East Wanneroo Precinct 3

Local Water Management Strategy

April 2025

Client: Satterley

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Executive Summary

Hyd2o was commissioned by Satterley to prepare this Local Water Management Strategy (LWMS) in support of the proposed local structure plan for East Wanneroo Precinct 3 (herein referred to as the site).

The site is located approximately 20 km north of Perth City Centre within the City of Wanneroo. The site has an approximate area of 136 ha and is bound by rural residential areas to the north and south, Lenore Road and residential lots to the west, with market gardens, rural residential lots, pony clubs, and a racing circuit (Nanovich Park) to the east.

The local structure plan for the site was prepared by Burgess Design Group and will consist of residential lots, associated roads, school, local centre, public open space with stormwater management areas, and retained bushland. The site includes a total of 28 ha of POS/parkland reserve area comprising over 20% of the total site to retain existing areas of Marri/Jarrah and Banksia Woodland.

The site is characterised as rural with market gardens since the early 1970's. Topographically the site is undulating with elevations ranging from approximately 84 mAHD to 55 mAHD, with sandy permeable soils. Groundwater mapping based on local data indicates groundwater flow as to the south west with levels a minimum of 9m below natural surface in low lying areas of the site, ranging to in excess of 40m in elevated areas. The site is considered a Low Risk Classification for development based on Local Planning Policy 4.4 (City of Wanneroo, 2020).

The LWMS considers the overarching East Wanneroo District Structure Plan District Water Management Strategy (Urbaqua, 2021) and its requirements. It is important to note however that the site is different to most of the East Wanneroo District Structure Plan Area and is unconstrained hydrologically, particularly with regards to future groundwater rise considerations and arterial drainage planning and implementation needs to support its development. Given the depth to groundwater and permeable sandy soils in the area, all stormwater within the site can and will be locally managed and infiltrated within Precinct 3.

The LWMS has been prepared in accordance with the principles, objectives, and key criteria of Better Urban Water Management (Western Australian Planning Commission, 2008) and considered other key publications including City of Wanneroo guidelines in developing its approach.

Implementation of the strategy will be undertaken in accordance with Better Urban Water Management through the development and implementation of Urban Water Management Plans for individual stages of development within the site.

Local Water Management Strategy Summary

Strategy Elements	LWMS Method & Approach
Water Use Sustainability	
Water Efficiency	• Use of water efficient fixtures and fittings. • Use of native plantings in POS / stormwater management areas. • Maximise infiltration of stormwater at source. • Retention of Bushland and native vegetation POS areas.
Water Supply	• Water Corporation IWSS for lots with rainwater tanks optional. • POS Irrigation via Superficial Aquifer and existing licences. • No long-term irrigation of conservation areas/Public Open Space.
Wastewater	• Water Corporation reticulated sewerage.
Stormwater	
Ecological Protection/ Water Quality (15 mm Event)	▪ Implement both structural and non-structural controls. • Use of soakwells at lot scale to retain 15mm on site. • Local centre to retain all stormwater on site up to 1% AEP event. • Total storage volume of 3684 m^3 and area of 1.23 ha required for biofiltration systems to treat and infiltrate 15mm events. representing approximately 0.9 % of total site area. • Local scale street scale measures to be detailed at UWMP stage in consultation the City of Wanneroo and project civil engineers.
Serviceability (20% Annual Exceedance Probability Event)	▪ Road drainage system designed so roads will be passable in the 20% AEP event. ▪ The total area required for management of the 20% AEP event is approximately 1.86 ha or 1.4% of the total site area with a total detention storage volume of approximately 6909 m^3.
Flood Protection (1% Annual Exceedance Probability Event)	• Provide flood paths for overland flows which exceed the capacity of piped drainage. • Establish minimum habitable floor levels at 0.3 m above the 1% AEP event flood level in local drainage network. • The total area within the site required for flood storage up to the 1% AEP event is approximately 2.53 ha or 1.9% of the total site area, with a total detention storage volume of approximately 22103 m^3. • Establish minimum habitable floor levels at 0.5m above the 1% AEP event flood level of stormwater storage areas.
Groundwater	
Fill & Subsoil Drainage	• Natural surface in excess of 9m above existing groundwater. • No subsoil required and site unaffected by potential future groundwater rise in Urbaqua(2021). • Earthworks for the site will comprise a cut and fill operation. Some fill may be required to meet gradient requirements, level lots, and interface with existing site boundaries and infrastructure.
ASS & Contamination	• No known risk of Contamination and ASS.

1 Introduction

Hyd2o was commissioned by Satterley to prepare this Local Water Management Strategy (LWMS) in support of the proposed local structure plan for East Wanneroo Precinct 3 (herein referred to as the site).

The site is located approximately 20 km north of Perth City Centre within the City of Wanneroo (Figure 1). The site has an approximate area of 136 ha and is bound by rural residential areas to the north and south, Lenore Road and residential lots to the west, with market gardens, rural residential lots, pony clubs, and a racing circuit (Nanovich Park) to the east.

The local structure plan for the site prepared by Burgess Design Group is included as Figure 2. The proposed development will consist of residential lots, associated roads, school, local centre, public open space with stormwater management areas, and retained bushland.

This LWMS details the outcomes of site specific analysis relating to groundwater and surface water investigations, and provides an assessment of the pre-development environment, development of water use sustainability initiatives, a stormwater management strategy, a groundwater management strategy and a plan for implementation. It provides a total water cycle management approach to development and has been prepared with consideration of the overarching East Wanneroo District Structure Plan District Water Management Strategy (Urbaqua, 2021) and its requirements.

This LWMS has been prepared in accordance with the principles, objectives, and key criteria of Better Urban Water Management (Western Australian Planning Commission, 2008) and considered other key publications including council guidelines in developing its approach. Implementation of the strategy will be undertaken in accordance with Better Urban Water Management through the development and implementation of Urban Water Management Plans for individual stages of development within the site.

A copy of the Better Urban Water Management (WAPC, 2008) LWMS Checklist for Developers is included as Appendix A to assist the Department of Water and Environmental Regulation (DWER) and City of Wanneroo (CoW) in review of this document.

1.1 Planning Background

The site is currently zoned 'Urban Deferred' and 'Rural' under the Metropolitan Region Scheme and zoned as 'Rural' under the City of Wanneroo District Planning Scheme No. 2.

The site is located within the East Wanneroo District Structure Plan Area for which a DWMS was previously prepared by Urbaqua (2021).

It is important to note that the site is different to many areas of the East Wanneroo District Structure Plan Area and is unconstrained hydrologically, particularly with regards to future groundwater rise considerations and arterial drainage planning and implementation needs to support development.

The urban water management planning process for the site is shown in Table 1.

This LWMS supports the proposed local structure plan for the site.

Table 1: Integrated Planning and Urban Water Management Process

Planning Phase	Planning Document	Urban Water Management Document and Status
District	District Structure Plan	East Wanneroo District Water Management Strategy (Urbaqua 2021)
Local	Local Structure Plan	East Wanneroo Precinct 3 Local Water Management Strategy **THIS DOCUMENT**
Subdivision	Subdivision Application	Urban Water Management Plan (for individual subdivision applications) **FUTURE PREPARATION**

1.2 Key Documents and Previous Studies

This LWMS uses the following key water management planning documents to define its principles, criteria, and objectives:

- East Wanneroo District Structure Plan District Water Management Strategy (Urbaqua, 2021)
- Stormwater Management Manual for WA (Department of Water and Environmental Regulation, 2022)
- Local Planning Policy 4.4: Urban Water Management (City of Wanneroo, 2020).
- Local Planning Policy 4.3: Public Open Space (City of Wanneroo, 2021).
- Stormwater Drainage Design Guidelines WD5 (City of Wanneroo, 2019)
- Decision Process for Stormwater Management in WA (Department of Water, 2017)
- Better Urban Water Management (WAPC, 2008)

2 Proposed Development

The structure plan for the site is shown in Figure 2. Consideration of the predevelopment environment of the site and existing constraints has guided the development of the plan.

The proposed development consists of residential lots, road reserves, public open spaces, parkland reserves, a local centre, primary school, and grouped dwellings. The proposed average lot size is approximately 400 m^2.

The site includes approximately 26 ha of POS and parkland reserve areas, well above typical 10% POS requirements to retain Bush Forever areas and Marri/Jarrah and Banskia Woodlands.

The site will create multiple use areas with POS for stormwater management at the existing natural low-lying areas of the site.

Details of the sizing of the stormwater management areas are presented in Section 6.

3 Pre-Development Environment

3.1 Site Conditions

A site conditions plan is included as Figure 3, showing an aerial view of the site and its surrounding area.

The existing site is characterised by rural properties with mainly horticultural use, and pockets of Marri/Jarrah and Banksia Woodland remnant vegetation. Horticultural use has been prevalent within the site since the 1970's.

Topography is characterised as undulating and ranges from approximately 84 mAHD near the southwestern corner to 55 mAHD in the upper-middle low lying area of the site.

Climate in the region is defined as Mediterranean, experiencing warm dry summers and cool wet winters. Mean annual rainfall for the site over the period 1964-2024 is 737 mm/yr (BoM station: Wanneroo 009105), with the majority rainfall occurring in the winter months from May to September.

Evaporation predominantly exceeds rainfall, except for the wettest months.

3.2 Geotechnical

Environmental geology mapping on the Perth Metropolitan Region Sheet 2034 II and part 2034 III and 2134 III (Gozzard, 1986) is shown in Figure 4.

The site is characterised as mainly:

- S7 – SAND – Pale and olive yellow, medium to coarse grained, sub angular to sub rounded quartz, trace of feldspar, moderated sorted, of residual origin.

with a very minor area (<0.1% of site area) of

- Cps - PEATY CLAY - dark grey and black soft variable organic content some quartz sand in places of lacustrine origin.

This S7 classification extends over a very wide area around the site also indicating relatively consistent soil conditions across the broader region.

S7 is sand derived from Tamala Limestone (Qts) and is classified as having good permeability and considerable depth to groundwater (Gozzard,1986).

Lithological logs from groundwater bores installed by Hyd2o show fine to medium grained sand across the three bores drilled at the site. Lithological logs are included as Appendix B.

Due to fragmented land ownership, additional geotechnical investigations will be undertaken at UWMP stage to inform detailed design.

3.3 Acid Sulphate Soils

Acid Sulphate Soil (ASS) mapping in the vicinity of the site is shown in Figure 4.

Almost the whole site is classified as no known risk of ASS, with only a very minor portion (~1100 m^2, <0.1% of site area) having a high to moderate risk in the northeastern corner of the site.

3.4 Contaminated Sites

A search of the Department of Water and Environmental Regulation's Contaminated Sites database indicates no known contaminated areas within the site or within a 2 km radius of its boundary.

3.5 Wetlands

An environmental plan is included as Figure 5. According to Department of Environment and Conservation's (DEC's) Geomorphic Wetlands of the Swan Coastal Plain dataset, there are no mapped wetlands located within the site.

The nearest conservation category wetland is located approximately 600m south west of the site, with Lake Jandabup located 950m to the north east.

3.6 Surface Water

There are no defined waterways, watercourses, or drains within the site, and no external catchments drain into the site. All rainfall and surface runoff currently infiltrates through the sandy subsurface profile. Even in major events any diffuse overland flow which may occur in localised areas would be infiltrated on site.

The Urbaqua (2021) East Wanneroo DWMS Extracts provides stormwater management details and high level arterial drainage planning for the East Wanneroo area.

Extracts from the document relevant to the site are contained as Appendix C and summarised in Figure 6. A total storage volume of 22,800 m^3 for Precinct 3 is estimated in Urbaqua (2021) post development.

It is not clear however in the DWMS why large scale transfer of flow (3-4 m^3/s) across Precinct boundaries in this area is required, particularly given permeable sandy soils are present, a high clearance to groundwater exists, and considering this does not represent the predevelopment condition or existing hydrological behaviour. Urbaqua (2021) precinct transfer locations of flows are shown in Figure 6 and Appendix C.

Various agencies (DWER, DPLH, Urbaqua) have been unable to provide any clarification on this matter during the development of this DWMS. The DWMS therefore considers that given sandy soils and high clearance to groundwater that stormwater can be managed and infiltrated onsite up to the 1% AEP event, and operate fully independently of other precincts and without any cross boundary transfers in or out of the precinct being required.

This approach is consistent with best practice for stormwater management.

3.7 Groundwater

3.7.1 Groundwater Levels

In mid 2023, DWER revised the groundwater information reported on their Perth Groundwater Map (online) to report the Gnangara Jandakot maximum and minimum water table contours for 2019. Advice from DWER indicates these revised contours account for the declines and rises in water tables in recent decades and the impacts of current climate trends. These contours are understood to be based on the contouring of the actual recorded maximum and minimum groundwater levels at DWER bores in 2019.

Based on this dataset the 2019 maximum groundwater levels across the site ranged between 40.0 mAHD and 42.0 mAHD, with flow to the south west.

Hyd2o conducted a monthly groundwater level monitoring program from September 2022 through to November 2023 at the three site bores and four DWER bores. A summary of recorded water levels for the monitoring program are shown in Table 3 and Appendix D.

Minimum groundwater levels for the site bores were recorded mainly in March 2022 and ranged from 40.78 mAHD at EW02 to 41.40 mAHD at EW03. Maximum groundwater levels were recorded mainly in October 2022 ranging from 41.23 mAHD at EW02 to 42.13 mAHD at EW03. Maximum recorded levels during this period are shown on Table 3.

Groundwater flow across the site is in a south westerly direction, towards the western site boundary similar to DWER mapping.

DWER long-term hydrographs are included in Appendix E. DWER bores show a historical (2000 – 2023) annual seasonal variations of between 0.1 m – 0.6 m at WM22, between 0.2 m – 0.7 m at JP5B, between 0.1 m – 0.7 m at JB4, and between 0.2 m – 0.8 m at bore WM42.

The long-term hydrographs show a general declining trend in groundwater levels prior to 2000 with increasing levels in recent times. The maximum recorded groundwater levels during the 2022-2023 monitoring period at all DWER bores exceeded their respective AAMGL's for the period since 2000 ranging from 0.29 m to 0.47m above the AAMGL.

Given these results and the predicted future groundwater level rise in the area with development (Urbaqua, 2021) calculation of a historical AAMGL is not considered appropriate for the site to inform development.

Figure 7 therefore contours the maximum groundwater level (MGL) for the 2022-2023 monitoring period and notes the minimum clearance to these groundwater levels from natural surface in the site as approximately 9m in the north-eastern corner. Areas of the site are elevated more than 40m above regional groundwater

Given these clearances, the site will not be adversely affected by any predicted rise of groundwater levels as a result of land use change within the East Wanneroo District Structure Plan area (Urbaqua, 2021).

Table 3: Groundwater Level Summary

	EW01	EW02	EW03	WM22	WM42	JD5B	JB4
Easting	389876	389255	389849	387060	386832	389310	389846
Northing	6484333	6485192	6485613	6486557	6485295	6486042	6486155
TOC (mAHD)	51.94	58.24	54.44	65.52	39.15	77.00	63.48
Natural Surface (mAHD)	54.44	57.74	53.94	65.48	38.57	76.48	62.87
AAMGL (mAHD)*	-	-	-	37.34	27.79	41.63	42.56
MGL (mAHD) (during Hyd2o Monitoring Program 2022-2023)	41.46	41.23	42.13	37.80	28.26	42.01	42.85
Measured MGL (2022-2023) above AAMGL (mAHD)	-	-	-	+0.46	+0.47	+0.38	+0.29
Groundwater Level (mAHD)							
07/09/2022	41.35	41.12	42.05	-	-	-	-
08/10/2022	41.41	41.18	42.12	-	28.13	-	-
25/10/2022	41.46	41.21	42.13	37.65	28.13	41.88	42.82
21/11/2022	41.43	41.23	42.07	37.66	28.12	42.01	42.85
16/12/2022	41.33	41.14	41.95	37.62	27.92	41.79	42.83
24/01/2023	41.17	41.00	41.68	37.51	27.74	41.64	42.75
16/02/2023	41.06	40.95	41.58	37.53	27.63	41.57	42.72
15/03/2023	40.88	40.78	41.40	37.47	27.55	41.42	42.63
12/04/2023	40.85	40.79	41.42	37.47	27.56	41.41	42.60
12/05/2023	40.88	40.80	41.47	37.51	27.63	41.45	42.62
16/06/2023	40.93	40.83	41.62	37.55	27.78	41.48	42.58
18/07/2023	40.93	40.83	41.62	37.55	27.78	41.48	42.58
18/08/2023	41.38	41.21	42.08	37.80	28.26	41.85	42.82
19/09/2023	41.33	41.12	41.97	37.65	28.16	41.75	42.70
17/10/2023	41.35	41.18	42.01	37.62	28.05	41.77	42.75
17/11/2023	41.25	41.10	41.95	37.70	27.91	41.68	42.72

* AAMGL calculated based on DWER bores from 2000-2023

3.7.2 Groundwater Quality

Groundwater quality samples were taken from three site bores (EW01, EW02 and EW03) and one DWER bore (WM42) on five occasions across the predevelopment monitoring period. Groundwater quality results are summarised in Table 4 with detailed results and laboratory reports provided in Appendices F and G. Results are evaluated against ANZECC (2000) guidelines for highly coloured wetland ecosystems in South-west Australia and 95% level of protection for freshwater species.

Key results are summarised as follows:

- Mean EC was recorded as 0.516 mS/cm at EW01, 1.561 mS/cm at EW02, 0.343 mS/cm at EW03, and 1.156 mS/cm at WM42, remaining within ANZECC guidelines (0.300 - 1.500 mS/cm), apart from bore EW02 which slightly exceeded the trigger level.
- Mean pH was recorded as 6.11, 5.24, 6.65 and 6.52, at EW01, EW02, EW03 and WM42 respectively. This indicates groundwater across the site is slightly acidic and within the ANZECC (2000) guideline range of 4.50 - 6.50 pH, apart from bores EW03 and WM42 which are marginally above.
- Mean TN exceeded the ANZECC guidelines (1.5 mg/L) at bores EW02 and EW03. EW01, EW02, EW03 and WM42 were recorded as 0.93 mg/L, 100.40 mg/L, 2.32 mg/L, and 0.94 mg/L respectively. Historical land use is the likely cause of elevated readings at EW02, with historical aerial photographs from Landgate showing horticultural activity around bore EW02 dating back to the early 1970's.
- Mean NOx-N (mg/L) exceeded the ANZECC guideline of 0.1 mg/L at all bores, recording levels at bores EW01, EW02, EW03 and WM42 as 0.55 mg/L, 77.60 mg/L, 1.96 mg/L and 0.68 mg/L, respectively.
- Mean TP remained within the 0.060 mg/L ANZECC guideline at all bores, recording values below the laboratory detectable limit of 0.050 mg/L at all bores on all sampling occasions.
- Mean FRP remained within the ANZECC guideline of 0.03 mg/L at all bores, recording 0.006 mg/L at EW01, 0.005 mg/L at EW02, 0.005 mg/L at EW03, and 0.011 mg/L at WM42.
- Dissolved metals were within the ANZECC guideline trigger values, apart from Zn which exceeded the established 0.008 mg/L criteria at bores EW01, EW02 and WM42 recording mean Zn values of 0.01 mg/L, 0.049 mg/L and 0.019 mg/L, and for Cu which slightly exceeded the ANZECC trigger value of 0.0014 mg/L at bores EW01 (0.0015 mg/L) and EW02 (0.0023 mg/L).
- E.coli was recorded below detectable laboratory limit in all sampling occasions regarding all site bores and WM42.

Table 4: Groundwater Quality Summary

Parameter	ANZECC Guidelines (2000)	EW01 (mean)	EW02 (mean)	EW03 (mean)	WM42 (mean)
EC (mS/cm)	0.300 - 1.500[1]	0.516	1.561	0.343	1.156
pH	4.50 - 6.50[1]	6.11	5.24	6.65	6.52
TN (mg/L)	1.50[1]	0.93	100.40	2.32	0.94
NOx-N (mg/L)	0.10[1]	0.55	77.60	1.96	0.68
TP (mg/L)	0.06[1]	0.05	0.05	0.05	0.05
FRP (mg/L)	0.03[1]	0.006	0.005	0.005	0.011
Al (mg/L)	0.055[2]	0.155	0.032	0.022	0.01
As (mg/L)	0.024[2]	0.001	0.001	0.001	0.001
Cd (mg/L)	0.0002[2]	0.0001	0.0001	0.0001	0.0001
Cr (mg/L)	0.001[2]	0.001	0.001	0.001	0.001
Cu (mg/L)	0.0014[2]	0.0015	0.0023	0.001	0.0011
Fe (mg/L)	no data	1.47	0.147	0.018	0.01
Pb (mg/L)	0.0034[2]	0.001	0.001	0.001	0.001
Ni (mg/L)	0.011[2]	0.001	0.001	0.001	0.001
Zn (mg/L)	0.008[2]	0.01	0.049	0.005	0.019
Hg (mg/L)	0.0006[2]	0.00005	0.00005	0.00005	0.00005

1. ANZECC (2000) guidelines default trigger values for highly coloured wetland ecosystems in South-west Australia.

2. Trigger values for 95th percentile protection of freshwater species.

4 Design Criteria

Key design criteria for the site are shown in Table 5 and have been established consistent with criteria specified in the key reference documents previously detailed in Section 1.3. These design criteria are used in Sections 5, 6 and 7 together with the identified constraints and opportunities of the predevelopment environment (Section 3) to establish the water management strategy for the site.

Table 5: Key Urban Water Management Design Objectives

Water Supply	
Water Efficiency	• Use higher density residential zonings to reduce ex-house use. • Consumption target for water of 100 kL/person/yr. • Water efficient fixtures and fittings. • Retention of Bushland vegetation and use of native plantings in POS.
Water Supply	• Water Corporation IWSS for lots, rainwater tanks. • Groundwater for POS irrigation. • Minimise use of scheme water for non-drinking purposes.
Wastewater	• Water Corporation reticulated sewerage.
Stormwater	
Small Event (15mm Event)	• Use of soakwells at lot scale to infiltrate first 15mm on site. • Biofiltration areas for management and treatment of first 15mm road runoff within POS • Bottomless manholes within road reserves (subject to City of Wanneroo acceptance)
Serviceability (20% AEP Event)	• Piped drainage system sized to convey 20 % AEP event. • 20% AEP event for local stormwater managed and retained within multiple use POS areas.
Flood Protection (1% AEP Event)	• Overland flow paths within road reserves identified for safe conveyance of flows exceeding pipe drainage system capacity. • Minimum habitable floor levels shall be a minimum of 0.3 m above the % AEP storm event flood level in local drainage networks. • 1% AEP event for local stormwater to be all retained and infiltrated on site in POS areas. • Minimum habitable floor levels shall be a minimum of 0.5 m above the 1% AEP storm event in stormwater storage areas. • Local centre to manage up to 1% AEP event on site. • All stormwater to be infiltrated within 96 hrs to prevent mosquito and midge breeding.
Groundwater	
Fill & Subsoil	• Earthworks for the site will comprise a cut and fill operation required to meet gradient requirements, level lots, and interface with existing site boundaries and infrastructure
Acid Sulphate Soils	▪ Acid sulphate soils to be investigated as a separate process (if required) and reported at later stages of planning.
Implementation	
Process	• Future stages of planning to be consistent with BUWM (WAPC, 2008) requirements. • Post development monitoring to review system performance.

5 Water Use Sustainability Initiatives

5.1 Water Efficiency Measures

Development of the site will lead to an increased demand of potable water for residential use and irrigation of gardens and POS/drainage areas.

Water conservation measures implemented to reduce scheme water consumption within the development will be consistent with Water Corporation's "Waterwise" land development criteria including:

- Promotion of use of waterwise practices including water efficient fixtures and fittings (taps, showerheads, toilets, rainwater tanks, waterwise landscaping).
- Retention of vegetation and bushland areas
- Use of native plants in POS and drainage landscaped area.
- Maximising on site retention of stormwater.

Local aquifer water use is expected to reduce significantly within the site as a result of the change from horticultural land use to urban development.

5.2 Water Supply

Potable water supply to future homes in the site will be via the Water Corporation Integrated Water Supply System (IWSS). Rainwater tanks have been identified as a non-potable source to be integrated as part of the domestic water supply scheme to assist in reducing stormwater generation and minimise scheme water importation.

The site is located within the Wanneroo groundwater management area (GMA) Lake Gnangara Sub Area. DWER's online Water Register for Licence and Water Availability Information indicates that the superficial aquifer is fully allocated within this sub area and therefore further water is not available to be allocated for irrigation purposes. Deeper Leederville and Yaragadee aquifers are also fully allocated.

Based on the DWER's online Water Register, there are seventeen existing licence allocations within the site, totalling 469,588 kL/yr as shown in Table 5. Individual licence details are contained in Appendix H. Licences will be retained within the site to support future development and POS irrigation.

The subdivision application area contains 12.0 ha of active POS inclusive of a playing field and a further 14.3 ha of parkland conservation area (Figure 2). An estimate of the amount of groundwater required for POS irrigation is calculated based on a 12.0 ha POS irrigation area, and assuming an irrigation rate of 6,750 kL/ha/annum. The estimated 81,000 kL/yr required represents only 17% of current allocation within the site.

Indicative landscape concept plans prepared by Emerge Associates are contained as Appendix I. Stormwater management areas will be integrated in POS with landscaped biofiltration and infiltration storage areas for up to the 1% AEP event. Details of calculations for stormwater volumes used to inform landscape planning are contained in Section 6.

Table 5: Groundwater Resource and Licenced Allocation

Groundwater Area	Subarea	Aquifer	Licence	Allocation (kl/yr)	Water Availability
Wanneroo	Lake Gnangara	Superficial	53795	3,500	Fully Allocated
			96251	12,950	
			71191	49,500	
			169281	42,008	
			76456	4,150	
			107897	10,270	
			153256	9,815	
			203361	57,650	
			207394	60,000	
			98646	48,650	
			152615	43,400	
			66050	5,000	
			76617	49,950	
			71195	48,600	
			63494	12,575	
			95232	5,150	
			168640	6,420	
			Total : 469,588 kl/yr		

Further refinement and provision of landscape design plans will occur in consultation with the City of Wanneroo at UWMP stage prior to POS construction as engineering and landscape detailed design is progressed. Detailed landscape plans and engineering for POS will be provided to the CoW for approval during the detailed planning phase of POS.

Groundwater licences to support POS irrigation within the site will be ultimately transferred to the City of Wanneroo upon handover of POS areas.

5.3 Wastewater Management

Wastewater will be deep sewerage (reticulated) with management by the Water Corporation.

6 Stormwater Management Strategy

Stormwater management is proposed to be undertaken consistent with DWER water sensitive design practices, via a combination of lot soakwells and street scale infiltration, and biofiltration areas and multiple use flood storage areas within POS to capture and infiltrate all events on site up to the 1% AEP event. With respect to additional local scale street scale measures, these will be detailed and designed at UWMP stage in consultation the City of Wanneroo and project civil engineers.

The overall key components of stormwater management of the site are as follows :

- Land use types and densities to considerably reduce nutrient application and export relative to existing land use
- Lots to have soakwells/on-site systems to provide 15mm infiltration of stormwater at source.
- Road runoff to be conveyed using piped drainage, with bottomless manholes used (subject to CoW approval) to reduce bottom end infrastructure requirements.
- Treatment of road runoff within each catchment via specified biofiltration areas for water quality, with POS areas designed to be occasionally inundated for flood management in major events.

The site (Precinct 3) has been designed to be self contained in terms of stormwater management with no cross precinct flows in and out across precinct boundaries. Given its sandy soils and depth to groundwater it is not considered to require any regional stormwater infrastructure to facilitate its development.

6.1 Stormwater Modelling

Stormwater modelling for the site was performed using XP-Storm to determine stormwater flood storage requirements. The design storms modelled by XP-Storm were based on methodology in Australian Rainfall & Runoff (AR&R) and the Bureau of Meteorology Computerised Design IFD Rainfall System. The rainfall temporal pattern was assumed to be spatially uniform across the catchment. Storms modelled ranged from 30 mins to 72 hrs.

The following key parameters were used for modelling:

- Seven catchments based on existing topography and POS area locations determined in consultation with project engineering Cossill & Webley (Figure 8).
- 1:0 side slopes for biofiltration areas to a maximum depth of 0.3 m.
- Minimum side slopes of 1 in 6 for minor/major event flood storage.
- Maximum storage depth of 1.2 m (1% AEP Event).
- A saturated hydraulic conductivity of 5 m/day for modelling purposes.

Various runoff coefficients applied to different land uses for each of the events modelled are shown in Table 6. These have been determined using Hyd2o's CURRV runoff rate calculator with detailed calculations included as Appendix J. Hyd2o's CURRV runoff calculator is a standardised approach used by Hyd2o across all development projects to

estimate runoff rates. In estimating runoff rates CURRV considers rainfall IFD's, land use breakdown, percentages of impervious and pervious areas within land use type and likely initial and continuing loss of soil types. It is assumed all residential lots will have soakwells sized to retain a 15 mm event on site, and the local centre will be required to manage all events up to the 1% AEP on site.

Modelling results for the POS storages are provided in Table 6 and Figure 8, with modelling outputs shown in Appendix K. Note that storage shapes shown in Figure 8 are indicative only for determination of POS area requirements in the local structure plan. Landscape plans in Appendix I should be referenced for more detailed information regarding the integration of required storage volumes within POS.

Final infiltration area configurations, locations, and elevations will be documented in future UWMPs and will be dependent on final earthworks, drainage, and road design levels for the development. Tree retention will be a key factor in the final configurations adopted.

6.2 Major Event Flood Protection (1% AEP)

Modelled flood protection storage volumes, areas, and flood rises are detailed in Table 6 and Figure 8 which shows the extent of inundation of POS area for various flood management events. The total area within the site required for flood storage up to the 1% AEP event is approximately 2.53 ha or 1.9% of the total site area, with a total detention storage volume of approximately 25,265 m^3. This compares with 22,800 m^3 estimated for the Precinct in Urbaqua (2021).

The final storage area configuration (side slopes, treatments etc), location, and elevations will be documented in the UWMP and will be dependent on final earthworks, drainage, and road design levels for the development.

Refinements to catchment areas shown in this report may occur as detailed design proceeds, and stormwater modelling will be updated accordingly if required during the UWMP process. Opportunities for additional distributed storage and treatment throughout the site will also be reviewed at later stages of planning.

All building floor levels will comply with requirements for a 0.3 m clearance above the 100 year flood level within the street drainage system and 0.5 m above the flood level within stormwater storage areas.

6.3 Minor Event Serviceability (20% AEP)

Modelled storage volumes, areas, flood rise and inverts are detailed in Table 6 and Figure 8 for the 20% AEP flood event, showing the extent of inundation of POS area.

The total area required for the 20% AEP event is approximately 1.86 ha or 1.4% of the total site area with a total detention storage volume of approximately 6909 m^3. This compares with 7,500 m^3 estimated for the Precinct in Urbaqua (2021).

