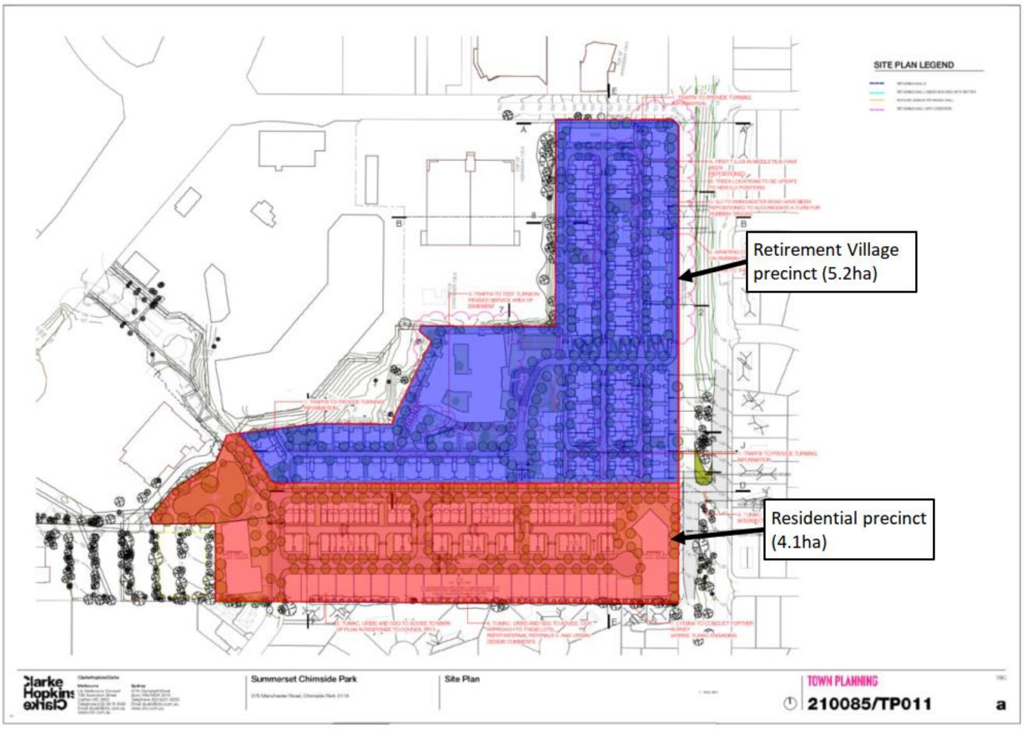

Figure 3 Precinct layout of subject site

3 Existing Conditions

3.1 Previous Drainage Strategies

A number of drainage investigations and assessments have previously been undertaken for the broader area known as the "Eastridge Development Precinct". A summary of these previous studies is provided below.

<u>Neil Craigie (2011)</u>

A Stormwater Management Strategy (SWMS) was originally developed by Neil Craigie for the overall 'Eastridge Development Precinct' (11 Jan 2011). This original SWMS set the principals and stormwater criteria for the area. The report identified that the Melbourne Water main drain servicing the site was at capacity and future development of the precinct would require retarding storage within the development. Melbourne Water's Mooroolbark North Drain is known to be of limited capacity. Melbourne Water have specified that the peak discharge from the total catchment at the southwest exit from the overall Eastridge Development must not exceed 12.30 m3/s in the 1% AEP event. This was effectively the 1% AEP discharge for the external catchment and the existing conditions (in 2011) for the Eastridge Development precinct. The Craigie report required retarding storage systems throughout the Eastridge Development precinct to comply with this condition.

The requirements from the Craigie strategy for the S4 parcel are shown in Figure 4. The northern subcatchment, identified by the red highlighted area was proposed to be managed via the Central Park Wetland/Retarding Basin. Low flows from this wetland were proposed to be directed around to the Entry Park Retarding Basin/Bio Retention Basin, and higher flows to continue downslope via pipeline and connect to the existing 1050 mm diameter pipe at the Eastridge Drive main entry roundabout.

The southern sub catchment, identified by the purple highlighted area was proposed to be managed via the South Park Bio Retention Basin/Retarding Basin. It was proposed that outfall connects to the existing Yarra Ranges Council drain.

Figure 4. *Extract from Craigie SWMS on proposed basins*

Davis, Naismith & McGovern Pty Ltd (2018)

A subsequent Stormwater Management Strategy (SWMS) was developed by Davis, Naismith & McGovern Pty Ltd (July 2018). The SWMS document summarises the existing buildings and proposed allotments and the treatment of stormwater for each of the proposed allotment in the Eastridge Development precinct.

The document identifies that the subject site ('Lot S4') is currently undeveloped, and it is likely to be developed as a residential site. As part of the Site ('Lot S4') development water quality improvements will be required and stormwater discharge will need to be limited to predevelopment levels for 1.5, 20, and 100 year ARI flows to the local statutory authority's approval and consistent with Neil Craigie's SWMS.

It was proposed that water quality improvements be provided by a bioretention basin and stormwater detention will be provided by a retarding basin referred to as "RB1" in Figure 5 below. It was proposed Retarding Basin 'RB1' will be designed and constructed as part of the Sites (Lot S4) future development

This 2018 report also identified that a drainage connection point for the S4 site had been allowed for via a junction pit at the roundabout on Eastridge Drive a part of the road and drainage plans. An extract of this information is provided in Figure 6. It was proposed that treated and retarded flows from the Site ('Lot S4') will pass through 'Lot 90' and 'CP1' via Easement 'E15' (Eastridge Drive) and flow through retarding basin 'RB3' once the Site ('Lot S4') is developed.

