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HALCYON ILLYARRIE LAND LEASE COMMUNITY, SINAGRA
STORMWATER MANAGEMENT PLAN

Presented below is the Stormwater Management Plan for the proposed Halcyon Illyarrie Land Lease Community in Sinagra.

1. BACKGROUND

Halcyon Illyarrie is a proposed Land Lease Community (LLC) for over 55's located within Stockland's Illyarrie Estate in Sinagra, approximately 25 km north of the Perth CBD and 4 km east of Joondalup town centre, Figure 1.

Illyarrie Estate covers Lot 1665 Wanneroo Road, Sinagra (40 ha), which was formerly a poultry processing facility which included a feedmill, a hatchery and growing sheds. The Estate is in the East Wanneroo Cell 2 (Sinagra) Structure Plan area (City of Wanneroo, 2023).

A Local Water Management Strategy [LWMS] (Strategen, 2019) was prepared in support of an amendment to the East Wanneroo Cell 2 (Sinagra) Structure Plan (Urbis, 2021) and an Urban Water Management Plan [UWMP] was prepared by JBS&G (2023) in support of subdivision of the 40 ha site and approved by the City of Wanneroo on 16 May 2023.

The LLC will comprise of 152 dwellings situated on leasehold lots with lots varying in size from 231 m^2 to 395 m^2 with an average lot area of 289 m^2 and a communal precinct located which will incorporate a club house, wellness building and numerous multi-functional spaces and facilities (CDP, 2024).

The LLC will be developed across 4 stages, Figure 1, progressively starting from the central area, Stage 1, then the western and eastern areas, Stages 2 & 3 respectively, and finally the southernmost lots backing on the Estate boundary, Stage 4. The communal precinct and associated buildings and facilities will be constructed as part of Stage 1 works.

JDA has been appointed by Stockland to prepare a Stormwater Management Plan for the LLC in support of the Development Application (DA) (CDP, 2024). A summary of the main parameters used in this report is presented in Table 1.

TABLE 1: KEY HYDROLOGICAL PARAMETER VALUES USED IN THIS REPORT

Parameters	Section	Value/Source
Design Rainfall	3	BoM (2016)
Rainfall Temporal Patterns	3	Ball et al. (2019)
In-situ soils hydraulic conductivity	2&3	5 m/day & 10 m/day (JBS&G, 2023)

2. SITE CHARACTERISTICS

The pre-development environment of the area is detailed in the LWMS (Strategen, 2019) and UWMP (JBS&G, 2023). The area encompassing the LLC site is generally described as having the following characteristics:

- The proposed LLC site formerly contained the growing sheds in the north and native vegetation in the south.
- The topography generally grades east to west across the LLC site from 66 mAHD to 60 mAHD. Topography in the vicinity of the growing sheds is flatter as these areas were previously excavated.
- The surface geology of the UWMP area was generally described in Galt Geotechnics (2017) as comprising of sandy/silty sand topsoil from surface to 0.2 to 0.3 m underlain by sands derived from Tamala Limestone to the test pit target depth of 2.8 m. The sandy subsurface of the area was described as very loose/loose from 0.3 to 3 m, loose/medium dense from 3 to 5.5 m and medium dense from 5.5-8.2 m. Stratigraphy below the target test pit depth of 2.8m was inferred from Cone Penetration Tests. Prior excavations near the southern boundary of the LWMS/UWMP area exposed numerous limestone pinnacles at the surface and it was inferred limestone pinnacles were likely present below the sand over most of the area.
- In-situ permeability testing by Galt Geotechnics (2017) across the UWMP area generally derived minimum unsaturated permeabilities of > 15 m/day at test depths of 0.75 to 1 m. Based on these investigations, a conservative saturated hydraulic conductivity of 10 m/day was adopted for stormwater modelling in Strategen (2019) & JBS&G (2023) with the exception of the 'small' event drainage where a saturated hydraulic conductivity of 5 m/day was used.
- Regional acid sulphate soils (A.S.S) mapping shows the site has no known risk of A.S.S within 3 m of natural surface (or deeper) in the Study Area due to the high clearance to groundwater. Soils beneath the groundwater table will not be disturbed during development.
- Groundwater level monitoring was conducted as part of a Detailed Site Investigation (Strategen, 2017) in 2 bores on 08 September 2017. Maximum groundwater level (MGL) contours were presented in Strategen (2019) which show MGLs range from approximately 38 mAHD (east) to 34 mAHD (west) across the LLC site with groundwater flow east to west towards Lake Joondalup, consistent with the trend in WRC (1997). There is greater than 25 m separation from MGLs across the LLC site to natural surface.
- There are no mapped wetlands within the vicinity of the LLC with the nearest wetland, Lake Joondalup, located more than 1 km down-gradient (west) of the site.

- There are no natural watercourses within the LLC, and rainfall will generally infiltrate across the sandy profile. More intense rainfall events may result in runoff and some overland flow with the grade of the land.
- There are no registered Contaminated Sites nor any registered Aboriginal Heritage Sites within the LLC site. A Detailed Site Investigation (Strategen, 2017) was conducted across the area due to the former use as a poultry processing facility to determine the nature and extent of any potential soil contamination. Minor localised soil contamination was identified and remediated during the decommission and construction phases in a manner consistent with the *Contaminated Sites Act 2003*. Strategen (2017) recommended that no further investigation or remediation of groundwater was required.
- Stockland has a current groundwater licence, GWL46759(6) for Illyarrie Estate for the abstraction of 74,250 kL/year for earthworks/construction purposes and irrigation of POS. This entitlement will decrease by 10% to 66,825 kL/year from 01 February 2029 as per the revised Gnangara Groundwater Allocation Plan (DWER, 2022b). This licence expires in January 2034. Stockland is currently reviewing options to retain an allocation for irrigation of the completed LLC.

3. STORMWATER MANAGEMENT

Drainage Overview

Stormwater management is proposed to be consistent with water sensitive design practices and to meet the key objectives and criteria for the LLC ('balance lot') as detailed in the Illyarrie Estate UWMP (JBS&G, 2023)

The stormwater drainage system has been designed based on management of the 'small', minor and major events.

'Small' event management concentrates on the first 15 mm of rainfall (approximately the 1 EY 1 hour event). The first 15 mm of stormwater runoff from impervious surfaces within leasehold lots will be retained at-source within soakwells. Stormwater runoff from the road reserve areas will be retained and infiltrated within raingardens located within the road reserve.

The minor drainage system is designed as a system of pipes, culverts, kerbs, gutters, etc. and has the capacity to convey stormwater runoff generated by high frequency storms, typically less than the 20% Annual Exceedance Probability (AEP) for residential areas.

The major drainage system is defined as the arrangement of roads and attenuation areas planned to provide safe passage of stormwater runoff from less frequent rainfall events (up to the 1% AEP).

The LLC stormwater management system will consist of raingardens and a pit-pipe drainage system. Stockland will be responsible for all stormwater management assets within the LLC, including ongoing maintenance and replacement indefinitely.

Design Criteria

The LLC site is described in JBS&G (2023) as a 'balance lot' and forms part of catchment A1. The 'balance lot' will become the LLC parent title upon formation of the approved WAPC subdivision approval.

Stormwater runoff from catchment A1 up to the major event (1% AEP) is retained and infiltrated within drainage basins located in the south-east corner of POS A. The first 15 mm of rainfall from catchment A1 ('small' event) is retained and infiltrated in a separate bio-retention basin sized for the 'small' event. Stormwater runoff in excess of the 'small' event overtops the bio-retention basin into a larger adjoining drainage basin. The Stormwater Event Plans from the JBS&G (2023) UWMP are attached in Appendix A.

The LLC stormwater management system will consist of raingardens, sized to manage the 'small' event stormwater runoff from roads, and a pit-pipe drainage system, designed to manage stormwater flows up to the minor event (20% AEP) prior to connection to the Illyarrie Estate stormwater drainage system.

The stormwater drainage system of the LLC has been designed to the criteria presented in the JBS&G (2023) UWMP and is summarised below.

Post-Development Catchments and Land Use

The proposed land use areas in the LLC are summarised in Table 2 and shown on Figures 1 and 2 for the two LLC stormwater catchments, *C_West* and *C_East*.

TABLE 2: LLC LAND USE BREAKDOWN

Land Use Description	C_West	C_East
	Area (ha)	
Residential	3.32	1.11
Access Roads	1.27	0.48
Public Open Space (POS) / Public Access Way (PAW)	0.08	0.08
Communal Areas	0.57	0
Total	**5.24**	**1.67**

The LLC has been divided into two catchments, C_West and C_East, based on site earthworks (Appendix B) and the proposed pit-pipe stormwater network (Figure 3). Catchment C_West will drain towards a PAW to Gumnut View at the western LLC boundary and C_East to a drainage easement adjacent to the LLC entry on Illyarie Rise, Figure 2.

Stormwater Modelling Parameters

The stormwater management plan for the LLC is shown on Figure 3 with stormwater runoff from the development retained in raingardens for the 'small' event (first 15 mm of rainfall) and in the down-gradient external drainage basins in POS A, Figure 3.

The stormwater management system has been modelled by JDA in PC-Sump Version 6.1 (JDA, 2020) ('small' event) and XP-STORM (minor and major events) based on the methodology in *Australian Rainfall and Runoff* (Ball et al., 2019) using BoM (2016) design rainfalls. The rainfall temporal pattern was assumed spatially uniform across the catchment with storm durations modelled ranging from 1 hour to 12 hours.

A summary of the rainfall-runoff loss model parameters for each land use is presented in Table 3 below for the land use areas presented in Table 2 and shown on Figures 3 and 4.

TABLE 3: RAINFALL-RUNOFF LOSS MODEL

Land Use	Initial Loss (mm)	Continuing Loss (mm/hr)	Proportional Loss (%)
Residential (≥ 300 m^2)	15		20
Residential (< 300 m^2)	15		100
Road Reserves	1.5		20
LLC Access Roads	0 ('small') 15 (20% & 1% AEP)	-	20
Communal Areas	15	-	20
POS / PAW	-	-	100 (< 20% AEP) 90 (> 20% AEP)
Drainage Basins	-	-	10

Residential lots ≥ 300 m^2 will retain the 1% AEP event runoff on lots via storage and infiltration within soakwells and infiltration in pervious garden areas. Residential lots < 300 m^2 were assumed to have a higher proportion of impervious areas such that only the first 15 mm of rainfall will be retained within the lot with the balance flowing overland into the road network drainage system. A proportional loss of 20% was assumed for lots < 300 m^2 representing pervious areas in rear of lots where stormwater generated will be retained and infiltrated. This modelling approach for residential lots is similar to the approved UWMP (JBS&G, 2023). In the LLC, 62% of lots are < 300 m^2 representing a total area of 2.53 ha, and in the external residential development, 52% of lots are < 300 m^2 representing a total area of 2.06 ha.

The LLC access roads were modelled in the minor and major events with an initial loss of 15 mm representing retention of the first 15 mm of rainfall within raingardens in the LLC.

The childcare centre and school in Illyarrie Estate were assumed to fully retain stormwater runoff generated up to the 1% AEP.

Stormwater modelling assumed a saturated hydraulic conductivity (K_{sat}) of 5 m/day, lower than the K_{sat} of 10 m/day used in the approved UWMP (JBS&G, 2023).

The drainage basins were modelled using the preliminary earthworks contours presented in the JBS&G (2023) UWMP and shown in the Illyarrie Estate Stage NC03 drawings attached in Appendix B.

'Small' Event Drainage System

The following strategies are proposed for management of the first 15 mm of rainfall ('small' event) within the LLC:

- Residential lots and community areas will have underground storage devices (e.g. soakwells or equivalent) to retain and infiltrate the first 15 mm of rainfall from connected impervious areas.
- Stormwater runoff from access roads will be conveyed via the pit-pipe road drainage network to the rain gardens located near the down-gradient low-points within the LLC. Proposed rain garden locations are shown on Figures 3 and 4 and the engineering drawings in Appendix B.

Raingardens were modelled collectively for each catchment with individual rain gardens volumes shown on Figure 3 and modelling result summarised in Table 4 below and in Appendix C.

The minimum treatment area criterion is based on the FAWB (2009) guideline for 2% of the connected impervious area and the proposed raingardens within the LLC development meet this requirement.

TABLE 4: SMALL EVENT MANAGEMENT - LLC RAINGARDENS

Raingardens	C_West	C_East
Catchment Details		
Road Reserve Area (ha)	1.27	0.48
Impervious Area (ha)	1.02	0.38
Minimum Treatment Area (m^2)	203	77
Bio-Retention Base Area Provided (m^2)	221	114
Raingarden Details		
Base Area (m^2)	221	114
Design Depth (m)	0.30	0.30
TWL Area (m^2)	399	192
Design Storage Volume (m^3)	93	46
Small Event Management		
Rainfall (mm)	15	15
Runoff Volume (m^3)	152	58
Water Depth (m)	0.25	0.17
Top Water Level Area (m^2)	367	157
Required Stored Volume (m^3)	76	25
Stored Volume/Runoff Volume (%)	50	43

The 'Small' Event Flood Plain is shown on Figure 4.