Table 6: Stormwater Modelling Summary

Catchment	Catchment A	Catchment B	Catchment C
Residential Lots 36% 1%AEP, 0% 15mm	18.06	10.28	9.35
Road Reserve 84% 1%AEP, 64% 15mm	11.11	5.51	5.21
POS 17% 1%AEP, 0% 15mm	1.39	1.33	0.69
Playing Fields 17% 1%AEP, 0% 15mm	-	-	-
Parkland Reserve 0% 1%AEP, 0% 15mm	3.43	-	-
Church 0% 1%AEP, 0% 15mm	1.96	-	-
Local Centre 0% 1%AEP, 0% 15mm	-	-	-
Primary School 0% 1%AEP, 0% 15mm	-	-	-
Total Catchment (ha)	35.95	17.12	15.25
20%/1%AEP EIA (ha)	16.07	8.55	7.86
15mm EIA (ha)	7.11	3.53	3.34
63% AEP Event (~15mm)			
Side Slopes for Biofiltration (1:v)	0	0	0
Flood Rise (m)	0.3	0.3	0.3
Base Area (m^2)	3550	1770	1680
Volume (m^3)	1067	530	501
Storage Characteristics			
Side Slopes for Flood Storage (1:v)	6	6	6
Nominal Basin Invert (mAHD)	56	56	56
Base Area (m^2)	5000	2450	2240
20% AEP Event			
Flood Rise (m)	0.44	0.50	0.50
Volume (m^3)	1782	1041	976
TWL Area (m^2)	5255	2708	2491
Critical Storm (hr)	3	3	3
1% AEP Event			
Flood Rise (m)	1.17	1.20	1.19
Volume (m^3)	6115	3287	3020
TWL Area (m^2)	6675	3701	3443
Critical Storm (hr)	6	6	6

Table 6: Stormwater Modelling Summary (Continued)

Catchment	Catchment D	Catchment E	Catchment F	Catchment G
Residential Lots 36% 1%AEP, 0% 15mm	11.43	5.87	6.52	4.39
Road Reserve 84% 1%AEP, 64% 15mm	6.29	3.91	3.92	2.60
POS 17% 1%AEP, 0% 15mm	0.70	1.73	1.16	0.51
Playing Fields 17% 1%AEP, 0% 15mm	4.52	-	-	-
Parkland Reserve 0% 1%AEP, 0% 15mm	3.04	-	7.85	-
Church 0% 1%AEP, 0% 15mm	-	-	-	-
Local Centre 0% 1%AEP, 0% 15mm	-	-	2.08	-
Primary School 0% 1%AEP, 0% 15mm	3.52	-	-	-
Total Catchment (ha)	29.50	11.51	21.52	7.50
20%/1%AEP EIA (ha)	10.28	5.69	5.83	3.85
15mm EIA (ha)	4.02	2.50	2.51	1.66
63% AEP Event (~15mm)				
Side Slopes for Biofiltration (1:v)	0	0	0	0
Flood Rise (m)	0.3	0.3	0.3	0.3
Base Area (m^2)	2030	1260	1260	750
Volume (m^3)	609	375	377	225
Storage Characteristics				
Side Slopes for Flood Storage (1:v)	6	6	6	6
Nominal Basin Invert (mAHD)	56	56	56	56
Base Area (m^2)	3010	1590	1650	1025
20% AEP Event				
Flood Rise (m)	0.47	0.50	0.51	0.56
Volume (m^3)	1144	714	739	513
TWL Area (m^2)	3261	1795	1871	1241
Critical Storm (hr)	3	3	3	3
1% AEP Event				
Flood Rise (m)	1.18	1.18	1.17	1.17
Volume (m^3)	3837	2175	2221	1448
TWL Area (m^2)	4399	2578	2646	1823
Critical Storm (hr)	6	6	6	6

6.4 Small Event Water Quality Treatment(15mm)

This LWMS proposes a treatment train approach to water quality management which includes non- structural as well as structural controls:

- **Non-Structural Controls**
  Planning: Lot product and Sizing, POS and storage locations and configuration
  Landscape: Native plantings and Bushland Retention, WSUD integration
  Maintenance: Storage areas, street sweeping manhole eduction
  Monitoring: Post development program and performance review
- **Structural Controls**
  Catchment Scale Infrastructure: Bioretention areas
  Local Scale Infrastructure: Soakwells at lot scale, bottomless manholes with roads

Measures adopted represent known best management practice as detailed in the Stormwater Management Manual for Western Australia (DWER, 2022).

Storm volumes for ecological protection based on the 63% AEP (15mm) event are provided in Table 6 and Figure 8 to provide a guide for storage requirements and areas for water quality treatment consistent with DWER (2022) and DWER (2017).

The total area estimated for biofiltration is approximately 1.23 ha (volume 3684 m^3).

Table 7 details a summary from the Stormwater Management Manual for Western Australia (DWER, 2022) of expected pollutant removal efficiencies for various WSUD measures in relation to water quality design criteria. While DWER (2022) does not provide expected pollutant removal efficiencies for all BMP's, application of a treatment train approach using a combination of the non-structural and structural measures will achieve the design objectives for water quality as detailed in WAPC (2008).

Bioretention areas will be sized to retain treat and infiltrate 15mm in accordance with agency requirements. Biofiltration systems will be designed consistent with the Adoption Guidelines for Stormwater Biofiltration Systems (CRC for Water Sensitive Cities, 2015).

With respect to disease vector and nuisance insect management, modelling shows stormwater management areas will have a maximum duration for standing water following small events (<15mm) of less than 6 hours, well within WAPC (2008) requirement of 96 hours.

Table 7: BMP Water Quality Performance in Relation to Design Criteria

Parameter	Criteria via WAPC (2008) (removal as compared to a development with no WSUD)	Nutrient Output Reduction viq DWER (2022)	
		Bioretention Systems	Detention/ Retention Storages
Total Suspended Solids	80%	60-80%	65-99%
Total Phosphorus	60%	30-50%	40-80%
Total Nitrogen	45%	25-40%	50-70%
Gross Pollutants	70%	-	>90%

6.5 Nutrient Assessment

The UNDO (Urban Nutrient Decision Outcomes) model is a conceptual decision support tool developed by DWER that evaluates nutrient reduction decisions for urban developments on the Swan Coastal Plain. It is designed for ease-of-use by urban development proponents and for assessment by local and state government authorities.

The tool was developed to assess nutrient impacts of urban development on the Swan Coastal Plain in a consistent and scientifically rigorous manner. The tool is web-based and provides users with the ability to implement a range of structural and/or non-structural design options to evaluate and reduce nutrients exported from an urban development.

Modelling outputs of the site's existing land use using UNDO are detailed in Appendix M.

Modelling outputs of the site's existing (pre-development) land use indicate nutrient inputs of 10,245 kg/yr of TN and 1816 kg/yr of TP to the environment annually based on typical rural nutrient application rate estimates. The resultant nutrient export was 810 kg/yr of TN and 12.1 kg/yr of TP. These export estimate considers soil types, groundwater gradients, and depth to groundwater in their calculation. They do not however consider the impact of horticultural use which UNDO doesn't include. DoW's (2010) Survey of Urban Nutrient Inputs on the Swan Coastal Plain publication indicate application for horticultural use are likely to be far greater. Estimates for the existing land use are therefore likely to be considerably underestimated.

Post development UNDO modelling shows the positive impact land use change at the site will have with respect to nutrient application and export. The modelling results indicate land use change will result in nutrient inputs of 4,089 kg/yr for TN and 740 kg/yr TP post development. This indicates a 6,156 kg/yr (60%) reduction in TN input and 1076 kg/yr (59%) reduction in TP input annually.

The resultant nutrient export inclusive of the impact of implementing water sensitive urban design measures was 284 kg/yr of TN and 6.3 kg/yr export of TP following development. This represents a significant 65% reduction in TN export and a 48% reduction in TP export to the environment post development as a result of land use change.

As previously discussed, actual reductions are likely to be much higher than estimated given current horticultural use within the site.

7 Groundwater Management Strategy

As discussed in Section 3.7.1, existing groundwater levels at the site range from a minimum of approximately 9m below surface to in excess of 40m. Given this clearance, the site will not be adversely affected by any predicted rise of groundwater levels as a result of land use change within the East Wanneroo District Structure Plan area (Urbaqua, 2021).

Groundwater levels are therefore not considered a development constraint for the site.

Earthworks for the site will comprise a cut and fill operation required to meet gradient requirements, level lots, and interface with existing site boundaries and infrastructure.

Water quality aspects of groundwater management will be achieved via biofiltration areas in future POS areas to treat stormwater runoff prior to infiltration at source.

Final finished lot levels are a detailed design issue to be addressed during the preparation of detailed engineering design drawings and preparation of the UWMP and will be ultimately submitted for council approval at that stage.

7.1 Acid Sulphate Soils

As previously detailed in Section 3.2, published acid sulphate risk mapping shows almost the whole site as no known risk of ASS, with only a very minor portion (~1100 m^2, <0.1% of site area) having a high to moderate risk in the northeastern corner of the site.

Groundwater in the area of the high to moderate risk ASS is estimated to be approximately 9m below natural surface (Figure 7) and is therefore unlikely to be disturbed during construction.

Further examination of ASS risks if required will be evaluated during the sites geotechnical investigations. Should ASS be identified, management will be addressed as a separate study to the LWMS/UWMP process, however details regarding the outcomes will be included as part of the Urban Water Management Plan (UWMP).

All assessment and management of ASS will be conducted in accordance with the Acid Sulphate Soil Guideline Series documentation (Department of Environmental Regulation, 2015a & b).

8 Urban Water Management Plans

Consistent with processes defined in WAPC (2008), an Urban Water Management Plan (UWMP's) will be developed and submitted to support subdivision development of the site. Given the size of the site, it is considered likely several UWMP's will be required.

The UWMP will address:

- Demonstrated compliance with LWMS criteria and objectives to the satisfaction of the City of Wanneroo and DWER.
- Agreed measures to achieve water conservation and efficiencies of water use.
- Geotechnical investigations, including permeability testing at storage locations.
- Detailed stormwater management design including the refinement of sizes, locations and design of public open space areas, integrating water quality treatment areas, and major and minor flood management capability.
- Details landscape plans developed in consultation with the City of Wanneroo.
- Earthworks, cut/fill, and detailed drainage design plans.
- Specific structural and non-structural BMPs and treatment measures to be implemented including their function, location, maintenance requirements, expected performance and agreed ongoing management arrangements.
- Management of subdivisional works.
- Implementation plan including roles, responsibilities, funding and maintenance arrangements.
- Further specific monitoring at individual stage level and reporting to be undertaken consistent with the monitoring program defined in this LWMS.
- Contingency plans (where necessary).

More detail on stormwater storage integration with POS areas will be provided during the development of the UWMP, including refinement of stormwater modelling, preparation of landscape plans (species selection and treatments), and detailed engineering design drawings.

Preparation of the UWMP will be the responsibility of the developer.

9 Monitoring

9.1 Pre Development Monitoring

Groundwater monitoring to support urban development is typically required for sites where groundwater is close to natural surface (< 4 m).

Predevelopment monitoring for the site has been undertaken consistent with specified requirements of the Urbaqua (2021) district scale monitoring program, and completed across two peak winter periods demonstrating a minimum depth to groundwater of approximately 9m at the site, with depths ranging to more than 40m below natural surface.

Water quality parameters consistent with Urbaquq (2021) requirements were undertaken as detailed in Section 3.2.

No further predevelopment monitoring is considered to be required to inform development of the site.

9.2 Post Development Monitoring

Due to the substantial depth to groundwater across the site, a post development groundwater monitoring program is not proposed.

An alternative program which focusses on the performance of stormwater management measures to function and perform in accordance with design is considered more appropriate as detailed in Table 8.

The monitoring program is proposed to operate over a two year post development period to assess the overall performance of the stormwater storage areas. This period of post development monitoring is considered appropriate to assess the functioning of the surface water management system within individual development areas.

A standardised proforma will be used to assess performance against design intent. The proforma will consider processes such as vegetation health, scour, erosion, deposition, water levels, and retention periods of standing water in bioretention and flood storage areas.

Assessment of monitoring outcomes and system performance will be undertaken as part of the annual review and reporting process. Should the system not be functioning in accordance with design a contingency action plan will be implemented, including:

- Assessing if an isolated, development area or regional occurrence.
- Determining if due to the development or other external factors.
    - a) Identify and remove any point sources causing problems.
    - b) Review operational and maintenance practices.
    - c) Consider alterations to POS areas and the stormwater system.
    - d) Consider initiation of community based projects.
- If necessary, inform residents of any required works and their purpose.

The program may need to be modified as data is collected to increase or decrease the monitoring effort in a particular area or to alter the scope of the program itself.

Any modification to the program would be identified through review of the collected data and would require the agreement of the City of Wanneroo and the developer.

Table 8: Post Development Monitoring Program

Monitoring	Parameter	Location	Method	Frequency/Timing
Local stormwater	Performance assessment via proforma	Biofiltration & flood storage areas	Visual assessment	Monthly, typically between June to October (5 times per year) for 2 years

10 Implementation

Table 9 details the roles, responsibilities and funding to implement the LWMS.

Should the UWMP require any deviations to the strategy detailed in this LWMS, this will require the agreement of all parties (DWER, City of Wanneroo, and developer).

Details of construction and maintenance responsibilities will be appropriately detailed at UWMP stage. Operation and maintenance of the stormwater management system will initially be the developer's responsibility, ultimately reverting to the City following handover. Details of maintenance responsibilities will be further outlined at UWMP stage.

The schedule for maintenance works will be consistent with typical requirements of the City of Wanneroo for stormwater management.

Table 9: Implementation Roles and Responsibilities

Implementation Action	Responsibility & Funding		
	Developer	City of Wanneroo	DWER
Preparation of LWMS (this document)	☑		
Review & Approval of UWMP		☑	☑
Preparation of UWMP's for individual stages	☑		
Review & Approval of UWMP's		☑	
Post Development Monitoring Program	☑		
Construction of Stormwater System	☑		
Operation & Maintenance			
a) Prior to Handover	☑		
b) Following Handover		☑	

11 References

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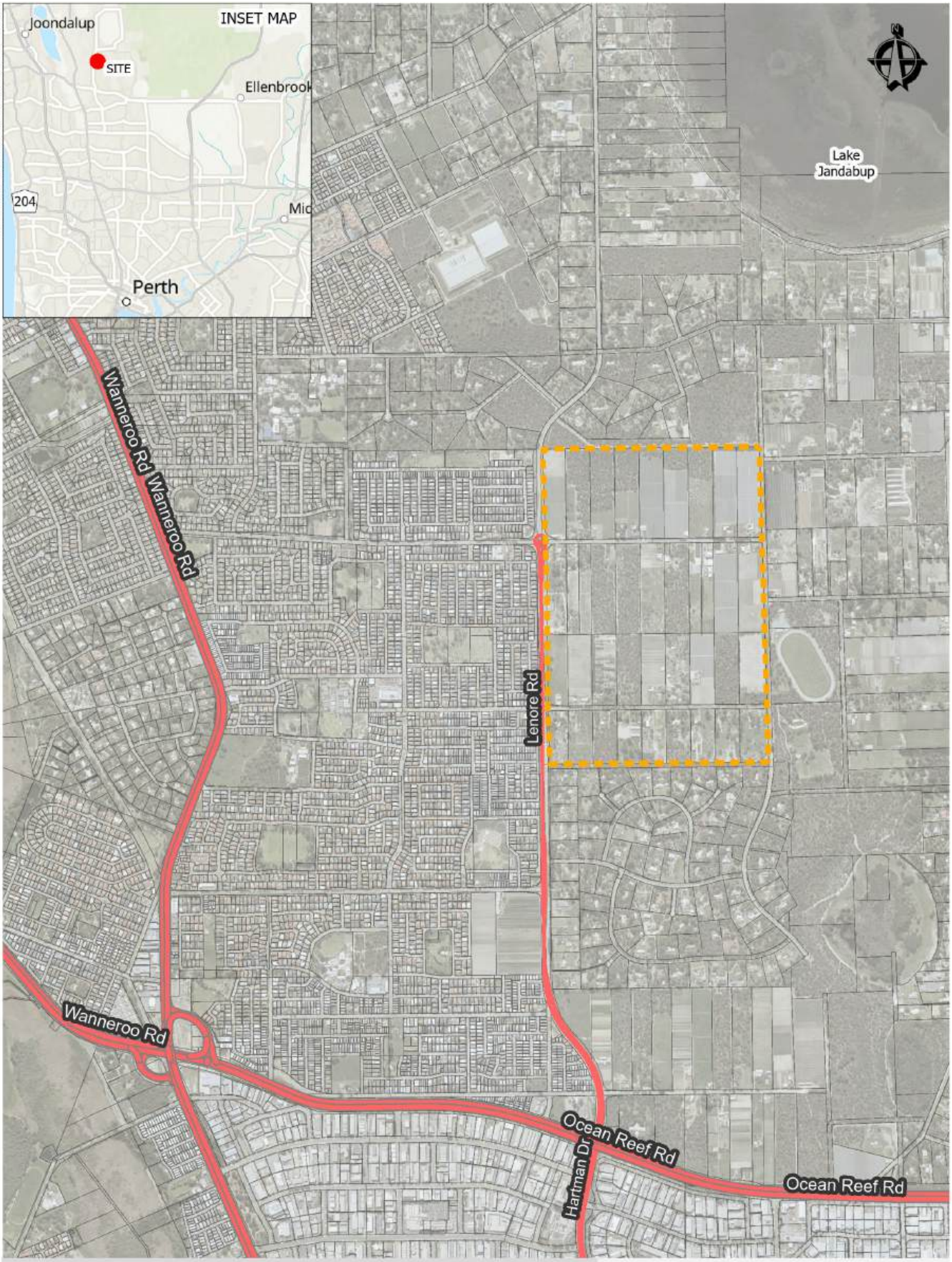
Western Australian Planning Commission (2008b). Better Urban Water Management

Western Australian Planning Commission (2009). Planning Bulletin 64/2009 Acid Sulphate Soils

FIGURES

Date: 03/04/2025 Job No. H24054



Site Boundary

0 500 1,000 Meters

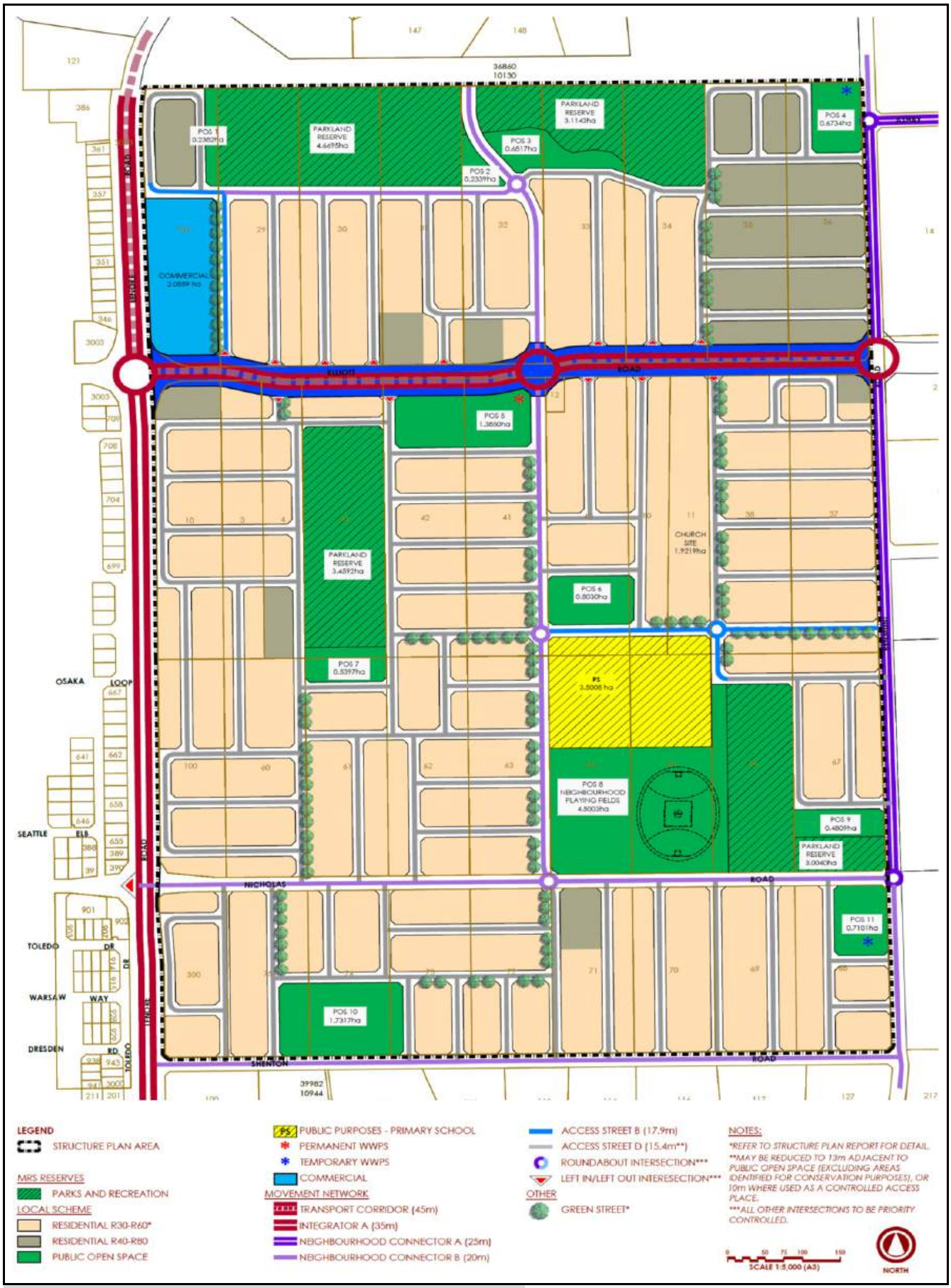
hyd2o

East Wanneroo Precinct 3 LWMS

Location Plan

Figure 1

Date: 7/4/2025 Job No. H24054



Source : Burgess Design Group 2025

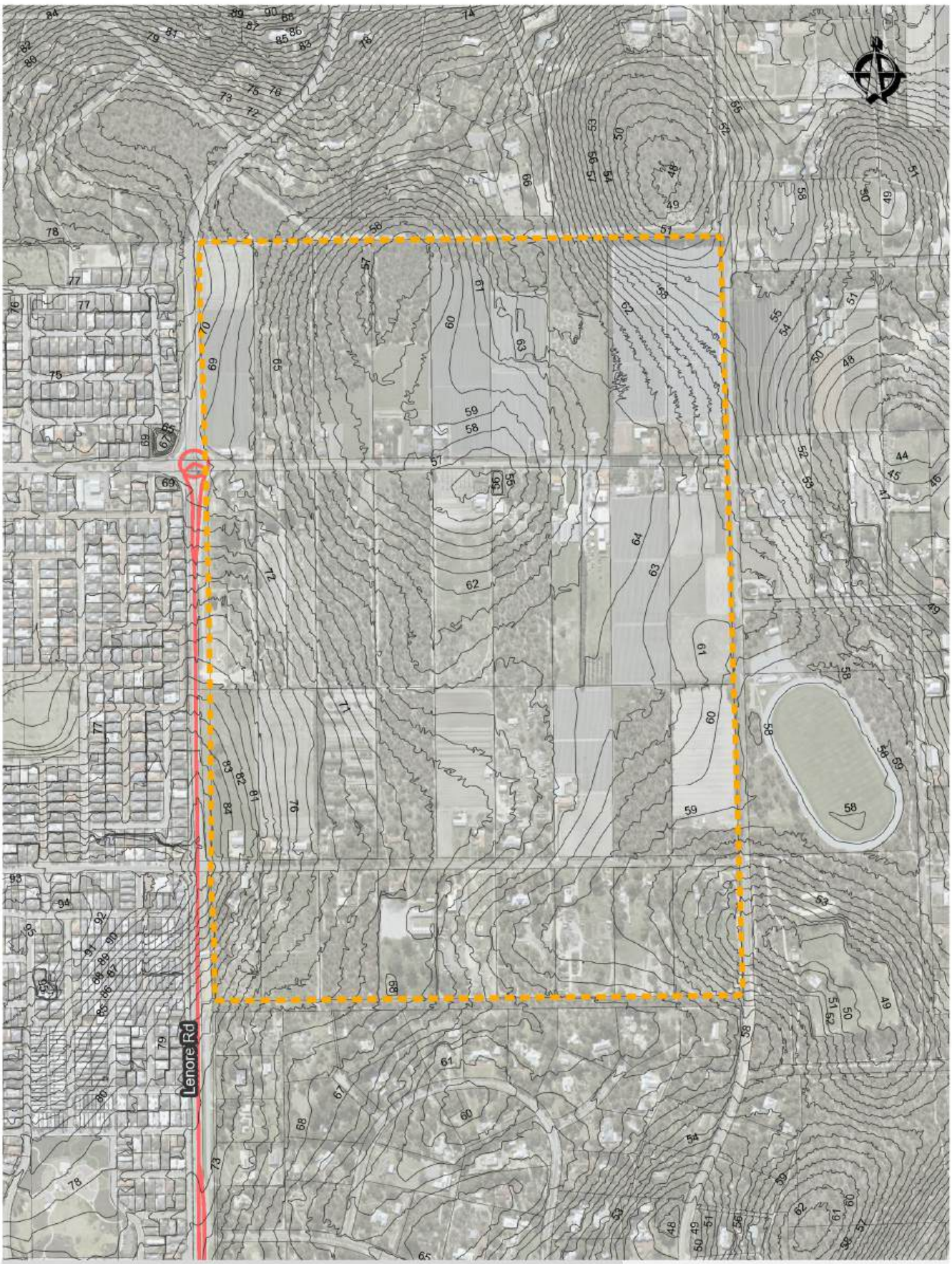
hyd2o

East Wanneroo Precinct 3 LWMS

Local Structure Plan

Figure 2

Date: 03/04/2025 Job No. H24054



Site Boundary

DWER 1 m LiDAR Contours (mAHD)

0 150 300 Meters

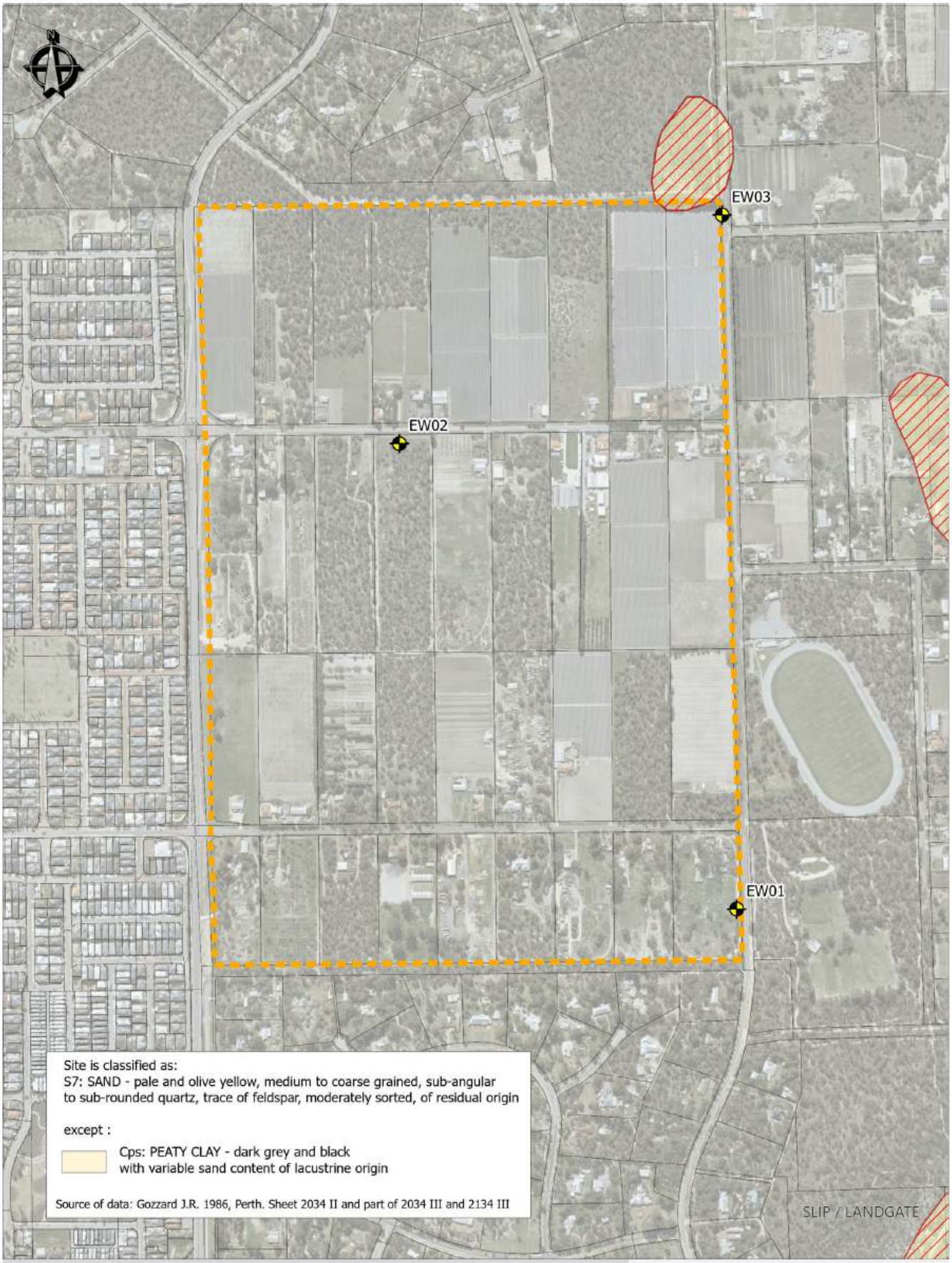
hyd2o

East Wanneroo Precinct 3 LWMS

Site Conditions

Figure 3

Date: 03/04/2025 Job No. H24054



Site is classified as:
S7: SAND - pale and olive yellow, medium to coarse grained, sub-angular to sub-rounded quartz, trace of feldspar, moderately sorted, of residual origin

except :

Cps: PEATY CLAY - dark grey and black with variable sand content of lacustrine origin

Source of data: Gozzard J.R. 1986, Perth. Sheet 2034 II and part of 2034 III and 2134 III

Site Boundary

Groundwater Monitoring Bores
Bore Logs (Hyd2o, 2022) recorded SAND fine to medium grained at all bores

High to moderate risk of ASS

Moderate to low risk of ASS

0 75 150 300 Meters

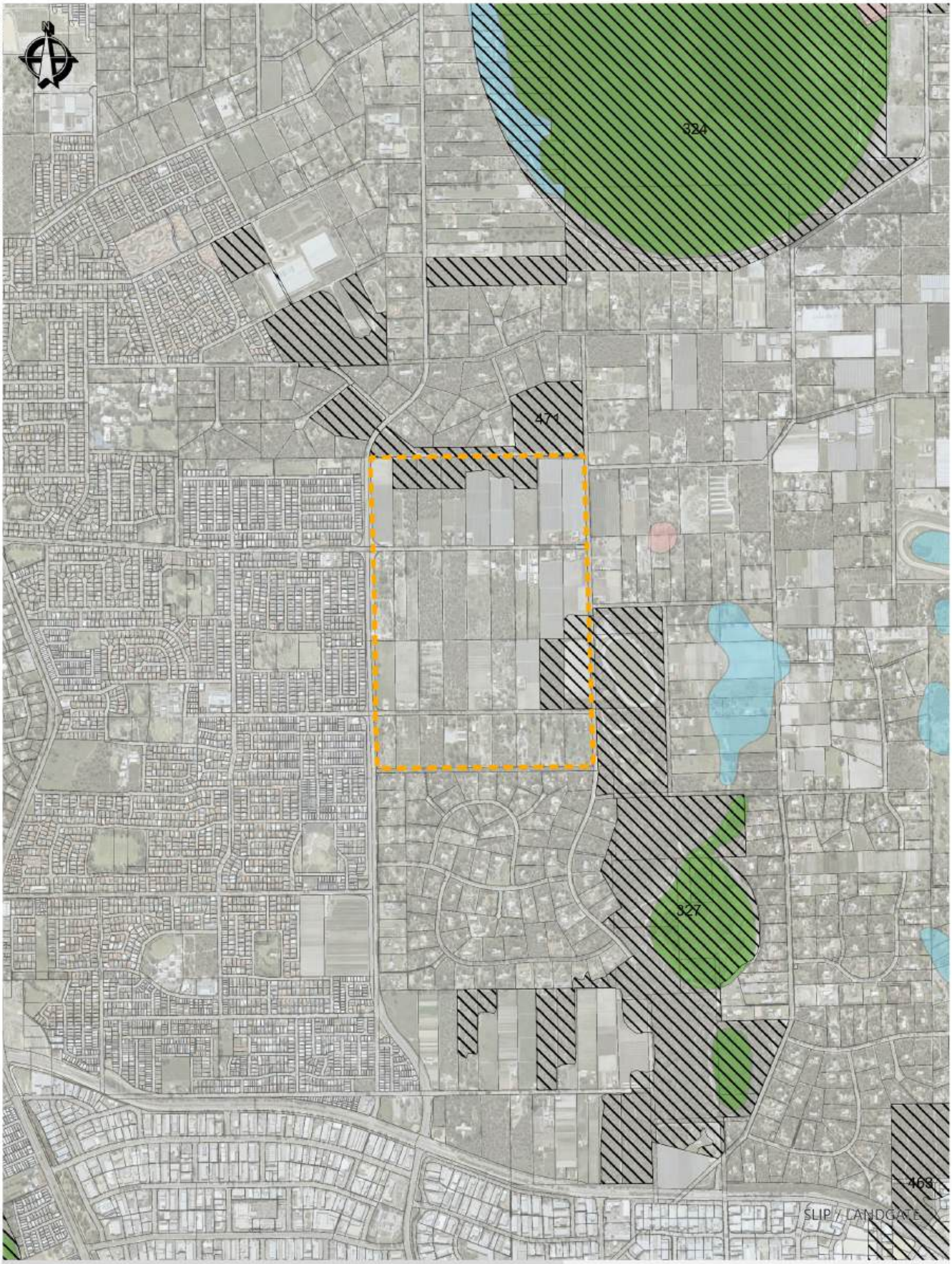
hyd2o

East Wanneroo Precinct 3 LWMS

Geotechnical Plan

Figure 4

Date: 03/04/2025 Job No. H24054



Site Boundary

Bush Forever Areas
Site No 327: Badgerup lake and Adjacent Bushland, Wanneroo
Site No 471: High Road Bushland, Wanneroo