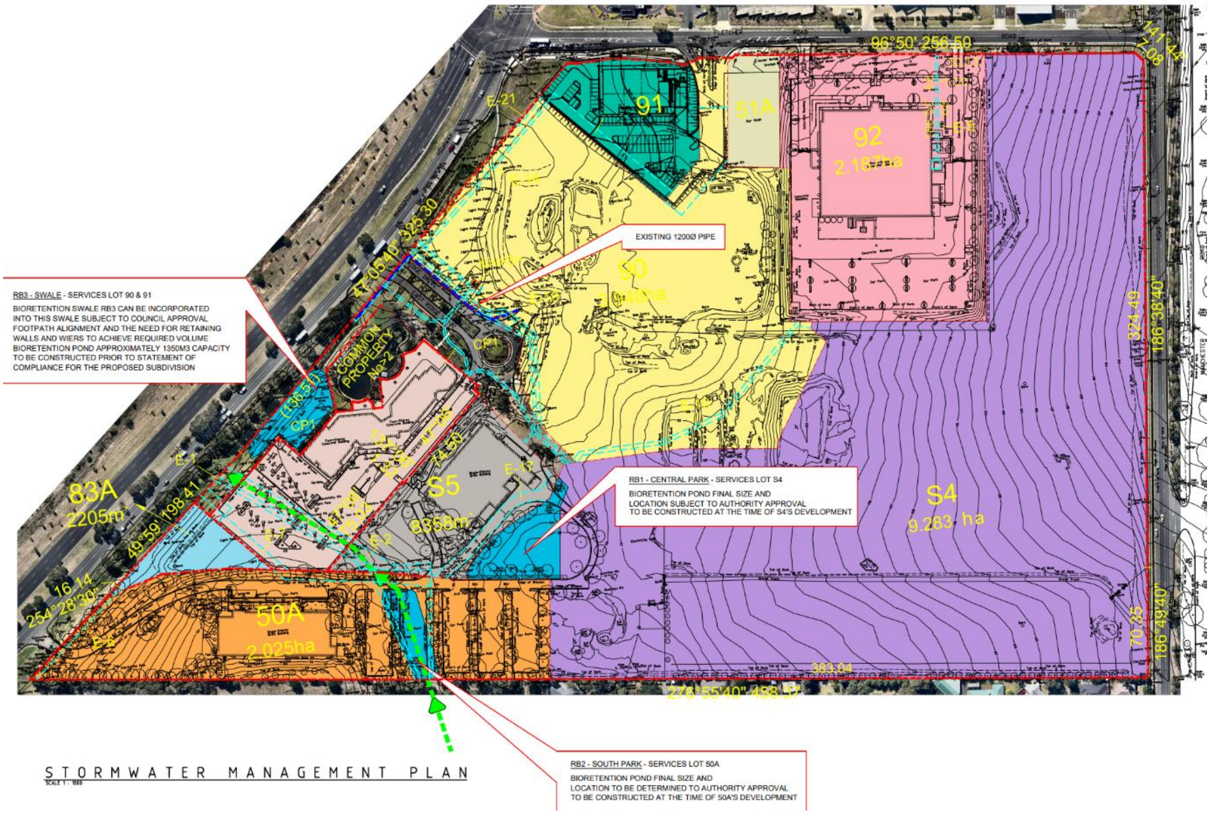

Figure 5. *SWMS plan from Davis, Naismith & McGovern (2018)*

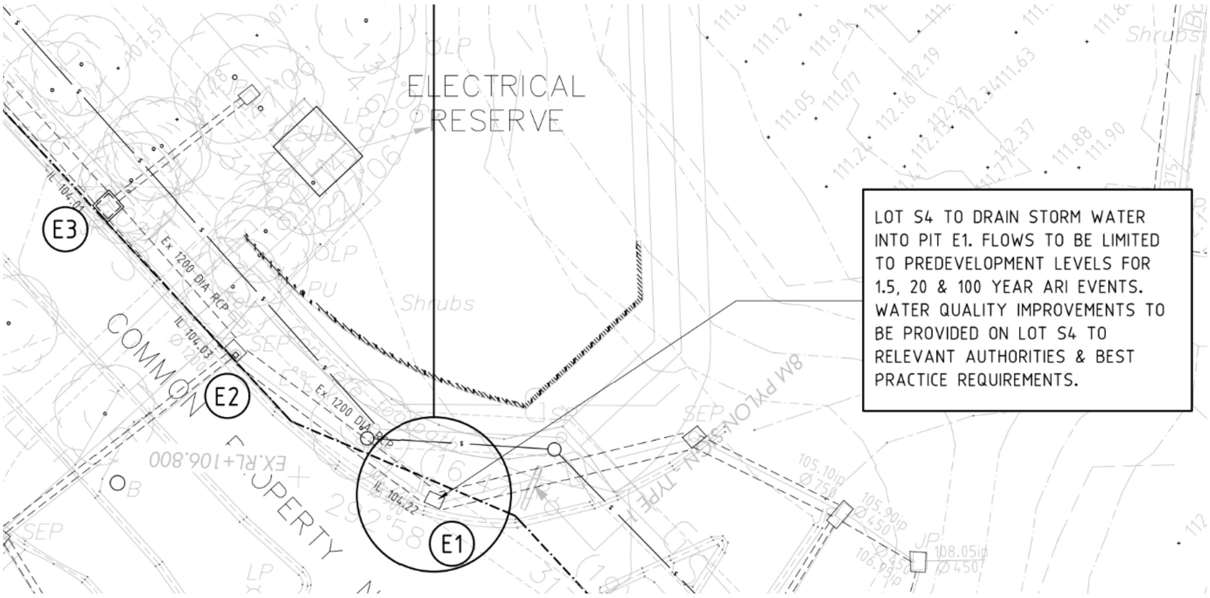

Figure 6. Extract *from Davis, Naismith & McGovern (2018) showing proposed outlet connection from S4 at the roundabout junction pit*

3.2 Existing Survey

The existing drainage infrastructure has been picked up by field survey in 2022. In general, the Eastridge Development precinct drains to the southwest corner. A 1050 mm diameter pipe draining the Hedwig Drive catchment enters the site in the southwest corner. This drain is the responsibility of Yarra Ranges Council for about 100 metres to a major grille intake structure located at the southeast boundary of the carpark for the Lifestyle Building. From this point on it is the responsibility of Melbourne Water and is referred to as the 'Mooroolbark North Drain'. Pipe size increases to 1350 mm diameter across the carpark to Maroondah Highway at which point it reverts to an open drain and turns southwest for about 100 metres along the highway frontage before continuing as a 1350 mm diameter pipe.

Figure 7. Melbourne Water main drain

Piped drainage systems have been constructed in the entry road from Maroondah Highway as far as the main roundabout. These drains are the main outfalls for the bulk of the development area and range in size up to 1050mm diameter. The pipe currently terminates immediately south of the entry road adjacent to the existing pond adjacent Maroondah Hwy.