Minor Event Drainage System

For the minor drainage system (events up to the 20% AEP), the following strategies are proposed:

- Residential lots and community areas will have underground storage devices (e.g. soakwells or equivalent) to retain and infiltrate the first 15 mm of rainfall from connected impervious areas.
- Stormwater runoff from access roads and runoff generated within residential lots in excess of lot soakwells will flow into road carriageway and be conveyed via the piped road drainage system to the downgradient low-points at the LLC site boundary in the west (PAW) and the north (near the entry road).

Modelling results for the minor event in the POS A basins are summarised in Table 5 below and the event plan is shown on Figure 4.

Major Event Drainage

The major drainage system is designed to manage rainfall events greater than the 20% AEP event up to the 1% AEP event for which the following strategies are proposed:

- Infiltration of stormwater into in-situ soils together with runoff from lots < 300 m^2 (excess of soakwells) and road stormwater runoff.

- Stormwater is conveyed both via the road pipe system and overland within the road carriageway with roads graded towards to the low-points of the LLC site. Stormwater flow will continue with the grade of the road to the down-gradient POS A drainage basins.
- Habitable building floor levels are a minimum 500 mm (0.5 m) separation from the 1% AEP top water level of the POS A basin, consistent with DWER (2017) and the UWMP (JBS&G, 2023)

Modelling results for the major event in basins are summarised in Table 5 below and the event plan is shown on Figure 4.

Stormwater Modelling Results

Modelling results for the drainage basins in the minor (20% AEP) and major (1% AEP) events including peak water levels, storage volumes and flood areas are summarised in Table 5 and shown on Figures 3 and 4.

The POS A bio-retention and drainage basins were modelled as separate basins connected by a 10 m wide overflow at 52.70 mAHD, 0.5 m above the basin inverts. In the minor event, only some flow overlaps the bio-retention basin into the minor/major drainage basin with the majority of stormwater runoff retained and infiltrated in the bio-retention basin. In the major event, the bio-retention and drainage basins combine into a singular basin with a peak water depth of 0.70 m, combined flood area of 4,600 m^2 and flood storage volume of 2,715 m^3.

TABLE 5: MODELLING RESULTS – DRAINAGE BASINS

	POS A Bio-Retention	POS A Drainage Basin
Contributing Catchment Areas (ha)		
Residential Lots (< 300 m^2)	4.59	
Communal Areas (LLC)	0.57	
Access Roads / Road Reserve	5.27	
POS / PAW / Drainage	2.04	
Storage Details		
Invert Level (mAHD)	55.20	55.20
Base Area (m^2)	800	2,300
Side Slopes (v:h)	1:6	1:6
20% AEP (Minor Event)		
Peak Water Level (mAHD)	55.81	55.33
Critical Storm Duration (hours)	2	3
Peak Water Depth (m)	0.61	0.13
Peak Water Level Area (m^2)	1,150	2,500
Peak Water Storage Volume (m^3)	615	310
1% AEP (Major Event)		
Peak Water Level (mAHD)	55.90	
Critical Duration (hours)	6	
Peak Water Depth (m)	0.70	
Peak Water Level Area (m^2)	4,600	
Peak Water Storage Volume (m^3)	2,715	

Current earthworks suggest proposed basin invert levels in POS A of 52.20 mAHD, 0.3 m lower than the designed presented in the JBS&G (2023) UWMP. JDA recommends infiltration testing of the excavated basin should be conducted prior to landscaping works to confirm the modelled K_{sat} of 5 m/day.

The modelled 1% AEP peak water depth for the POS A drainage basins of 0.70 m is lower than the design depth of 1.1 m stated in the JBS&G (2023) UWMP. JDA considers the stormwater modelling of the drainage basins can be reviewed and revised during the detailed design of POS A from the preliminary basin design contours shown in Appendix B.

Proposed finished lot levels in the LLC range from 58.60 mAHD to 68.30 mAHD (Appendix B), a minimum 2.7 m above the modelled 1% AEP basin flood level of 55.90 mAHD.

The stormwater drainage strategies adopted for the LLC are consistent with the approved UWMP and ensure the LLC appropriates integrates into the broader Illyarrie Estate Masterplan Community.

4. IMPLEMENTATION PLAN

Development Staging

The development of the LLC is to occur over several stages with indicative staging shown on Figure 1. Stage 1 of the LLC will incorporate the entry onto Illyarrie Rise and communal areas. Both the 'small' event raingardens within the LLC and the down-gradient discharge points to the Illyarrie Estate drainage system will be delivered with the initial Stages 1 and 2.

The wider Illyarrie Estate development is covered by the approved JBS&G (2023) UWMP and JDA understands detailed design of POS A, including the drainage basins, will commence shortly. As these basins will likely be constructed prior to development of the LLC, JDA considers temporary drainage arrangements for the LLC will not be required.

Maintenance

Drainage structures within the LLC will require regular maintenance to ensure efficient operation. Table 6 outlines a maintenance schedule for the LLC.

TABLE 6: MAINTENANCE SCHEDULE FOR DRAINAGE INFRASTRUCTURE

Item	Maintenance Interval		
	Quarterly	Biannually	As required
Drainage Structures			
Eduction of sediment and rubbish in manholes/pits	✓		
Removal of debris to prevent blockages	✓		
Rain Gardens			
Assess health of vegetation. Remove dead plants and replace where necessary.			3 times per year
Remove excessive sediment build-up.			✓
Removal of debris to prevent blockages	✓		
Use of slow release/low P fertilisers in turf areas		✓	

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ATTACHMENTS

Figure 1: Location Plan
Figure 2: Post-Development Land Use and Drainage Catchments
Figure 3: Stormwater Management Plan
Figure 4: Stormwater Event Plans
Appendix A: JBS&G (2023) Stormwater Event Plans
Appendix B: Stormwater Engineering Drawings (Cossill & Webley, 2024)
Appendix C: PC Sump Raingarden Modelling Results

If you have any queries, please do not hesitate to contact Michael Ioannidis on 6380 3427 or michael@jdahydro.com.au.

Yours sincerely,

JDA CONSULTANT HYDROLOGISTS

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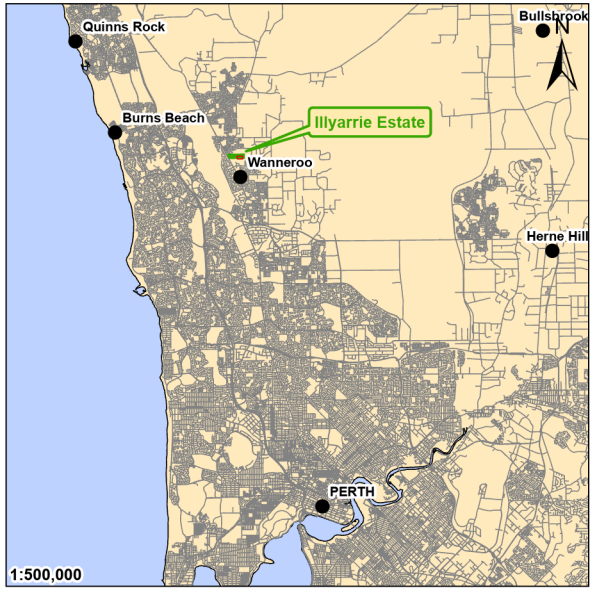
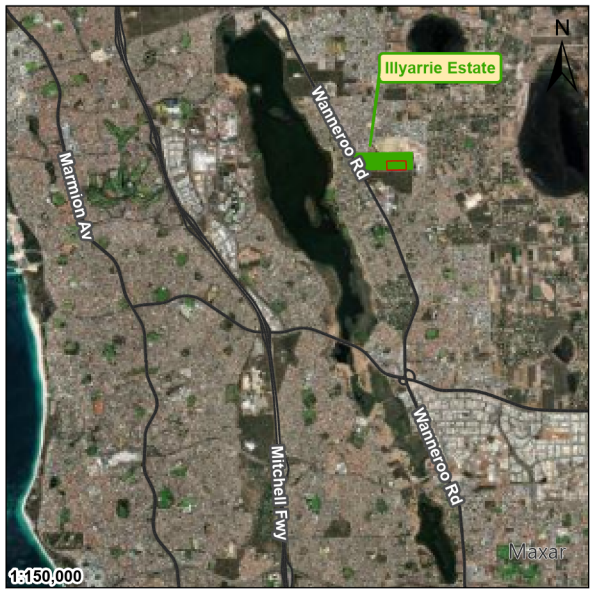
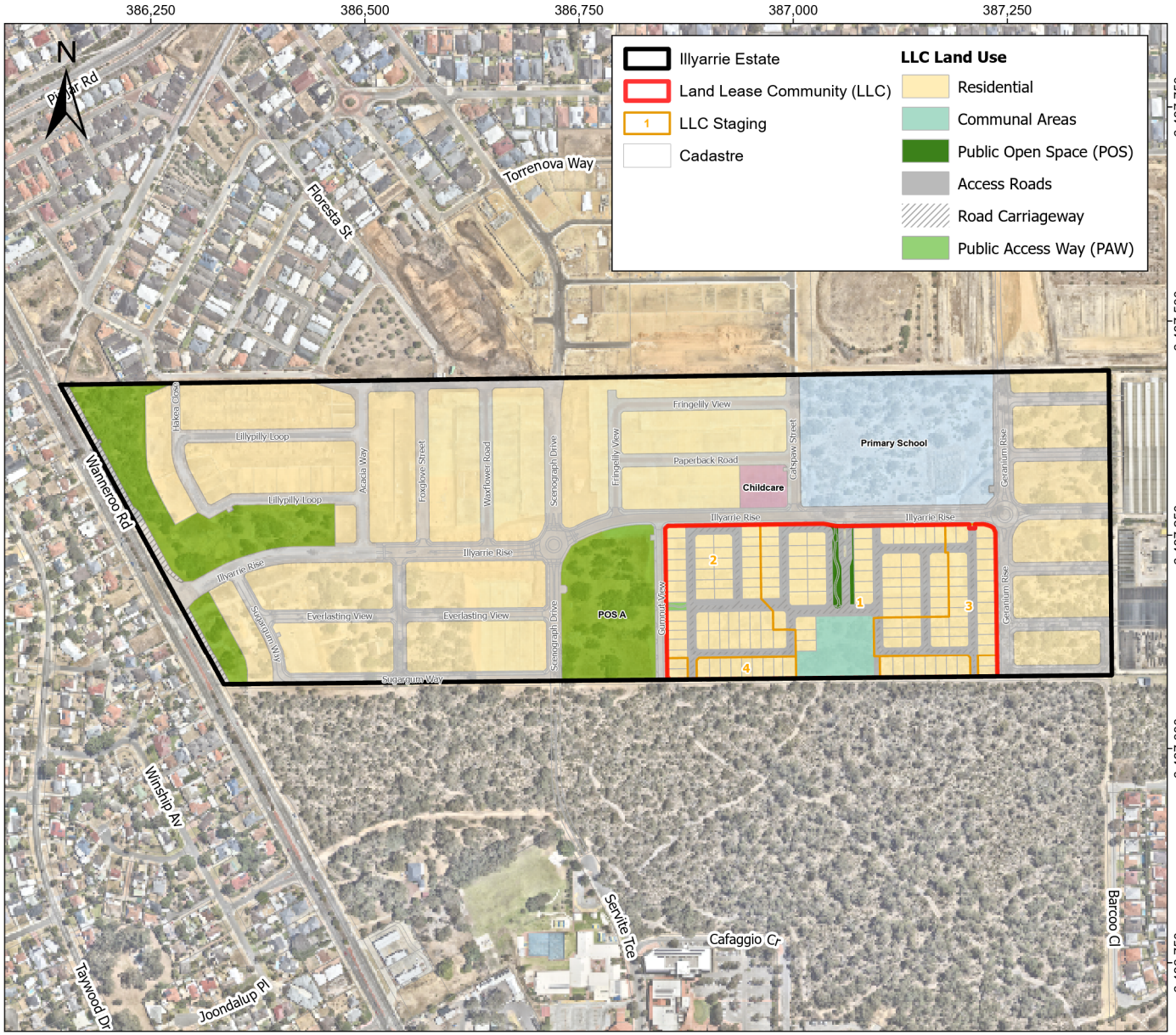
FIGURES







Data Source: Nearmap Digital Imagery (2024), 09 December 2023; Cossill & Webley (2024); MNG (2024).