0 400 800 Meters

Geomorphic Wetlands SCP

Conservation

Multiple Use

Resource Enhancement

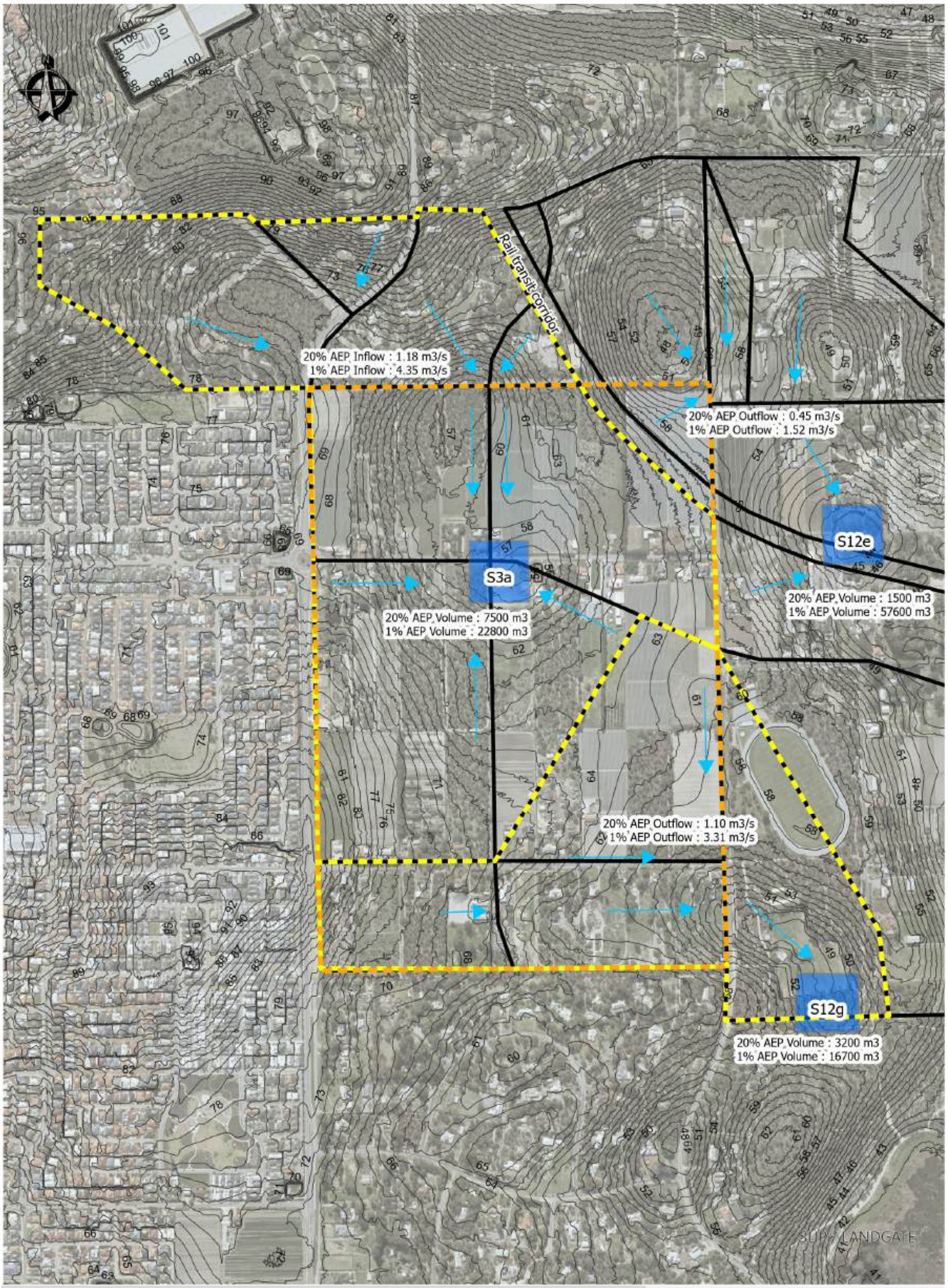
hyd2o

East Wanneroo Precinct 3

Environmental Plan

Figure 5

Date: 03/04/2025 Job No. H24054



Site Boundary

Modelled Storage (Urbaqua DWMS)

Modelled Subcatchments (Urbaqua DWMS)

Main Site Catchments

Flow Direction

DWER LiDAR Contours (mAHD)

0 200 400 Meters

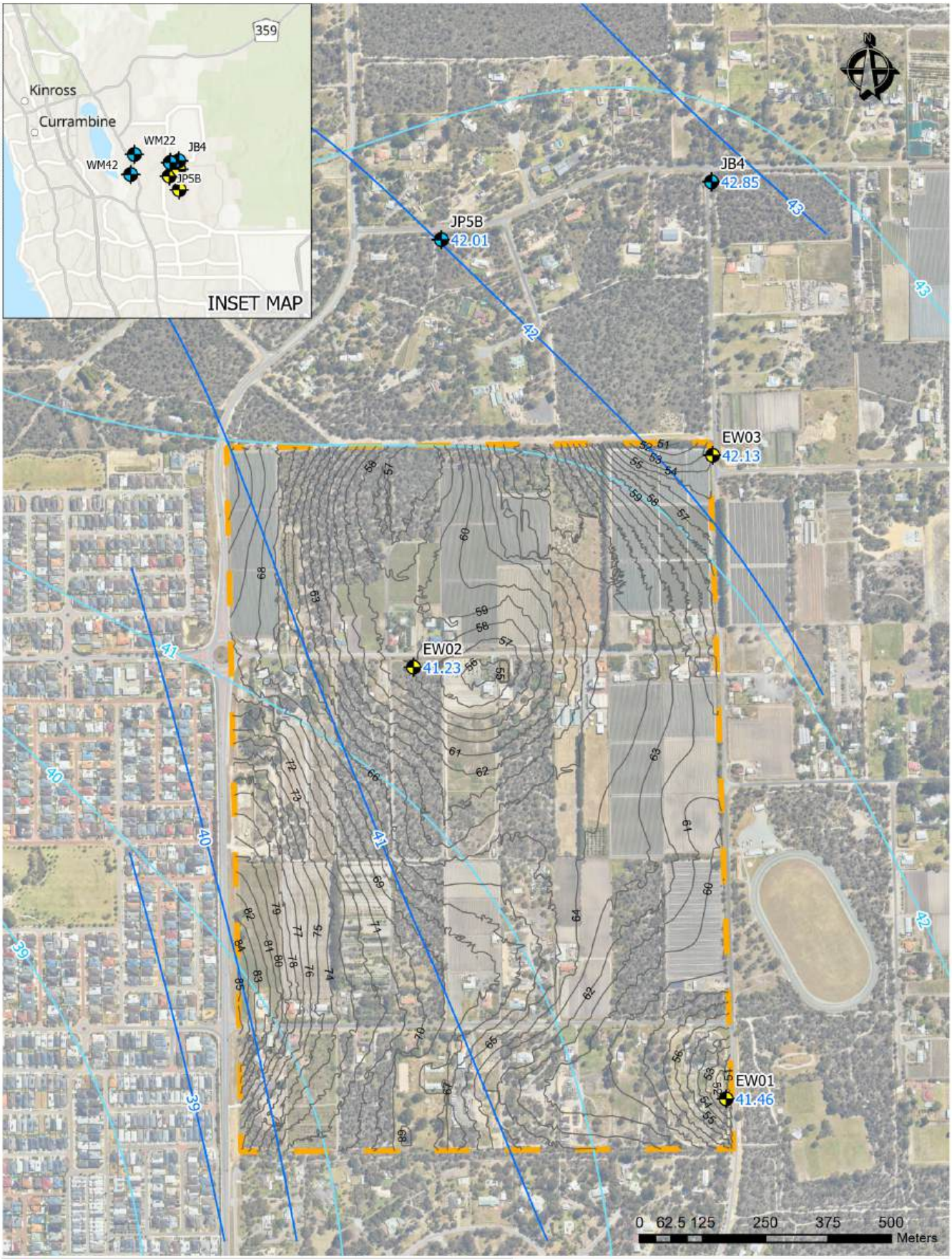
hyd2o

East Wanneroo Precinct 3 LWMS

Surface Water Plan

Figure 6

Date: 29/07/2024 Job No. H24054



Site Boundary

DWER Groundwater Contours Maximum 2019 (mAHD)

MGL for 2022 - 2023 Contours (mAHD)

DWER Monitoring Bore

Site Monitoring Bore 41.46 MGL 2022 - 2023 (mAHD)

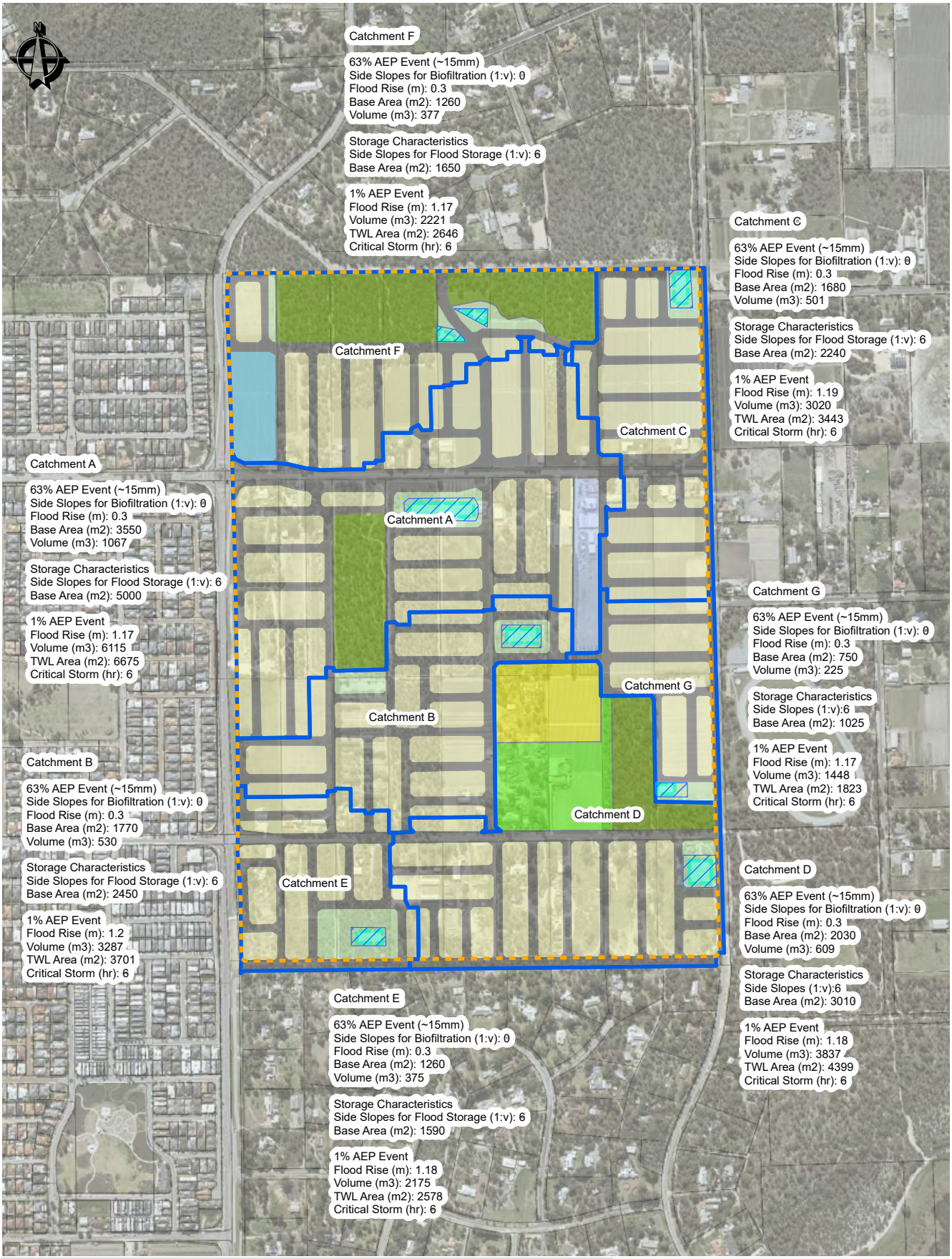
hyd2o

East Wanneroo Precinct 3 LWMS

Groundwater Plan

Figure 7

Date: 21/03/2025 Job No. H24054



Site Boundary

Catchments

15mm Biofiltration

1%AEP POS Storage

0 50 100 200 300 400 Meters

Land Use

Church

Residential Lots

Road Reserve

Local Centre

Primary School

POS

Reserve

Playing Field

hyd2o

East Wanneroo Precinct 3 LWMS

Stormwater Management Plan

Figure 8

APPENDIX A
LWMS Checklist

Better Urban Water Management LWMS Checklist

Local Water Management Strategy Item	Deliverable	✓	Comments
Executive summary			
Summary of the development design strategy, outlining how the design objectives are proposed to be met	Design elements and requirements for BMP's and critical control points	☑	Executive Summary & Section 4
Introduction			
Total water cycle management - principles and objectives Planning background Previous studies		☑	Introduction, Sections 1.1 & 1.2
Proposed development			
Structure plan, zoning and land use Key landscape features Previous land use	Site context plan Structure plan	☑	Section 1, 2, & 3. Figure 1, Figure 2, Figure 3
Landscape - proposed POS areas, POS credits, water source, bore(s), lake details (if applicable), irrigation areas	Landscape plan	☑	Stormwater Areas and Volumes to inform POS credits in Section 6 & Figure 8. Water availability identified in Section 5.2. Landscape Plan in Appendix I
Design criteria			
Agreed design objective and source of objective		☑	Section 4
Pre-development environment			
Existing information and more detailed assessments (monitoring). How do the site characteristics affect the design?		☑	Section 3 & Figures 3-7
Site conditions- existing topography/ contours, aerial photo underlay, major physical features	Site condition plan	☑	Section 3.1, Figure 3
Geotechnical - topography, soils including acid sulfate soils and infiltration capacity, test pit locations	Geotechnical plan	☑	Section 3.2 & 3.3, Figure 4
Environmental- areas of significant flora and fauna, wetlands and buffers, waterways and buffers, contaminated sites	Environmental plan plus supporting data where appropriate	☑	Sections 3.4-3.5, Figure 5
Surface water- topography, 100 year floodways and flood fringe areas, water quality of flows entering and leaving (if applicable)	Surface water plan	☑	Section 3.6, Figure 6
Groundwater - topography, pre development groundwater levels and water quality, test bore locations	Groundwater plan plus details of groundwater monitoring and testing	☑	Section 3.7, Figure 7, Appendices D,E,F,G
Water use sustainability initiatives			
Water efficiency measures- private and public open spaces including method of enforcement		☑	Section 5.1
Water supply (fit- for-purpose strategy), agreed actions and implementation. If non-potable supply, support with water balance		☑	Section 5.2, Appendix H
Wastewater management		☑	Section 5.3
Stormwater management strategy			
Flood protection - peak flow rates, volumes and top water levels at control points, 100 year flow paths and 100 year detentions storage areas	100yr event plan Long section of critical points	☑	Section 6, 6.1,6.2, Figure 8, Table 6 , Appendix K
Manage serviceability - storage and retention required for the critical 5 year ARI storm events Minor roads should be passable in the 5 year ARI event	5yr event plan	☑	Section 6, 6.1 & 6.3, Figure 8, Table 6, Appendix K
Protect ecology - detention areas for the 1 yr 1 hr ARI event, areas for water quality treatment and types of (including indicative locations for) agreed structural and non-structural best management practices and treatment trains. Protection of waterways, wetlands (and their buffers), remnant vegetation and ecological linkages	1 yr event plan Typical cross sections	☑	Section 6 , 6.1 & 6.4 Figure 8, Table 6-7

Local Water Management Strategy Item	Deliverable	✓	Comments
Groundwater management strategy			
Post development groundwater levels, fill requirements (including existing and likely final surface levels), outlet controls, and subsoil areas/exclusion zones	Groundwater/subsoil plan	☑	Section 7
Actions to address acid sulphate soils or contamination		☑	Section 7.1
The next stage - subdivision and urban water management plans			
Content and coverage of future urban water management plans to be completed at subdivision. Include areas where further investigations are required prior to detailed design		☑	Section 8
Monitoring			
Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions		☑	Section 9
Implementation			
Developer commitments		☑	Section 10
Roles, responsibilities, funding for implementation		☑	Section 10
Review		☑	Section 10

APPENDIX B

Hyd2o Groundwater Bore Lithological Logs

Lithological Log

Hyd2o
Unit 1 387 Hay St
Subiaco, WA 6008

PO Box 1055
Subiaco WA 6904

Date :	**12/08/2022**			Bore Name
Client :	**LWP Group Pty Ltd**	Job Number :	H21064	
Project:	**East Wanneroo Precinct 3**	Start Hole :	**11:40**	
Easting	**389876.074**	End Hole :	**17:00**	
Northing	**6484333.08**	Logged by :	**Georgia**	**EW01**
Datum:	MGA Zone 50, GDA 94	Total Depth :	**14.5 m**	
Drill type:	Drill Rig Hollow Auger	RL Top of Casing :	**51.937**	
Hole diameter:	75 mm	RL Nat Surface :	**51.437**	

support	backfill	water	Slot / Screen Depth	Depth (metres)	Soil Characteristics: Colour	Particle Size	Texture	Organic Content	Moisture	Comment
PVC (Class 9)					Dark Brown/Grey	Fine to Medium	Sand	Trace Organics	Dry	
				1.0m	Black/Dark Brown			None		
				2.0m	Brown					
				3.0m	Light Brown					
				4.0m						
				5.0m						
				6.0m						
				7.0m						
				8.0m						
				9.0m						
				10.0m	Light Brown/ Beige					
				11.0m	Beige				Moist	
		▽		12.0m						
				13.0m					Saturated	
				14.0m						
				15.0m						

COLOUR : Black, White, Biege
Dark/Medium/Light : Brown, Red, Orange, Yellow, Grey, Blue
Composition : Solid , Blemish, Mottle

PARTICLE SIZE : Fine, Medium, Course

TEXTURE : Sand, Loamy Sand, Clayey Sand
Silt, Loam, Sandy Loam, Clayey Loam
Clay, Sandy Clay

ORGANICS : High, Medium, Low

MOISTURE : Dry, Slightly Moist, Moist, Saturated

Static Water Level

Date	12/08/2022
Stickup above NS (m)	0.5
Water Level bTOC (m)	12.0
Water Level bNS (m)	11.5

Lithological Log

Hyd2o
Unit 1 387 Hay St
Subiaco, WA 6008

PO Box 1055
Subiaco WA 6904

Date :	**12/08/2022**				Bore Name
Client :	**LWP Group Pty Ltd**	Job Number :	H21064		
Project:	**East Wanneroo Precinct 3**	Start Hole :	**7:30**		
Easting	**389254.623**	End Hole :	**11:20**		**EW02**
Northing	**6485192.046**	Logged by :	**Georgia**		
Datum:	MGA Zone 50, GDA 94	Total Depth :	**17.5m**		
Drill type:	Drill Rig Hollow Auger	RL Top of Casing :	**58.237**		
Hole diameter:	75 mm	RL Nat Surface :	**57.737**		

support	backfill	water	Slot / Screen Depth	Depth (metres)	Soil Characteristics: Colour	Particle Size	Texture	Organic Content	Moisture	Comment
PVC (Class 9)				1.0m	Black/Dark Brown	Fine to Medium	Sand	Trace	Dry	
				2.0m	Dark Brown			None		
				3.0m	Brown					
				4.0m	Light Brown					
				5.0m	Light Brown/ Yellow					
				6.0m	Yellow					
				7.0m						
				8.0m						
				9.0m						
				10.0m						
				11.0m						
				12.0m	Pale Yellow					
				13.0m						
				14.0m						
				15.0m						
				16.0m						
		▽		17.0m					Moist	
				18.0m					Saturated	
				19.0m						
				20.0m	Beige					
				21.0m						

COLOUR :	Black, White, Biege
	Dark/Medium/Light : Brown, Red, Orange, Yellow, Grey, Blue
	Composition : Solid , Blemish, Mottle
PARTICLE SIZE :	Fine, Medium, Course
TEXTURE :	Sand, Loamy Sand, Clayey Sand
	Silt, Loam, Sandy Loam, Clayey Loam
	Clay, Sandy Clay
ORGANICS :	High, Medium, Low
MOISTURE :	Dry, Slightly Moist, Moist, Saturated

Static Water Level

Date	12/08/2022
Stickup above NS (m)	0.5
Water Level bTOC (m)	17.5
Water Level bNS (m)	17

Lithological Log

Hyd2o
Unit 1 387 Hay St
Subiaco, WA 6008

PO Box 1055
Subiaco WA 6904

Date :	**7/09/2022**			Bore Name
Client :	**LWP Group Pty Ltd**	Job Number :	H21064	
Project:	**East Wanneroo Precinct 3**	Start Hole :	**8:30**	**EW03**
Easting	**389849.307**	End Hole :	**11:00**	
Northing	**6485613.339**	Logged by :	**Georgia**	
Datum:	MGA Zone 50, GDA 94	Total Depth :	**16m**	
Drill type:	Drill Rig Hollow Auger	RL Top of Casing :	**54.435**	
Hole diameter:	75 mm	RL Nat Surface :	**53.935**	

support	backfill	water	Slot / Screen Depth	Depth (metres)	Soil Characteristics: Colour	Particle Size	Texture	Organic Content	Moisture	Comment
PVC (Class 9)					Dark Brown/Grey	Fine to Medium	Sand	Trace Organics	Dry	
				1.0m	Light Brown/ Brown Orange			None		
				2.0m						
				3.0m	Light Brown/ Orange					
				4.0m	Yellow					
				5.0m						
				6.0m						
				7.0m						
				8.0m						
				9.0m						
				10.0m	Orange					
					Pale Orange					
				11.0m	Pale Orange/ Beige					
					Pale Yellow/ Beige					
				12.0m						
		▽		13.0m	Beige				Moist	
				14.0m					Saturated	
				15.0m						
				16.0m	White					

COLOUR : Black, White, Biege
Dark/Medium/Light : Brown, Red, Orange, Yellow, Grey, Blue
Composition : Solid , Blemish, Mottle

PARTICLE SIZE : Fine, Medium, Course

TEXTURE : Sand, Loamy Sand, Clayey Sand
Silt, Loam, Sandy Loam, Clayey Loam
Clay, Sandy Clay

ORGANICS : High, Medium, Low

MOISTURE : Dry, Slightly Moist, Moist, Saturated

Static Water Level

Date	7/09/2022
Stickup above NS (m)	0.5
Water Level bTOC (m)	13.5
Water Level bNS (m)	13

APPENDIX C

Urbaqua (2021)

East Wanneroo DWMS Extracts

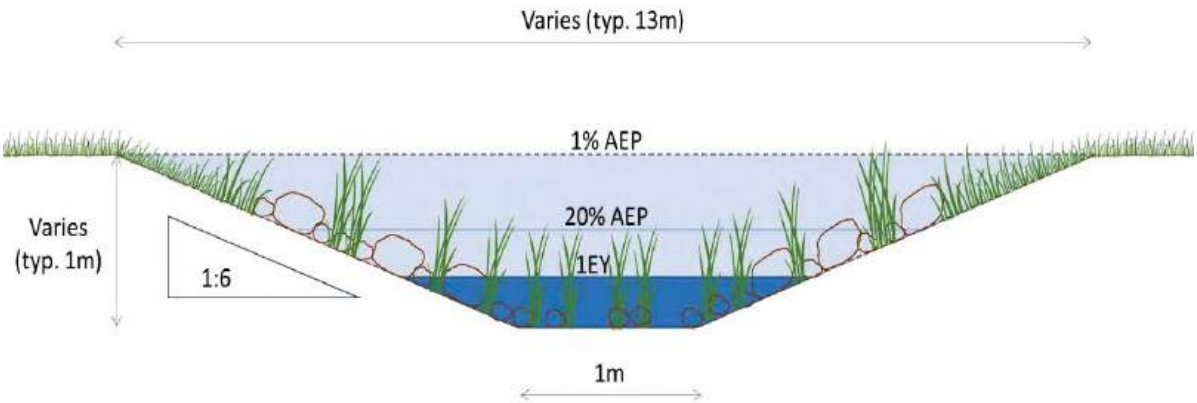


Figure 28: Modelled arterial drainage swale

Preliminary stormwater modelling indicates flows across precinct boundaries will be required in some locations, whilst others may be able to manage all minor (20%AEP) and major (1%AEP) events with their boundaries. Indicative peak flow rates across precinct boundaries are presented in Table 26. However, it will be necessary to undertake more detailed modelling to determine cross-boundary flows to be accommodated within precincts for reporting at the local structure planning (LWMS) stage. Controlled groundwater levels at each crossing locations are also provided in Table 26 and it is recommended that the invert levels of stormwater drainage systems are set at least 0.3m above the local controlled groundwater level.

Table 26: Indicative peak flows crossing precinct boundaries

Location (refer to Figures 32 to 51 in App. C)	Controlled groundwater level (mAHD)	20% AEP Peak flow (m^3/s)	1% AEP Peak flow (m^3/s)
1a	39.63	0.15	0.45
2a	40.54	0.32	1.02
3a	41.27	1.10	3.31
3b	42.58	0.45	1.52
4a	41.38	0.41	1.54
4a	41.38	0.19	0.42
5a	42.31	1.57	5.82
6a	41.66	2.40	8.92
6b	43.03	2.20	8.60
10a	46.50	0.36	1.26
12a	42.86	0.39	1.20
12b	45.22	0.54	1.35
13a	41.86	1.18	4.35
13b	42.66	0.32	1.18
13b	42.66	0.14	0.37
13c	43.07	0.86	3.04
13d	45.40	0.28	0.70
13e	45.22	0.19	0.47
15a	44.51	0.25	0.66

Location (refer to Figures 32 to 51 in App. C)	Controlled groundwater level (mAHD)	20% AEP Peak flow (m^3/s)	1% AEP Peak flow (m^3/s)
15b	44.73	0.63	1.67
15c	44.63	0.18	0.43
15d	42.40	0.37	1.27
17a	41.33	0.79	2.67
23a	44.20	0.53	2.04
23b	41.74	0.64	2.60
23c	42.75	0.68	2.63
23c	42.75	0.17	0.52
23d	44.11	0.49	2.06
24a	49.29	0.25	1.01

Storage requirements

Preliminary stormwater modelling indicates that new infiltration or detention storages will be required in some precincts, whilst others may be able to manage all minor (20%AEP) and major (1%AEP) events with the capacity available in existing wetlands. Indicative volumes are provided for new storages in Table 27. However, it will be necessary to undertake more detailed modelling to determine storage volumes and locations to be accommodated within precincts for reporting at the local structure planning (LWMS) stage. Controlled groundwater levels are provided in Table 27 at the location of each storage and it is recommended that the inverts of stormwater storages are set at least 0.3m above the local controlled groundwater level.

Detailed surface water modelling will be required to support future local structure plans and presented in local water management strategies. This modelling will need to include consideration of the risks associated with surface and groundwater interaction both now and in the future. The establishment of appropriate antecedent conditions in drainage infiltration basins and wetlands functioning as part of the surface water management system will need to consider changing groundwater levels and the performance of subsurface drainage systems under flood conditions.

Table 27: Indicative constructed storage volumes

Location (refer to Figures 32 to 51 in App. C)	Controlled groundwater level (mAHD)	20% AEP Volume (m^3)	1% AEP Volume (m^3)
S1a	39.51	4,400	13,300
S1b	38.38	4,600	5,400
S2a	38.32	4,600	4,600
S3a	41.34	7,500	22,800
S4a	39.66	4,600	5,600
S4b	39.24	4,600	5,500
S6a	39.46	300	4,100
S10a	42.88	1,300	46,800
S10b	43.38	3,200	13,600

Location (refer to Figures 32 to 51 in App. C)	Controlled groundwater level (mAHD)	20% AEP Volume (m^3)	1% AEP Volume (m^3)
S11a	42.60	6,700	43,800
S12a	44.53	11,900	61,300
S12b	44.45	100	10,500
S12c	44.12	12,900	54,100
S12d	43.16	6,400	34,200
S12e	42.86	1,500	57,600
S12f	42.80	8,600	41,600
S12g	41.44	3,200	16,700
S13a	45.14	4,500	15,900
S14b	44.98	200	11,900
S15a	46.00	3,800	23,000
S16a	42.42	7,700	39,800
S16b	39.62	10,300	48,000
S16c	38.43	10,600	49,400
S20a	43.20	600	14,200
S20b	44.36	3,200	13,200
S23a	47.49	2,300	92,100
S23b	48.72	3,400	10,700
S23c	49.61	2,000	8,700
S23d	49.44	1,800	6,900
S23e	48.56	3,900	12,400
S24a	44.03	2,600	11,400
S24c	47.58	4,400	15,800
S25a	41.93	800	145,700

Where existing wetlands are proposed for integration with the arterial drainage system and/or will receive floodwaters during minor or major flood events it is important that the design of the system and its outlets is consistent with protection of wetland values. Guidance for the design of drainage system discharges at their interface with wetlands is provided in section 5.1.3.

Summary of precinct drainage system requirements

Table 28 provides a summary of stormwater and groundwater drainage system requirements for each precinct.