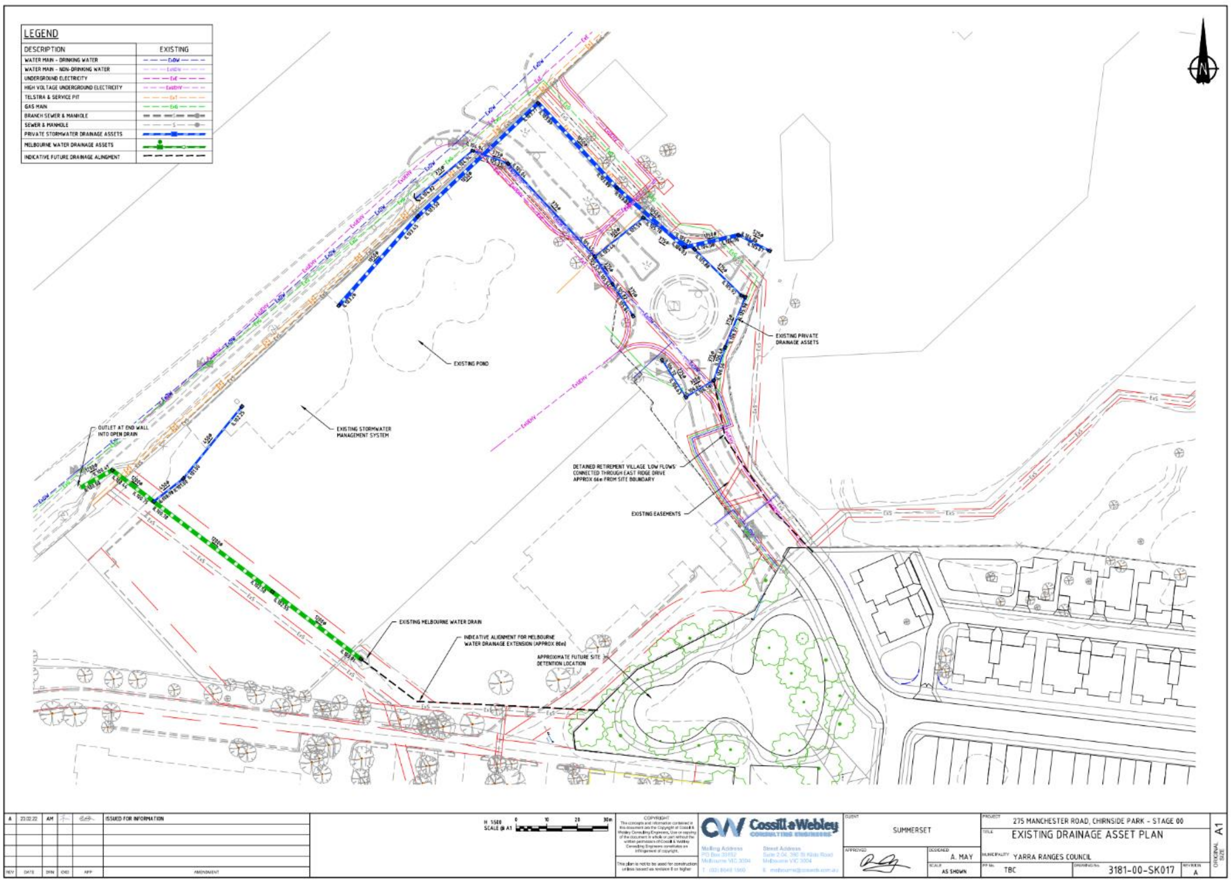

Figure 8. Field survey of existing drainage infrastructure

Topography

Summerset engaged Lyssna to conduct an existing site survey for the subject site in October 2021 (refer to Figure 9). The subject site falls steeply towards the west, with an average grade of approximately 10%. The slope is steepest on the eastern boundary of the subject site with the slope becoming more gradual towards the south eastern corner.

Figure 9 Existing conditions survey for the subject site (Lyssna, Oct 2021)

4 Hydrologic Analysis Existing Conditions

The hydrological conditions of the subject site were established using the RORB software package and rational method. These tools were used to estimate the peak design flows from the subject area under existing (i.e. pre-development of Lot S4) conditions discharging from the south-western corner of the subject site.

The following design rainfall parameters were adopted for the subject site based upon the Bureau of Meteorology's (BOM) "Intensity Frequency Duration (IFD) Tool – AR&R 2019) (refer to Figure 10).