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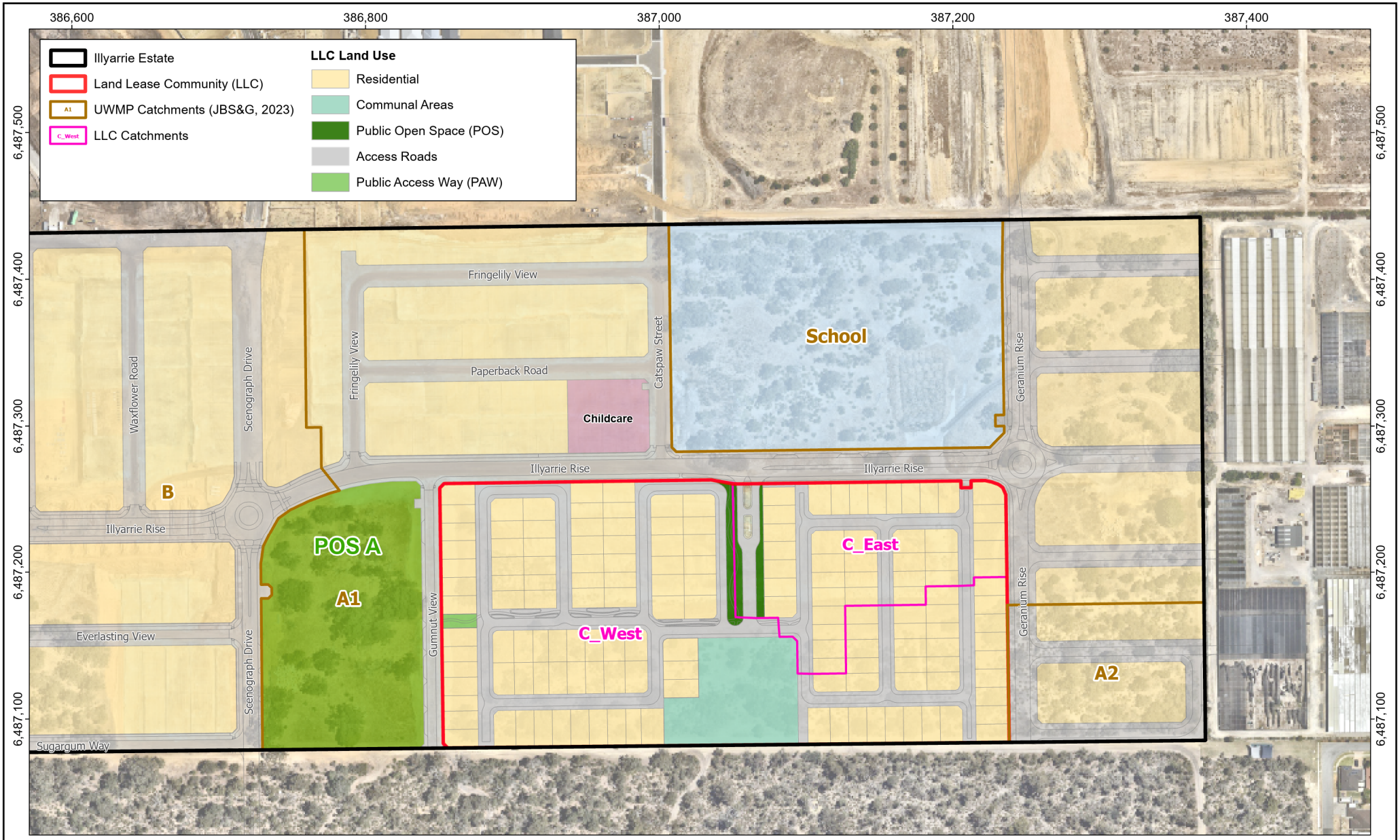
Halcyon Illyarrie Land Lease Community, Piara Waters: Stormwater Management Plan
Figure 1: Location Plan and Proposed Land Use



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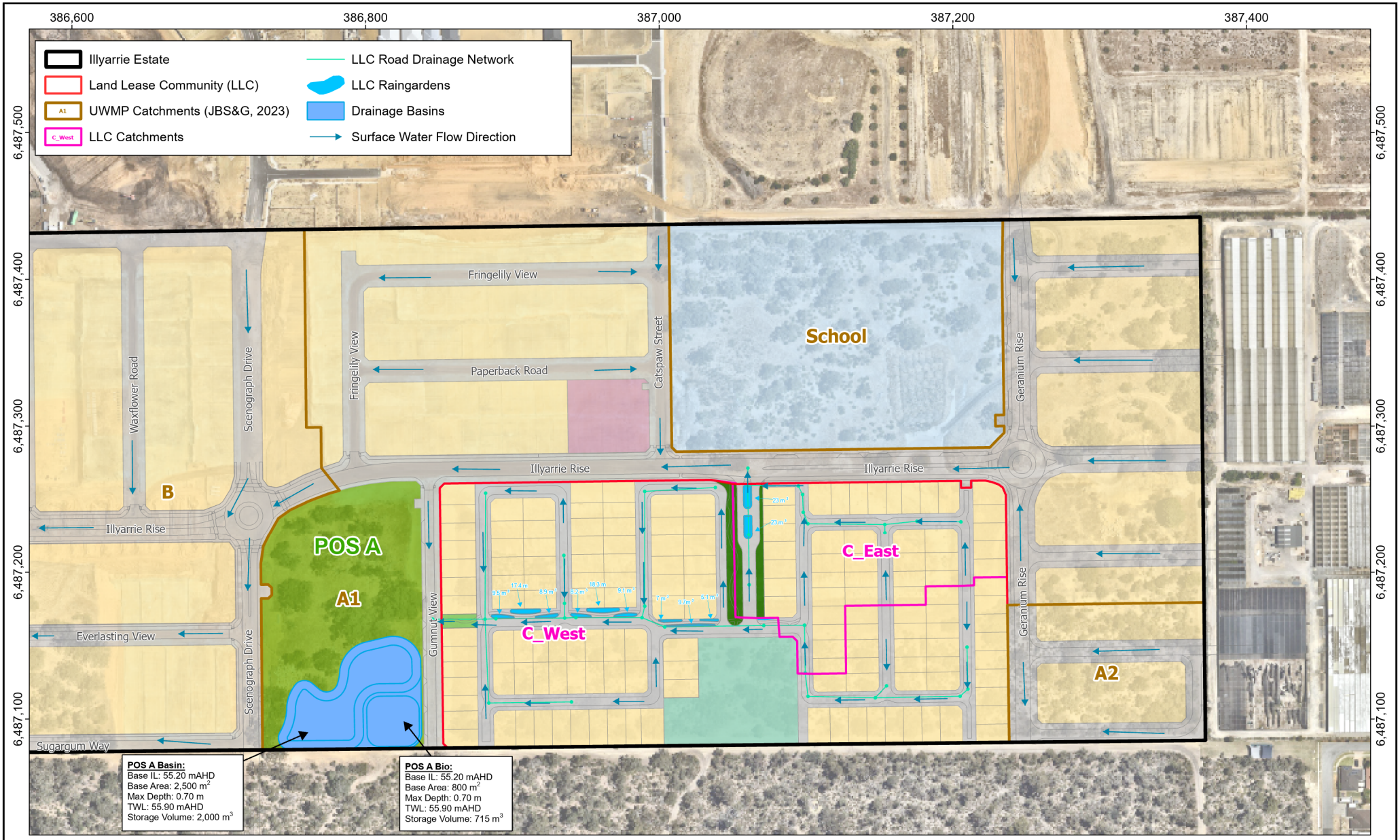
Halcyon Illyarrie Land Lease Community, Piara Waters: Stormwater Management Plan
Figure 2: Post-Development Land Use and Drainage Catchments



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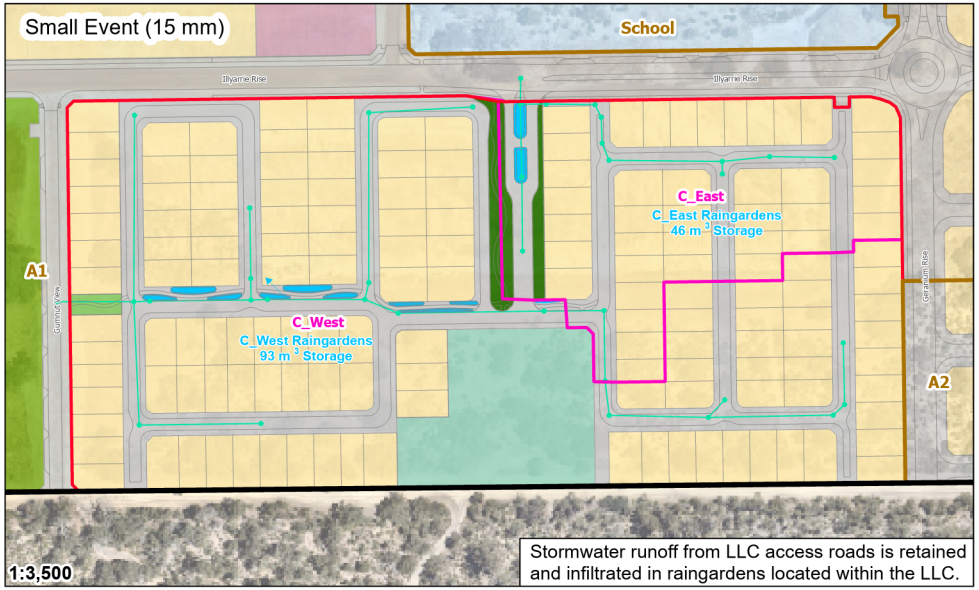
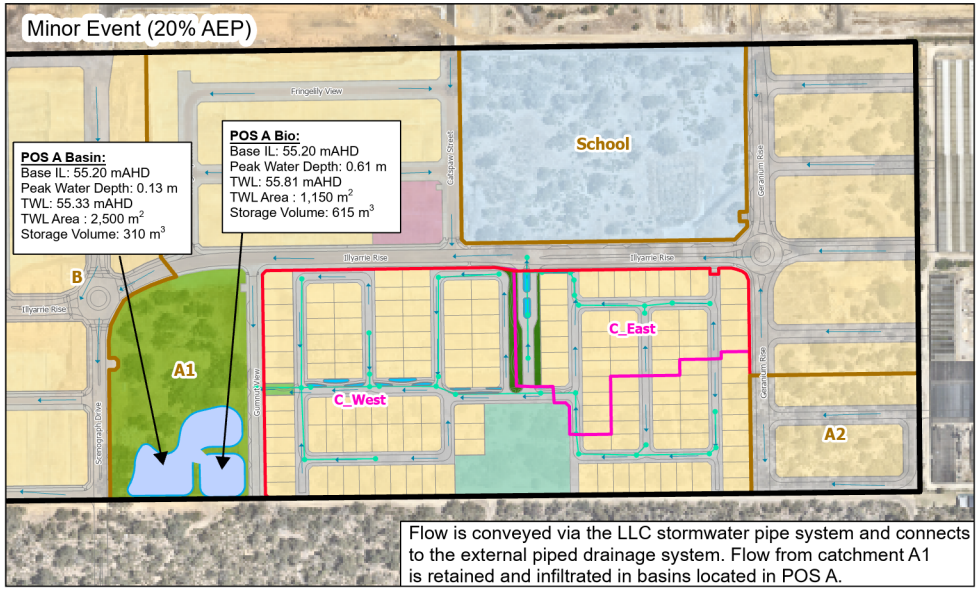
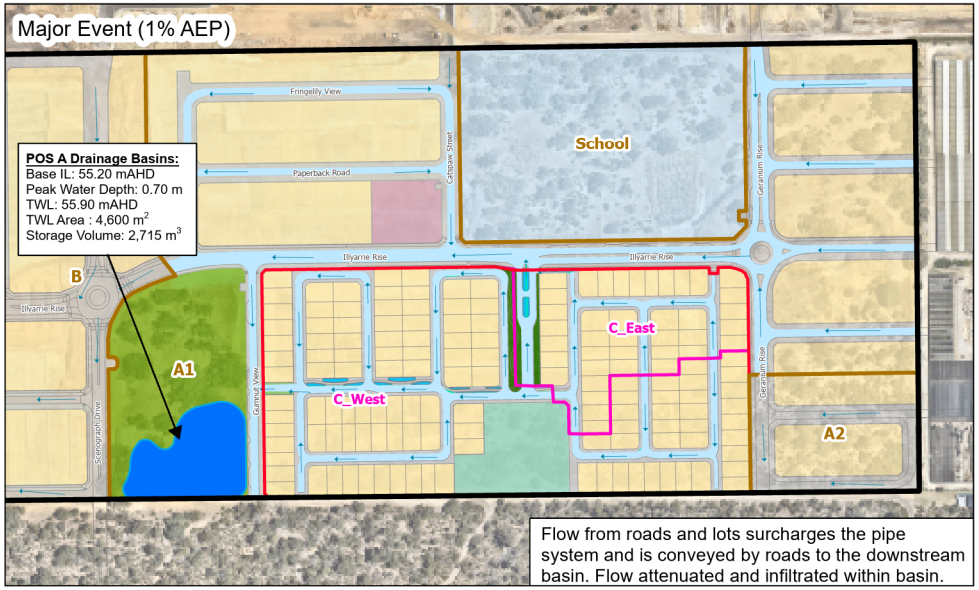
Stockland
Halcyon Illyarrie Land Lease Community, Piara Waters: Stormwater Management Plan
Figure 3: Stormwater Management Plan







Illyarrie Estate
Land Lease Community (LLC)
UWMP Catchments (JBS&G, 2023)
LLC Catchments

Stormwater Management

'Small' Event LLC Raingardens
Minor Event (20% AEP)
Major Event (1% AEP)
1% AEP Overland Flood Path (within carriageway)
LLC Road Drainage Network
Surface Water Flow Direction

SMALL EVENT MANAGEMENT - LLC RAINGARDENS

	C_West	C_East
Catchment Details		
Road Reserve Area (ha)	1.27	0.48
Impervious Area (ha)	1.02	0.38
Raingarden Details		
Base Area (m^2)	221	114
Design Depth (m)	0.30	0.30
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Design Storage Volume (m^3)	93	46
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Rainfall (mm)	15	15
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Water Depth (m)	0.25	0.17
Top Water Level Area (m^2)	367	157
Required Stored Volume (m^3)	76	25

Data Source: LD Total (2022); JBS&G (2023); Nearmaps (2024), Cossill & Webley (2024); MNG (2024).