Table 28: Summary precinct drainage requirements

Precinct	Land Use Context	Wetlands	Stormwater management (Small rainfall events)	Stormwater management (Minor and Major rainfall events)	Groundwater management
P1	Residential area with access to regional reserves and wetland system	Little Badgerup Lake (CCW) is located in the eastern portion of the precinct.	Small rainfall events are to be managed at source (in lots and streets) wherever possible. All small event stormwater management systems are to be accommodated outside of retained wetlands and their buffers.	Contains four catchments. Part of this precinct drains into Little Badgerup Lake located in the east of the precinct, part drains to the north into Precinct 2 via two discharge locations and part drains offsite to the west and may require detention capacity of up to 5ML prior to discharge into the existing adjacent drainage system. The remainder, and largest part of this precinct drains into an infiltration basin located in the south of the precinct with a capacity of up to 15ML.	Approximately 17 hectares of the precinct may require groundwater management in future generating a potential flow rate of around 9L/s. A 24hour shutdown storage volume of 760m3 will need to be accommodated at three potential pump station locations.
P2	Low Density Residential area with access to regional reserves and wetland system	Badgerup Lake (CCW) is located in the eastern portion of the precinct.	Small rainfall events are to be managed at source (in lots and streets) wherever possible. All small event stormwater management systems are to be accommodated outside of retained wetlands and their buffers.	Contains two catchments. Runoff from Precinct 1 enters this precinct at 2 locations on the southern boundary. precincts. The majority of this precinct discharges into Badgerup Lake located partially within the precinct in the east. A very small portion of the precinct drains into a detention basin that may need to have capacity of up to 5ML located in the south west of the precinct prior to discharge offsite.	Approximately 27 hectares of the precinct may require groundwater management in future generating a potential flow rate of around 10L/s. A 24hour shutdown storage volume of 830m3 will need to be accommodated at one potential pump station location.
P3	Residential area. Access is available to regional reserves, however wetland system is some distance to the precinct boundary.	N/A	Small rainfall events are to be managed at source (in lots and streets) wherever possible. All small event stormwater management systems are to be accommodated outside of retained wetlands and their buffers.	Contains two catchments. Runoff from parts of Precinct 4 and Precinct 13 enters this precinct from the north and a portion of this Precinct drains into Precinct 12 to the east. The majority of this precinct drains to a centrally located infiltration basin with capacity of up to 26ML.	Groundwater management is not expected to be required in this precinct
P4	Residential area	N/A	Small rainfall events are to be managed at source (in lots and streets) wherever possible. All small event stormwater management systems are to be accommodated outside of retained wetlands and their buffers.	Contains three catchments. Runoff from part of this precinct drains into Precinct 3 via Precinct 13 precincts. A portion of the precinct in the west drains offsite and will require one or two detention basins of up to 5ML capacity each to protect the downstream system.	Approximately 8 hectares of the precinct may require groundwater management in future generating a potential flow rate of around 6L/s. A 24hour shutdown storage volume of 500m3 will need to be accommodated at one potential pump station location.
P5	Residential area bisected by road and rail corridor. Eastern section has access to regional reserves and wetland systems. Includes area of public purpose reserve (water supply tanks).	Lake Jandabup (CCW) is partially located in this precinct to the east.	Small rainfall events are to be managed at source (in lots and streets) wherever possible. All small event stormwater management systems are to be accommodated outside of retained wetlands and their buffers.	Contains three catchments. Runoff from the western side of this precinct drains into Precinct 6 to the north. The majority of runoff generated within this precinct drains into Lake Jandabup which is partially within the precinct in the east. The precinct is bisected by the proposed rail transit corridor and may require additional detention on the western side of the corridor prior to discharge.	Groundwater management is not expected to be required in this precinct
P6	Residential area including large park and recreation area in the centre. Access to Lake Mariginiup is available through reserve 46711.	Lake Jandabup (CCW) is partially located in this precinct to the east.	Small rainfall events are to be managed at source (in lots and streets) wherever possible. All small event stormwater management systems are to be accommodated outside of retained wetlands and their buffers.	Contains four catchments. The majority of the precinct drains to the north into Precinct 7 within a regional open space corridor prior to discharging into Mariginiup Lake located in Precinct 7. Most of the remaining precinct area drains to the east into Lake Jandabup located partially within the precinct. A very small portion of the precinct drains into a detention basin of up to 5ML capacity located in the south west of the precinct prior to discharge offsite.	Approximately 3 hectares of the precinct may require groundwater management in future generating a potential flow rate of less than 1L/s. A 24hour shutdown storage volume of 30m3 will need to be accommodated at one potential pump station location.
P7	Residential area bisected by road and rail corridor. Access to regional reserves and wetland systems is available both sides of the corridor.	Mariginiup Lake (CCW) is located in this precinct and a small portion of Lake Jandabup is also within the eastern portion of the precinct	Small rainfall events are to be managed at source (in lots and streets) wherever possible. All small event stormwater management systems are to be accommodated outside of retained wetlands and their buffers.	Contains two catchments. Runoff from Precinct 6 enters this precinct from the south and a small portion of Precinct 15 from the north east. The majority of the precinct drains into Mariginiup Lake which is located partially within the precinct. A small portion of the precinct area to the east of the proposed rail transit corridor drains into Lake Jandabup located partially within the precinct.	Groundwater management is not expected to be required in this precinct
P8	Residential area with access to regional reserves and wetland system	The northern portion of Mariginiup Lake (CCW) and the whole of Little Mariginiup	Small rainfall events are to be managed at source (in lots and streets) wherever possible. All small event stormwater management	Contains two catchments. Runoff from portions of Precinct 15 enters this precinct from the east at two locations. The majority of the precinct drains into Mariginiup Lake which is	Approximately 50 hectares of the precinct may require groundwater management in future generating a potential flow rate of around

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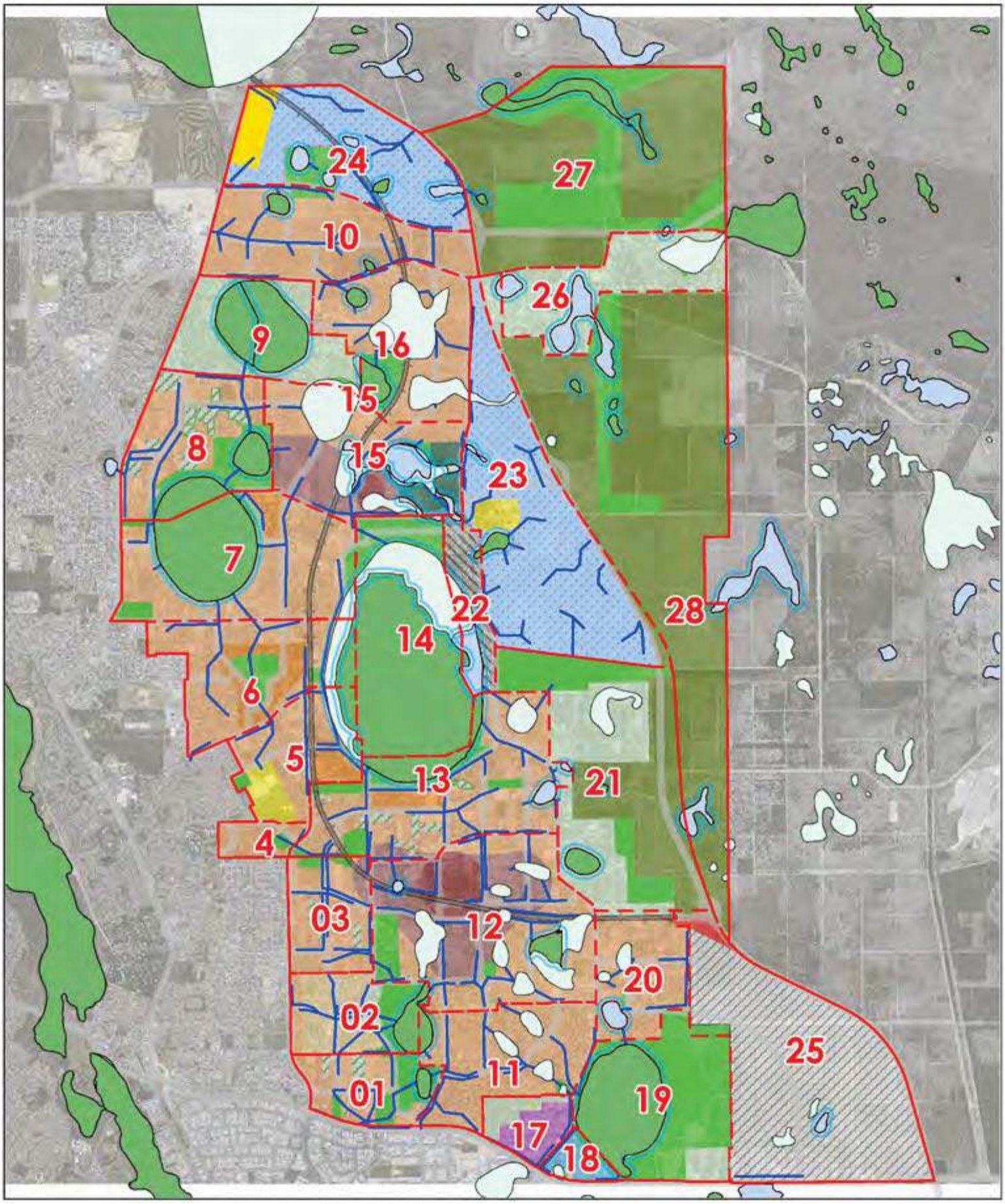
Figure 33: Layout plan for Figures 34 - 51 Precinct drainage assessment



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Data sourceLandgate. DPLH Created by: HBrookes Projection: MGA: zone 50.

@ A4

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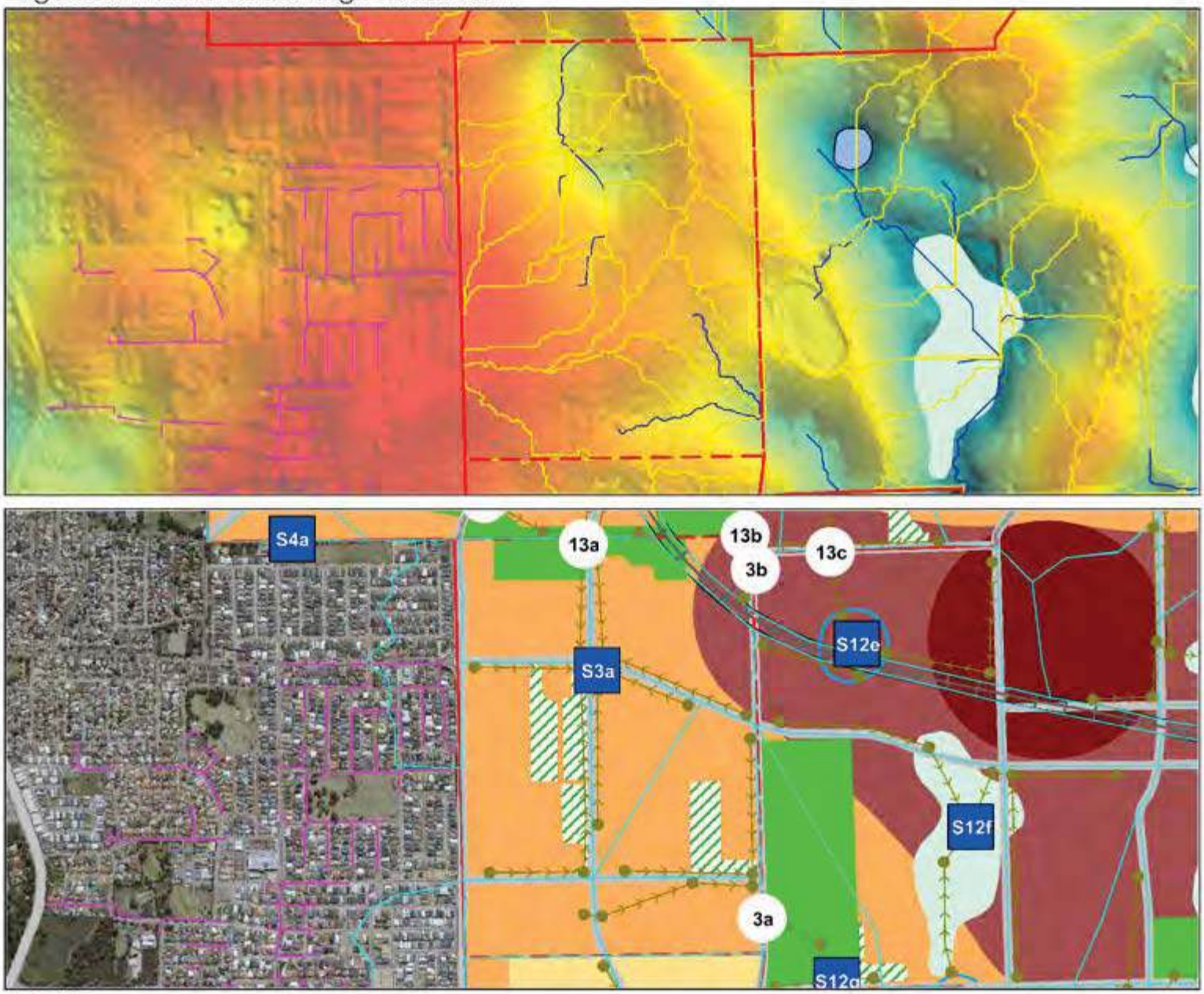
Figure 36 Precinct 3 drainage assessment



LEGEND:

Structure Plan Boundary

Geomorphic Wetlands

- Conservation
- Resource Enhancement
- Multiple Use

Indicative 50m wetland buffers

Potential contaminated sites

Indicative flowpaths

Topographic subcatchments

Modelled subcatchments

Modelled drainage

Modelled node

EWDSP Land uses

- Centre
- Urban neighbourhood
- Character areas
- Suburban neighbourhood
- Special residential area
- Industrial
- Public purpose
- Regional open space
- Employment area

Precinct boundaries

Rail transit corridor

Road alignments

- High priority vegetation area
- Regional sporting fields
- Rural
- Service commercial
- State forest
- Tourism oppertunities
- Intersection area
- Subject to further planning

S1a Modelled storages

1a Precinct boundary crossings

Elevation

85 mAHD

1 mAHD

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Data sourceLandcate. DPLH Created by: HBrookes Projection: MGA: zone 50.

N

0 500

metres

Scale 1:20,000 @ A4

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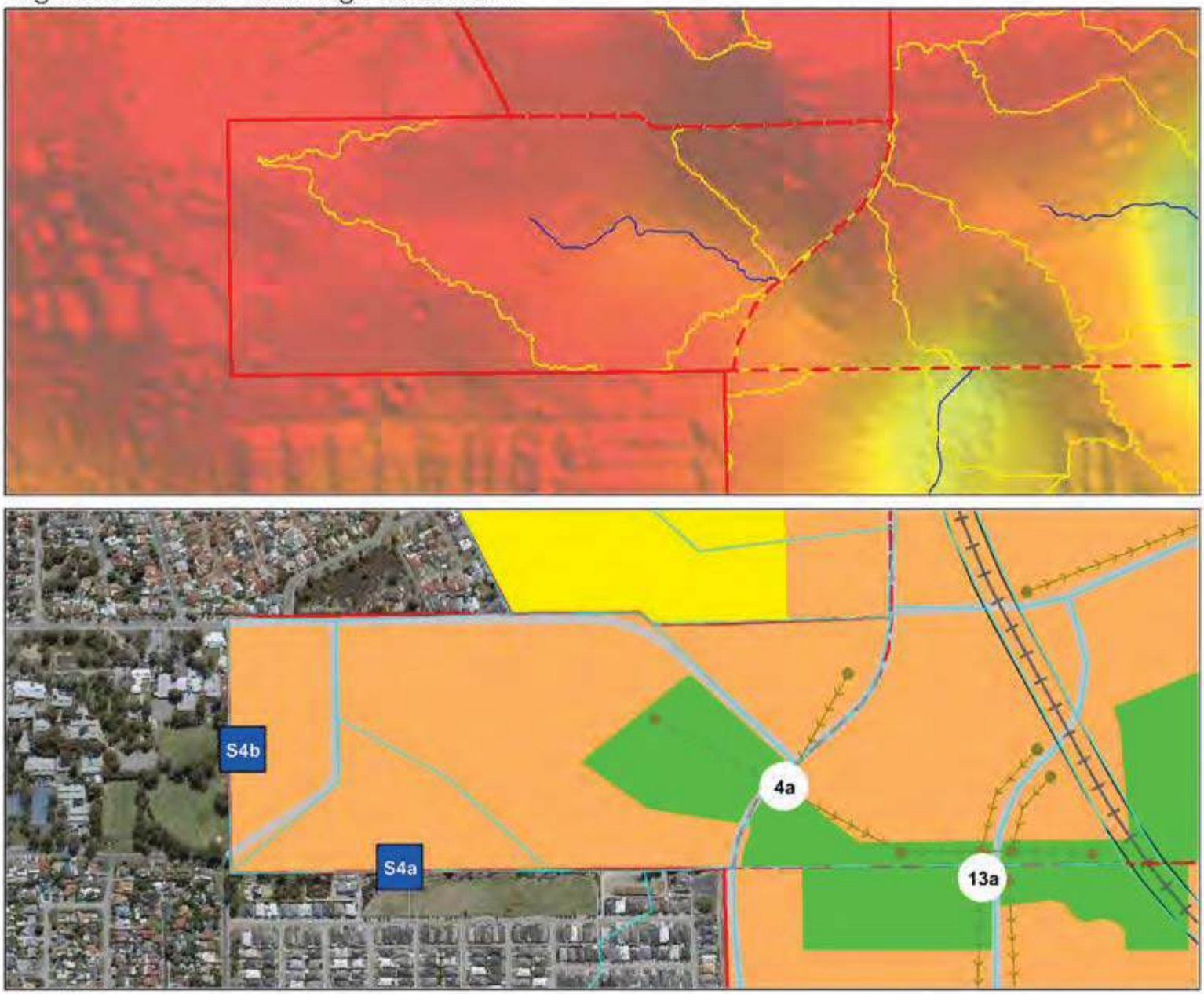
Figure 37 Precinct 4 drainage assessment



LEGEND:

Structure Plan Boundary

Geomorphic Wetlands

- Conservation
- Resource Enhancement
- Multiple Use

Indicative 50m wetland buffers

Potential contaminated sites

Indicative flowpaths

Topographic subcatchments

Modelled subcatchments

Modelled drainage

Modelled node

EWDSP Land uses

- Centre
- Urban neighbourhood
- Character areas
- Suburban neighbourhood
- Special residential area
- Industrial
- Public purpose
- Regional open space
- Employment area

Precinct boundaries

Rail transit corridor

Road alignments

- High priority vegetation area
- Regional sporting fields
- Rural
- Service commercial
- State forest
- Tourism oppertunities
- Intersection area
- Subject to further planning

S1a Modelled storages

1a Precinct boundary crossings

Elevation

85 mAHD

1 mAHD

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Data sourceLandcate, DPLH Created by: HBrookes Projection: MGA: zone 50.

N

0 250

metres

Scale 1:10,000 @ A4

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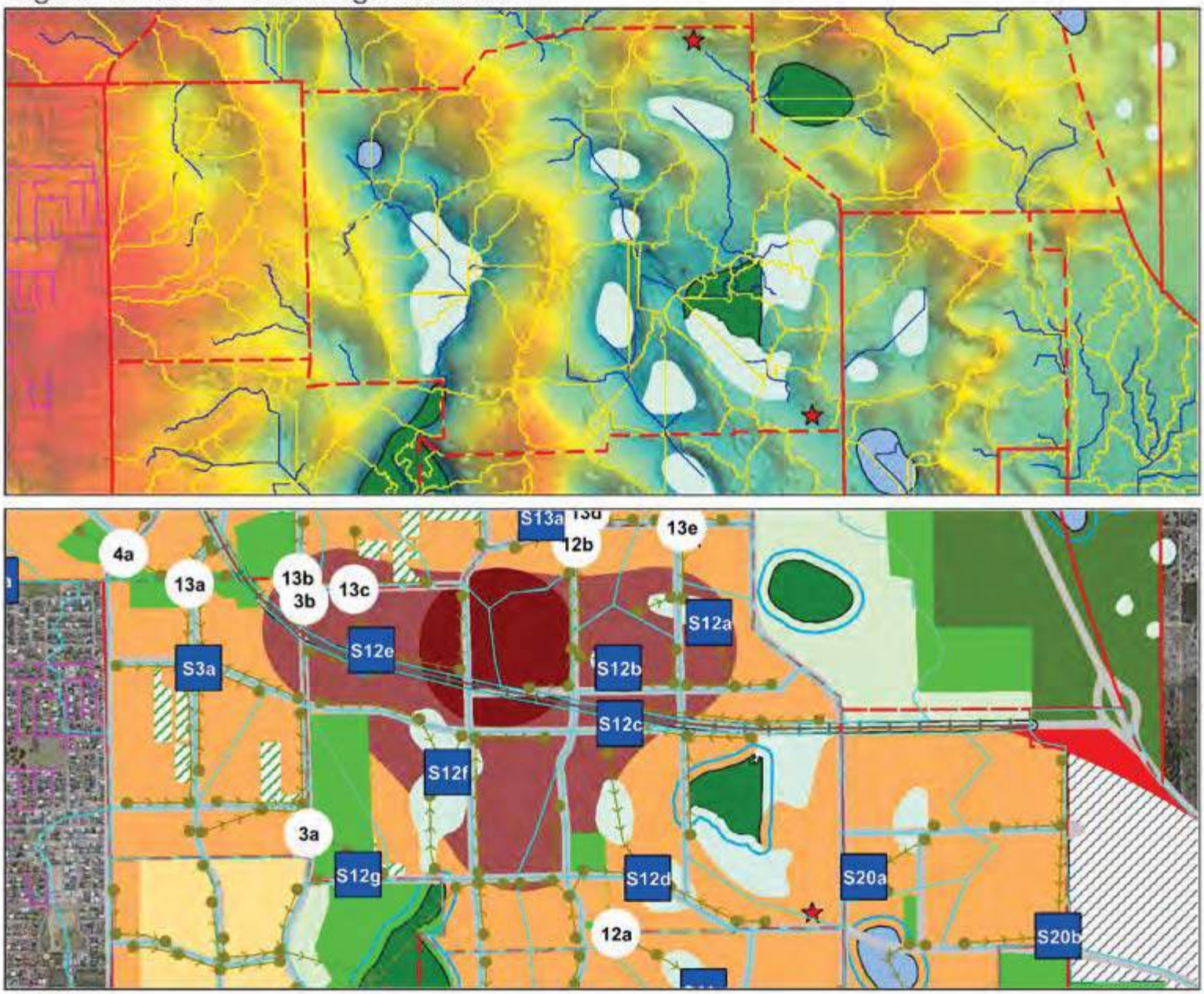
Department of Planning, Lands and Heritage - East Wanneroo District Structure Plan: District Water Management Strategy

Figure 44 Precinct 12 drainage assessment



LEGEND:

- Structure Plan Boundary

Geomorphic Wetlands

- Conservation
- Resource Enhancement
- Multiple Use
- Indicative 50m wetland buffers
- Potential contaminated sites
- Indicative flowpaths
- Topographic subcatchments
- Modelled subcatchments
- Modelled drainage
- Modelled node

EWDSP Land uses

- Centre
- Urban neighbourhood
- Character areas
- Suburban neighbourhood
- Special residential area
- Industrial
- Public purpose
- Regional open space
- Employment area
- Precinct boundaries
- Rail transit corridor
- Road alignments
- High priority vegetation area
- Regional sporting fields
- Rural
- Service commercial
- State forest
- Tourism oppertunities
- Intersection area
- Subject to further planning
- S1a Modelled storages
- 1a Precinct boundary crossings

Elevation

85 mAHD

1 mAHD

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Data sourceLandcate. DPLH Created by: HBrookes Projection: MGA: zone 50.

0 750

metres

Scale 1:30,000 @ A4

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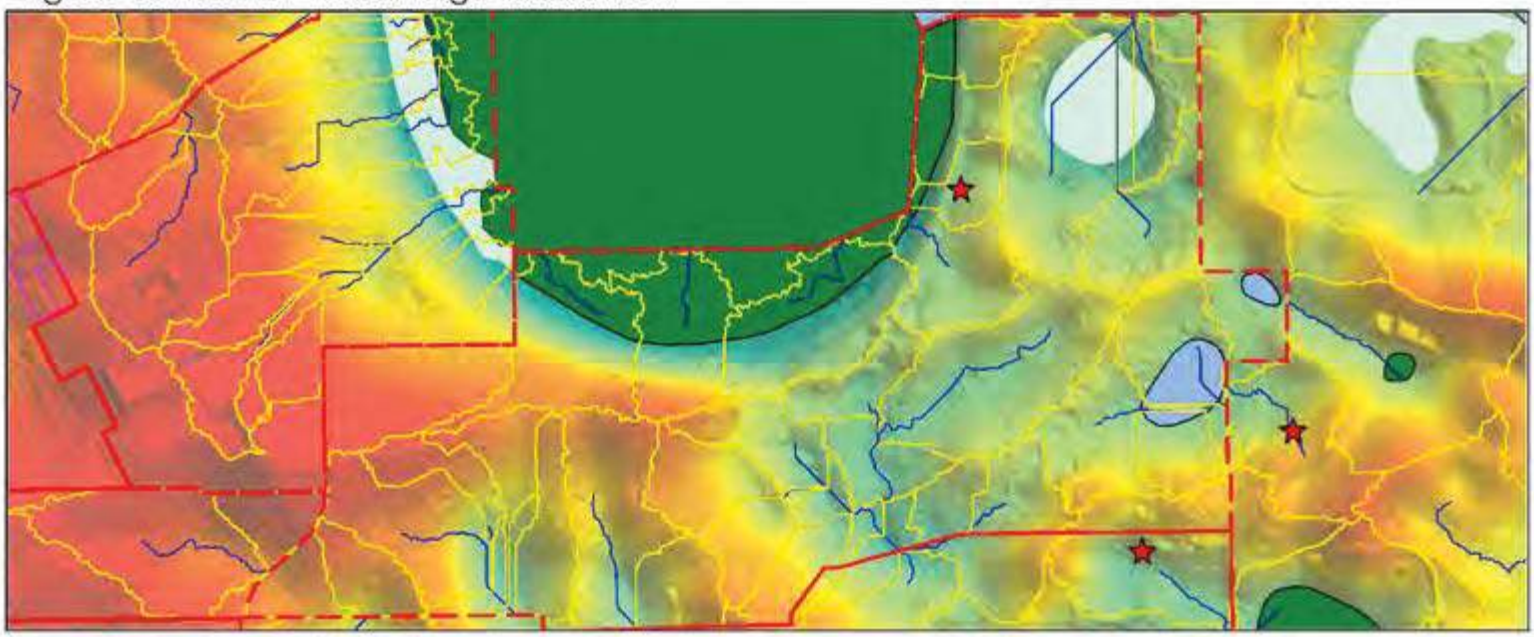
land and water solutions

Department of Planning, Lands and Heritage - East Wanneroo District Structure Plan: District Water Management Strategy

Figure 45 Precinct 13 drainage assessment



LEGEND:

Structure Plan Boundary

Geomorphic Wetlands

- Conservation
- Resource Enhancement
- Multiple Use

Indicative 50m wetland buffers

Potential contaminated sites

Indicative flowpaths

Topographic subcatchments

Modelled subcatchments

Modelled drainage

Modelled node

EWDSP Land uses

- Centre
- Urban neighbourhood
- Character areas
- Suburban neighbourhood
- Special residential area
- Industrial
- Public purpose
- Regional open space
- Employment area

Precinct boundaries

Rail transit corridor

Road alignments

- High priority vegetation area
- Regional sporting fields
- Rural
- Service commercial
- State forest
- Tourism oppertunities
- Intersection area
- Subject to further planning

S1a Modelled storages

1a Precinct boundary crossings

Elevation

85 mAHD

1 mAHD

* ©2020. While Urbaqua has taken care to ensure the accuracy of this product, Urbaqua and client make no representations or warranties about its accuracy, completeness or suitability for any particular purpose. Urbaqua and client cannot accept liability of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred as a result of the product being inaccurate, incomplete or unsuitable in any way and for any reason.

Data sourceLandcate. DPLH Created by: HBrookes Projection: MGA: zone 50.

N

0 624.4 metres

Scale 1:24,980@ A4

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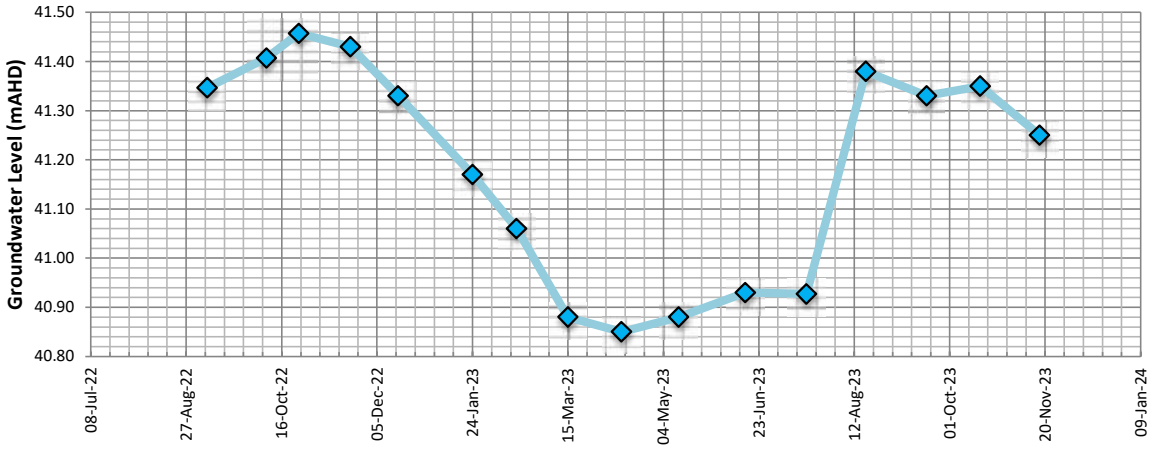
APPENDIX D
Groudwater Level Data

H21064 East Wanneroo Monitoring

EW01 Bore 1 - Nicholas Rd

				Natural Surface (mAHD)	51.44
Data Analysis Period Start Date	7/09/2022	Easting	389876.074	Top of Casing (m AHD)	51.94
Data Analysis Period End Date	17/11/2023	Northing	6484333.08	End of Hole (mAHD)	

Report Date : 7/04/2025



Date	Groundwater bTOC	Groundwater mAHD	Depth Below NS m
7/09/2022	10.59	41.35	10.09
8/10/2022	10.53	41.41	10.03
25/10/2022	10.48	41.46	9.98
21/11/2022	10.51	41.43	10.01
16/12/2022	10.61	41.33	10.11
24/01/2023	10.77	41.17	10.27
16/02/2023	10.88	41.06	10.38
15/03/2023	11.06	40.88	10.56
12/04/2023	11.09	40.85	10.59
12/05/2023	11.06	40.88	10.56
16/06/2023	11.01	40.93	10.51
18/07/2023	11.01	40.93	10.51
18/08/2023	10.56	41.38	10.06
19/09/2023	10.61	41.33	10.11
17/10/2023	10.59	41.35	10.09
17/11/2023	10.69	41.25	10.19

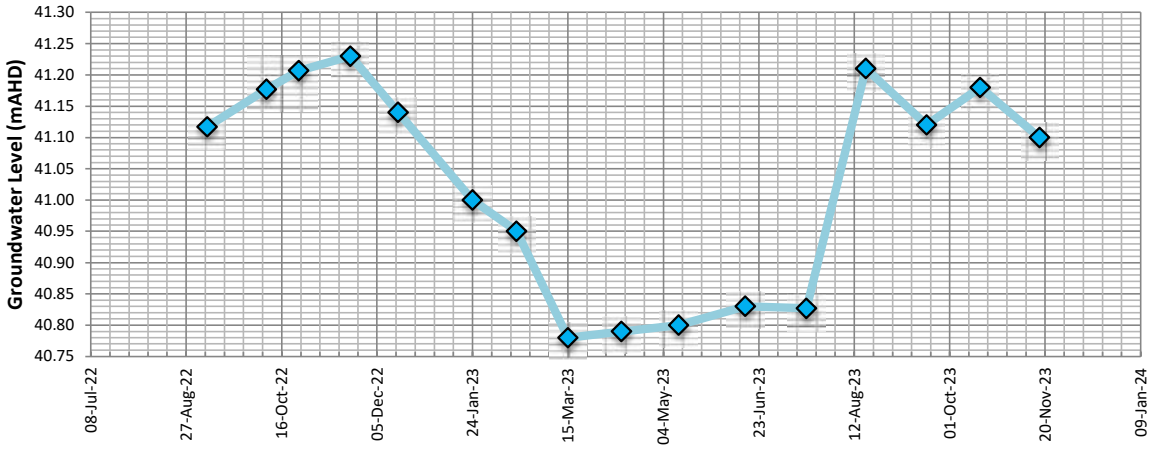
Minimum Recorded Level (mAHD)	40.85
Maximum Recorded Level (mAHD)	41.457

H21064 East Wanneroo Monitoring

EW02 Bore 2 - Lot 206

				Natural Surface (mAHD)	57.74
Data Analysis Period Start Date	7/09/2022	Easting	389254.623	Top of Casing (m AHD)	58.24
Data Analysis Period End Date	17/11/2023	Northing	6485192.046	End of Hole (mAHD)	