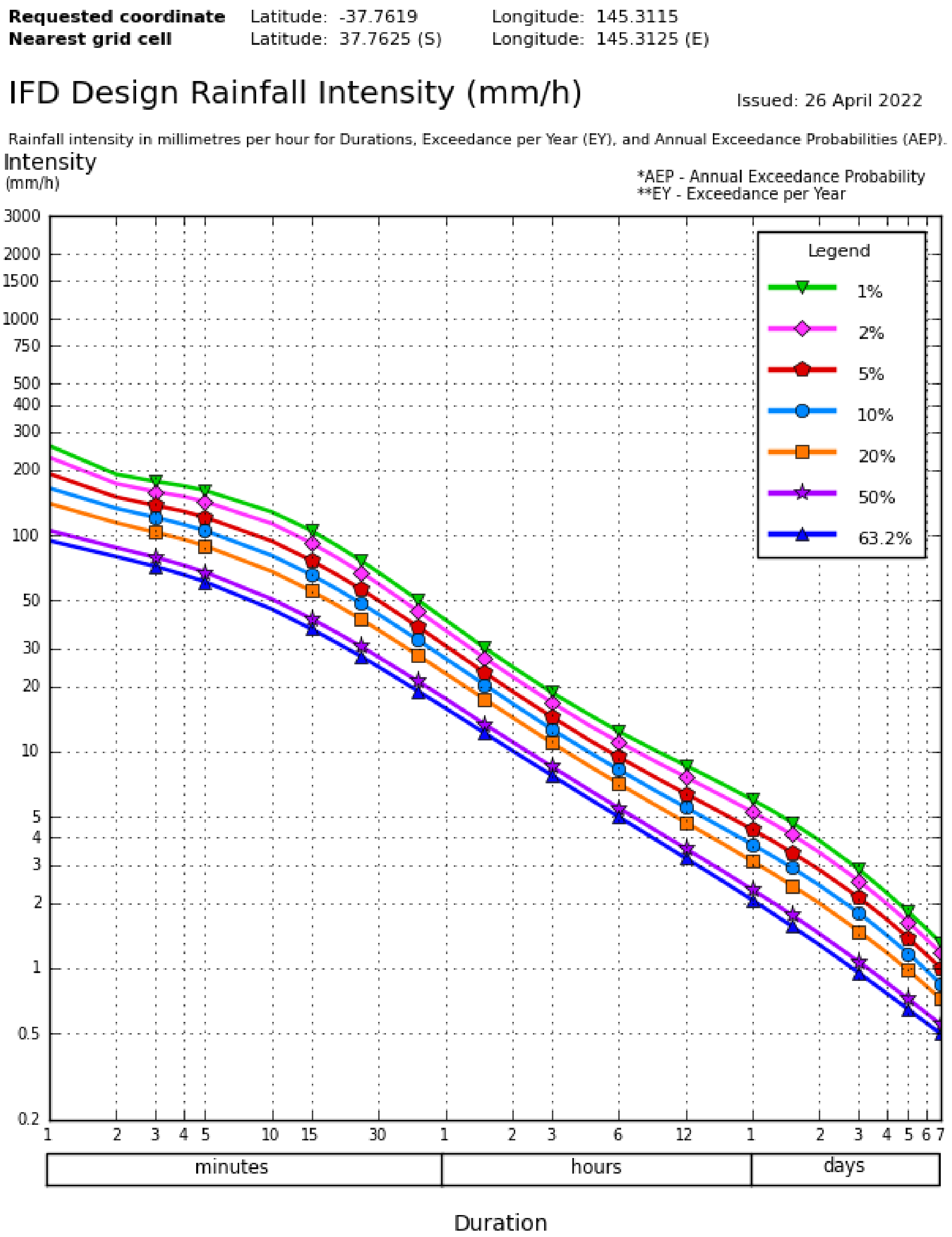

Figure 10 Design rainfall intensities for subject site

RORB is a general runoff routing program used to determine flood hydrographs from rainfall. In accordance with best practice modelling procedures, at least 4 subareas exist upstream from the point of interest. The hydrologic modelling considered a range of design storms, from 10 minutes duration through to 72 hours, for a range of temporal patterns, in order to determine the critical duration event with respect to storage (i.e. the

60th percentile peak flow for a given duration). Due to the existing land use of the subject area a fraction impervious of 0.1 was adopted.

Although a RORB model was previously prepared in Neil Craigie's 2011 SWMS, the catchment size investigated was much larger than the subject area of this report. The model was also based on Australian Rainfall & Runoff 1987. As such, a new RORB model was prepared by Alluvium based on the principals established in the Craigie strategy (ie peak flow rates attenuated to pre-development peak flow rates and the location for discharge outfalls).

The Australian Rainfall & Runoff 2019 guidelines suggests that where calibration to a gauging station is not available then model parameters should be derived using regional equations or relationships based on other gauged stations. The two most relevant equations to estimate the RORB "kc" parameter is provided in Table 1.

Table 1 Pre-developed RORB model inputs variables

Estimation Method	Relationship	Kc value
Pearse et al	Kc = 1.25 * dav	0.39
Melbourne Water Regional Equation for the Yarra & Maribyrnong catchments	kc = 1.19 * A^0.56	0.31

As a verification check a comparison of the RORB peak flows with the rational method estimate (VicRoads approach) for a rural catchment was undertaken. The Pearse et al estimate of kc provided flows that were similar to the rational flow estimate (see Table 2).

Table 2 Pre-developed peak flowrates

Location	Peak pre-developed flow rate (Rational Method)	Peak pre-developed flow rate (RORB)
	(m^3/s)	(m^3/s)
Outfall of Retirement Village precinct	0.46	0.51
Outfall of Residential precinct	0.38	0.47
Total outfall of subject site	0.84	0.86

As per the recommendations in ARR2019, the Initial Loss (IL) and Continuing Loss (CL) values were used from the ARR datahub. Table 3 summarises the adopted pre-developed RORB model parameters.

Table 3 Pre-developed RORB model inputs variables

RORB input variable (Pre-developed)	Value	Method of derivation
m	0.8	Standard value
Kc	0.39	Pearce et al and supported by rational method estimates
IL	23.1	ARR datahub value (minus medium pre-burst value)
CL	3.6	ARR datahub

5 Stormwater Management Objectives

The criteria for the proposed strategy, based on the analysis of existing conditions and drainage authority requirements are as follows:

- Meet best practice pollutant removal targets
- Convey major flows through road and drainage reserves
- Convey minor flows through local catchments in a piped network
- Stormwater runoff under developed conditions retarded back to the equivalent pre-developed peak flowrates for flows up to the 1%AEP event

Following discussions with Council, Summerset were advised that Council required that stormwater runoff from the Retirement Village Precinct (privately owned) be controlled (both quantity and quality) before connecting to the Council managed drainage system.

Legal Point of Discharge

As detailed in Section 3, there are two points of discharge from the subject site as follows (see Figure 11):

- To the existing 1050mm Yarra Ranges Shire Council drain located to the west of the subject site. The catchment draining to this outfall is from the Residential Precinct (4.1ha). The peak flow rate in a 1% AEP is limited to the equivalent pre-development peak flow rate of discharge of 0.47 cumecs.
- To the 1050mm drain located to the north-west of the subject site at the roundabout junction pit. The catchment draining to this outfall is from the Retirement Village Precinct (5.2ha). The peak flow rate in a 1% AEP is limited to the equivalent pre-development peak flow rate of discharge of 0.51 cumecs.