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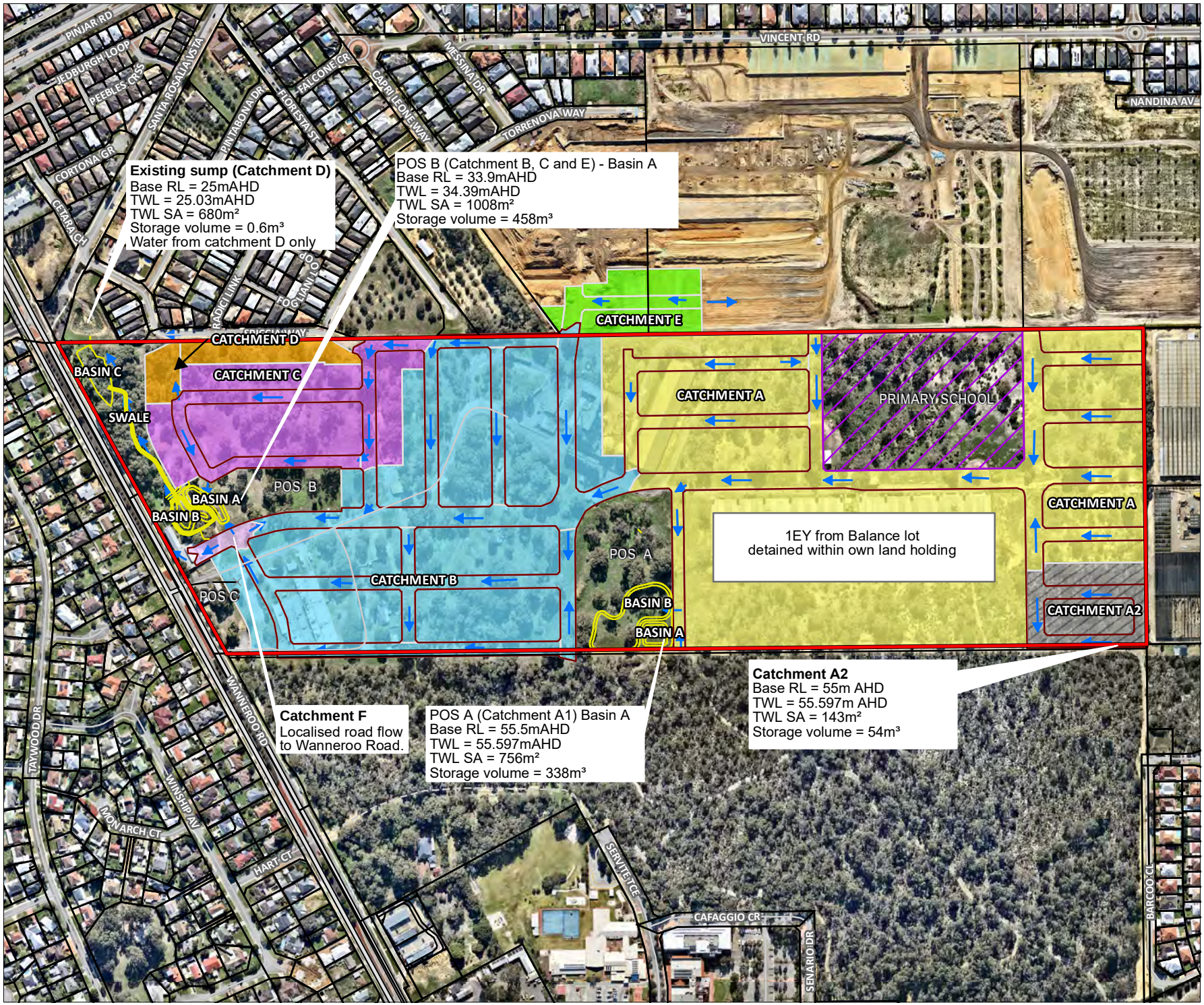
Halcyon Illyarrie Land Lease Community, Piara Waters: Stormwater Management Plan

Figure 4: Stormwater Event Plans

APPENDICES

APPENDIX A

JBS&G (2023) Stormwater Event Plans



Legend

- Project area
- Cadastral boundary
- Primary school
- Road reserve
- Proposed lots
- Catchment A
- Catchment A2 "Not in study area – subject to future UWMP"
- Catchment B
- Catchment C
- Catchment D
- Catchment E
- Catchment F
- Flow path
- Existing powerlines
- Basins and swales
- Highways
- Main road
- Minor road
- Track

JBS&G

Job No: 63395

Client: Stockland

Version: A | Date 21/04/2023

Drawn By: droberts | Checked By: CT

Scale 1:5,750 at A4

0 100 200
metres

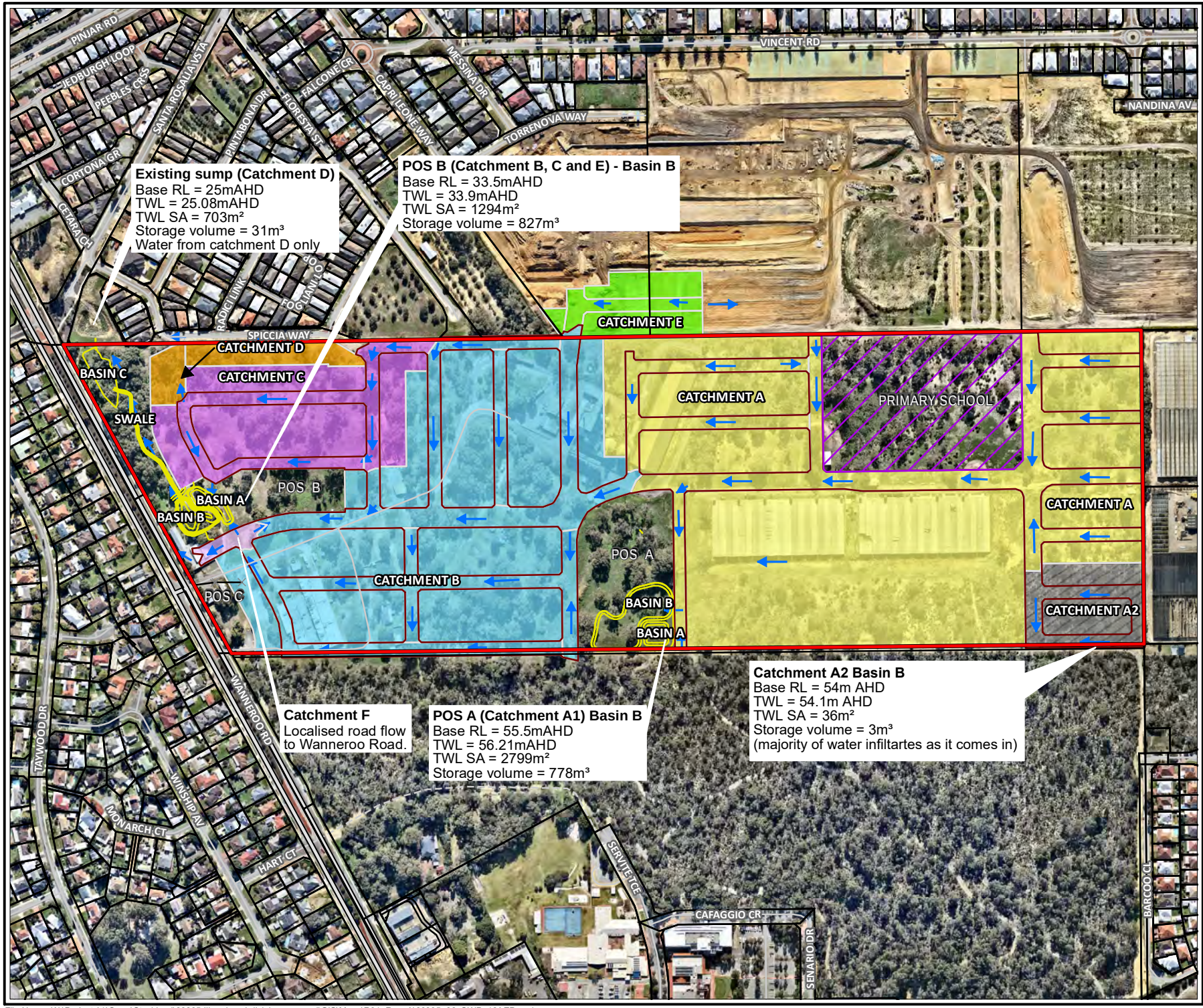
Coor. Sys. GDA2020 MGA Zone 50

Illyarrie,
Lot 1665 Wanneroo Road
Sinagra, WA

SURFACE WATER PLAN - SMALL EVENT

FIGURE 5

File Name: W:\Projects\1)Open\Stockland\63395 Illyarrie subdivision approval\GIS\Maps\R01_Rev_A\63395_05_SWP_SmallEvent.mxd
Image Reference: www.nearmap.com© - Imagery Date: 28. May 2022.



Legend

- Project area
- Cadastral boundary
- Primary school
- Road reserve
- Proposed lots
- Catchment A
- Catchment A2 "Not in study area – subject to future UWMP"
- Catchment B
- Catchment C
- Catchment D
- Catchment E
- Catchment F
- Flow path
- Existing powerlines
- Basins and swales
- Highways
- Main road
- Minor road
- Track