Report Date : 7/04/2025



Date	Groundwater bTOC	Groundwater mAHD	Depth Below NS m
7/09/2022	17.12	41.12	16.62
8/10/2022	17.06	41.18	16.56
25/10/2022	17.03	41.21	16.53
21/11/2022	17.01	41.23	16.51
16/12/2022	17.10	41.14	16.60
24/01/2023	17.24	41.00	16.74
16/02/2023	17.29	40.95	16.79
15/03/2023	17.46	40.78	16.96
12/04/2023	17.45	40.79	16.95
12/05/2023	17.44	40.80	16.94
16/06/2023	17.41	40.83	16.91
18/07/2023	17.41	40.83	16.91
18/08/2023	17.03	41.21	16.53
19/09/2023	17.12	41.12	16.62
17/10/2023	17.06	41.18	16.56
17/11/2023	17.14	41.10	16.64

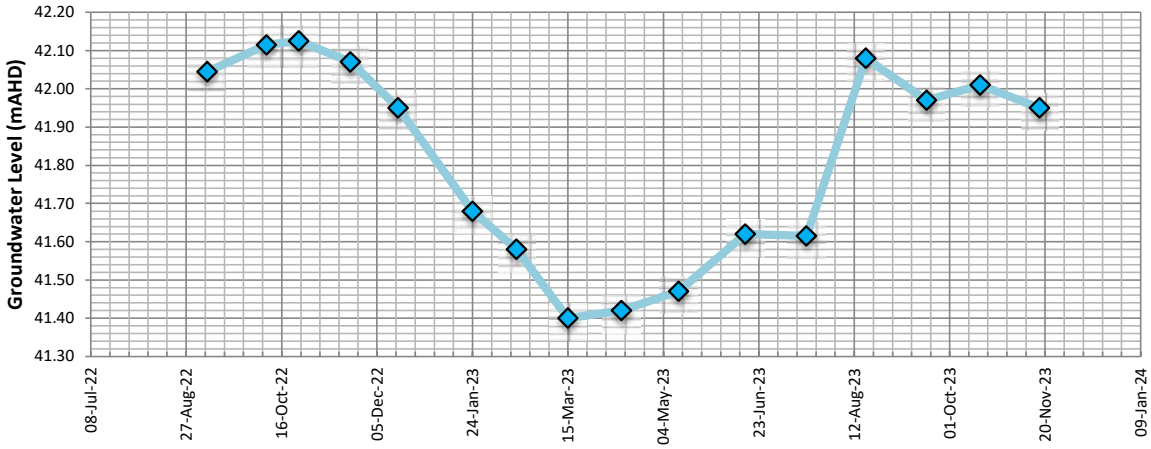
Minimum Recorded Level (mAHD)	40.78
Maximum Recorded Level (mAHD)	41.23

H21064 East Wanneroo Monitoring

EW03 Bore 3 - Carbone

				Natural Surface (mAHD)	53.94
Data Analysis Period Start Date	7/09/2022	Easting	389849.307	Top of Casing (m AHD)	54.44
Data Analysis Period End Date	17/11/2023	Northing	6485613.339	End of Hole (mAHD)	

Report Date : 7/04/2025



Date	Groundwater bTOC	Groundwater mAHD	Depth Below NS m
7/09/2022	12.39	42.05	11.89
8/10/2022	12.32	42.12	11.82
25/10/2022	12.31	42.13	11.81
21/11/2022	12.37	42.07	11.87
16/12/2022	12.49	41.95	11.99
24/01/2023	12.76	41.68	12.26
16/02/2023	12.86	41.58	12.36
15/03/2023	13.04	41.40	12.54
12/04/2023	13.02	41.42	12.52
12/05/2023	12.97	41.47	12.47
16/06/2023	12.82	41.62	12.32
18/07/2023	12.82	41.62	12.32
18/08/2023	12.36	42.08	11.86
19/09/2023	12.47	41.97	11.97
17/10/2023	12.43	42.01	11.93
17/11/2023	12.49	41.95	11.99

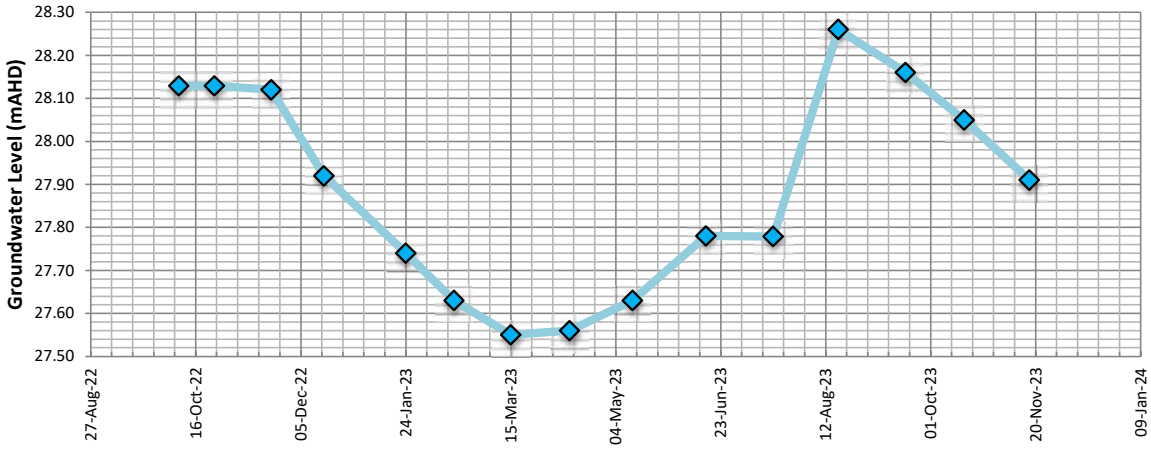
Minimum Recorded Level (mAHD)	41.4
Maximum Recorded Level (mAHD)	42.125

H21064 East Wanneroo Monitoring

WM42 WM42

				Natural Surface (mAHD)	38.57
Data Analysis Period Start Date	7/09/2022	Easting	386832	Top of Casing (m AHD)	39.15
Data Analysis Period End Date	17/11/2023	Northing	6485295	End of Hole (mAHD)	

Report Date : 7/04/2025



Date	Groundwater bTOC	Groundwater mAHD	Depth Below NS m
8/10/2022	11.02	28.13	10.44
25/10/2022	11.02	28.13	10.44
21/11/2022	11.03	28.12	10.45
16/12/2022	11.23	27.92	10.65
24/01/2023	11.41	27.74	10.83
16/02/2023	11.52	27.63	10.94
15/03/2023	11.60	27.55	11.02
12/04/2023	11.59	27.56	11.01
12/05/2023	11.52	27.63	10.94
16/06/2023	11.37	27.78	10.79
18/07/2023	11.37	27.78	10.79
18/08/2023	10.89	28.26	10.31
19/09/2023	10.99	28.16	10.41
17/10/2023	11.10	28.05	10.52
17/11/2023	11.24	27.91	10.66

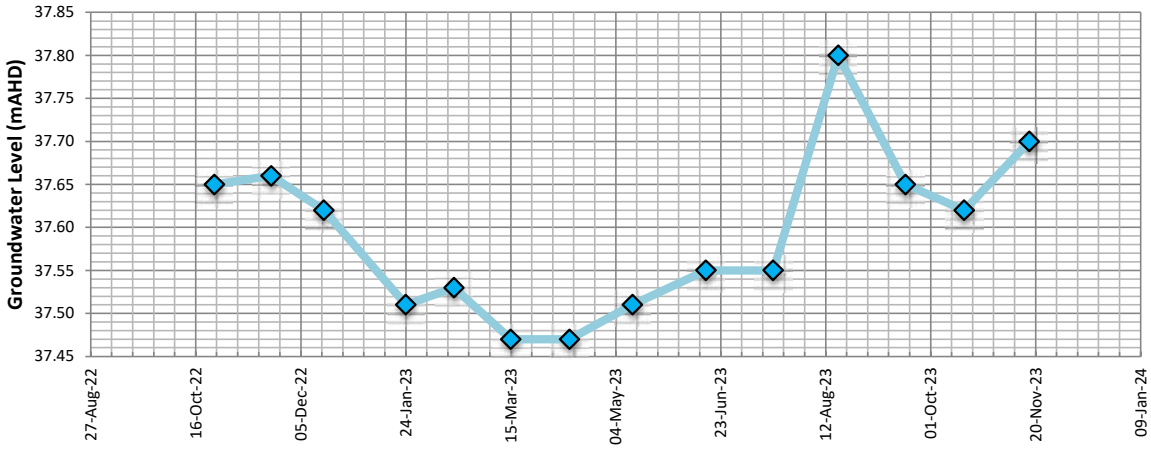
Minimum Recorded Level (mAHD)	27.55
Maximum Recorded Level (mAHD)	28.26

H21064 East Wanneroo Monitoring

WM22 WM22

				Natural Surface (mAHD)	65.48
Data Analysis Period Start Date	7/09/2022	Easting	387060	Top of Casing (m AHD)	66.03
Data Analysis Period End Date	17/11/2023	Northing	6486557	End of Hole (mAHD)	

Report Date : 7/04/2025



Date	Groundwater bTOC	Groundwater mAHD	Depth Below NS m
25/10/2022	28.38	37.65	27.83
21/11/2022	28.37	37.66	27.82
16/12/2022	28.41	37.62	27.86
24/01/2023	28.52	37.51	27.97
16/02/2023	28.50	37.53	27.95
15/03/2023	28.56	37.47	28.01
12/04/2023	28.56	37.47	28.01
12/05/2023	28.52	37.51	27.97
16/06/2023	28.48	37.55	27.93
18/07/2023	28.48	37.55	27.93
18/08/2023	28.23	37.80	27.68
19/09/2023	28.38	37.65	27.83
17/10/2023	28.41	37.62	27.86
17/11/2023	28.33	37.70	27.78

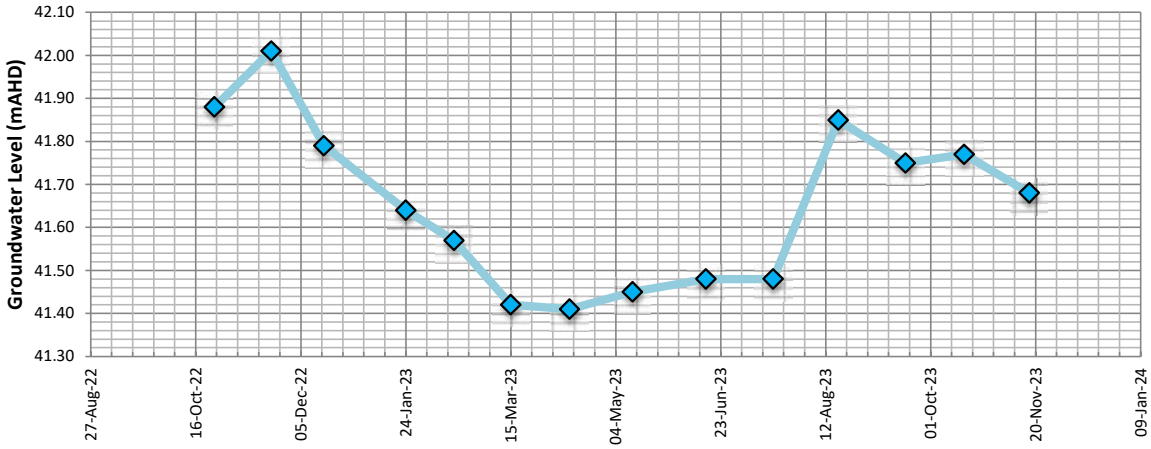
Minimum Recorded Level (mAHD)	37.47
Maximum Recorded Level (mAHD)	37.8

H21064 East Wanneroo Monitoring

JP5B Jandabup Monitoring - JP5B

				Natural Surface (mAHD)	76.48
Data Analysis Period Start Date	7/09/2022	Easting	389310	Top of Casing (m AHD)	77.00
Data Analysis Period End Date	17/11/2023	Northing	6486042	End of Hole (mAHD)	

Report Date : 7/04/2025



Date	Groundwater bTOC	Groundwater mAHD	Depth Below NS m
25/10/2022	35.12	41.88	34.60
21/11/2022	34.99	42.01	34.47
16/12/2022	35.21	41.79	34.69
24/01/2023	35.36	41.64	34.84
16/02/2023	35.43	41.57	34.91
15/03/2023	35.58	41.42	35.06
12/04/2023	35.59	41.41	35.07
12/05/2023	35.55	41.45	35.03
16/06/2023	35.52	41.48	35.00
18/07/2023	35.52	41.48	35.00
18/08/2023	35.15	41.85	34.63
19/09/2023	35.25	41.75	34.73
17/10/2023	35.23	41.77	34.71
17/11/2023	35.32	41.68	34.80

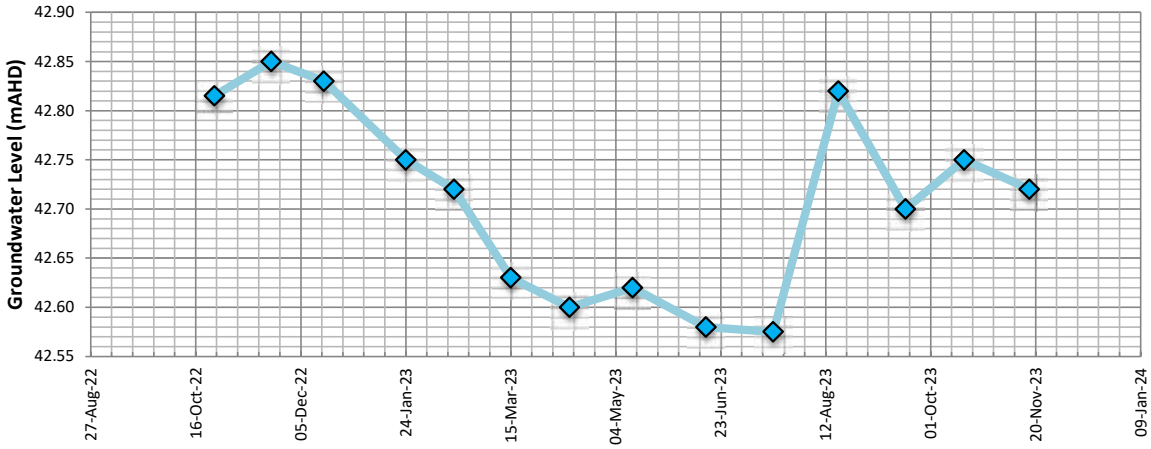
Minimum Recorded Level (mAHD)	41.41
Maximum Recorded Level (mAHD)	42.01

H21064 East Wanneroo Monitoring

JB4 Jandabup Monitoring - JB4

				Natural Surface (mAHD)	62.87
Data Analysis Period Start Date	7/09/2022	Easting	389845.72	Top of Casing (m AHD)	63.48
Data Analysis Period End Date	17/11/2023	Northing	6486155.13	End of Hole (mAHD)	

Report Date : 7/04/2025



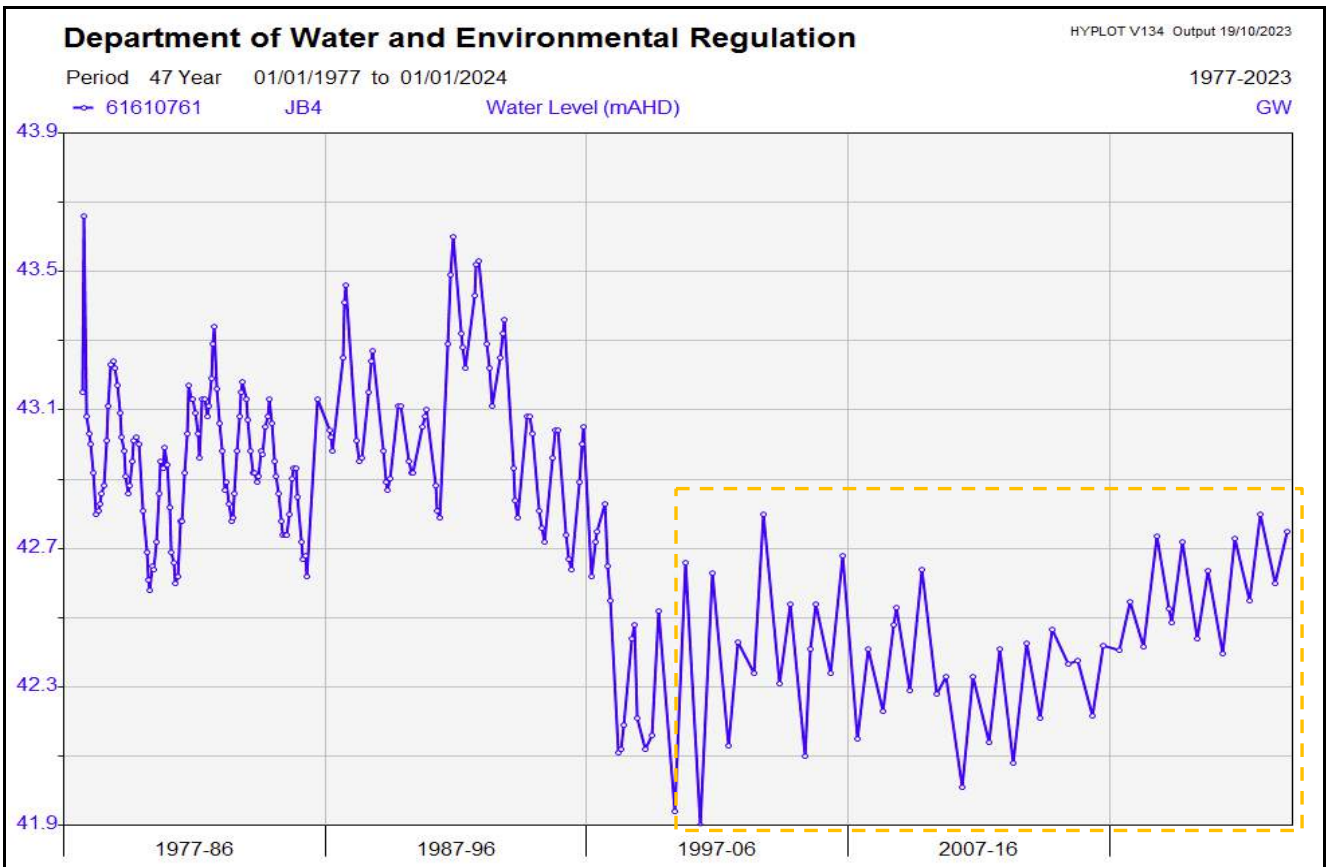
Date	Groundwater bTOC	Groundwater mAHD	Depth Below NS m
25/10/2022	20.66	42.82	20.06
21/11/2022	20.63	42.85	20.02
16/12/2022	20.65	42.83	20.04
24/01/2023	20.73	42.75	20.12
16/02/2023	20.76	42.72	20.15
15/03/2023	20.85	42.63	20.24
12/04/2023	20.88	42.60	20.27
12/05/2023	20.86	42.62	20.25
16/06/2023	20.90	42.58	20.29
18/07/2023	20.90	42.58	20.30
18/08/2023	20.66	42.82	20.05
19/09/2023	20.78	42.70	20.17
17/10/2023	20.73	42.75	20.12
17/11/2023	20.76	42.72	20.15

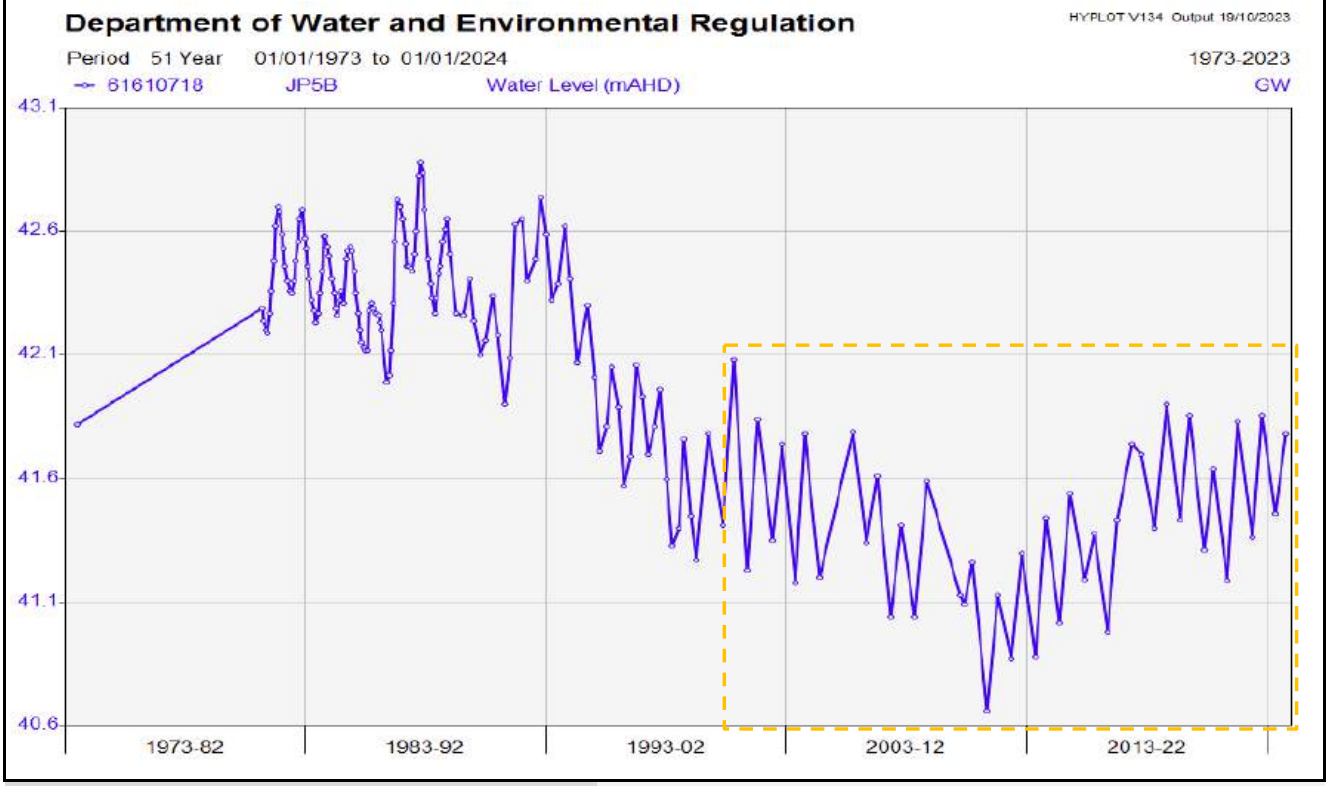
Minimum Recorded Level (mAHD)	42.575
Maximum Recorded Level (mAHD)	42.85

APPENDIX E

DWER Long Term Bore Hydrographs

Date: 04/04/2025 Job No. H24054





Period of Record from 2000 onwards

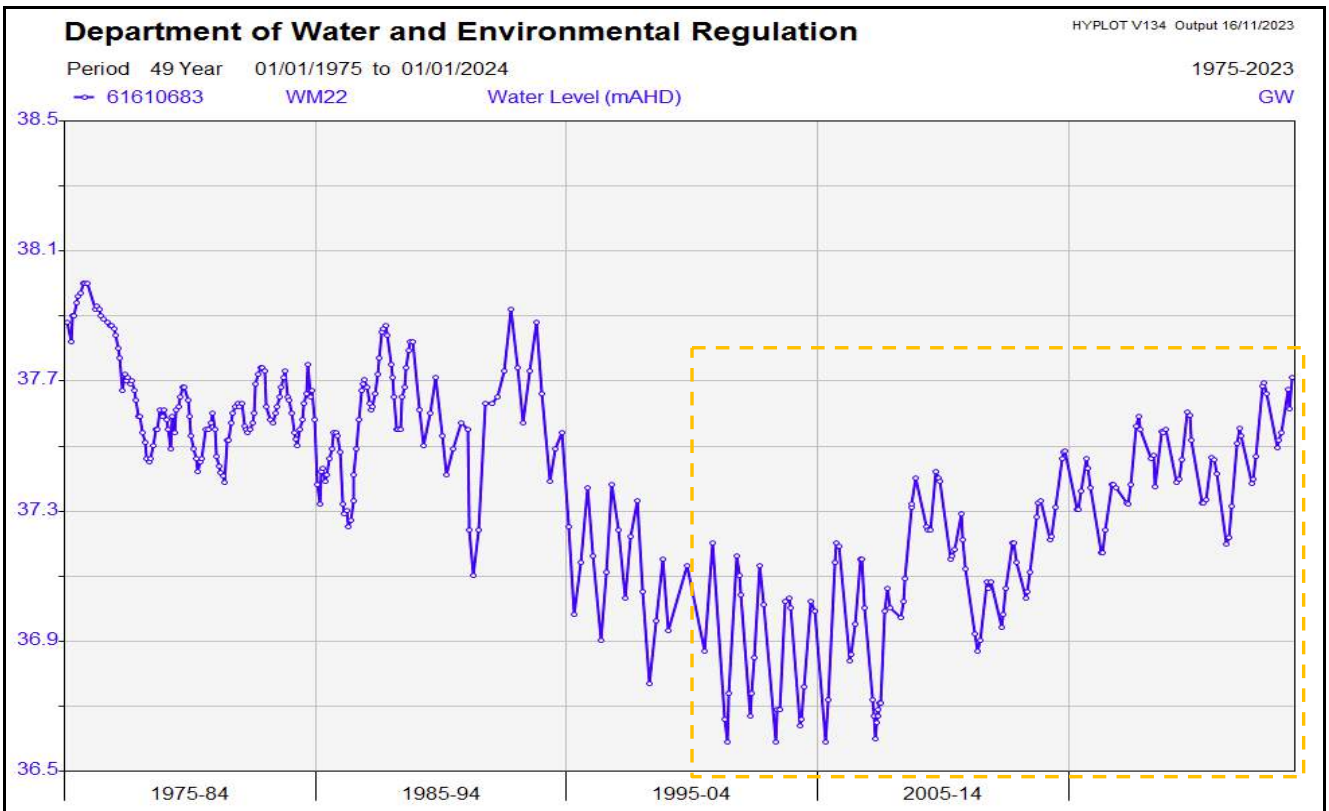
hyd2o

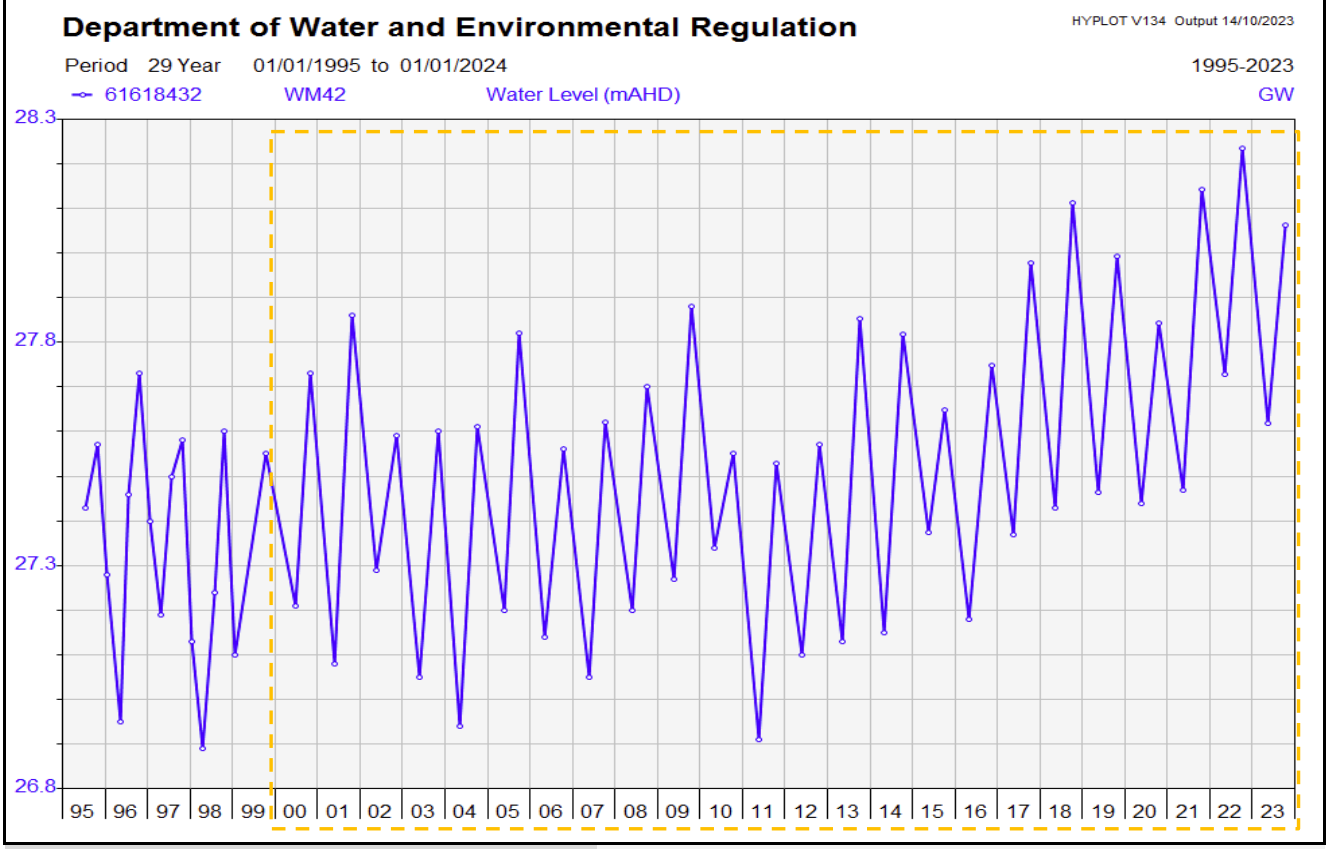
East Wanneroo Precinct 3 LWMS

DWER Long term Groundwater Level Hydrographs

Appendix E1

Date: 04/04/2025 Job No. H24054





Period of Record from 2000 onwards

hyd2o

East Wanneroo Precinct 3 LWMS

DWER Long Term Groundwater Level Hydrographs

Appendix E2

APPENDIX F
Water Quality Results

H21064 East Wanneroo Monitoring

EW01 Bore 1 - Nicholas Rd

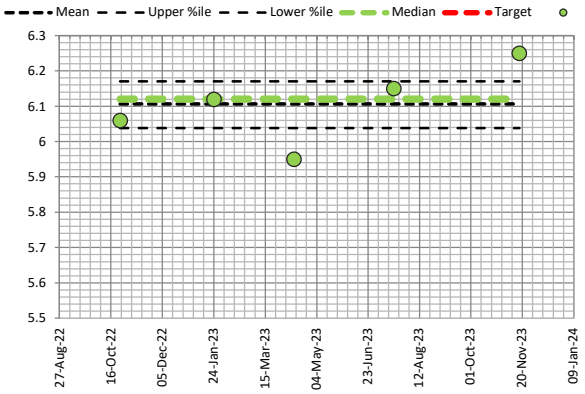
Easting	389876.07	Data Analysis Period Start Date	7/09/2022
Northing	6484333.1	Data Analysis Period End Date	17/11/2023

hyd2o HYDROLOGY

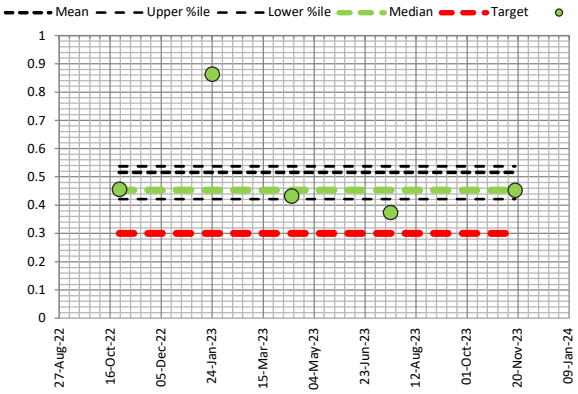
Report Date : 7/04/2025

Parameter	Description	Units	Samples	Minimum	Low %ile 20	Mean	Median	High %ile 80	Maximum	Target ANZECC 95%	Times Exceeded
GWL bToC	Groundwater Level	mBToC	16	10.48	10.56	10.75	**10.65**	11.01	11.09		0
GWL mAHD	Groundwater Level	mAHD	16	40.85	40.93	41.19	**41.29**	41.38	41.46		0
T	Temperature	°C	5	18.20	21.480	25.000	**22.600**	29.660	33.100		0
EC	Electrical Conductivity	mS/cm	5	0.37	0.421	0.516	**0.453**	0.537	0.863	0.300	5
DO %	Dissolved Oxygen	%	5	1.55	7.51	17.71	**15.80**	23.00	44.60		0
pH	pH	pH	5	5.95	6.04	6.11	**6.12**	6.17	6.25	7-8.5	
TN	Total Nitrogen	mg/L	5	0.30	0.43	0.93	**0.50**	1.27	2.40	1.50	1
TKN	Total Kjeldahl Nitrogen	mg/L	5	0.20	0.24	0.39	**0.27**	0.46	0.88		0
NOx-N	Nitrate + Nitrite as N	mg/L	5	0.05	0.19	0.55	**0.26**	0.82	1.60	0.10	4
NH3	Ammonia	mg/L	5	0.01	0.01	0.03	**0.01**	0.04	0.08	0.90	0
TP	Total Phosphorous	mg/L	5	0.05	0.05	0.05	**0.05**	0.05	0.05	0.06	0
FRP	Filterable Reactive Phosphorous	mg/L	5	0.01	0.01	0.006	**0.005**	0.01	0.01	0.03	0
As	Arsenic	mg/L	5	0.00	0.00	0.001	**0.001**	0.00	0.00	0.02	0
Cd	Cadmium	mg/L	5	0.0001	0.0001	0.0001	**0.0001**	0.0001	0.0001	0.0002	0
Cr	Chromium	mg/L	5	0.0010	0.0010	0.0010	**0.0010**	0.0010	0.0010		0
Cu	Copper	mg/L	5	0.0010	0.0010	0.0015	**0.0013**	0.0018	0.0028	0.0014	2
Pb	Lead	mg/L	5	0.0010	0.0010	0.0010	**0.0010**	0.0010	0.0010	0.0034	0
Ni	Nickel	mg/L	5	0.00	0.00	0.001	**0.001**	0.00	0.00	0.01	0
Zn	Zinc	mg/L	5	0.005	0.005	0.010	**0.010**	0.014	0.014	0.008	3
Hg	Mercury	mg/L	5	0.00005	0.00005	0.00005	**0.00005**	0.00005	0.00005	0.00060	0
Al	Aluminium	mg/L	3	0.043	0.051	0.155	**0.063**	0.241	0.360		0
Fe	Iron	mg/L	3	0.620	0.812	1.473	**1.100**	2.060	2.700		0
Cl	Chloride	mg/L	3	81.00	81.40	82.33	**82.00**	83.20	84.00		0
SO4	Sulphate	mg/L	3	60.00	60.80	62.00	**62.00**	63.20	64.00		0
E.coli	Pathogen E.coli	cfu/100mL	3	1.00	1.00	4.00	**1.00**	6.40	10.00		0
ON	Organic Nitrogen	mg/L	3	0.19	0.21	0.22	**0.24**	0.24	0.24		0