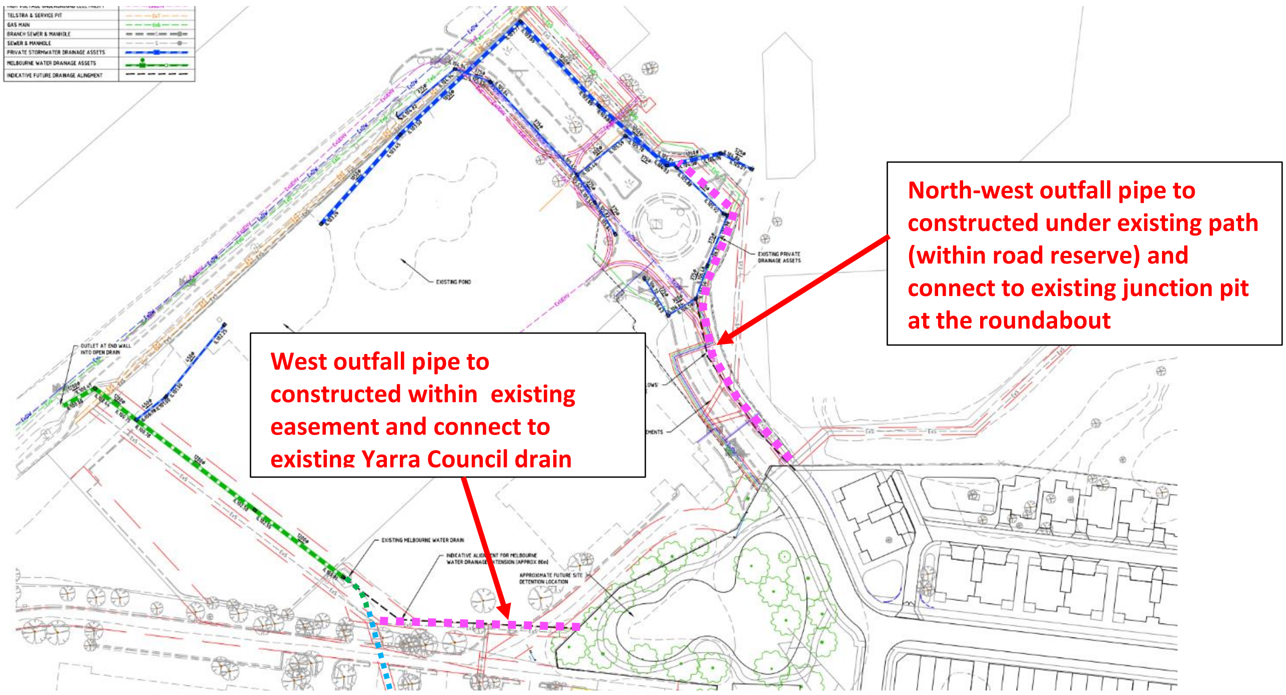

Figure 11 Legal points of discharge and required outfall pipes (shown via pink dash line)

6 Stormwater Quantity – Proposed Strategy

The proposed internal drainage system should be designed and constructed in accordance with the minor / major drainage system philosophy. For drainage assets within a catchment area of 60 hectares, Council design standards are expected to apply. For drainage assets greater than 60 hectares, Melbourne Water design standards are expected to apply.

Minor and major flows within the subject area were determined using a combination of RORB and the rational method. As flow paths within the subject area will mainly follow road reserve and local highpoints, catchment delineation for the rational method was conducted based on the proposed road network (Figure 12). Although the proposed road network is subject to change, this allowed for high level estimates to be made on peak flowrates, indicative pipe sizing and ensuring that flowrates can be contained within the road reserve.

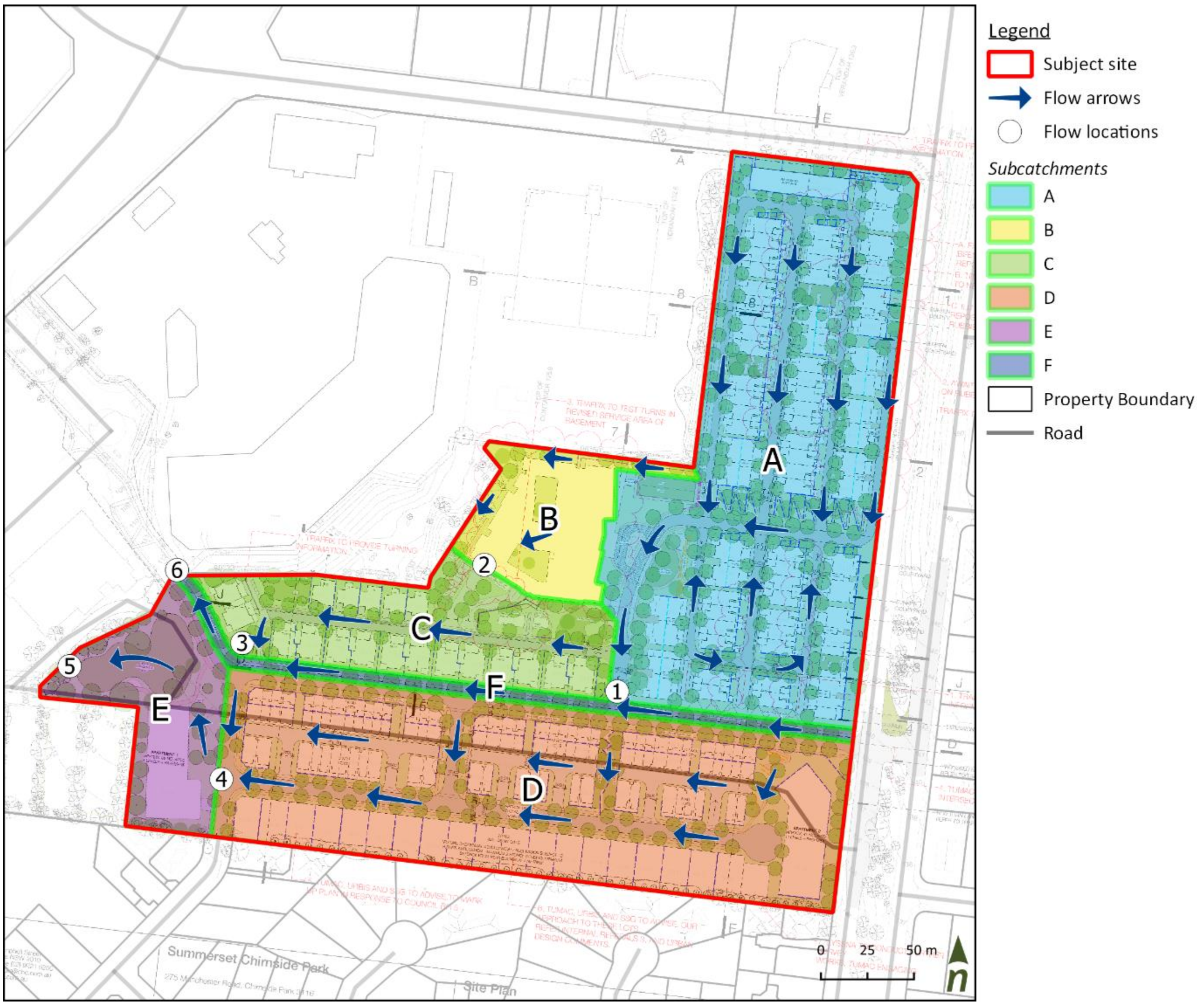

Figure 12 Catchment plan of subject area

Table 4 Description of sub-catchments

Sub-catchment Label	Area (ha)	Comment
A	3.535	Catchment A outfalls through catchment F
B	0.569	Catchment B outfalls through catchment C
C	1.104	Catchment C outfalls through catchment F
D	3.096	Catchment D outfalls through catchment E
E	0.712	Outfalls through southwest corner of subject area (Flow location 5)
F	0.27	Outfall through west boundary of subject area. Catchment F covers the road reserve north of the midline of the east-west road through the subject site. This catchment will outfall into flow location 6, however is not expected to pass through any flow attenuation assets. The area of the road reserve south of the midline is captured within catchment D and eventually outfall at flow location 5.