strategen JBS&G

Job No: 63395

Client: Stockland

Version: A | Date 21/04/2023

Drawn By: droberts | Checked By: CT

Scale 1:5,750 at A4

0 100 200
metres

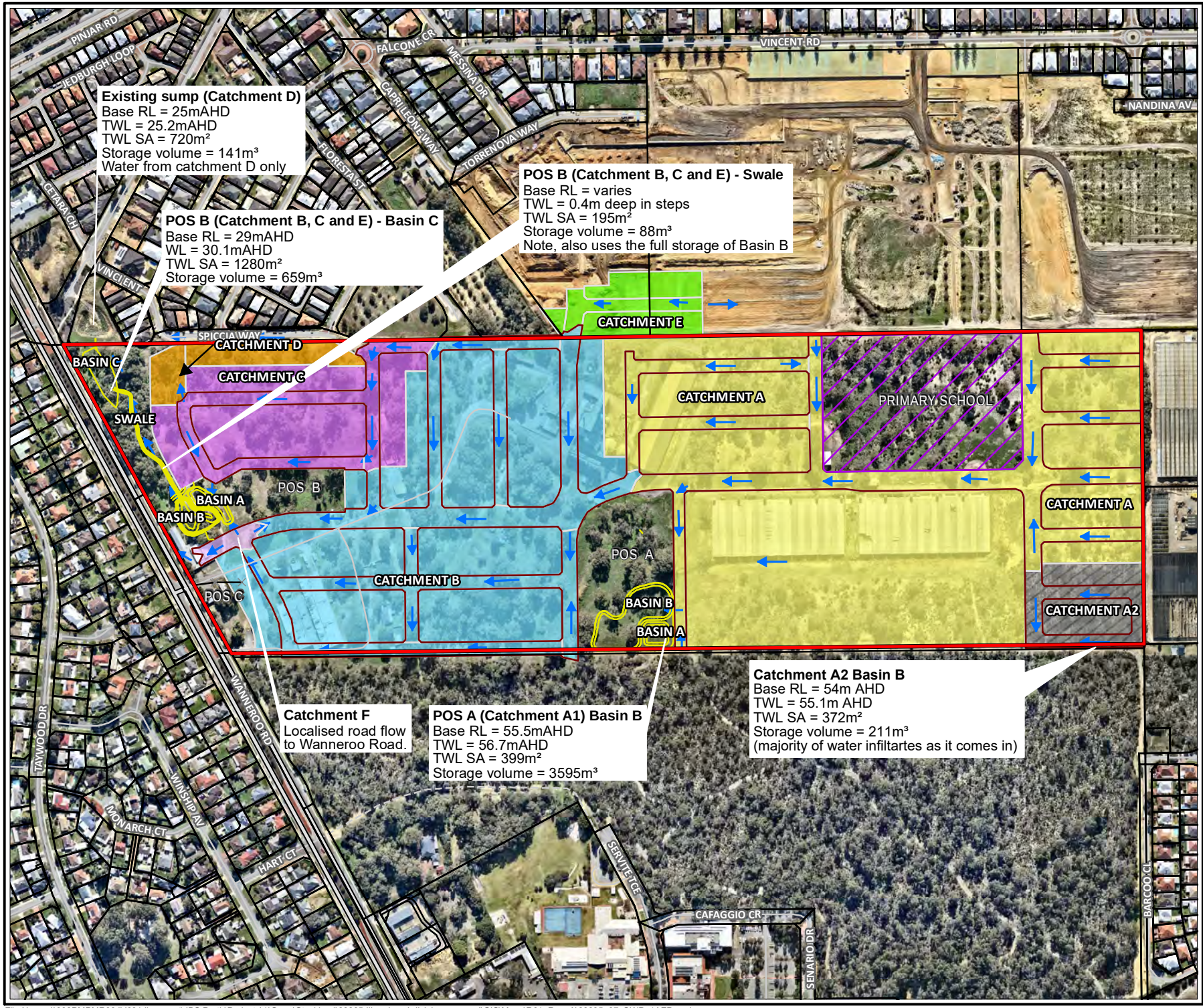
Coor. Sys. GDA2020 MGA Zone 50

Illyarrie,
Lot 1665 Wanneroo Road
Sinagra, WA

SURFACE WATER PLAN - 18% AEP

FIGURE 6

File Name: W:\Projects\1)Open\Stockland\63395 Illyarrie subdivision approval\GIS\Maps\R01_Rev_A\63395_06_SWP_18AEP.mxd
Image Reference: www.nearmap.com© - Imagery Date: 28. May 2022.



Legend

- Project area
- Cadastral boundary
- Primary school
- Road reserve
- Proposed lots
- Catchment
- Catchment A2 "Not in study area – subject to future UWMP"
- Catchment B
- Catchment C
- Catchment D
- Catchment E
- Catchment F
- Flow path
- Existing powerlines
- Basins and swales
- Highways
- Main road
- Minor road
- Track

strategen JBS&G

Job No: 63395

Client: Stockland

Version: A	Date 21/04/2023
Drawn By: droberts	Checked By: CT

Scale 1:5,750 at A4

0 100 200
metres

Coor. Sys. GDA2020 MGA Zone 50

Illyarrie,
Lot 1665 Wanneroo Road
Sinagra, WA

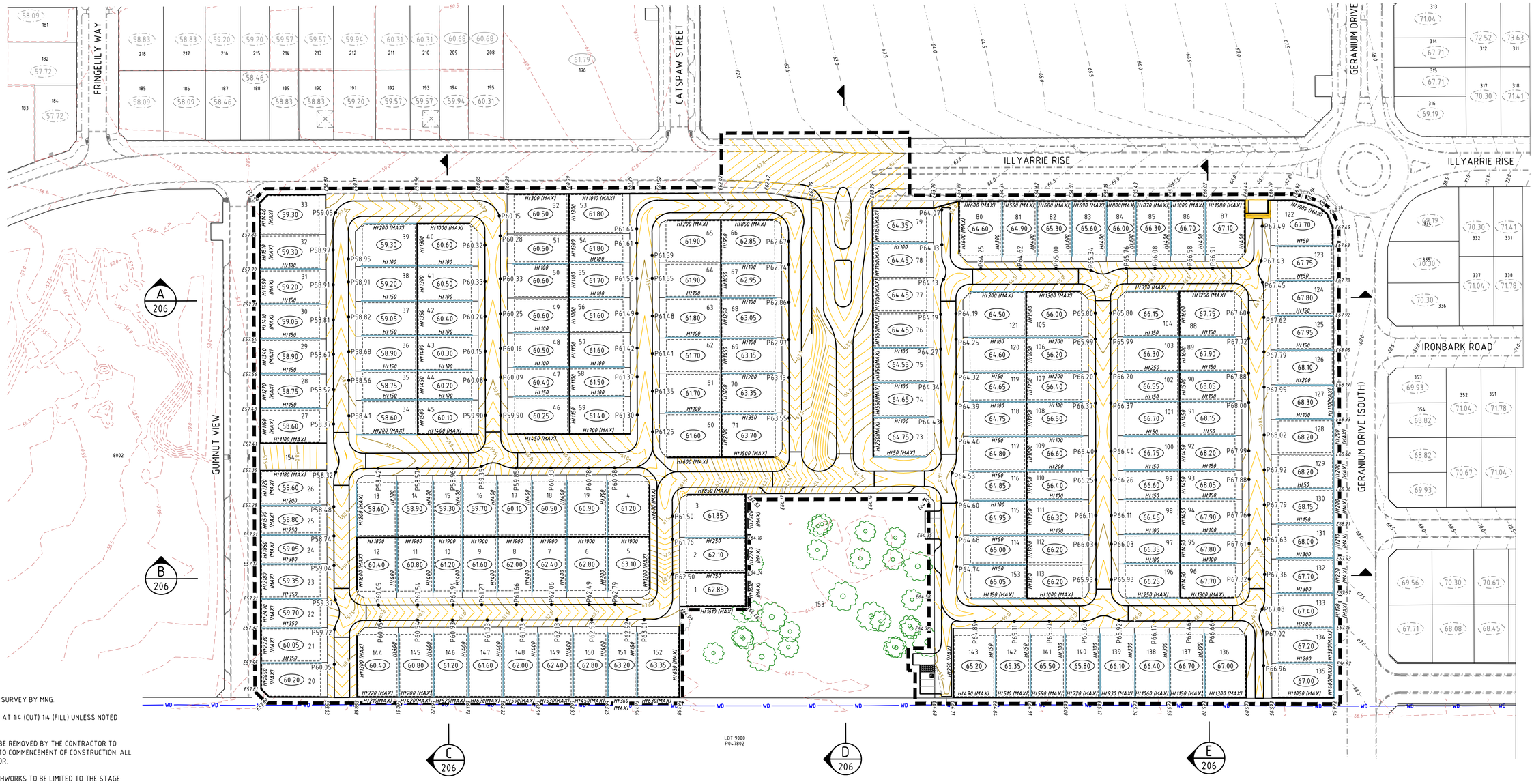
SURFACE WATER PLAN - 1% AEP

FIGURE 7

File Name: \\008PMPMR004V001.jbsg.aust\JBS Perth\Projects\1)Open\Stockland\63395 Illyarrie subdivision approval\GIS\Maps\R01_Rev_A\63395_07_SWP_1AEP.mxd
Image Reference: www.nearmap.com© - Imagery Date: 28. May 2022.

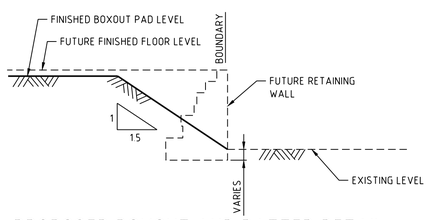
APPENDIX B

Stormwater Engineering Drawings
(Cossill & Webley, 2024)



NOTES

1. ALL LEVELS IN METRES TO AHD. SURVEY BY MNG.
2. BATTERS TO EXISTING SURFACE AT 1:4 (CUT) 1:4 (FILL) UNLESS NOTED OTHERWISE.
3. ALL UNSUITABLE MATERIAL TO BE REMOVED BY THE CONTRACTOR TO APPROVED TIPPING SITE PRIOR TO COMMENCEMENT OF CONSTRUCTION. ALL FEES TO BE PAID BY CONTRACTOR.
4. EXTENT OF CLEARING AND EARTHWORKS TO BE LIMITED TO THE STAGE CLEARING BOUNDARY UNLESS AGREED WITH THE SUPERINTENDENT.
5. ALL CLEARED MATERIAL TO BE MULCHED AND STOCKPILED ON SITE AS DIRECTED BY THE SUPERINTENDENT.
6. CONTRACTOR TO LOCATE ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS ON SITE.
7. CONTRACTOR TO GRADE EVENLY BETWEEN DESIGN CONTOURS AND MATCH INTO EXISTING SURFACE AT LIMIT OF EARTHWORKS BOUNDARY WHERE APPROPRIATE.
8. EXCESS CUT FROM EARTHWORKS SHALL BE PLACED ON SITE AS DIRECTED BY THE SUPERINTENDENT.
9. WHERE LIMESTONE IS WITHIN 600mm OF THE FINAL SURFACE LEVEL THE CONTRACTOR SHALL TREAT THE SITE IN ACCORDANCE WITH THE SPECIFICATION.
10. DESIGN LEVELS SHOWN SHALL BE ON THE FINISHED SURFACE.
11. THE CONTRACTOR SHALL LIMIT THE MOVEMENT OF EQUIPMENT AND MANPOWER TO THE MINIMUM AREA NECESSARY AND PROTECT ALL VEGETATION AND EXISTING SERVICES ON SITE.
12. ADJACENT RESIDENTS TO BE NOTIFIED OF THE WORKS AT LEAST TWO WEEKS IN ADVANCE. CONTRACTOR TO PROVIDE MOBILE NUMBER FOR SUPERVISOR AS PART OF NOTIFICATION.
13. TOPSOIL IS NOT TO BE RESPREAD OVER COMPLETED EARTHWORKS.



PROPOSED BOXOUT AND BATTER DETAIL
FOR FUTURE RETAINING WALLS
SCALE: N.T.S

LEGEND

DESCRIPTION	SYMBOL
LIMIT OF WORKS BOUNDARY	
FINISHED CONTOUR MAJOR (0.5m INTERVAL)	25.0
FINISHED CONTOUR MINOR (0.1m INTERVAL)	
EXISTING SURFACE CONTOUR (0.5m INTERVAL)	25.0
FUTURE SURFACE CONTOUR (0.5m INTERVAL)	25.0
FINISHED FLOOR LEVEL	25.00
PAD EXTENT	
PROPOSED RETAINING WALL (BY CIVIL)	
PROPOSED RETAINING WALL (BY BUILDER)	
EDGE OF PAVEMENT SPOT LEVEL AT DRIVEWAY TIE-IN	P28.61
EXISTING SPOT LEVEL	E28.61
EXISTING DN1000 WATER MAIN	WD
TREE TO BE RETAINED	

REV	DATE	DRN	CKD	APP	AMENDMENT
B	28.03.24	HVD	dlf	Tom Cowan	EARTHWORKS AMENDED TO REFLECT CAD/PLANNING CHANGES
A	10.10.23	RJW	LR	T. BOEKEMAN	ISSUED FOR APPROVAL