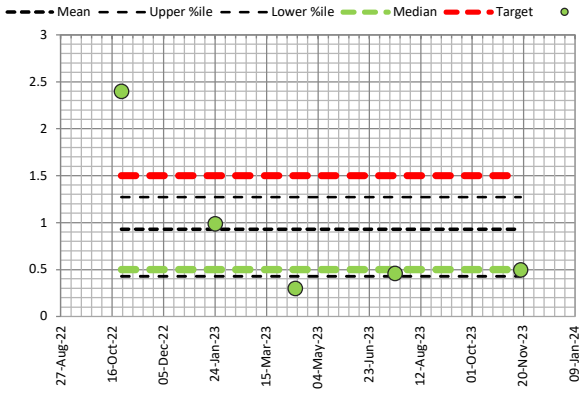
pH



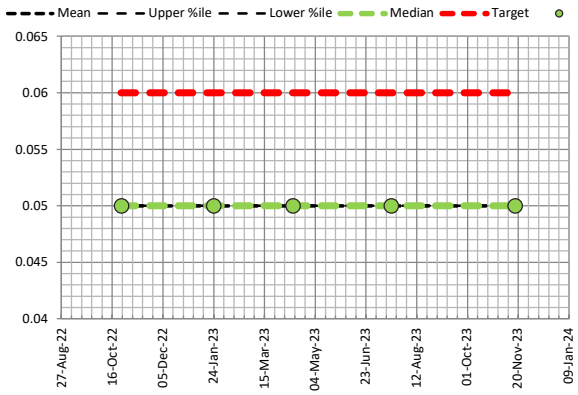
Electrical Conductivity



Total Nitrogen



Total Phosphorous



FieldDAE
Field Data Analysis & Evaluation System

H21064 East Wanneroo Monitoring

EW02 Bore 2 - Lot 206

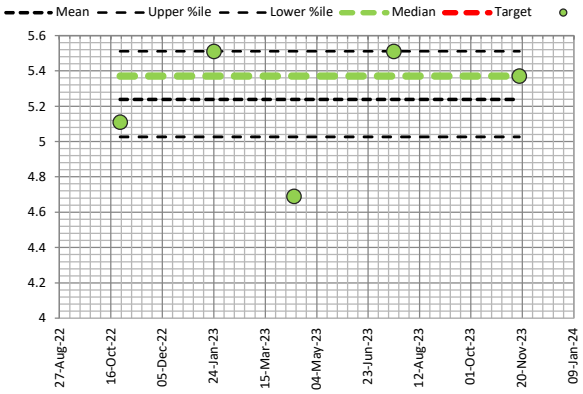
Easting	389254.62	Data Analysis Period Start Date	7/09/2022
Northing	6485192	Data Analysis Period End Date	17/11/2023

hyd2o HYDROLOGY

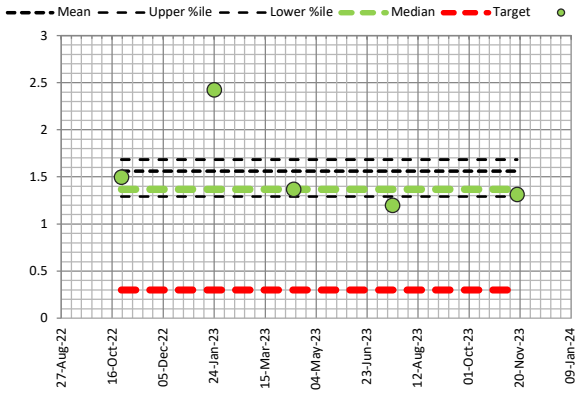
Report Date : 7/04/2025

Parameter	Description	Units	Samples	Minimum	Low %ile 20	Mean	Median	High %ile 80	Maximum	Target ANZECC 95%	Times Exceeded
GWL bToC	Groundwater Level	mBToC	16	17.01	17.06	17.21	**17.13**	17.41	17.46		0
GWL mAHD	Groundwater Level	mAHD	16	40.78	40.83	41.03	**41.11**	41.18	41.23		0
T	Temperature	°C	5	19.20	21.360	23.280	**21.900**	25.980	27.900		0
EC	Electrical Conductivity	mS/cm	5	1.20	1.291	1.561	**1.368**	1.683	2.424	0.300	5
DO %	Dissolved Oxygen	%	5	17.70	23.38	28.26	**32.60**	32.80	33.60		0
pH	pH	pH	5	4.69	5.03	5.24	**5.37**	5.51	5.51	7-8.5	
TN	Total Nitrogen	mg/L	5	70.00	82.00	100.40	**87.00**	124.00	140.00	1.50	5
TKN	Total Kjeldahl Nitrogen	mg/L	5	0.10	8.82	24.22	**11.00**	39.00	67.00		0
NOx-N	Nitrate + Nitrite as N	mg/L	5	72.00	74.40	77.60	**76.00**	79.20	88.00	0.10	5
NH3	Ammonia	mg/L	5	0.01	0.01	0.01	**0.01**	0.01	0.02	0.90	0
TP	Total Phosphorous	mg/L	5	0.05	0.05	0.05	**0.05**	0.05	0.05	0.06	0
FRP	Filterable Reactive Phosphorous	mg/L	5	0.01	0.01	0.005	**0.005**	0.01	0.01	0.03	0
As	Arsenic	mg/L	5	0.00	0.00	0.001	**0.001**	0.00	0.00	0.02	0
Cd	Cadmium	mg/L	5	0.0001	0.0001	0.0001	**0.0001**	0.0001	0.0001	0.0002	0
Cr	Chromium	mg/L	5	0.0010	0.0010	0.0010	**0.0010**	0.0010	0.0010		0
Cu	Copper	mg/L	5	0.0010	0.0014	0.0023	**0.0024**	0.0028	0.0042	0.0014	4
Pb	Lead	mg/L	5	0.0010	0.0010	0.0010	**0.0010**	0.0010	0.0010	0.0034	0
Ni	Nickel	mg/L	5	0.00	0.00	0.001	**0.001**	0.00	0.00	0.01	0
Zn	Zinc	mg/L	5	0.043	0.045	0.049	**0.051**	0.053	0.055	0.008	5
Hg	Mercury	mg/L	5	0.00005	0.00005	0.00005	**0.00005**	0.00005	0.00005	0.00060	0
Al	Aluminium	mg/L	3	0.028	0.029	0.032	**0.030**	0.035	0.039		0
Fe	Iron	mg/L	3	0.092	0.123	0.147	**0.170**	0.176	0.180		0
Cl	Chloride	mg/L	3	130.00	134.00	140.00	**140.00**	146.00	150.00		0
SO4	Sulphate	mg/L	3	130.00	130.00	133.33	**130.00**	136.00	140.00		0
E.coli	Pathogen E.coli	cfu/100mL	3	1.00	1.00	4.00	**1.00**	6.40	10.00		0
ON	Organic Nitrogen	mg/L	3	11.00	19.40	36.67	**32.00**	53.00	67.00		0

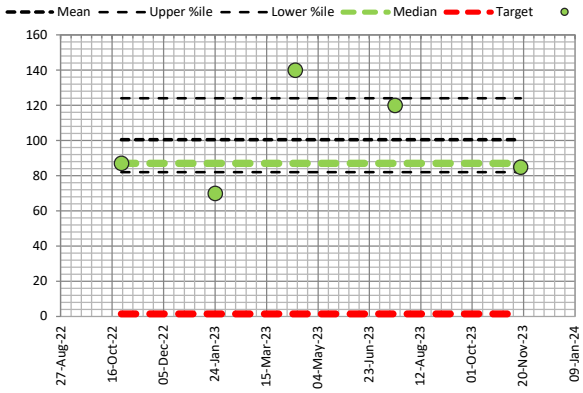
pH



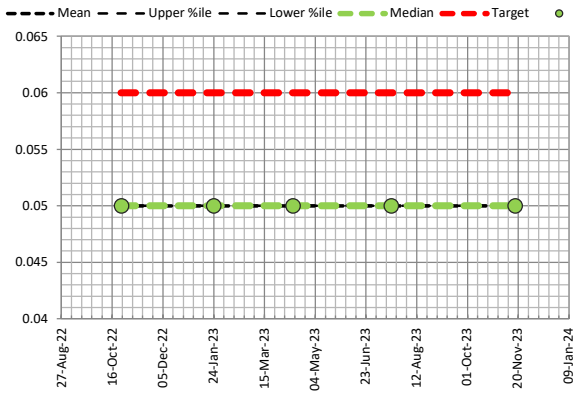
Electrical Conductivity



Total Nitrogen



Total Phosphorous



FieldDAE
Field Data Analysis & Evaluation System

H21064 East Wanneroo Monitoring

EW03 Bore 3 - Carbone

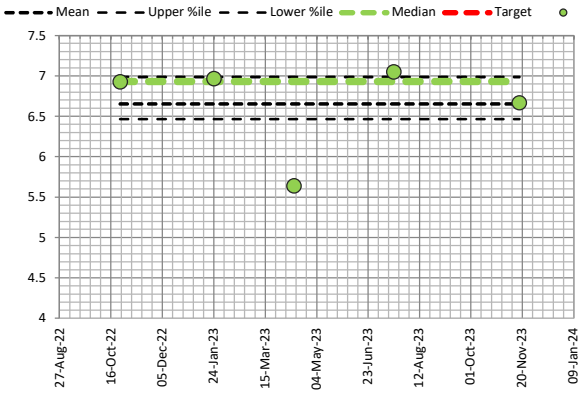
Easting	389849.31	Data Analysis Period Start Date	7/09/2022
Northing	6485613.3	Data Analysis Period End Date	17/11/2023

hyd2o HYDROLOGY

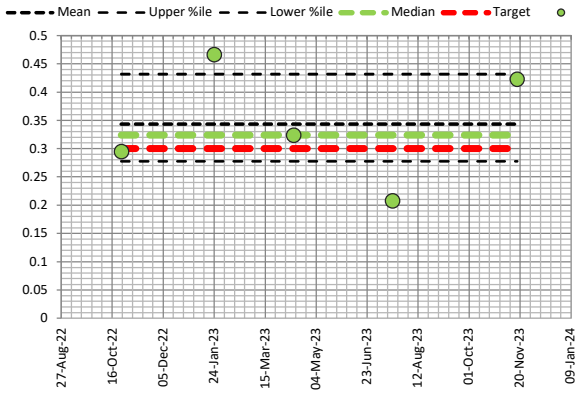
Report Date : 7/04/2025

Parameter	Description	Units	Samples	Minimum	Low %ile 20	Mean	Median	High %ile 80	Maximum	Target ANZECC 95%	Times Exceeded
GWL bToC	Groundwater Level	mBToC	16	12.31	12.37	12.62	**12.49**	12.86	13.04		0
GWL mAHD	Groundwater Level	mAHD	16	41.40	41.58	41.82	**41.95**	42.07	42.13		0
T	Temperature	°C	5	19.10	22.460	25.380	**24.100**	29.780	30.900		0
EC	Electrical Conductivity	mS/cm	5	0.21	0.278	0.343	**0.324**	0.432	0.466	0.300	3
DO %	Dissolved Oxygen	%	5	53.00	55.08	63.12	**68.20**	68.86	70.30		0
pH	pH	pH	5	5.64	6.46	6.65	**6.93**	6.99	7.05	7-8.5	
TN	Total Nitrogen	mg/L	5	1.00	1.24	2.32	**2.00**	3.32	4.20	1.50	3
TKN	Total Kjeldahl Nitrogen	mg/L	5	0.10	0.28	0.38	**0.36**	0.48	0.70		0
NOx-N	Nitrate + Nitrite as N	mg/L	5	0.94	0.96	1.96	**1.70**	2.86	3.50	0.10	5
NH3	Ammonia	mg/L	5	0.01	0.01	0.01	**0.01**	0.01	0.01	0.90	0
TP	Total Phosphorous	mg/L	5	0.05	0.05	0.05	**0.05**	0.05	0.05	0.06	0
FRP	Filterable Reactive Phosphorous	mg/L	5	0.01	0.01	0.005	**0.005**	0.01	0.01	0.03	0
As	Arsenic	mg/L	5	0.00	0.00	0.001	**0.001**	0.00	0.00	0.02	0
Cd	Cadmium	mg/L	5	0.0001	0.0001	0.0001	**0.0001**	0.0001	0.0001	0.0002	0
Cr	Chromium	mg/L	5	0.0010	0.0010	0.0010	**0.0010**	0.0010	0.0010		0
Cu	Copper	mg/L	5	0.0010	0.0010	0.0010	**0.0010**	0.0010	0.0010	0.0014	0
Pb	Lead	mg/L	5	0.0010	0.0010	0.0010	**0.0010**	0.0010	0.0010	0.0034	0
Ni	Nickel	mg/L	5	0.00	0.00	0.001	**0.001**	0.00	0.00	0.01	0
Zn	Zinc	mg/L	5	0.001	0.001	0.005	**0.002**	0.006	0.015	0.008	1
Hg	Mercury	mg/L	5	0.00005	0.00005	0.00005	**0.00005**	0.00005	0.00005	0.00060	0
Al	Aluminium	mg/L	3	0.010	0.010	0.022	**0.010**	0.032	0.046		0
Fe	Iron	mg/L	3	0.010	0.012	0.018	**0.016**	0.023	0.028		0
Cl	Chloride	mg/L	3	11.00	12.60	15.00	**15.00**	17.40	19.00		0
SO4	Sulphate	mg/L	3	4.20	4.52	6.10	**5.00**	7.46	9.10		0
E.coli	Pathogen E.coli	cfu/100mL	3	1.00	1.00	4.00	**1.00**	6.40	10.00		0
ON	Organic Nitrogen	mg/L	3	0.10	0.20	0.30	**0.36**	0.40	0.43		0

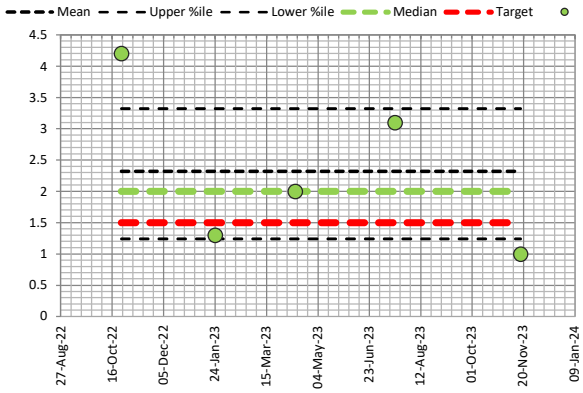
pH



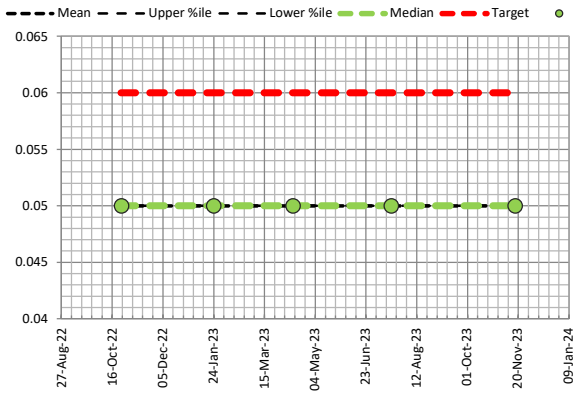
Electrical Conductivity



Total Nitrogen



Total Phosphorous



FieldDAE
Field Data Analysis & Evaluation System

H21064 East Wanneroo Monitoring

WM42 WM42

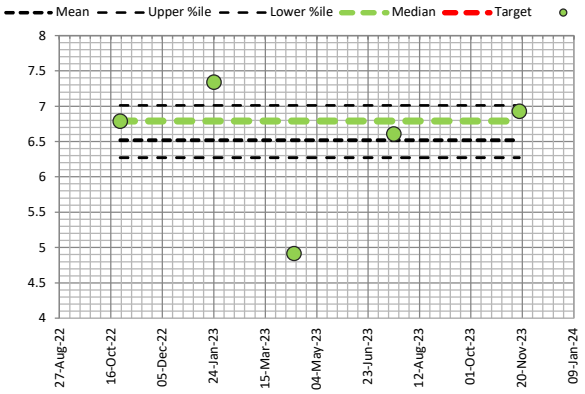
Easting	386832	Data Analysis Period Start Date	7/09/2022
Northing	6485295	Data Analysis Period End Date	17/11/2023

hyd2o HYDROLOGY

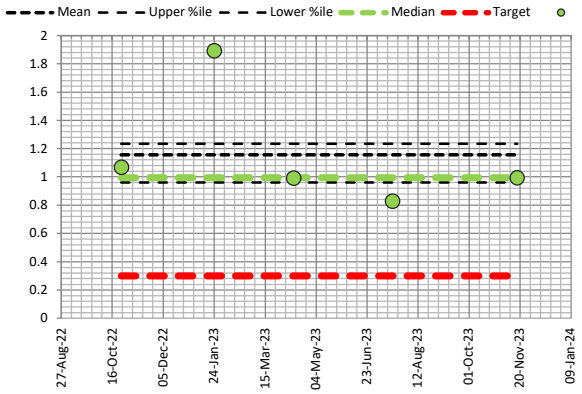
Report Date : 7/04/2025

Parameter	Description	Units	Samples	Minimum	Low %ile 20	Mean	Median	High %ile 80	Maximum	Target ANZECC 95%	Times Exceeded
GWL bToC	Groundwater Level	mBToC	15	10.89	11.02	11.26	**11.24**	11.52	11.60		0
GWL mAHD	Groundwater Level	mAHD	15	27.55	27.63	27.89	**27.91**	28.13	28.26		0
T	Temperature	°C	5	19.30	20.740	24.140	**22.700**	28.380	29.500		0
EC	Electrical Conductivity	mS/cm	5	0.83	0.960	1.156	**0.995**	1.234	1.892	0.300	5
DO %	Dissolved Oxygen	%	5	9.70	14.90	28.04	**27.70**	40.66	47.70		0
pH	pH	pH	5	4.92	6.27	6.52	**6.79**	7.01	7.34	7-8.5	
TN	Total Nitrogen	mg/L	6	0.64	0.72	0.94	**0.78**	1.30	1.40	1.50	0
TKN	Total Kjeldahl Nitrogen	mg/L	6	0.10	0.22	0.26	**0.25**	0.34	0.38		0
NOx-N	Nitrate + Nitrite as N	mg/L	6	0.42	0.53	0.68	**0.60**	0.93	0.97	0.10	6
NH3	Ammonia	mg/L	6	0.01	0.01	0.06	**0.03**	0.06	0.21	0.90	0
TP	Total Phosphorous	mg/L	6	0.05	0.05	0.05	**0.05**	0.05	0.05	0.06	0
FRP	Filterable Reactive Phosphorous	mg/L	6	0.01	0.01	0.011	**0.007**	0.02	0.02	0.03	0
As	Arsenic	mg/L	6	0.00	0.00	0.001	**0.001**	0.00	0.00	0.02	0
Cd	Cadmium	mg/L	6	0.0001	0.0001	0.0001	**0.0001**	0.0001	0.0001	0.0002	0
Cr	Chromium	mg/L	6	0.0010	0.0010	0.0010	**0.0010**	0.0010	0.0010		0
Cu	Copper	mg/L	6	0.0010	0.0010	0.0011	**0.0010**	0.0010	0.0014	0.0014	0
Pb	Lead	mg/L	6	0.0010	0.0010	0.0010	**0.0010**	0.0010	0.0010	0.0034	0
Ni	Nickel	mg/L	6	0.00	0.00	0.001	**0.001**	0.00	0.00	0.01	0
Zn	Zinc	mg/L	6	0.004	0.004	0.019	**0.014**	0.038	0.042	0.008	3
Hg	Mercury	mg/L	6	0.00005	0.00005	0.00005	**0.00005**	0.00005	0.00005	0.00060	0
Al	Aluminium	mg/L	4	0.010	0.010	0.010	**0.010**	0.010	0.010		0
Fe	Iron	mg/L	4	0.010	0.010	0.010	**0.010**	0.010	0.010		0
Cl	Chloride	mg/L	4	160.00	160.00	160.00	**160.00**	160.00	160.00		0
SO4	Sulphate	mg/L	4	170.00	170.00	170.00	**170.00**	170.00	170.00		0
E.coli	Pathogen E.coli	cfu/100mL	4	1.00	1.00	5.50	**5.50**	10.00	10.00		0
ON	Organic Nitrogen	mg/L	4	0.10	0.10	0.15	**0.15**	0.19	0.19		0

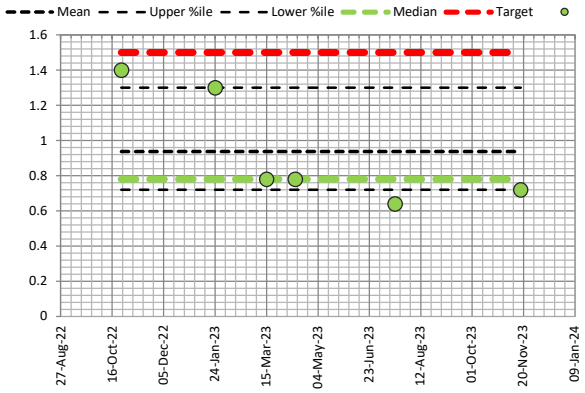
pH



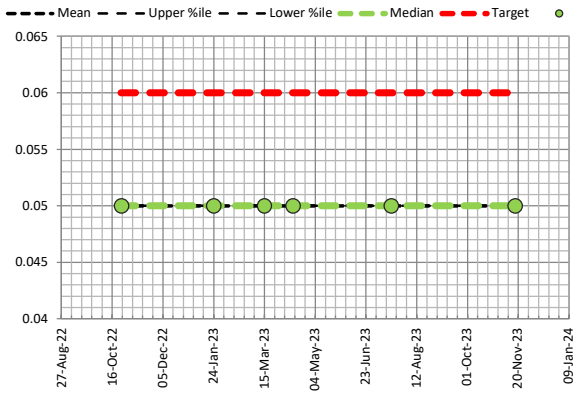
Electrical Conductivity



Total Nitrogen



Total Phosphorous



FieldDAE

Field Data Analysis & Evaluation System

FieldDAE

Field Data Analysis & Evaluation System

Water Quality Monitoring Data

	Date	Site	Monitored	GWL bToC	GWL mAHD	T	EC	DO %	pH	TN	TKN	NOx-N	NH3	TP	FRP	As	Cd	Cr	Cu	Pb	Ni	Zn	Hg	Al	Fe	Cl	SO4	E.coli	ON
				mBToC	mAHD	°C	mS/cm	%	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	cfu/100mL	mg/L
1	7/09/2022	EW01	GR	10.59	41.35																								
2	7/09/2022	EW02	GR	17.12	41.12																								
3	7/09/2022	EW03	GR	12.39	42.05																								
4	8/10/2022	EW01	BL	10.53	41.41																								
5	8/10/2022	EW02	BL	17.06	41.18																								
6	8/10/2022	EW03	BL	12.32	42.12																								
7	8/10/2022	WM22	BL																										
8	8/10/2022	WM42	BL	11.02	28.13																								
9	8/10/2022	JP5B	BL																										
10	8/10/2022	JB4	BL																										
11	25/10/2022	EW01	BL	10.48	41.46	22.30	0.456	1.55	6.060	2.40	0.88	1.60	0.08	0.050	0.005	0.001	0.0001	0.001	0.0013	0.001	0.0010	0.014	0.00005						
12	25/10/2022	EW02	BL	17.03	41.21	21.90	1.498	17.70	5.110	87.00	11.0	77.00	0.02	0.050	0.005	0.001	0.0001	0.001	0.0042	0.001	0.0015	0.055	0.00005						
13	25/10/2022	EW03	BL	12.31	42.13	23.30	0.295	70.30	6.930	4.20	0.7	3.50	0.005	0.050	0.005	0.001	0.0001	0.001	0.0010	0.001	0.0010	0.001	0.00005						
14	25/10/2022	WM22	BL	28.38	37.65																								
15	25/10/2022	WM42	BL	11.02	28.13	21.10	1.069	27.70	6.790	1.40	0.38	0.97	0.005	0.050	0.017	0.001	0.0001	0.001	0.0014	0.001	0.0010	0.038	0.00005						
16	25/10/2022	JP5B	BL	35.12	41.88																								
17	25/10/2022	JB4	BL	20.66	42.82																								
18	21/11/2022	EW01	AFR	10.51	41.43																								
19	21/11/2022	EW02	AFR	17.01	41.23																								
20	21/11/2022	EW03	AFR	12.37	42.07																								
21	21/11/2022	WM22	AFR	28.37	37.66																								
22	21/11/2022	WM42	AFR	11.03	28.12																								
23	21/11/2022	JP5B	AFR	34.99	42.01																								
24	21/11/2022	JB4	AFR	20.63	42.85																								
25	16/12/2022	EW01	AFR	10.61	41.33																								
26	16/12/2022	EW02	AFR	17.10	41.14																								
27	16/12/2022	EW03	AFR	12.49	41.95																								
28	16/12/2022	WM22	AFR	28.41	37.62																								
29	16/12/2022	WM42	AFR	11.23	27.92																								
30	16/12/2022	JP5B	AFR	35.21	41.79																								
31	16/12/2022	JB4	AFR	20.65	42.83																								
32	24/01/2023	EW01	AFR	10.77	41.17	33.10	0.863	15.80	6.120	0.99	0.36	0.63	0.005	0.050	0.006	0.001	0.0001	0.001	0.0015	0.001	0.0010	0.0054	0.00005						
33	24/01/2023	EW02	AFR	17.24	41.00	27.90	2.424	32.60	5.510	70.00	0.10	72.00	0.005	0.050	0.005	0.001	0.0001	0.001	0.0015	0.001	0.0013	0.0450	0.00005						
34	24/01/2023	EW03	AFR	12.76	41.68	30.90	0.466	53.00	6.970	1.30	0.32	0.94	0.005	0.050	0.005	0.001	0.0001	0.001	0.001	0.001	0.0010	0.0038	0.00005						
35	24/01/2023	WM22	AFR	28.52	37.51																								
36	24/01/2023	WM42	AFR	11.41	27.74	28.10	1.892	47.70	7.340	1.30	0.34	0.93	0.005	0.050	0.020	0.001	0.0001	0.001	0.001	0.001	0.0010	0.0210	0.00005						
37	24/01/2023	JP5B	AFR	35.36	41.64																								
38	24/01/2023	JB4	AFR	20.73	42.75																								
39	16/02/2023	EW01	AFR	10.88	41.06																								
40	16/02/2023	EW02	AFR	17.29	40.95																								
41	16/02/2023	EW03	AFR	12.86	41.58																								
42	16/02/2023	WM22	AFR	28.50	37.53																								
43	16/02/2023	WM42	AFR	11.52	27.63																								
44	16/02/2023	JP5B	AFR	35.43	41.57																								
45	16/02/2023	JB4	AFR	20.76	42.72																								
46	15/03/2023	EW01	AFR	11.06	40.88																								
47	15/03/2023	EW02	AFR	17.46	40.78																								
48	15/03/2023	EW03	AFR	13.04	41.40																								
49	15/03/2023	WM22	AFR	28.56	37.47																								