6.1 Minor Drainage

The minor drainage system would consist essentially of an underground piped network and should be designed to accommodate a 20% annual exceedance probability (AEP) rainfall event. The calculations adopted a 20% AEP runoff coefficient of 0.70 for residential areas, based on an average fraction impervious for the site of 0.69. Table 5 summarises the minor drainage flows for the subject site, derived using the rational method.

Table 5 Minor drainage for subject site

Location	Contributing catchment	Area	tc	I (20% AEP)	Minor flows (20% AEP)	Indicative pipe size
		(ha)	(min)	(mm/h)	(m^3/s)	(mm)
1	A	3.54	8.55	101.12	0.70	450
2	B	0.57	7.27	107.56	0.12	225
3	B, C	1.67	7.84	104.70	0.34	375
4	D	3.10	8.01	103.83	0.63	375
5	D, E	3.81	RORB	RORB	0.34*	600
6	A, B, C, F	5.48	RORB	RORB	0.49*	600

'* Attenuated flow from the retarding basin, which is sized to convey the 1% AEP peak flow

Based on the catchment areas, the pipe networks within the residential precinct of the subject site is expected to become the responsibility of Council.

Stormwater quantity criteria:

- ✓ Convey minor flows (20% AEP) through residential catchments in a piped network
  - ✓ Maximum pipe size of 600 mm
  - ✓ All pipes are Council assets

6.2 Major Drainage

The major drainage system will convey the 1% AEP flows through the study area. This consists of the road reserves throughout the development. Generally, the flows required to be conveyed in road reserves will be the gap flow. The gap flow is the 1% AEP flow minus the pipe flow (ie 20% AEP) which will be contained within the minor piped drainage system. The calculations adopted a 1% AEP runoff coefficient of 0.80 for residential areas, based on an average fraction impervious of 0.69. Table 6 summarises the major drainage flows for the subject site, derived using the rational method.

Table 6 Major drainage flowrates for subject site

Location	Contributing catchment	Area	Tc	I (1%AEP)	Major flow (1%AEP)	Gap flow (1%AEP minus 20%AEP)
		(ha)	(min)	(mm/h)	(m3/s)	(m3/s)
1	A	3.54	8.55	137.42	1.08	0.39
2	B	0.57	7.27	145.72	0.18	0.07
3	B, C	1.67	7.84	142.03	0.53	0.19
4	D	3.10	8.01	140.91	0.97	0.35
5	D, E	3.81	RORB	RORB	0.34	-*
6	A, B, C, F	5.48	RORB	RORB	0.49	-*

'* Attenuated flow from the retarding basin, which is sized to be conveyed by a pipe to the outfall

Based on the road width and slope, and the maximum allowable nature strip cross-fall of 1 in 15, the capacity that can be contained within the main road reserves is shown in Table 7. This capacity has been determined using HEC-RAS based on the DELWP 2019 document "Guidelines for Development in Flood Affected Areas" and Council's requirement that 1% AEP design flows must be contained within the road reserve and must not enter any part of private allotments.

Table 7 Road reserve flow capacities

Flow loc.	Road reserve width	Slope	Road capacity (m^3/s)
1	16m	1.0 %	2.3
2	16m	2 %	2.4
3	16m	5 %	2.4
4	8m	1.5 %	1.4

Stormwater quantity criteria:

- ✓ Convey internal major flows through road reserves and pipe system
  - Maximum gap flow = 0.39 m^3/s

6.3 Retardation storage

In the development scenario of the subject site, detention storage is required to attenuate flows back to the existing peak flow rates identified in Section 4. Specifically, this requires peak flow rates from the Retirement Village precinct to be attenuated back to 0.51 cumecs for the 1% AEP event and peak flow rates from the Residential Precinct to be attenuated back to 0.47 cumecs for the 1% AEP event.

After discussions with Summerset and its civil engineers (Cossill Webley), it is understood the detention will be achieved by four underground storage tanks throughout the development. Three underground detention tanks will attenuate flows with the Retirement Village precinct, and another one underground detention tank will service the Residential Precinct (refer to Figure 13).

Hydrologic Modelling

Similar to deriving the peak flows under pre-developed conditions, the RORB software package was used to produce a hydrological model and determine the retardation storage requirements for the site under developed conditions. Table 8 summarises the RORB input variables used for the developed conditions.

Table 8 Developed RORB inputs variables

RORB input variable (Developed)	Value	Method of derivation
m	0.8	Standard value
kc	0.39	Same kc adopted from existing conditions
IL	14.34	Taken as 60% of ARR datahub value (minus medium pre-burst value)
CL	2.5	Typical value for urban catchments

The RORB hydrological model was iteratively run to determine the minimum storage size for the each of the detention tanks while still meeting the 1% AEP flowrate requirements. A summary of the detention modelling results for the 1% AEP event is provided in Table 9. Based on these detention tank sizes, peak flow rates were determined at the subject site's outfall locations (refer to Table 10).

Table 9 Detention tank parameters

Detention Tank	Critical storm duration	Peak storage	Outlet pipe diameter*	Peak outflow rate	Existing peak flow rate at same location**
	(min)	(m^3)	(mm)	(m^3/s)	(m^3/s)
T1	45	700	450	0.30	0.44
T2	20	80	225	0.07	0.10
T3	45	180	375	0.20	0.21
T4	45	760	450	0.34	0.47

*Based on indicative pipe size estimates from Section 6.1

**Note: attenuating flows at each detention back to existing conditions not a necessity, however, was used to ensure the that flow attenuation was balanced across detention tanks.