N

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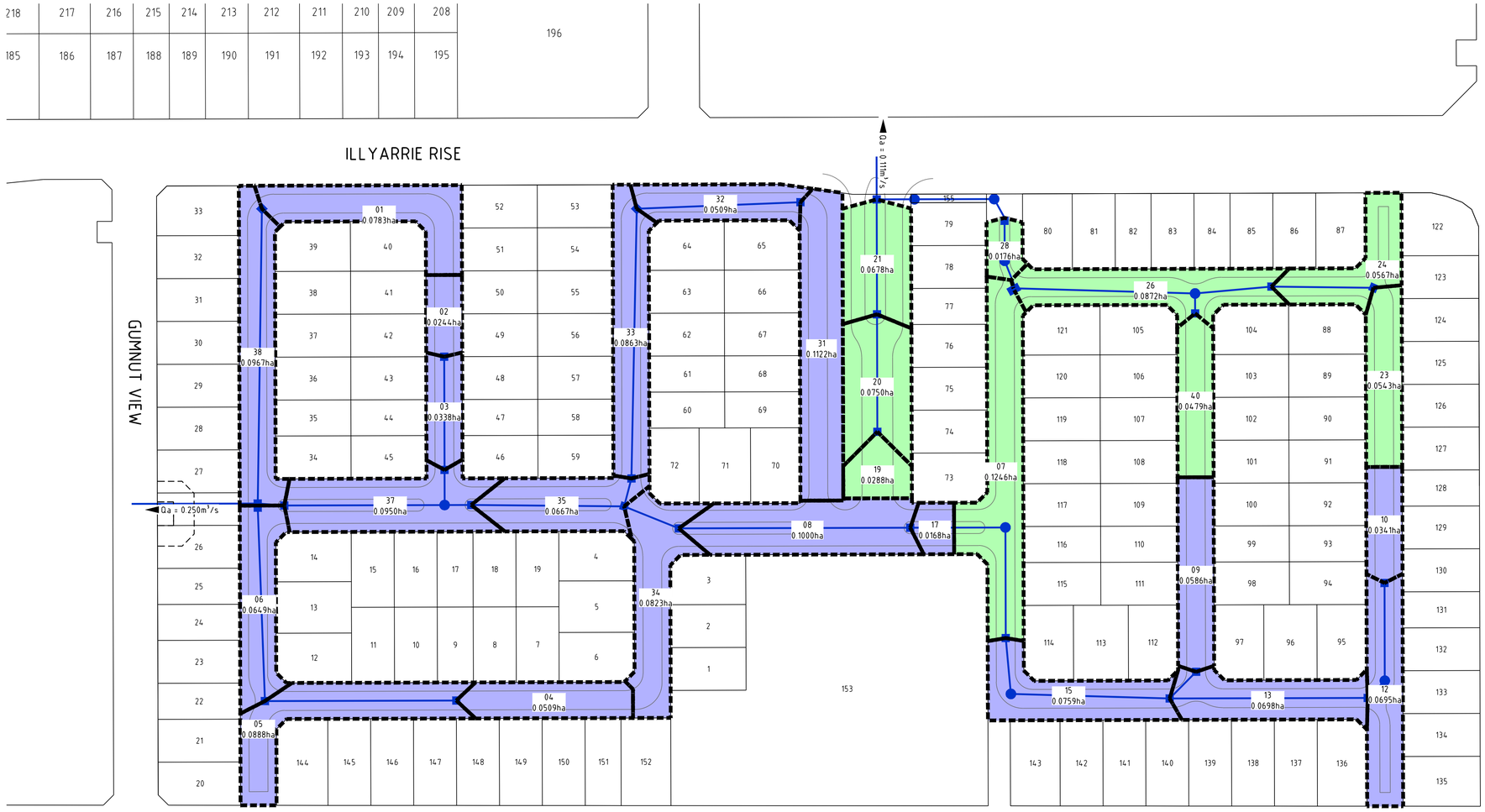
0m 15 30 45
1:750

Cossill & Webley CONSULTING ENGINEERS
Mailing Address: PO Box 680, Subiaco WA 6904
Street Address: B12 (Level 2) 431 Roberts Road, Subiaco WA 6008
T (08) 9422 5800 F (08) 9422 5801 E admin@cosweb.com.au

CLIENT: Stockland
APPROVED: 28.03.24
DESIGNED: ARH
SCALE: 1:750

PROJECT: ILLYARRIE - STAGE LLC
TITLE: FINISHED SURFACE PLAN SHEET 1 OF 1
WAPC No.: ----
DRAWING No.: 6373-LLC-205
REVISION: B
ORIGINAL SIZE: A1



LEGEND

DESCRIPTION	SYMBOL
PROPOSED DRAINAGE PIPE	
EXISTING DRAINAGE PIPE	
FUTURE DRAINAGE PIPE	
PROPOSED DRAINAGE PIPE WITH JUNCTION PIT (JP), SIDE ENTRY PIT (SEP), GRATED PIT (GP) AND CIRCULAR GRATED PIT (CGP)	
DRAINAGE PIT LABEL	PIT TYPE JP, PIT ID 01
PROPOSED ROAD	
EXISTING ROAD	
FUTURE ROAD	
CATCHMENT AREA (m^2)	1000
CATCHMENT AREA (Ha)	0.100
CATCHMENT A	
CATCHMENT B	

NOTES

1 STORAGE VOLUMES AND FLOOD LEVELS TAKEN FROM APPROVED U.W.M.P AS PREPARED BY STRATEGEN

REV	DATE	DRN	CKD	APP	AMENDMENT
A	21.02.24	XXX	TB		ISSUED FOR APPROVAL

N

0m 15 30 45
1:750

Cossill & Webley CONSULTING ENGINEERS
Mailing Address: PO Box 680, Subiaco WA 6904
Street Address: B12 (Level 2) 431 Roberts Road, Subiaco WA 6008
T (08) 9422 5800 F (08) 9422 5801 E admin@cosweb.com.au

CLIENT: Stockland

APPROVED: 21.02.24

DESIGNED: ARH

SCALE: 1:750

PROJECT: ILLYARRIE - STAGE LLC

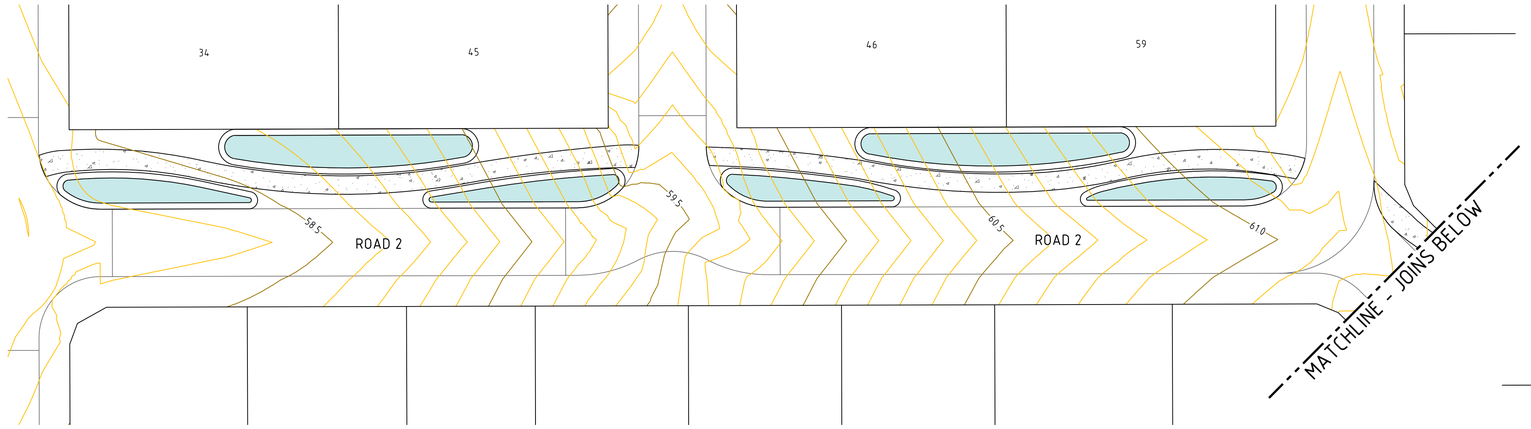
TITLE: STORMWATER DRAINAGE CATCHMENT PLAN SHEET 1 OF 1

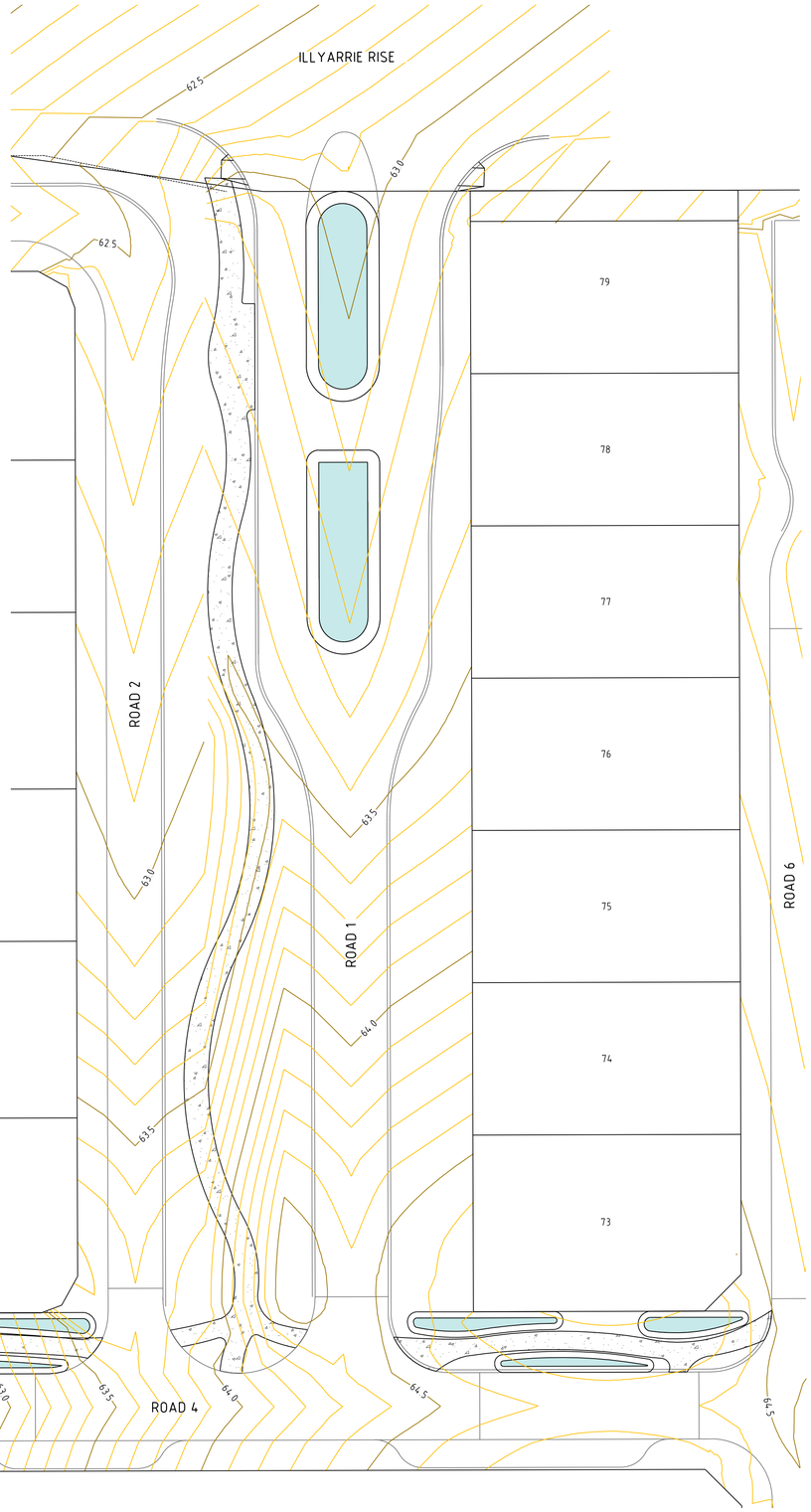
WAPC No.: ----

DRAWING No.: 6373-LLC-710

REVISION: A

ORIGINAL SIZE: A1





LEGEND

- PROPOSED RAIN GARDEN
- PROPOSED ROAD
- PROPOSED PATH NETWORK
- 28.0 FINISHED SURFACE CONTOURS (0.5m)
- FINISHED SURFACE CONTOURS (0.1m)

REV	DATE	DRN	CKD	APP	AMENDMENT
A	28.03.24	HVD			ISSUED FOR INFORMATION

N

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This plan shall only be printed in full colour. If this plan is printed in black and white or grey scale it is not to be used for construction

This plan is not to be used for construction unless issued as revision 0 or higher