FieldDAE

Field Data Analysis & Evaluation System

Water Quality Monitoring Data

	Date	Site	Monitored	GWL bToC	GWL mAHD	T	EC	DO %	pH	TN	TKN	NOx-N	NH3	TP	FRP	As	Cd	Cr	Cu	Pb	Ni	Zn	Hg	Al	Fe	Cl	SO4	E.coli	ON
				mBToC	mAHD	°C	mS/cm	%	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	cfu/100mL	mg/L
50	15/03/2023	WM42	AFR	11.60	27.55																								
51	15/03/2023	JP5B	AFR	35.58	41.42																								
52	15/03/2023	JB4	AFR	20.85	42.63																								
53	12/04/2023	EW01	AFR	11.09	40.85	22.60	0.433	9.00	5.950	0.30	0.25	0.045	0.0085	0.050	0.005	0.001	0.0001	0.001	0.001	0.001	0.001	0.0046	0.00005	0.36	1.1	81	62	10	0.24
54	12/04/2023	EW02	AFR	17.45	40.79	21.90	1.368	33.60	4.690	140.00	67.0	76.000	0.005	0.050	0.005	0.001	0.0001	0.001	0.0024	0.001	0.0012	0.0430	0.00005	0.028	0.092	140	140	10	67
55	12/04/2023	EW03	AFR	13.02	41.42	24.10	0.324	68.50	5.640	2.00	0.36	1.700	0.005	0.050	0.005	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.00005	0.046	0.028	19	9.1	10	0.36
56	12/04/2023	WM22	AFR	28.56	37.47																								
57	12/04/2023	WM42	AFR	11.59	27.56	22.70	0.993	9.70	4.920	0.78	0.25	0.530	0.0570	0.050	0.0074	0.001	0.0001	0.001	0.001	0.001	0.001	0.0040	0.00005	0.01	0.01	160	170	10	0.19
58	12/04/2023	JP5B	AFR	35.59	41.41																								
59	12/04/2023	JB4	AFR	20.88	42.60																								
60	12/05/2023	EW01	AFR	11.06	40.88																								
61	12/05/2023	EW02	AFR	17.44	40.80																								
62	12/05/2023	EW03	AFR	12.97	41.47																								
63	12/05/2023	WM22	AFR	28.52	37.51																								
64	12/05/2023	WM42	AFR	11.52	27.63																								
65	12/05/2023	JP5B	AFR	35.55	41.45																								
66	12/05/2023	JB4	AFR	20.86	42.62																								
67	16/06/2023	EW01	AFR	11.01	40.93																								
68	16/06/2023	EW02	AFR	17.41	40.83																								
69	16/06/2023	EW03	AFR	12.82	41.62																								
70	16/06/2023	WM22	AFR	28.48	37.55																								
71	16/06/2023	WM42	AFR	11.37	27.78																								
72	16/06/2023	JP5B	AFR	35.52	41.48																								
73	16/06/2023	JB4	AFR	20.90	42.58																								
74	18/07/2023	EW01	BL	11.01	40.93	18.20	0.37	17.60	6.15	0.46	0.2	0.26	0.012	0.050	0.005	0.001	0.0001	0.001	0.0028	0.001	0.002	0.0099	0.00005	0.043	0.62	82	60	1	0.19
75	18/07/2023	EW02	BL	17.41	40.83	19.20	1.20	24.80	5.51	120.00	32.0	88.00	0.005	0.050	0.005	0.001	0.0001	0.001	0.001	0.001	0.0017	0.052	0.00005	0.03	0.18	150	130	1	32
76	18/07/2023	EW03	BL	12.82	41.62	19.10	0.21	68.20	7.05	3.10	0.43	2.70	0.0059	0.050	0.005	0.001	0.0001	0.001	0.001	0.001	0.001	0.015	0.00005	0.01	0.01	15	5	1	0.43
77	18/07/2023	WM22	BL	28.48	37.55																								
78	18/07/2023	WM42	BL	11.37	27.78	19.30	0.83	16.20	6.61	0.64	0.22	0.42	0.21	0.050	0.0055	0.001	0.0001	0.001	0.001	0.001	0.001	0.0076	0.00005	0.01	0.01	160	170	1	0.1
79	18/07/2023	JP5B	BL	35.52	41.48																								
80	18/07/2023	JB4	BL	20.90	42.58																								
81	18/08/2023	EW01	AFR	10.56	41.38																								
82	18/08/2023	EW02	AFR	17.03	41.21																								
83	18/08/2023	EW03	AFR	12.36	42.08																								
84	18/08/2023	WM22	AFR	28.23	37.80																								
85	18/08/2023	WM42	AFR	10.89	28.26																								
86	18/08/2023	JP5B	AFR	35.15	41.85																								
87	18/08/2023	JB4	AFR	20.66	42.82																								
88	19/09/2023	EW01	AFR	10.61	41.33																								
89	19/09/2023	EW02	AFR	17.12	41.12																								
90	19/09/2023	EW03	AFR	12.47	41.97																								
91	19/09/2023	WM22	AFR	28.38	37.65																								
92	19/09/2023	WM42	AFR	10.99	28.16																								
93	19/09/2023	JP5B	AFR	35.25	41.75																								
94	19/09/2023	JB4	AFR	20.78	42.70																								
95	17/10/2023	EW01	AFR	10.59	41.35																								
96	17/10/2023	EW02	AFR	17.06	41.18																								
97	17/10/2023	EW03	AFR	12.43	42.01																								
98	17/10/2023	WM22	AFR	28.41	37.62																								

FieldDAE

Field Data Analysis & Evaluation System

Water Quality Monitoring Data

	Date	Site	Monitored	GWL bToC	GWL mAHD	T	EC	DO %	pH	TN	TKN	NOx-N	NH3	TP	FRP	As	Cd	Cr	Cu	Pb	Ni	Zn	Hg	Al	Fe	Cl	SO4	E.coli	ON
				mBToC	mAHD	°C	mS/cm	%	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	cfu/100mL	mg/L
99	17/10/2023	WM42	AFR	11.10	28.05																								
100	17/10/2023	JP5B	AFR	35.23	41.77																								
101	17/10/2023	JB4	AFR	20.73	42.75																								
102	17/11/2023	EW01	AFR & TD	10.69	41.25	28.8	0.453	44.60	6.25	0.50	0.27	0.23	0.03	0.05	0.0079	0.001	0.0001	0.001	0.001	0.001	0.001	0.014	0.00005	0.063	2.7	84	64	1	0.24
103	17/11/2023	EW02	AFR & TD	17.14	41.10	25.5	1.314	32.60	5.37	85.00	11.0	75.00	0.005	0.05	0.0072	0.001	0.0001	0.001	0.0025	0.001	0.0012	0.051	0.00005	0.039	0.17	130	130	1	11
104	17/11/2023	EW03	AFR & TD	12.49	41.95	29.5	0.423	55.60	6.67	1.00	0.1	0.97	0.005	0.05	0.005	0.001	0.0001	0.001	0.001	0.001	0.001	0.0022	0.00005	0.01	0.016	11	4.2	1	0.1
105	17/11/2023	WM22	AFR & TD	28.33	37.70																								
106	17/11/2023	WM42	AFR & TD	11.24	27.91	29.5	0.995	38.90	6.93	0.72	0.1	0.67	0.005	0.05	0.0075	0.001	0.0001	0.001	0.001	0.001	0.001	0.042	0.00005	0.01	0.01	160	170	1	0.1
107	17/11/2023	JP5B	AFR & TD	35.32	41.68																								
108	17/11/2023	JB4	AFR & TD	20.76	42.72																								

APPENDIX G
Laboratory Reports

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Certificate of Analysis PDJ1431

Client Details

Client	Hyd2O
Contact	Brian Lau
Address	Suite 6B, 103 Rokeby Rd, SUBIACO, WA, 6008

Sample Details

Your Reference	H21064 East Wanneroo Monitoring
Number of Samples	4 Groundwater
Date Samples Received	25/10/2022
Date Samples Registered	25/10/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date Results Requested by	01/11/2022
Date of Issue	01/11/2022

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Accredited for compliance with ISO/IEC 17025. Tests not covered by NATA are denoted with *.

Authorisation Details

Results Approved By	Heram Halim, Operations Manager Michael Hall, Inorganics & Metals Supervisor Michael Mowle, Inorganics Supervisor Todd Lee, Group Operations Manager
Laboratory Manager	Michael Kubiak

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Samples in this Report

Envirolab ID	Sample ID	Matrix	Date Sampled	Date Received
PDJ1431-01	EW1	Groundwater	24/10/2022	25/10/2022
PDJ1431-02	EW2	Groundwater	24/10/2022	25/10/2022
PDJ1431-03	EW3	Groundwater	24/10/2022	25/10/2022
PDJ1431-04	WM42	Groundwater	24/10/2022	25/10/2022

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Acid Extractable Metals (Groundwater)

Envirolab ID	**Units**	**PQL**	PDJ1431-01	PDJ1431-02	PDJ1431-03	PDJ1431-04
Your Reference			EW1	EW2	EW3	WM42
Date Sampled			24/10/2022	24/10/2022	24/10/2022	24/10/2022
Phosphorus	mg/L	0.050	<0.050	<0.050	<0.050	<0.050

Certificate of Analysis PDJ1431

Dissolved Low Level Metals (Groundwater)

Envirolab ID	**Units**	**PQL**	PDJ1431-01	PDJ1431-02	PDJ1431-03	PDJ1431-04
Your Reference			EW1	EW2	EW3	WM42
Date Sampled			24/10/2022	24/10/2022	24/10/2022	24/10/2022
Arsenic	µg/L	1.0	<1.0	<1.0	<1.0	<1.0
Cadmium	µg/L	0.10	<0.10	<0.10	<0.10	<0.10
Chromium	µg/L	1.0	1.0	<1.0	<1.0	<1.0
Copper	µg/L	1.0	1.3	4.2	<1.0	1.4
Mercury	µg/L	0.050	<0.050	<0.050	<0.050	<0.050
Nickel	µg/L	1.0	<1.0	1.5	<1.0	1.0
Lead	µg/L	1.0	<1.0	<1.0	<1.0	<1.0
Zinc	µg/L	1.0	14	55	<1.0	38

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Inorganics (Groundwater)

Envirolab ID	**Units**	**PQL**	PDJ1431-01	PDJ1431-02	PDJ1431-03	PDJ1431-04
Your Reference			EW1	EW2	EW3	WM42
Date Sampled			24/10/2022	24/10/2022	24/10/2022	24/10/2022
Ammonia as N	mg/L	0.0050	0.077	0.020	<0.0050	<0.0050
Nitrate as N	mg/L	0.0050	1.5	77	3.5	0.97
Nitrite as N	mg/L	0.0050	0.018	<0.0050	<0.0050	<0.0050
Total Nitrogen	mg/L	0.10	2.4	87	4.2	1.4
NOx as N	mg/L	0.0050	1.6	77	3.5	0.97
Phosphate as P	mg/L	0.0050	<0.0050	<0.0050	<0.0050	0.017
Organic Nitrogen by calc.	mg/L	0.10	0.80	11	0.70	0.38
TKN as N by calculation	mg/L	0.10	0.88	11	0.70	0.38
Nitrate as NO3 by calculation	mg/L	0.020	6.8	340	16	4.3
Nitrite as NO2 by calculation	mg/L	0.020	0.058	<0.020	<0.020	<0.020

Method Summary

Method ID	Methodology Summary
Calc	Calculation
Calc - TKN	TKN determined by calculation (Total Nitrogen - NOx).
INORG-055	Nitrate/Nitrite/NOx/TKN - determined colourimetrically. Waters samples are filtered on receipt prior to analysis. Soils/solids are analysed following a water extraction.
INORG-057	Ammonia - determined colourimetrically. Water samples are filtered on receipt prior to analysis. Soils and OHS media are analysed following a water extraction. Alternatively, Ammonia can be extracted from soil using 1M KCl.
INORG-060	Phosphate - determined colourimetrically using APHA latest edition 4500 P E. Water samples are filtered on receipt prior to analysis. Soils are analysed from a water extract.
INORG-127	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Organic Carbon forms (inorganic, organic, total) determined using a TOC/NDIR analyser via combustion. Dissolved forms require filtering prior to determination.
METALS-020	Determination of various metals by ICP-OES.
METALS-021	Determination of Mercury by Cold Vapour AAS.
METALS-022	Determination of various metals by ICP-MS.

Certificate of Analysis PDJ1431

Result Definitions

Identifier	Description
NR	Not reported
NEPM	National Environment Protection Measure
NS	Not specified
LCS	Laboratory Control Sample
RPD	Relative Percent Difference
>	Greater than
<	Less than
PQL	Practical Quantitation Limit
INS	Insufficient sample for this test
NA	Test not required
NT	Not tested
DOL	Samples rejected due to particulate overload (air filters only)
RFD	Samples rejected due to filter damage (air filters only)
RUD	Samples rejected due to uneven deposition (air filters only)

Quality Control Definitions

Blank

This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, and is determined by processing solvents and reagents in exactly the same manner as for samples.

Surrogate Spike

Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

LCS (Laboratory Control Sample)

This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Matrix Spike

A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

Duplicate

This is the complete duplicate analysis of a sample from the process batch. The sample selected should be one where the analyte concentration is easily measurable.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria. Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction. Spikes for Physical and Aggregate Tests are not applicable. For VOCs in water samples, three vials are required for duplicate or spike analysis.

General Acceptance Criteria (GAC) - Analyte specific criteria applies for some analytes and is reflected in QC recovery tables.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% - see ELN-P05 QAQC tables for details (available on request); <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase. Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was typically insufficient in order to satisfy laboratory QA/QC protocols.

Miscellaneous Information

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Two significant figures are reported for the majority of tests and with a high degree of confidence, for results <10*PQL, the second significant figure may be in doubt i.e. has a relatively high degree of uncertainty and is provided for information only.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS where sediment/solids are included by default.

Urine Analysis - The BEI values listed are taken from the 2022 edition of *TLVs and BEIs Threshold Limits by ACGIH*.

Air volume measurements are not covered by Envirolab's NATA accreditation.

Data Quality Assessment Summary PDJ1431

Client Details

Client	Hyd2O
Your Reference	H21064 East Wanneroo Monitoring
Date Issued	01/11/2022

Recommended Holding Time Compliance

Recommended holding time exceedances exist - See detailed list below

Quality Control and QC Frequency

QC Type	Compliant	Details
Blank	Yes	No Outliers
LCS	Yes	No Outliers
Duplicates	Yes	No Outliers
Matrix Spike	No	Matrix Spike Outliers Exist - See detailed list below
Surrogates / Extracted Internal Standards	Yes	No Outliers
QC Frequency	Yes	No Outliers

Surrogates/Extracted Internal Standards, Duplicates and/or Matrix Spikes are not always relevant/applicable to certain analyses and matrices. Therefore, said QC measures are deemed compliant in these situations by default. See Laboratory Acceptance Criteria for more information

Data Quality Assessment Summary PDJ1431

Recommended Holding Time Compliance

Analysis	Sample Number(s)	Date Sampled	Date Extracted	Date Analysed	Compliant
Total Phosphorus | Water	1-4	24/10/2022	27/10/2022	28/10/2022	Yes
Dissolved Metals (LL) | Water	1-4	24/10/2022	27/10/2022	28/10/2022	Yes
Dissolved Metals (LL)-Hg | Water	1-4	24/10/2022	27/10/2022	27/10/2022	Yes
Nitrogen - Ammonia | Water	1-4	24/10/2022	26/10/2022	26/10/2022	Yes
Nitrogen - Nitrate | Water	1-4	24/10/2022	26/10/2022	26/10/2022	Yes
Nitrogen - Nitrite | Water	1-4	24/10/2022	26/10/2022	26/10/2022	Yes
Nitrogen - NOx | Water	1-4	24/10/2022	26/10/2022	26/10/2022	Yes
Nitrogen - Total N | Water	1-4	24/10/2022	27/10/2022	27/10/2022	No
Phosphate as P | Water	1-4	24/10/2022	26/10/2022	26/10/2022	Yes
TKN as N calc | Water	1-4	24/10/2022	31/10/2022	31/10/2022	Yes

Outliers: Matrix Spike

INORG-055 | Inorganics (Water) | Batch BDJ2504

Sample ID	Analyte	% Limits	% Recovery
BDJ2504-MS2#	Nitrite as N	70 - 130	##[1]

INORG-127 | Inorganics (Water) | Batch BDJ2661

Sample ID	Analyte	% Limits	% Recovery
PDJ1431-02	Total Nitrogen	70 - 130	##[1]

Quality Control PDJ1431

METALS-020 | Acid Extractable Metals (Water) | Batch BDJ2717

Analyte	Units	PQL	Blank	DUP1 BDJ2717-DUP1# Samp | QC | RPD %	DUP2 BDJ2717-DUP2# Samp | QC | RPD %	LCS %	Spike % BDJ2717-MS1#
Phosphorus	mg/L	0.050	<0.050	5.96 | 6.10 | 2.42	<0.050 | <0.050 | [NA]	103	84.3

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

METALS-021 | Dissolved Low Level Metals (Water) | Batch BDJ2607

Analyte	Units	PQL	Blank	DUP1 BDJ2607-DUP1# Samp | QC | RPD %	DUP2 BDJ2607-DUP2# Samp | QC | RPD %	LCS %	Spike % BDJ2607-MS1#
Mercury	µg/L	0.050	<0.050	<0.050 | <0.050 | [NA]	<0.050 | <0.050 | [NA]	95.6	99.6

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

METALS-021 | Dissolved Low Level Metals (Water) | Batch BDJ2608

Analyte	Units	PQL	Blank	DUP1 PDJ1431-04 Samp | QC | RPD %	DUP2 BDJ2608-DUP2# Samp | QC | RPD %	LCS %	Spike % BDJ2608-MS1#
Mercury	µg/L	0.050	<0.050	<0.050 | <0.050 | [NA]	<0.050 | <0.050 | [NA]	96.0	98.0

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

METALS-022 | Dissolved Low Level Metals (Water) | Batch BDJ2703

Analyte	Units	PQL	Blank	DUP1 BDJ2703-DUP1# Samp | QC | RPD %	DUP2 BDJ2703-DUP2# Samp | QC | RPD %	LCS %	Spike % BDJ2703-MS1#
Arsenic	µg/L	1.0	<1.0	1.03 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	107	113
Cadmium	µg/L	0.10	<0.10	<0.10 | <0.10 | [NA]	<0.10 | <0.10 | [NA]	107	111
Chromium	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	108	109
Copper	µg/L	1.0	<1.0	4.20 | 4.32 | 2.82	<1.0 | <1.0 | [NA]	109	107
Lead	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	111	106
Nickel	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	110	106
Zinc	µg/L	1.0	<1.0	<1.0 | 1.00 | [NA]	9.60 | 9.77 | 1.72	110	110

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

METALS-022 | Dissolved Low Level Metals (Water) | Batch BDJ2704

Analyte	Units	PQL	Blank	DUP1 PDJ1431-02 Samp | QC | RPD %	DUP2 BDJ2704-DUP2# Samp | QC | RPD %	LCS %	Spike % PDJ1431-03
Arsenic	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	105	108
Cadmium	µg/L	0.10	<0.10	<0.10 | <0.10 | [NA]	<0.10 | <0.10 | [NA]	104	111
Chromium	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	107	108
Copper	µg/L	1.0	<1.0	4.17 | 4.17 | 0.168	<1.0 | <1.0 | [NA]	104	102
Lead	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	107	108
Nickel	µg/L	1.0	<1.0	1.52 | 1.55 | 1.50	<1.0 | <1.0 | [NA]	105	103
Zinc	µg/L	1.0	<1.0	55.3 | 55.5 | 0.419	<1.0 | <1.0 | [NA]	105	109

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

Quality Control PDJ1431

INORG-057 | Inorganics (Water) | Batch BDJ2504

Analyte	Units	PQL	Blank	DUP1 BDJ2504-DUP1# Samp | QC | RPD %	DUP2 PDJ1431-01 Samp | QC | RPD %	LCS %	Spike % BDJ2504-MS1#
Ammonia as N	mg/L	0.0050	<0.0050	0.0322 | 0.0287 | 11.6	0.0771 | 0.0746 | 3.31	112	75.7
Nitrate as N	mg/L	0.0050	<0.0050	0.505 | 0.490 | 3.08	1.54 | 1.53 | 0.696	118	113
Nitrite as N	mg/L	0.0050	<0.0050	0.0261 | 0.0259 | 0.635	0.0178 | 0.0177 | 0.480	117	[NA]
NOx as N	mg/L	0.0050	<0.0050	0.532 | 0.516 | 2.96	1.56 | 1.55 | 0.694	118	115
Phosphate as P	mg/L	0.0050	<0.0050	<0.0050 | <0.0050 | [NA]	<0.0050 | <0.0050 | [NA]	113	130
Nitrate as NO3 by calculation	mg/L	0.020	<0.020			[NA]	[NA]
Nitrite as NO2 by calculation	mg/L	0.020	<0.020			[NA]	[NA]

Analyte	Units	PQL	Blank	LCS %	Spike % BDJ2504-MS2#
Nitrite as N	mg/L	0.005		[NA]	##[1]

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

INORG-127 | Inorganics (Water) | Batch BDJ2661

Analyte	Units	PQL	Blank	DUP1 PDJ1431-01 Samp | QC | RPD %	DUP2 BDJ2661-DUP2# Samp | QC | RPD %	LCS %	Spike % PDJ1431-02
Total Nitrogen	mg/L	0.10	<0.10	2.44 | 2.47 | 1.42	8.21 | 8.39 | 2.17	108	##[1]

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

QC Comments

Identifier	Description
[1]	Spike recovery is not applicable due to the relatively high analyte background in the sample (>3* spike level). However, the LCS recovery is within acceptance criteria.

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www.mpl.com.au

Certificate of Analysis PEA1022

Client Details

Client	Hyd2O
Contact	Andre Righetti
Address	Suite 6B, 103 Rokeby Rd, SUBIACO, WA, 6008

Sample Details

Your Reference	H21064 - East Wanneroo Monitoring
Number of Samples	4 Groundwater
Date Samples Received	24/01/2023
Date Samples Registered	24/01/2023

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date Results Requested by	02/02/2023
Date of Issue	03/02/2023

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Authorisation Details

Results Approved By	Heram Halim, Operations Manager Todd Lee, Group Operations Manager
Laboratory Manager	Michael Kubiak

Certificate of Analysis PEA1022

Samples in this Report

Envirolab ID	Sample ID	Matrix	Date Sampled	Date Received
PEA1022-01	EW1	Groundwater	24/01/2023	24/01/2023
PEA1022-02	EW2	Groundwater	24/01/2023	24/01/2023
PEA1022-03	EW3	Groundwater	24/01/2023	24/01/2023
PEA1022-04	WM42	Groundwater	24/01/2023	24/01/2023

Certificate of Analysis PEA1022

Acid Extractable Metals (Groundwater)

Envirolab ID	Units	PQL	PEA1022-01	PEA1022-02	PEA1022-03	PEA1022-04
Your Reference			EW1	EW2	EW3	WM42
Date Sampled			24/01/2023	24/01/2023	24/01/2023	24/01/2023
Phosphorus	mg/L	0.050	<0.050	<0.050	<0.050	<0.050

Certificate of Analysis PEA1022

Dissolved Low Level Metals (Groundwater)

Envirolab ID	**Units**	**PQL**	PEA1022-01	PEA1022-02	PEA1022-03	PEA1022-04
Your Reference			EW1	EW2	EW3	WM42
Date Sampled			24/01/2023	24/01/2023	24/01/2023	24/01/2023
Arsenic	µg/L	1.0	<1.0	<1.0	<1.0	<1.0
Cadmium	µg/L	0.10	<0.10	<0.10	<0.10	<0.10
Chromium	µg/L	1.0	<1.0	<1.0	<1.0	<1.0
Copper	µg/L	1.0	1.5	1.5	<1.0	<1.0
Mercury	µg/L	0.050	<0.050	<0.050	<0.050	<0.050
Nickel	µg/L	1.0	<1.0	1.3	<1.0	<1.0
Lead	µg/L	1.0	<1.0	<1.0	<1.0	<1.0
Zinc	µg/L	1.0	5.4	45	3.8	21

Certificate of Analysis PEA1022

Inorganics (Groundwater)

Envirolab ID	Units	PQL	PEA1022-01	PEA1022-02	PEA1022-03	PEA1022-04
Your Reference			EW1	EW2	EW3	WM42
Date Sampled			24/01/2023	24/01/2023	24/01/2023	24/01/2023
Ammonia as N	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrate as N	mg/L	0.0050	0.64	72	0.93	0.93
Nitrite as N	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Nitrogen	mg/L	0.10	0.99	70	1.3	1.3
NOx as N	mg/L	0.0050	0.63	72	0.94	0.93
Phosphate as P	mg/L	0.0050	0.0060	<0.0050	<0.0050	0.020
Organic Nitrogen by calc.	mg/L	0.10	0.36	<0.10	0.32	0.34
TKN as N by calculation	mg/L	0.10	0.36	<0.10	0.32	0.34
Nitrate as NO3 by calculation	mg/L	0.020	2.8	320	4.1	4.1
Nitrite as NO2 by calculation	mg/L	0.020	<0.020	<0.020	<0.020	<0.020

Method Summary

Method ID	Methodology Summary
Calc	Calculation
Calc - TKN	TKN determined by calculation (Total Nitrogen - NOx).
INORG-055	Nitrate/Nitrite/NOx/TKN - determined colourimetrically. Waters samples are filtered on receipt prior to analysis. Soils/solids are analysed following a water extraction.
INORG-057	Ammonia - determined colourimetrically. Water samples are filtered on receipt prior to analysis. Soils and OHS media are analysed following a water extraction. Alternatively, Ammonia can be extracted from soil using 1M KCl.
INORG-060	Phosphate - determined colourimetrically using APHA latest edition 4500 P E. Water samples are filtered on receipt prior to analysis. Soils are analysed from a water extract.
INORG-127	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Organic Carbon forms (inorganic, organic, total) determined using a TOC/NDIR analyser via combustion. Dissolved forms require filtering prior to determination.
METALS-020	Determination of various metals by ICP-OES.
METALS-021	Determination of Mercury by Cold Vapour AAS.
METALS-022	Determination of various metals by ICP-MS.

Result Definitions

Identifier	Description
NR	Not reported
NEPM	National Environment Protection Measure
NS	Not specified
LCS	Laboratory Control Sample
RPD	Relative Percent Difference
>	Greater than
<	Less than
PQL	Practical Quantitation Limit
INS	Insufficient sample for this test
NA	Test not required
NT	Not tested
DOL	Samples rejected due to particulate overload (air filters only)
RFD	Samples rejected due to filter damage (air filters only)
RUD	Samples rejected due to uneven deposition (air filters only)
##	Indicates a laboratory acceptance criteria outlier, for further details, see Result Comments and/or QC Comments

Quality Control Definitions

Blank

This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, and is determined by processing solvents and reagents in exactly the same manner as for samples.

Surrogate Spike

Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

LCS (Laboratory Control Sample)

This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Matrix Spike

A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

Duplicate

This is the complete duplicate analysis of a sample from the process batch. The sample selected should be one where the analyte concentration is easily measurable.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria. Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction. Spikes for Physical and Aggregate Tests are not applicable. For VOCs in water samples, three vials are required for duplicate or spike analysis.

General Acceptance Criteria (GAC) - Analyte specific criteria applies for some analytes and is reflected in QC recovery tables.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% - see ELN-P05 QAQC tables for details (available on request); <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase. Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was typically insufficient in order to satisfy laboratory QA/QC protocols.

Miscellaneous Information

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached. We have taken the sampling date as being the date received at the laboratory.

Two significant figures are reported for the majority of tests and with a high degree of confidence, for results <10*PQL, the second significant figure may be in doubt i.e. has a relatively high degree of uncertainty and is provided for information only.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS where sediment/solids are included by default.

Urine Analysis - The BEI values listed are taken from the 2022 edition of *TLVs and BEIs Threshold Limits by ACGIH*.

Air volume measurements are not covered by Envirolab's NATA accreditation.

Data Quality Assessment Summary PEA1022

Client Details

Client	Hyd2O
Your Reference	H21064 - East Wanneroo Monitoring
Date Issued	03/02/2023

Recommended Holding Time Compliance

Recommended holding time exceedances exist - See detailed list below

Quality Control and QC Frequency

QC Type	Compliant	Details
Blank	Yes	No Outliers
LCS	Yes	No Outliers
Duplicates	No	Duplicate Outliers Exist - See detailed list below
Matrix Spike	No	Matrix Spike Outliers Exist - See detailed list below
Surrogates / Extracted Internal Standards	Yes	No Outliers
QC Frequency	Yes	No Outliers

Surrogates/Extracted Internal Standards, Duplicates and/or Matrix Spikes are not always relevant/applicable to certain analyses and matrices. Therefore, said QC measures are deemed compliant in these situations by default. See Laboratory Acceptance Criteria for more information

Data Quality Assessment Summary PEA1022

Recommended Holding Time Compliance

Analysis	Sample Number(s)	Date Sampled	Date Extracted	Date Analysed	Compliant
Total Phosphorus | Water	1-4	24/01/2023	31/01/2023	01/02/2023	Yes
Dissolved Metals (LL) | Water	1-4	24/01/2023	31/01/2023	02/02/2023	Yes
Dissolved Metals (LL)-Hg | Water	1-4	24/01/2023	31/01/2023	01/02/2023	Yes
Nitrogen - Ammonia | Water	1-4	24/01/2023	27/01/2023	27/01/2023	Yes
Nitrogen - Nitrate | Water	1-4	24/01/2023	27/01/2023	27/01/2023	Yes
Nitrogen - Nitrite | Water	1-4	24/01/2023	27/01/2023	27/01/2023	No
Nitrogen - NOx | Water	1-4	24/01/2023	27/01/2023	27/01/2023	Yes
Nitrogen - Total N | Water	1-4	24/01/2023	30/01/2023	01/02/2023	No
Phosphate as P | Water	1-4	24/01/2023	27/01/2023	27/01/2023	No
TKN as N calc | Water	1-4	24/01/2023	24/01/2023	02/02/2023	Yes

Outliers: Duplicates

INORG-060|Inorganics (Water)| Batch BEA2062

Sample ID	Duplicate ID	Analyte	% Limits	RPD
BEA2062-DUP2#	DUP2	Phosphate as P	20.00	200

Outliers: Matrix Spike

METALS-022|Dissolved Low Level Metals (Water)| Batch BEA2294

Sample ID	Analyte	% Limits	% Recovery
BEA2294-MS1#	Zinc	70 - 130	##[1]

Quality Control PEA1022

METALS-020 | Acid Extractable Metals (Water) | Batch BEA2268

Analyte	Units	PQL	Blank	DUP1 BEA2268-DUP1# Samp | QC | RPD %	DUP2 PEA1022-01 Samp | QC | RPD %	LCS %	Spike % BEA2268-MS1#
Phosphorus	mg/L	0.050	<0.050	<0.050 | <0.050 | [NA]	<0.050 | <0.050 | [NA]	113	111

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

METALS-021 | Dissolved Low Level Metals (Water) | Batch BEA2284

Analyte	Units	PQL	Blank	DUP1 BEA2284-DUP1# Samp | QC | RPD %	DUP2 PEA1022-03 Samp | QC | RPD %	LCS %	Spike % BEA2284-MS1#
Mercury	µg/L	0.050	<0.050	<0.050 | <0.050 | [NA]	<0.050 | <0.050 | [NA]	110	102

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

METALS-022 | Dissolved Low Level Metals (Water) | Batch BEA2294

Analyte	Units	PQL	Blank	DUP1 BEA2294-DUP1# Samp | QC | RPD %	DUP2 BEA2294-DUP2# Samp | QC | RPD %	LCS %	Spike % BEA2294-MS1#
Arsenic	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	108	107
Cadmium	µg/L	0.10	<0.10	<0.10 | <0.10 | [NA]	<0.10 | <0.10 | [NA]	109	108
Chromium	µg/L	1.0	<1.0	2.58 | 3.05 | 16.7	<1.0 | <1.0 | [NA]	102	102
Copper	µg/L	1.0	<1.0	3.03 | 3.02 | 0.331	<1.0 | <1.0 | [NA]	109	111
Lead	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	113	91.3
Nickel	µg/L	1.0	<1.0	1.51 | 1.47 | 2.68	<1.0 | <1.0 | [NA]	109	110
Zinc	µg/L	1.0	<1.0	737 | 757 | 2.63	1.46 | 1.44 | 1.58	109	##[1]

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

INORG-057 | Inorganics (Water) | Batch BEA2062

Analyte	Units	PQL	Blank	DUP1 BEA2062-DUP1# Samp | QC | RPD %	DUP2 BEA2062-DUP2# Samp | QC | RPD %	LCS %	Spike % BEA2062-MS1#
Ammonia as N	mg/L	0.0050	<0.0050	<0.0050 | <0.0050 | [NA]	<0.0050 | <0.0050 | [NA]	96.0	97.4
Nitrate as N	mg/L	0.0050	<0.0050	3.47 | 3.45 | 0.648	2.16 | 2.12 | 1.66	99.5	97.9
Nitrite as N	mg/L	0.0050	<0.0050	<0.0050 | <0.0050 | [NA]	<0.0050 | <0.0050 | [NA]	112	123
NOx as N	mg/L	0.0050	<0.0050	3.47 | 3.45 | 0.646	2.16 | 2.12 | 1.66	99.5	97.4
Phosphate as P	mg/L	0.0050	<0.0050	0.00552 | 0.00532 | 3.69	0.00645 | <0.0050 | 200	105	105
Nitrate as NO3 by calculation	mg/L	0.020	<0.020			[NA]	[NA]
Nitrite as NO2 by calculation	mg/L	0.020	<0.020			[NA]	[NA]

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

INORG-127 | Inorganics (Water) | Batch BEA2197

Analyte	Units	PQL	Blank	DUP1 BEA2197-DUP1# Samp | QC | RPD %	DUP2 PEA1022-01 Samp | QC | RPD %	LCS %	Spike % BEA2197-MS1#
Total Nitrogen	mg/L	0.10	<0.10	70.3 | 72.0 | 2.44	0.993 | 0.999 | 0.592	106	84.5

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

QC Comments

Identifier	Description
[1]	Spike recovery is not applicable due to the relatively high analyte background in the sample (>3* spike level). However, the LCS recovery is within acceptance criteria.