Table 10 Developed peak flowrates after attenuation

Location	Critical storm duration	Peak developed flow rate	Peak existing flow rates
	(min)	(m^3/s)	(m^3/s)
Outfall of Retirement Village precinct	45	0.49	0.51
Outfall of Residential precinct	45	0.34	0.47
Total outfall of subject site	45	0.83	0.86

As demonstrated in Table 10 all developed flowrates outfalling from the subject site are less than existing peak flowrates.

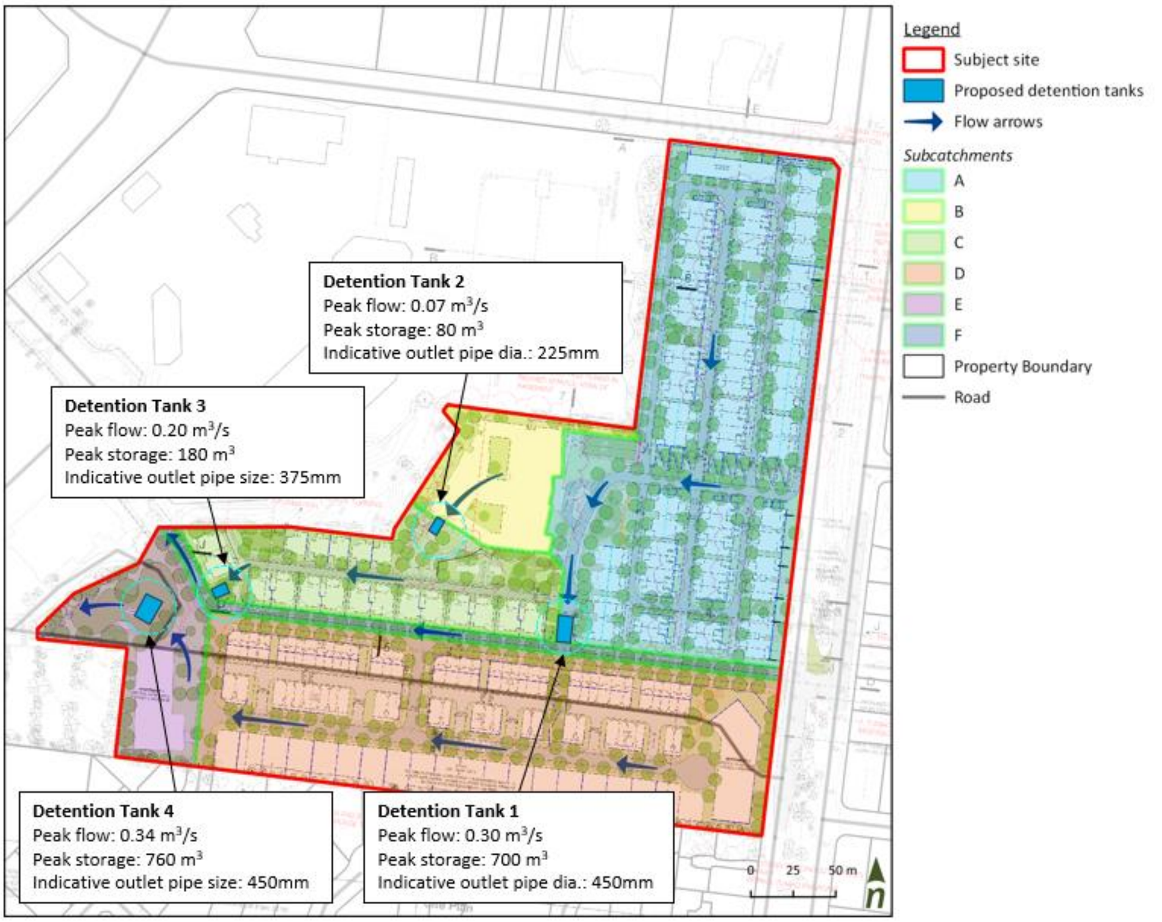

Figure 13 Proposed layout of detention tanks

Figure 14 RORB layout for developed conditions

7 Stormwater Quality

Alluvium understands that a key principle for the development of the site is that all stormwater is to be treated to best practice (ie Best Practice Environmental Management Guidelines (BPEM)) before being discharged into the downstream receiving drain. The following BPEM targets have been adopted:

- 70% removal of the total Gross Pollutant load
- 80% removal of total Suspended Solids (TSS)
- 45% removal of total Nitrogen (TN)
- 45% removal of total Phosphorus (TP)

In summary the approach for meeting stormwater quality treatment requirements on the site is as follows:

- Residential precinct: All roads and reserves are public assets. Treatment to meet best practice pollutant reduction targets (from roads, reserves and residential allotments) will be achieved by a single asset located within a drainage reserve in the south-west corner of the site. The ownership and management of the treatment asset will be the responsibility of Council

- Retirement Village precinct: All roads, reserves and dwellings are private assets. Treatment to meet best practice pollutant reduction targets will be achieved by distributed stormwater quality treatment assets throughout the retirement village precinct. The ownership and management of the treatment assets will be the responsibility of Summerset Group Holdings.

  The location and integration of the distributed stormwater quality treatment assets within the Retirement Village precinct is being undertaken by the ESD consultant. Therefore the SWMS provides the high level information on the criteria and sizing options (eg “x” m^2 of raingarden for “y” m^2 of catchment based on “z” fraction imperviousness).

7.1 Stormwater quality management principles

Given that stormwater is required to be treated on site, the following principles have been adopted in developing a strategy for managing stormwater quality:

- For the retirement village precinct treat stormwater as close as possible to source before it enters the piped network. This avoids the need to daylight stormwater pipe for stormwater treatment which would require “deeper” assets with potentially largely footprint. Integrate water quality assets with the proposed urban design, built form and landscape

- For the residential precinct minimise number of water quality assets for Council

7.2 Stormwater quality management approach

Based on these principles, a stormwater quality management approach is proposed that consists of raingardens (bioretention) distributed throughout the retirement village and a single bioretention asset for the residential precinct.

The advantages of raingardens are outlined below:

- They can fit in tight spaces and integrate with the urban design and development layout proposed
- They are highly efficient in treating stormwater in terms of footprint requirements

- They can have trees planted in the filter media or in proximity (e.g. along the raingarden batters) thus providing a source of passive irrigation for the trees.