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CLIENT Stockland

APPROVED 28.03.24

DESIGNED ARH

SCALE 1:200 & 1:100

PROJECT ILLYARRIE - LLC

TITLE CONCEPT RAIN GARDEN LAYOUT SHEET 1 OF 1

WAPC No. -

DRAWING No. 6373-LLC-SK210

REVISION A

ORIGINAL SIZE A1

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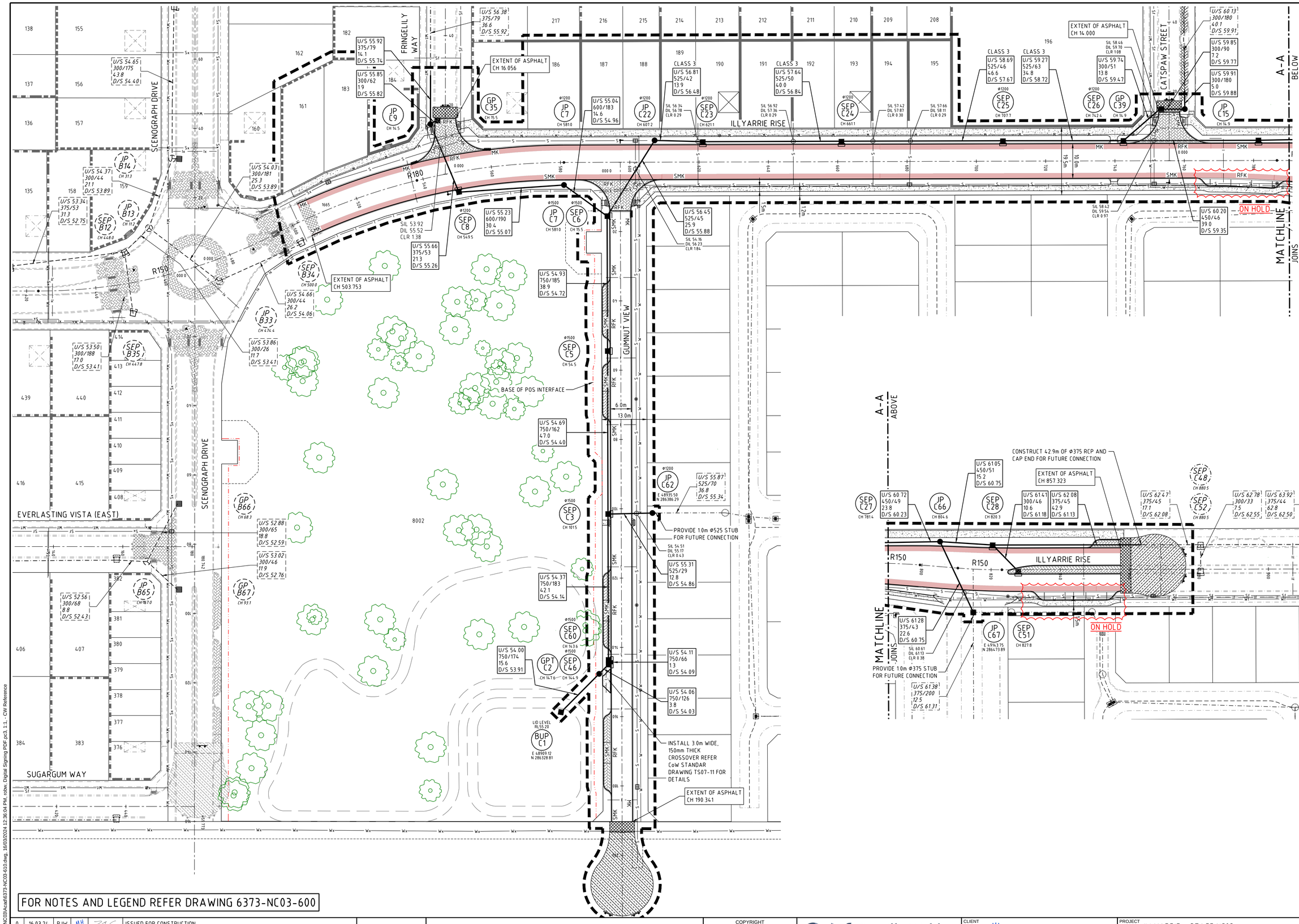

FOR NOTES AND LEGEND REFER DRAWING 6373-NC03-600

REV	DATE	DRN	CKD	APP	AMENDMENT
0	16.03.24	RJW	MH	T. BOEKEMAN	ISSUED FOR CONSTRUCTION
E	12.03.24	BVS	TB	T. BOEKEMAN	AMENDED FOOTPATH & ADDED CARBAYS ALONG ILLYARIE RISE
D	26.02.24	RJW	TB	T. BOEKEMAN	PIPE SIZING/GRADING AMENDED
C	21.02.24	RJW	TB	T. BOEKEMAN	PIPE SIZING/GRADING AMENDED
B	05.12.23	RJW	MH	T. BOEKEMAN	ILLYARRIE RISE EXTENDED

N

1:500 0m 10 20 30m

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Cossill & Webley CONSULTING ENGINEERS
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CLIENT Stockland

APPROVED 18.03.24

DESIGNED ARH

SCALE 1:500

PROJECT ILLYARRIE - STAGE NC03

TITLE ROADWORKS AND STORMWATER DRAINAGE

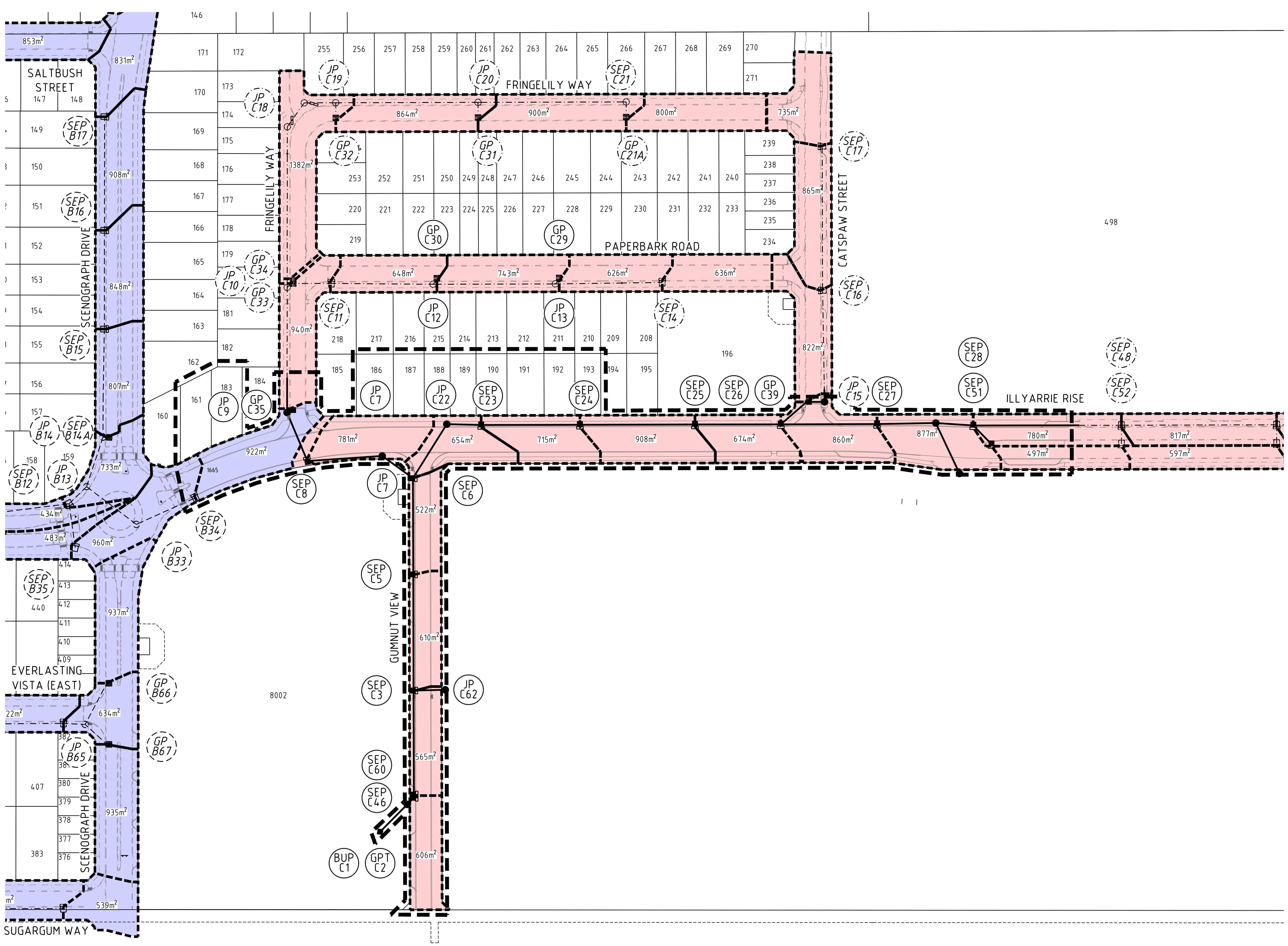
WAPC No. 161417

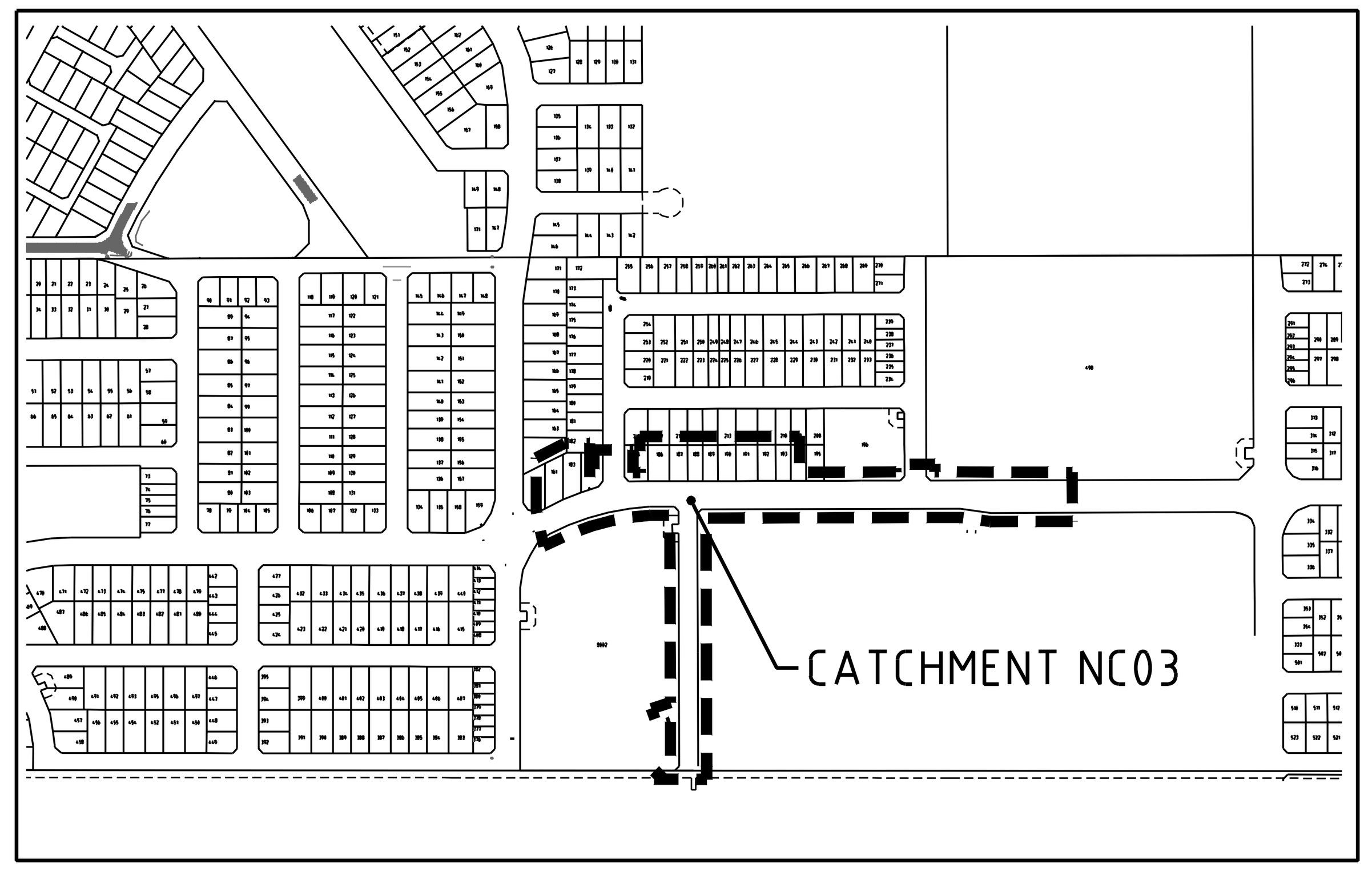
DRAWING No. 6373-NC03-610

REVISION 0

ORIGINAL SIZE A1

P:\6373 Ingham Sinagra\6373-NC03\Acad\6373-NC03-610.dwg, 16/03/2024 12:36:04 PM, robw, Digital Signing PDF.pc3, 1:1, - CW Reference





LOCALITY PLAN

LEGEND

DESCRIPTION	SYMBOL
PROPOSED DRAINAGE PIPE	
EXISTING DRAINAGE PIPE	
FUTURE DRAINAGE PIPE	
PROPOSED DRAINAGE PIPE WITH JUNCTION PIT (JP), SIDE ENTRY PIT (SEP), GRATED PIT (GP) AND CIRCULAR GRATED PIT (CGP)	
DRAINAGE PIT LABEL	PIT TYPE JP; PIT ID 01
PROPOSED ROAD	
EXISTING ROAD	
FUTURE ROAD	
CATCHMENT AREA (m²)	1000
CATCHMENT AREA (Ha)	0.100
DRAINAGE CATCHMENT BOUNDARY	

NOTES

1. STORAGE VOLUMES AND FLOOD LEVELS TAKEN FROM APPROVED U.W.M.P AS PREPARED BY STRATEGEN

CATCHMENTS

REFERENCE	SYMBOL
CATCHMENT A	
CATCHMENT B	
CATCHMENT C	
CATCHMENT D	
CATCHMENT E	
CATCHMENT F	

REV	DATE	DRN	CKD	APP	AMENDMENT
C	15.03.24	RJW	MH		DRAINAGE DETAILS UPDATED
B	27.11.23	RJW	MH	T. BOEKEMAN	ILLYARRIE RISE EXTENDED
A	17.08.22	JWD		T. BOEKEMAN	ISSUED FOR APPROVAL

N

1:1000 0m 20 40 60m

Cossill & Webley CONSULTING ENGINEERS
Mailing Address PO Box 680 Subiaco WA 6904
Street Address B12 (Level 2) 431 Roberts Road Subiaco WA 6008
T (08) 9422 5800 F (08) 9422 5801 E admin@cosweb.com.au

CLIENT Stockland

APPROVED 18.03.24
DESIGNED ARH
SCALE 1:1000

PROJECT ILLYARRIE - STAGE NC03

TITLE STORMWATER DRAINAGE CATCHMENT PLAN

WAPC No. 161417
DRAWING No. 6373-NC03-710
REVISION C
ORIGINAL SIZE A1

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APPENDIX C

PC Sump Raingarden Modelling Results

PCSump Version 6.1

Environmental and Water Resource Software

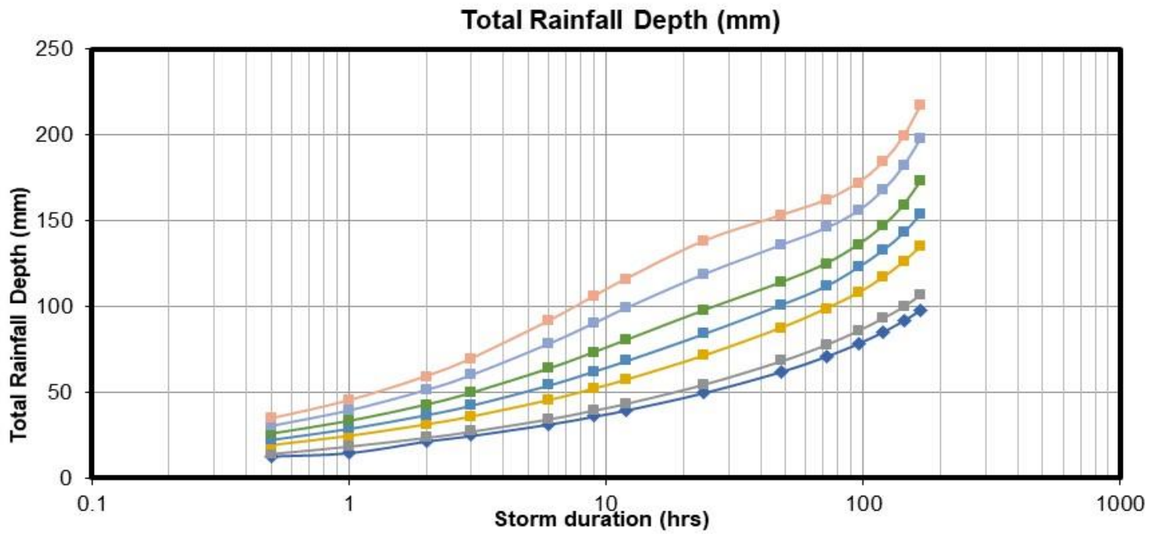
Project Number/Name: J7483: Illyarie LLC, Sinagra

Project Description: Small' Event Raingardens
Catchment C_East

Model Selection:	Deep Water Table Model
Design AEP(EY)/ARI	1 EY (1 year ARI)
Design Rainfall Region:	Perth Metro
Design Rainfall Location:	CUSTOM
Latitude:	31.7375 (S)
Longitude:	115.8125 (E)
Temporal Pattern:	West Flatlands
Climate Change Selection (Y/N)	N
Effective Service Life	
Consequence of Failure	
Adjustment Applied	

Swale Selection (Y/N)	N

Total Rainfall Depth (mm)							
Duration	EY	Annual Exceedance Probability (AEP)					
	1 EY	50%	20%	10%	5%	2%	1%
30 min	13	14.4	19.1	22.4	25.9	30.8	34.7
1 hour	15	18.7	24.5	28.8	33.3	39.8	45.2
2 hour	21.7	23.8	31.2	36.8	42.8	51.7	59.3
3 hour	25	27.4	35.8	42.4	49.7	60.4	69.7
6 hour	31.6	34.6	45.4	54.1	63.8	78.6	91.6
9 hour	36.2	39.7	52.1	62.2	73.4	90.6	106
12 hour	39.8	43.6	57.3	68.3	80.5	99.4	116
24 hour	49.9	54.7	71.3	84	97.7	119	138
48 hour	62.2	68.3	87.5	101	114	136	153
72 hour	71.1	77.9	98.8	112	125	146	162
96 hour	78.6	86.1	108	123	136	156	172
120 hour	85.4	93.4	117	133	147	168	184
144 hour	91.9	100	126	143	159	182	199
168 hour	98.1	107	135	154	173	198	217



Basin:

Type	Area (ha)	IL (mm)	CL (mm/hr)	PL(%)
Road Res	0.48			20.0%

Basin Parameters:

Soil Characteristics:	
Saturated Hydraulic Cond. (m/day)	5
Clogged Layer Permeability (m/day)	
Clogged Layer Thickness (mm)	
Soil Suction (cm)	-5
Porosity	0.2
Aquifer Storage Coefficient	
Base of Aquifer (mAHD)	
Design Groundwater Level (mAHD)	
Initial Conditions:	
Water Depth in Basin (m)	0
Wetting Front Depth (m)	0
Initial Degree of Soil Saturation (%)	20%
Basin Geometry:	
Stage-Area-Volume Relationship Entered (Y/N)	Y
Base Length (m)	11
Base Width (m)	10
Average Slope (1 in X)	6
Basin Base Elevation (mAHD)	63
Maximum Allowable TWL (mAHD)	63.3

Stage-Area-Volume Relationship:

Stage (mAHD)	Area (m^2)	Volume (m^3)
63	114	0
63.3	192	45.9

Pipe Outflow:

Entrance Type	
Pipe Diameter (mm)	
Pipe Length (m)	
Upstream Invert Level (mAHD)	
Downstream Invert Level (mAHD)	

Weir Outflow:

Weir Type:	
Weir Coefficient	
Weir Width (m)	
Weir Level (mAHD)	

PCSUMP
Environmental and Water Resource Software

Project Number / Name:

J7483: Illyarie LLC, Sinagra

Project Description:

Small' Event Raingardens
Catchment C_East

Model Selection: **Deep Water Table Model**

Results:

	Design Storms				Maximum (Mean of Temporal Patterns)					
	Storm	Duration [hrs]	Rainfall Depth [mm]	EY/AEP [%]	Depth [m]	Level [mAHD]	Clearance to Allowable TWL [m]	Volume [m^3]	Area [m^2]	Temporal Pattern No.
	1	1 hour	15.0	1 EY	0.17	63.17	0.13	25	157	2
Critical	***1***	***1 hour***	***15.0***	***1 EY***	***0.17***	***63.17***	***0.13***	***25***	***157***	***2***

Notes:

Temporal pattern matching closest to mean water level

If Water Level is coloured Red, Maximum Capacity of the Basin has been Exceeded

PCSump Version 6.1

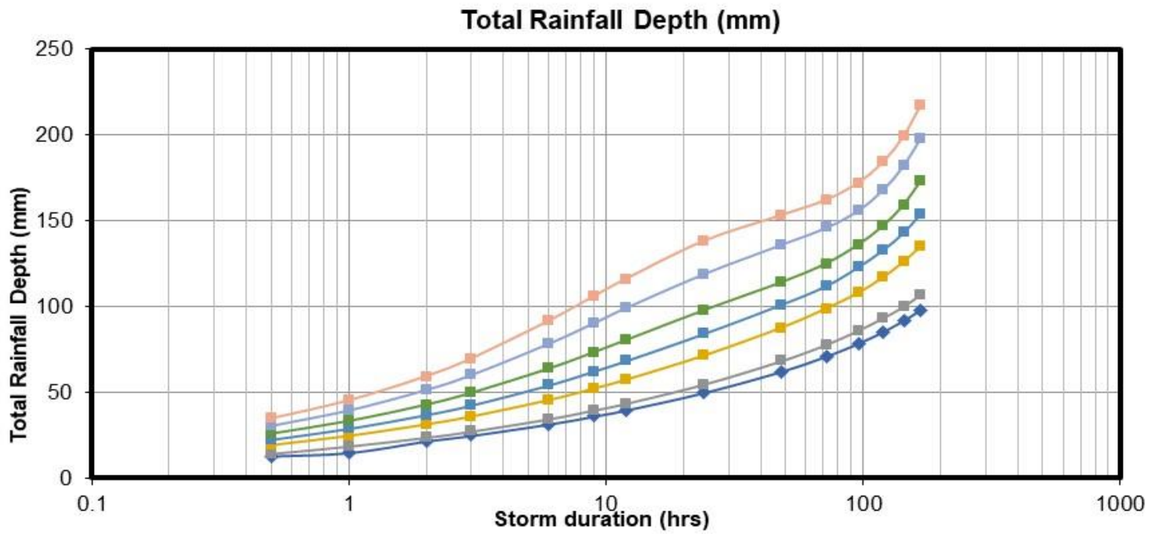
Environmental and Water Resource Software

Project Number/Name:	J7483: Illyarie LLC, Sinagra
Project Description:	Small' Event Raingardens
	Catchment C_West

Model Selection:	Deep Water Table Model
Design AEP(EY)/ARI	1 EY (1 year ARI)
Design Rainfall Region:	Perth Metro
Design Rainfall Location:	CUSTOM
Latitude:	31.7375 (S)
Longitude:	115.8125 (E)
Temporal Pattern:	West Flatlands
Climate Change Selection (Y/N)	N
Effective Service Life	
Consequence of Failure	
Adjustment Applied	

Swale Selection (Y/N)	N

Total Rainfall Depth (mm)							
Duration	**EY**	**Annual Exceedance Probability (AEP)**					
	1 EY	**50%**	**20%**	**10%**	**5%**	**2%**	**1%**
30 min	13	14.4	19.1	22.4	25.9	30.8	34.7
1 hour	15	18.7	24.5	28.8	33.3	39.8	45.2
2 hour	21.7	23.8	31.2	36.8	42.8	51.7	59.3
3 hour	25	27.4	35.8	42.4	49.7	60.4	69.7
6 hour	31.6	34.6	45.4	54.1	63.8	78.6	91.6
9 hour	36.2	39.7	52.1	62.2	73.4	90.6	106
12 hour	39.8	43.6	57.3	68.3	80.5	99.4	116
24 hour	49.9	54.7	71.3	84	97.7	119	138
48 hour	62.2	68.3	87.5	101	114	136	153
72 hour	71.1	77.9	98.8	112	125	146	162
96 hour	78.6	86.1	108	123	136	156	172
120 hour	85.4	93.4	117	133	147	168	184
144 hour	91.9	100	126	143	159	182	199
168 hour	98.1	107	135	154	173	198	217



Basin:

Type	Area (ha)	IL (mm)	CL (mm/hr)	PL(%)
Road Res	1.27			20.0%

Basin Parameters:

Soil Characteristics:	
Saturated Hydraulic Cond. (m/day)	5
Clogged Layer Permeability (m/day)	
Clogged Layer Thickness (mm)	
Soil Suction (cm)	-5
Porosity	0.2
Aquifer Storage Coefficient	
Base of Aquifer (mAHD)	
Design Groundwater Level (mAHD)	
Initial Conditions:	
Water Depth in Basin (m)	0
Wetting Front Depth (m)	0
Initial Degree of Soil Saturation (%)	20%
Basin Geometry:	
Stage-Area-Volume Relationship Entered (Y/N)	Y
Base Length (m)	22
Base Width (m)	10
Average Slope (1 in X)	6
Basin Base Elevation (mAHD)	59
Maximum Allowable TWL (mAHD)	59.3

Stage-Area-Volume Relationship:

Stage (mAHD)	Area (m^2)	Volume (m^3)
59	221	0
59.3	399	93

Pipe Outflow:

Entrance Type	
Pipe Diameter (mm)	
Pipe Length (m)	
Upstream Invert Level (mAHD)	
Downstream Invert Level (mAHD)	

Weir Outflow:

Weir Type:	
Weir Coefficient	
Weir Width (m)	
Weir Level (mAHD)	

PCSUMP
Environmental and Water Resource Software

Project Number / Name:

J7483: Illyarie LLC, Sinagra

Project Description:

Small' Event Raingardens
Catchment C_West

Model Selection: **Deep Water Table Model**

Results:

	Design Storms				Maximum (Mean of Temporal Patterns)					
	Storm	Duration [hrs]	Rainfall Depth [mm]	EY/AEP [%]	Depth [m]	Level [mAHD]	Clearance to Allowable TWL [m]	Volume [m^3]	Area [m^2]	Temporal Pattern No.
	1	1 hour	15.0	1 EY	0.25	59.25	0.05	76	367	5
Critical	***1***	***1 hour***	***15.0***	***1 EY***	***0.25***	***59.25***	***0.05***	***76***	***367***	***5***

Notes:

Temporal pattern matching closest to mean water level

If Water Level is coloured Red, Maximum Capacity of the Basin has been Exceeded

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