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7.3 Stormwater Treatment Sizing

The catchments and stormwater treatment assets have been modelled using MUSIC. The analysis has been based on the latest Melbourne Water MUSIC modelling guidelines. This includes:

- The ten year rainfall template for the 850-1100mm rainfall band (based on Narre Warren north station) between the years 1984 – 1993
- Soil store parameters with a soil store capacity of 120mm and a field capacity of 50mm.

Alluvium was provided with the following land use breakdown from Summerset:

TOTAL SITE AREA	92830.0m²	
TOTAL ROAD SURFACE AND DRIVEWAY	21416.0m²	23.1%
TOTAL FOOTPATHS	4736.0m²	5.1%
TOTAL BUILDING FOOTPRINTS	27343.7m²	29.5%
TOTAL SITE COVERAGE	53495.7m²	57.6%

Based on the above and allowing for other hardstand areas (such as paving), Alluvium has adopted a conservative overall fraction impervious value of 70% across the development.

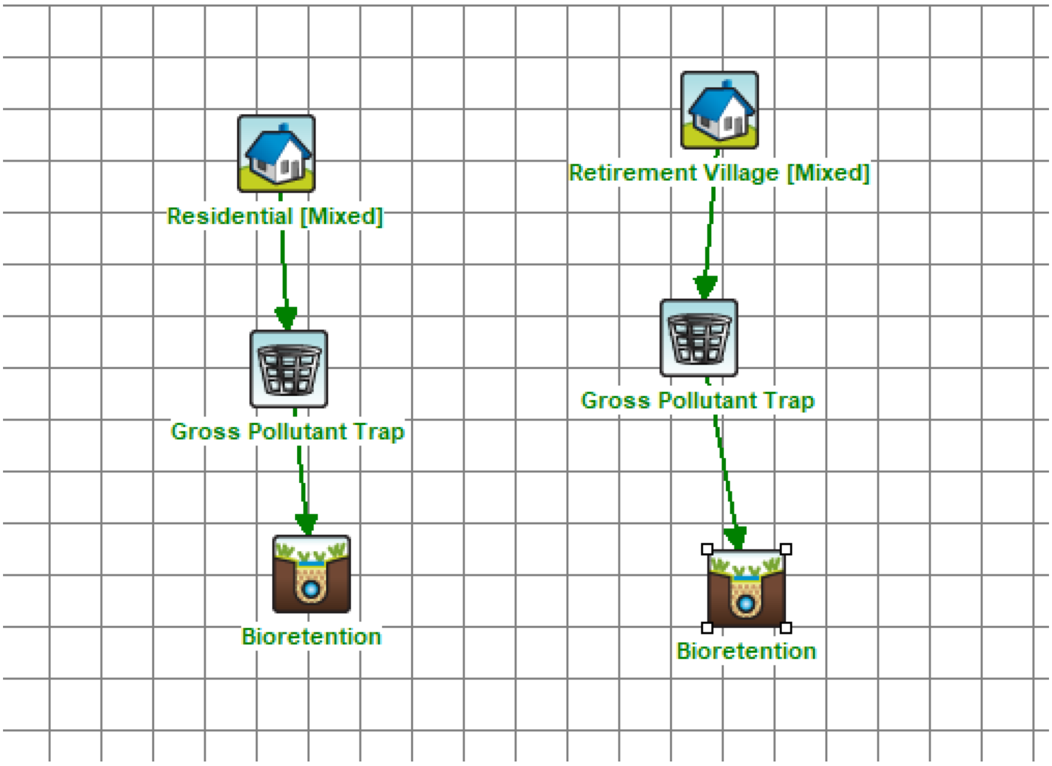

Figure 15. *MUSIC model for the subject site*

Residential Precinct

- Catchment area of 4.1 ha
- Bioretention (raingarden) treatment area of 160m2
- Extended detention depth of 150mm
- Filter media depth 600mm
- Transition + drainage layer depth 400mm
- Saturated zone 400mm
- TN content of filter media (800 mg/kg)
- Orthophosphate content of filter media (45 mg/kg)

Table 11. Treatment performance of the system for the residential precinct

Parameter	Annual Pollutant Load Reduction
Total Suspended Solids (TSS) removed	81.4%
Total Phosphorus (TP) removed	46.3%
Total Nitrogen (TN) removed	46.7%

Figure 16. *Residential treatment precinct*

Further design information on the bioretention / raingarden system will be provided during the civil engineering functional layout and documentation process.

Retirement Village Precinct

- Catchment area of 5.2 ha (overall faction impervious value of 70%)
- Overall bioretention (raingarden) treatment area of 210m2
    - Indicative sizing based on subcatchments with different fraction impervious values
        - For a 500m2 catchment
            - If 100% impervious then 3.5m2 of raingarden treatment needed
            - If 70% impervious then 2.02m2 of raingarden treatment needed
            - If 50% impervious then 1.50m2 of raingarden treatment needed
- The location and integration of the distributed stormwater quality treatment assets within the Retirement Village precinct is being undertaken by the ESD consultant
- Extended detention depth of 100mm
- Filter media depth 600mm
- Transition + drainage layer depth 400mm
- Saturated zone 400mm
- TN content of filter media (800 mg/kg)
- Orthophosphate content of filter media (45 mg/kg)

Table 12. Treatment performance of the system for the Retirement Village precinct

Parameter	Annual Pollutant Load Reduction
Total Suspended Solids (TSS) removed	81.5%
Total Phosphorus (TP) removed	47.0%
Total Nitrogen (TN) removed	45.3%

7.4 Raingarden examples

Raingardens can be provided at a range of spatial scales. Some examples are provided below.

Street scale

Medium/large scale

8 Conclusion

This Storm Water Management Strategy (SWMS) report has proposed a management strategy for stormwater quantity and quality for the 275 Manchester Road development site (ie Lot S4). Hydrological assessment has been conducted for the site and stormwater infrastructure and assets have been modelled to meet stormwater quantity and quality objectives. Through meeting these objectives, this SWMS acts as a critical component of the development servicing strategy and ensures stormwater is managed in accordance with Melbourne Water's and Council's requirements.

APPENDIX A

DEVELOPMENT CONCEPT LAYOUT


SITE PLAN LEGEND
TOWN PLANNING
210085/TP011
Site Plan
Summerset Chirnside Park
275 Manchester Road, Chirnside Park 3116
Clarke Hopkins Clarke