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Certificate of Analysis PED0680

Client Details

Client	Hyd2O
Contact	Sean O'Sullivan
Address	Suite 6B, 103 Rokeby Rd, SUBIACO, WA, 6008

Sample Details

Your Reference	H21064 East Wanneroo Monitoring
Number of Samples	4 Groundwater
Date Samples Received	13/04/2023
Date Samples Registered	13/04/2023

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date Results Requested by	20/04/2023
Date of Issue	20/04/2023

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Authorisation Details

Results Approved By	Jessica Miller, Microbiological Supervisor Michael Hall, Inorganics & Metals Supervisor Michael Mowle, Inorganics Supervisor Todd Lee, Group Operations Manager
Laboratory Manager	Michael Kubiak

Certificate of Analysis PED0680

Samples in this Report

Envirolab ID	Sample ID	Matrix	Date Sampled	Date Received
PED0680-01	EW01	Groundwater	12/04/2023	13/04/2023
PED0680-02	EW02	Groundwater	12/04/2023	13/04/2023
PED0680-03	EW03	Groundwater	12/04/2023	13/04/2023
PED0680-04	WM42	Groundwater	12/04/2023	13/04/2023

Certificate of Analysis PED0680

Acid Extractable Metals (Groundwater)

Envirolab ID	Units	PQL	PED0680-01	PED0680-02	PED0680-03	PED0680-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			12/04/2023	12/04/2023	12/04/2023	12/04/2023
Phosphorus	mg/L	0.050	<0.050	<0.050	<0.050	<0.050

Certificate of Analysis PED0680

Dissolved Low Level Metals (Groundwater)

Envirolab ID	**Units**	**PQL**	PED0680-01	PED0680-02	PED0680-03	PED0680-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			12/04/2023	12/04/2023	12/04/2023	12/04/2023
Aluminium	µg/L	10	360	28	46	<10
Arsenic	µg/L	1.0	<1.0	<1.0	<1.0	<1.0
Cadmium	µg/L	0.10	<0.10	<0.10	<0.10	<0.10
Chromium	µg/L	1.0	<1.0	<1.0	<1.0	<1.0
Copper	µg/L	1.0	<1.0	2.4	<1.0	<1.0
Iron	µg/L	10	1100	92	28	<10
Mercury	µg/L	0.050	<0.050	<0.050	<0.050	<0.050
Nickel	µg/L	1.0	<1.0	1.2	<1.0	<1.0
Lead	µg/L	1.0	<1.0	<1.0	<1.0	<1.0
Zinc	µg/L	1.0	4.6	43	<1.0	4.0

Certificate of Analysis PED0680

Inorganics - Ionic Balance and Indexes (Groundwater)

Envirolab ID	**Units**	**PQL**	PED0680-01	PED0680-02	PED0680-03	PED0680-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			12/04/2023	12/04/2023	12/04/2023	12/04/2023
Chloride	mg/L	1.0	81	140	19	160
Sulfate	mg/L	1.0	62	140	9.1	170

Certificate of Analysis PED0680

Inorganics - Nutrients (Groundwater)

Envirolab ID	Units	PQL	PED0680-01	PED0680-02	PED0680-03	PED0680-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			12/04/2023	12/04/2023	12/04/2023	12/04/2023
Ammonia as N	mg/L	0.0050	0.0085	<0.0050	<0.0050	0.057
Nitrate as N	mg/L	0.0050	0.042	76	1.7	0.53
Nitrate as NO3 by calculation	mg/L	0.020	0.19	340	7.4	2.4
Nitrite as N	mg/L	0.0050	<0.0050	0.0064	<0.0050	<0.0050
Nitrite as NO2 by calculation	mg/L	0.020	<0.020	0.021	<0.020	<0.020
NOx as N	mg/L	0.0050	0.045	76	1.7	0.53
TKN as N by calculation	mg/L	0.10	0.25	67	0.36	0.25
Organic Nitrogen by calc.	mg/L	0.10	0.24	67	0.36	0.19
Total Nitrogen	mg/L	0.10	0.30	140	2.0	0.78
Phosphate as P	mg/L	0.0050	<0.0050	<0.0050	<0.0050	0.0074

Certificate of Analysis PED0680

Microbiological Suite (Groundwater)

Envirolab ID	Units	PQL	PED0680-01	PED0680-02	PED0680-03	PED0680-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			12/04/2023	12/04/2023	12/04/2023	12/04/2023
Thermotolerant Coliforms	cfu/100mL	1	<10 [1]	<10 [1]	<10 [1]	<10 [1]
E.coli	cfu/100mL	1	<10 [1]	<10 [1]	<10 [1]	<10 [1]

Result Comments

Identifier	Description
[1]	Microbiological testing PQL raised due to high sample turbidity and/or matrix interference.

Method Summary

Method ID	Methodology Summary
Calc	Calculation
Calc - TKN	TKN determined by calculation (Total Nitrogen - NOx).
INORG-055	Nitrate/Nitrite/NOx/TKN - determined colourimetrically. Waters samples are filtered on receipt prior to analysis. Soils/solids are analysed following a water extraction.
INORG-057	Ammonia - determined colourimetrically. Water samples are filtered on receipt prior to analysis. Soils and OHS media are analysed following a water extraction. Alternatively, Ammonia can be extracted from soil using 1M KCl.
INORG-060	Phosphate - determined colourimetrically using APHA latest edition 4500 P E. Water samples are filtered on receipt prior to analysis. Soils are analysed from a water extract.
INORG-081	Anions determined by Ion Chromatography. Waters samples are filtered on receipt prior to analysis. Solids are analysed from a water extract. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
INORG-127	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Organic Carbon forms (inorganic, organic, total) determined using a TOC/NDIR analyser via combustion. Dissolved forms require filtering prior to determination.
METALS-020	Determination of various metals by ICP-OES.
METALS-021	Determination of Mercury by Cold Vapour AAS.
METALS-022	Determination of various metals by ICP-MS.
MICRO-001B	E. coli/Thermotolerant coliforms: Microbial Water Analysis - in accordance with MICRO-001 (AS4276.5-latest edition). Recommended maximums based on NHMRC Australian Drinking Water Guidelines. Please note that results for this test derived from counts outside of the range 10-100 are considered approximate as per AS4276.1.

Result Definitions

Identifier	Description
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NEPM	National Environment Protection Measure
NS	Not specified
LCS	Laboratory Control Sample
RPD	Relative Percent Difference
>	Greater than
<	Less than
PQL	Practical Quantitation Limit
INS	Insufficient sample for this test
NA	Test not required
NT	Not tested
DOL	Samples rejected due to particulate overload (air filters only)
RFD	Samples rejected due to filter damage (air filters only)
RUD	Samples rejected due to uneven deposition (air filters only)
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Quality Control Definitions

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Duplicate

This is the complete duplicate analysis of a sample from the process batch. The sample selected should be one where the analyte concentration is easily measurable.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria. Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction. Spikes for Physical and Aggregate Tests are not applicable. For VOCs in water samples, three vials are required for duplicate or spike analysis.

General Acceptance Criteria (GAC) - Analyte specific criteria applies for some analytes and is reflected in QC recovery tables.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% - see ELN-P05 QAQC tables for details (available on request); <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase. Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was typically insufficient in order to satisfy laboratory QA/QC protocols.

Miscellaneous Information

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached. We have taken the sampling date as being the date received at the laboratory.

Two significant figures are reported for the majority of tests and with a high degree of confidence, for results <10*PQL, the second significant figure may be in doubt i.e. has a relatively high degree of uncertainty and is provided for information only.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS where sediment/solids are included by default.

Urine Analysis - The BEI values listed are taken from the 2022 edition of *TLVs and BEIs Threshold Limits by ACGIH*.

Air volume measurements are not covered by Envirolab's NATA accreditation.

Data Quality Assessment Summary PED0680

Client Details

Client	Hyd2O
Your Reference	H21064 East Wanneroo Monitoring
Date Issued	20/04/2023

Recommended Holding Time Compliance

No recommended holding time exceedances

Quality Control and QC Frequency

QC Type	Compliant	Details
Blank	Yes	No Outliers
LCS	Yes	No Outliers
Duplicates	Yes	No Outliers
Matrix Spike	Yes	No Outliers
Surrogates / Extracted Internal Standards	Yes	No Outliers
QC Frequency	Yes	No Outliers

Surrogates/Extracted Internal Standards, Duplicates and/or Matrix Spikes are not always relevant/applicable to certain analyses and matrices. Therefore, said QC measures are deemed compliant in these situations by default. See Laboratory Acceptance Criteria for more information

Data Quality Assessment Summary PED0680

Recommended Holding Time Compliance

Analysis	Sample Number(s)	Date Sampled	Date Extracted	Date Analysed	Compliant
Total Phosphorus | Water	1-4	12/04/2023	17/04/2023	17/04/2023	Yes
Dissolved Metals (LL) | Water	1-4	12/04/2023	17/04/2023	18/04/2023	Yes
Dissolved Metals (LL)-Hg | Water	1-4	12/04/2023	13/04/2023	14/04/2023	Yes
Chloride | Water	1-4	12/04/2023	14/04/2023	14/04/2023	Yes
Sulfate | Water	1-4	12/04/2023	14/04/2023	14/04/2023	Yes
Nitrogen - Ammonia | Water	1-4	12/04/2023	14/04/2023	14/04/2023	Yes
Nitrogen - Nitrate | Water	1-4	12/04/2023	14/04/2023	14/04/2023	Yes
Nitrogen - Nitrite | Water	1-4	12/04/2023	14/04/2023	14/04/2023	Yes
Nitrogen - NOx | Water	1-4	12/04/2023	14/04/2023	14/04/2023	Yes
Nitrogen - Total N | Water	1-3	12/04/2023	14/04/2023	14/04/2023	Yes
	4	12/04/2023	14/04/2023	15/04/2023	Yes
Phosphate as P | Water	1-4	12/04/2023	14/04/2023	14/04/2023	Yes
TKN as N calc | Water	1-4	12/04/2023	14/04/2023	14/04/2023	Yes
E. coli & T.T.coli | Water	1-4	12/04/2023	13/04/2023	13/04/2023	Yes

Quality Control PED0680

METALS-020 | Acid Extractable Metals (Water) | Batch BED1311

Analyte	Units	PQL	Blank	DUP1 BED1311-DUP1# Samp | QC | RPD %	DUP2 BED1311-DUP2# Samp | QC | RPD %	LCS %	Spike % BED1311-MS1#
Phosphorus	mg/L	0.050	<0.050	0.514 | 0.513 | 0.261	8.01 | 7.95 | 0.660	108	102

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

METALS-021 | Dissolved Low Level Metals (Water) | Batch BED1105

Analyte	Units	PQL	Blank	DUP1 BED1105-DUP1# Samp | QC | RPD %	DUP2 BED1105-DUP2# Samp | QC | RPD %	LCS %	Spike % BED1105-MS1#
Mercury	µg/L	0.050	<0.050	<0.050 | <0.050 | [NA]	<0.050 | <0.050 | [NA]	99.2	99.2

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

METALS-022 | Dissolved Low Level Metals (Water) | Batch BED1285

Analyte	Units	PQL	Blank	DUP1 BED1285-DUP1# Samp | QC | RPD %	DUP2 BED1285-DUP2# Samp | QC | RPD %	LCS %	Spike % BED1285-MS1#
Aluminium	µg/L	10	<10	<10 | <10 | [NA]	203 | 203 | 0.187	101	112
Arsenic	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	8.36 | 7.88 | 5.91	101	106
Cadmium	µg/L	0.10	<0.10	<0.10 | <0.10 | [NA]	7.01 | 6.63 | 5.57	102	106
Chromium	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	2.93 | 2.69 | 8.54	101	102
Copper	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	8.46 | 7.46 | 12.6	102	88.4
Iron	µg/L	10	<10	3560 | 3600 | 1.18	648 | 641 | 1.09	114	79.8
Lead	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	104	95.8
Nickel	µg/L	1.0	<1.0	6.91 | 6.73 | 2.57	7.85 | 7.14 | 9.47	101	95.1
Zinc	µg/L	1.0	<1.0	15.9 | 15.6 | 1.43	127 | 122 | 3.86	94.7	81.8

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

INORG-081 | Inorganics - Ionic Balance and Indexes (Water) | Batch BED1190

Analyte	Units	PQL	Blank	DUP1 BED1190-DUP1# Samp | QC | RPD %	DUP2 PED0680-01 Samp | QC | RPD %	LCS %	Spike % BED1190-MS1#
Chloride	mg/L	1.0	<1.0	273 | 274 | 0.332	80.7 | 81.0 | 0.295	100	71.3
Sulfate	mg/L	1.0	<1.0	154 | 155 | 0.458	61.9 | 61.9 | 0.127	95.4	100

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

INORG-057 | Inorganics - Nutrients (Water) | Batch BED1185

Analyte	Units	PQL	Blank	DUP1 BED1185-DUP1# Samp | QC | RPD %	DUP2 PED0680-01 Samp | QC | RPD %	LCS %	Spike % BED1185-MS1#
Ammonia as N	mg/L	0.0050	<0.0050	0.108 | 0.112 | 3.74	0.00850 | 0.00870 | 2.27	108	98.4
Nitrate as N	mg/L	0.0050	<0.0050	0.525 | 0.519 | 1.11	0.0422 | 0.0425 | 0.733	102	97.0
Nitrate as NO3 by calculation	mg/L	0.020	<0.020			[NA]	[NA]
Nitrite as N	mg/L	0.0050	<0.0050	0.0116 | 0.0120 | 3.39	<0.0050 | <0.0050 | [NA]	111	125
Nitrite as NO2 by calculation	mg/L	0.020	<0.020			[NA]	[NA]
NOx as N	mg/L	0.0050	<0.0050	0.536 | 0.531 | 1.01	0.0454 | 0.0458 | 0.844	102	97.0
Phosphate as P	mg/L	0.0050	<0.0050	<0.0050 | <0.0050 | [NA]	<0.0050 | <0.0050 | [NA]	113	120

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

INORG-127 | Inorganics - Nutrients (Water) | Batch BED1203

Analyte	Units	PQL	Blank	DUP1 BED1203-DUP1# Samp | QC | RPD %	DUP2 PED0680-01 Samp | QC | RPD %	LCS %	Spike % BED1203-MS1#
Total Nitrogen	mg/L	0.10	<0.10	0.753 | 0.620 | 19.3	0.297 | 0.297 | 0.0224	108	106

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

Quality Control PED0680

MICRO-001B | Microbiological Suite (Water) | Batch BED1161

Analyte	Units	PQL	Blank	DUP1 BED1161-DUP1# Samp | QC | RPD %	DUP2 BED1161-DUP2# Samp | QC | RPD %	LCS %
Thermotolerant Coliforms	cfu/100mL	1	<1	<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]
E.coli	cfu/100mL	1	<1	<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]

Analyte	Units	PQL	Blank	DUP3 BED1161-DUP3# Samp | QC | RPD %	DUP4 BED1161-DUP4# Samp | QC | RPD %	LCS %
Thermotolerant Coliforms	cfu/100mL	1		1.00 | 1.00 | 0.00	<1 | <1 | [NA]	[NA]
E.coli	cfu/100mL	1		1.00 | 1.00 | 0.00	<1 | <1 | [NA]	[NA]

Analyte	Units	PQL	Blank	DUP5 BED1161-DUP5# Samp | QC | RPD %	DUP6 BED1161-DUP6# Samp | QC | RPD %	LCS %
Thermotolerant Coliforms	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]
E.coli	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]

Analyte	Units	PQL	Blank	DUP7 BED1161-DUP7# Samp | QC | RPD %	DUP8 BED1161-DUP8# Samp | QC | RPD %	LCS %
Thermotolerant Coliforms	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]
E.coli	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
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Certificate of Analysis PEG1093

Client Details

Client	Hyd2O
Contact	Brian Lau
Address	Suite 6B, 103 Rokeby Rd, SUBIACO, WA, 6008

Sample Details

Your Reference	H21064 - East Wanneroo Monitoring
Number of Samples	4 Groundwater
Date Samples Received	19/07/2023
Date Samples Registered	19/07/2023

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date Results Requested by	26/07/2023
Date of Issue	26/07/2023

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Accredited for compliance with ISO/IEC 17025. Tests not covered by NATA are denoted with *.

Authorisation Details

Results Approved By	Heram Halim, Operations Manager Jessica Miller, Microbiological Supervisor Michael Hall, Inorganics & Metals Supervisor
Laboratory Manager	Michael Kubiak

Certificate of Analysis PEG1093

Samples in this Report

Envirolab ID	Sample ID	Matrix	Date Sampled	Date Received
PEG1093-01	EW01	Groundwater	18/07/2023	19/07/2023
PEG1093-02	EW02	Groundwater	18/07/2023	19/07/2023
PEG1093-03	EW03	Groundwater	18/07/2023	19/07/2023
PEG1093-04	WM42	Groundwater	18/07/2023	19/07/2023

Certificate of Analysis PEG1093

Acid Extractable Metals (Groundwater)

Envirolab ID	Units	PQL	PEG1093-01	PEG1093-02	PEG1093-03	PEG1093-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			18/07/2023	18/07/2023	18/07/2023	18/07/2023
Phosphorus	mg/L	0.050	<0.050	<0.050	<0.050	<0.050

Certificate of Analysis PEG1093

Dissolved Low Level Metals (Groundwater)

Envirolab ID	**Units**	**PQL**	PEG1093-01	PEG1093-02	PEG1093-03	PEG1093-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			18/07/2023	18/07/2023	18/07/2023	18/07/2023
Aluminium	µg/L	10	43	30	<10	<10
Arsenic	µg/L	1.0	<1.0	<1.0	<1.0	<1.0
Cadmium	µg/L	0.10	<0.10	<0.10	<0.10	<0.10
Chromium	µg/L	1.0	<1.0	<1.0	<1.0	<1.0
Copper	µg/L	1.0	2.8	<1.0	<1.0	<1.0
Iron	µg/L	10	620	180	<10	<10
Mercury	µg/L	0.050	<0.050	<0.050	<0.050	<0.050
Nickel	µg/L	1.0	2.0	1.7	<1.0	<1.0
Lead	µg/L	1.0	<1.0	<1.0	<1.0	<1.0
Zinc	µg/L	1.0	9.9	52	15	7.6

Certificate of Analysis PEG1093

Inorganics - Ionic Balance and Indexes (Groundwater)

Envirolab ID	Units	PQL	PEG1093-01	PEG1093-02	PEG1093-03	PEG1093-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			18/07/2023	18/07/2023	18/07/2023	18/07/2023
Chloride	mg/L	1.0	82	150	15	160
Sulfate	mg/L	1.0	60	130	5.0	170

Certificate of Analysis PEG1093

Inorganics - Nutrients (Groundwater)

Envirolab ID	Units	PQL	PEG1093-01	PEG1093-02	PEG1093-03	PEG1093-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			18/07/2023	18/07/2023	18/07/2023	18/07/2023
Ammonia as N	mg/L	0.0050	0.012	<0.0050	0.0059	0.21
Nitrate as N	mg/L	0.0050	0.25	88	2.7	0.42
Nitrate as NO3 by calculation	mg/L	0.020	1.1	390	12	1.8
Nitrite as N	mg/L	0.0050	0.0050	0.0064	<0.0050	0.0052
Nitrite as NO2 by calculation	mg/L	0.020	<0.020	0.021	<0.020	<0.020
NOx as N	mg/L	0.0050	0.26	88	2.7	0.42
TKN as N by calculation	mg/L	0.10	0.20	32	0.43	0.22
Organic Nitrogen by calc.	mg/L	0.10	0.19	32	0.43	<0.10
Total Nitrogen	mg/L	0.10	0.46	120	3.1	0.64
Phosphate as P	mg/L	0.0050	<0.0050	<0.0050	<0.0050	0.0055

Certificate of Analysis PEG1093

Microbiological Suite (Groundwater)

Envirolab ID	Units	PQL	PEG1093-01	PEG1093-02	PEG1093-03	PEG1093-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			18/07/2023	18/07/2023	18/07/2023	18/07/2023
Thermotolerant Coliforms	cfu/100mL	1	<1	<1	3	<1
E.coli	cfu/100mL	1	<1	<1	<1	<1

Method Summary

Method ID	Methodology Summary
Calc	Calculation
Calc - TKN	TKN determined by calculation (Total Nitrogen - NOx).
INORG-055	Nitrate/Nitrite/NOx/TKN - determined colourimetrically. Waters samples are filtered on receipt prior to analysis. Soils/solids are analysed following a water extraction.
INORG-057	Ammonia - determined colourimetrically. Water samples are filtered on receipt prior to analysis. Soils and OHS media are analysed following a water extraction. Alternatively, Ammonia can be extracted from soil using 1M KCl.
INORG-060	Phosphate - determined colourimetrically using APHA latest edition 4500 P E. Water samples are filtered on receipt prior to analysis. Soils are analysed from a water extract.
INORG-081	Anions determined by Ion Chromatography. Waters samples are filtered on receipt prior to analysis. Solids are analysed from a water extract. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
INORG-127	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Organic Carbon forms (inorganic, organic, total) determined using a TOC/NDIR analyser via combustion. Dissolved forms require filtering prior to determination.
METALS-020	Determination of various metals by ICP-OES.
METALS-021	Determination of Mercury by Cold Vapour AAS.
METALS-022	Determination of various metals by ICP-MS. Please note for Bromine and Iodine, any forms of these elements that are present are included together in the one result reported for each of these two elements.
MICRO-001B	E. coli/Thermotolerant coliforms: Microbial Water Analysis - in accordance with MICRO-001 (AS4276.5-latest edition). Recommended maximums based on NHMRC Australian Drinking Water Guidelines. Please note that results for this test derived from counts outside of the range 10-100 are considered approximate as per AS4276.1.

Result Definitions

Identifier	Description
NR	Not reported
NEPM	National Environment Protection Measure
NS	Not specified
LCS	Laboratory Control Sample
RPD	Relative Percent Difference
>	Greater than
<	Less than
PQL	Practical Quantitation Limit
INS	Insufficient sample for this test
NA	Test not required
NT	Not tested
DOL	Samples rejected due to particulate overload (air filters only)
RFD	Samples rejected due to filter damage (air filters only)
RUD	Samples rejected due to uneven deposition (air filters only)
##	Indicates a laboratory acceptance criteria outlier, for further details, see Result Comments and/or QC Comments

Quality Control Definitions

Blank

This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, and is determined by processing solvents and reagents in exactly the same manner as for samples.

Surrogate Spike

Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

LCS (Laboratory Control Sample)

This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Matrix Spike

A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

Duplicate

This is the complete duplicate analysis of a sample from the process batch. The sample selected should be one where the analyte concentration is easily measurable.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria. Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction. Spikes for Physical and Aggregate Tests are not applicable. For VOCs in water samples, three vials are required for duplicate or spike analysis.

General Acceptance Criteria (GAC) - Analyte specific criteria applies for some analytes and is reflected in QC recovery tables.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% - see ELN-P05 QAQC tables for details (available on request); <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase. Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was typically insufficient in order to satisfy laboratory QA/QC protocols.

Miscellaneous Information

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached. We have taken the sampling date as being the date received at the laboratory.

Two significant figures are reported for the majority of tests and with a high degree of confidence, for results <10*PQL, the second significant figure may be in doubt i.e. has a relatively high degree of uncertainty and is provided for information only.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS where sediment/solids are included by default.

Urine Analysis - The BEI values listed are taken from the 2022 edition of *TLVs and BEIs Threshold Limits by ACGIH*.

Air volume measurements are not covered by Envirolab's NATA accreditation.

Data Quality Assessment Summary PEG1093

Client Details

Client	Hyd2O
Your Reference	H21064 - East Wanneroo Monitoring
Date Issued	26/07/2023

Recommended Holding Time Compliance

No recommended holding time exceedances

Quality Control and QC Frequency

QC Type	Compliant	Details
Blank	Yes	No Outliers
LCS	Yes	No Outliers
Duplicates	No	Duplicate Outliers Exist - See detailed list below
Matrix Spike	No	Matrix Spike Outliers Exist - See detailed list below
Surrogates / Extracted Internal Standards	Yes	No Outliers
QC Frequency	Yes	No Outliers

Surrogates/Extracted Internal Standards, Duplicates and/or Matrix Spikes are not always relevant/applicable to certain analyses and matrices. Therefore, said QC measures are deemed compliant in these situations by default. See Laboratory Acceptance Criteria for more information

Data Quality Assessment Summary PEG1093

Recommended Holding Time Compliance

Analysis	Sample Number(s)	Date Sampled	Date Extracted	Date Analysed	Compliant
Total Phosphorus | Water	1-4	18/07/2023	21/07/2023	24/07/2023	Yes
Dissolved Metals (LL) | Water	1-4	18/07/2023	20/07/2023	25/07/2023	Yes
Dissolved Metals (LL)-Hg | Water	1-4	18/07/2023	21/07/2023	24/07/2023	Yes
Chloride | Water	1-4	18/07/2023	20/07/2023	21/07/2023	Yes
Sulfate | Water	1-4	18/07/2023	20/07/2023	21/07/2023	Yes
Nitrogen - Ammonia | Water	1-4	18/07/2023	20/07/2023	20/07/2023	Yes
Nitrogen - Nitrate | Water	1-4	18/07/2023	20/07/2023	20/07/2023	Yes
Nitrogen - Nitrite | Water	1-4	18/07/2023	20/07/2023	20/07/2023	Yes
Nitrogen - NOx | Water	1-4	18/07/2023	20/07/2023	20/07/2023	Yes
Nitrogen - Total N | Water	1-4	18/07/2023	21/07/2023	22/07/2023	Yes
Phosphate as P | Water	1-4	18/07/2023	20/07/2023	20/07/2023	Yes
TKN as N calc | Water	1-4	18/07/2023	25/07/2023	25/07/2023	Yes
E. coli & T.T.coli | Water	1-4	18/07/2023	19/07/2023	19/07/2023	Yes

Outliers: Duplicates

INORG-057|Inorganics - Nutrients (Water)| Batch BEG2156

Sample ID	Duplicate ID	Analyte	% Limits	RPD
BEG2156-DUP2#	DUP2	Ammonia as N	20.00	20.4[2]

METALS-022|Dissolved Low Level Metals (Water)| Batch BEG2209

Sample ID	Duplicate ID	Analyte	% Limits	RPD
BEG2209-DUP1#	DUP1	Chromium	20.00	39.6[2]
BEG2209-DUP1#	DUP1	Nickel	20.00	33.0[3]

Outliers: Matrix Spike

METALS-022|Dissolved Low Level Metals (Water)| Batch BEG2209

Sample ID	Analyte	% Limits	% Recovery
BEG2209-MS1#	Aluminium	70 - 130	##[1]
BEG2209-MS1#	Iron	70 - 130	##[1]

Quality Control PEG1093

METALS-020 | Acid Extractable Metals (Water) | Batch BEG2323

Analyte	Units	PQL	Blank	DUP1 BEG2323-DUP1# Samp | QC | RPD %	DUP2 PEG1093-03 Samp | QC | RPD %	LCS %	Spike % BEG2323-MS1#
Phosphorus	mg/L	0.050	<0.050	0.192 | 0.194 | 1.29	<0.050 | <0.050 | [NA]	102	97.0

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

METALS-022 | Dissolved Low Level Metals (Water) | Batch BEG2209

Analyte	Units	PQL	Blank	DUP1 BEG2209-DUP1# Samp | QC | RPD %	DUP2 BEG2209-DUP2# Samp | QC | RPD %	LCS %	Spike % BEG2209-MS1#
Aluminium	µg/L	10	<10	486 | 457 | 6.07	441 | 427 | 3.16	112	##[1]
Arsenic	µg/L	1.0	<1.0	8.46 | 8.22 | 2.82	1.46 | 1.41 | 3.48	110	115
Cadmium	µg/L	0.10	<0.10	0.335 | 0.335 | 0.00	<0.10 | <0.10 | [NA]	107	113
Chromium	µg/L	1.0	<1.0	9.31 | 13.9 | 39.6 [2]	3.30 | 3.25 | 1.68	107	107
Copper	µg/L	1.0	<1.0	58.2 | 57.3 | 1.58	2.16 | 2.06 | 4.27	106	106
Iron	µg/L	10	<10	552 | 539 | 2.45	631 | 640 | 1.37	114	##[1]
Lead	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	106	103
Nickel	µg/L	1.0	<1.0	18.6 | 25.9 | 33.0 [3]	1.02 | 1.10 | 7.58	106	105
Zinc	µg/L	1.0	<1.0	13.4 | 13.0 | 3.00	13.3 | 13.1 | 1.70	109	105

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

METALS-021 | Dissolved Low Level Metals (Water) | Batch BEG2387

Analyte	Units	PQL	Blank	DUP1 BEG2387-DUP1# Samp | QC | RPD %	DUP2 PEG1093-02 Samp | QC | RPD %	LCS %	Spike % BEG2387-MS1#
Mercury	µg/L	0.050	<0.050	<0.050 | <0.050 | [NA]	<0.050 | <0.050 | [NA]	100	96.0

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

INORG-081 | Inorganics - Ionic Balance and Indexes (Water) | Batch BEG2178

Analyte	Units	PQL	Blank	DUP1 BEG2178-DUP1# Samp | QC | RPD %	DUP2 BEG2178-DUP2# Samp | QC | RPD %	LCS %	Spike % BEG2178-MS1#
Chloride	mg/L	1.0	<1.0	1000 | 1000 | 0.443	854 | 860 | 0.756	99.2	103
Sulfate	mg/L	1.0	<1.0	3400 | 3390 | 0.420	2320 | 2340 | 0.802	97.6	82.3

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

INORG-057 | Inorganics - Nutrients (Water) | Batch BEG2156

Analyte	Units	PQL	Blank	DUP1 BEG2156-DUP1# Samp | QC | RPD %	DUP2 BEG2156-DUP2# Samp | QC | RPD %	LCS %	Spike % BEG2156-MS1#
Ammonia as N	mg/L	0.0050	<0.0050	0.358 | 0.329 | 8.65	0.00685 | 0.00558 | 20.4 [2]	112	107
Nitrate as N	mg/L	0.0050	<0.0050	<0.0050 | <0.0050 | [NA]	0.185 | 0.189 | 2.29	92.8	113
Nitrate as NO3 by calculation	mg/L	0.020	<0.020			[NA]	[NA]
Nitrite as N	mg/L	0.0050	<0.0050	<0.0050 | <0.0050 | [NA]	0.0151 | 0.0156 | 3.00	101	108
Nitrite as NO2 by calculation	mg/L	0.020	<0.020			[NA]	[NA]
NOx as N	mg/L	0.0050	<0.0050	<0.0050 | <0.0050 | [NA]	0.200 | 0.205 | 2.35	92.8	106
Phosphate as P	mg/L	0.0050	<0.0050	0.0428 | 0.0419 | 2.04	0.0396 | 0.0392 | 0.927	105	113

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

INORG-127 | Inorganics - Nutrients (Water) | Batch BEG2290

Analyte	Units	PQL	Blank	DUP1 BEG2290-DUP1# Samp | QC | RPD %	DUP2 BEG2290-DUP2# Samp | QC | RPD %	LCS %	Spike % BEG2290-MS1#
Total Nitrogen	mg/L	0.10	<0.10	43.3 | 43.6 | 0.815	3.07 | 3.08 | 0.230	111	92.8

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

Quality Control PEG1093

INORG-127 | Inorganics - Nutrients (Water) | Batch BEG2291

Analyte	Units	PQL	Blank	DUP1 BEG2291-DUP1# Samp | QC | RPD %	DUP2 BEG2291-DUP2# Samp | QC | RPD %	LCS %	Spike % BEG2291-MS1#
Total Nitrogen	mg/L	0.10	<0.10	<0.10 | <0.10 | [NA]	<0.50 | <0.50 | [NA]	107	109

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

MICRO-001B | Microbiological Suite (Water) | Batch BEG2085

Analyte	Units	PQL	Blank	DUP1 BEG2085-DUP1# Samp | QC | RPD %	DUP2 BEG2085-DUP2# Samp | QC | RPD %	LCS %
Thermotolerant Coliforms	cfu/100mL	1	<1	<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]
E.coli	cfu/100mL	1	<1	<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]

Analyte	Units	PQL	Blank	DUP3 BEG2085-DUP3# Samp | QC | RPD %	DUP4 BEG2085-DUP4# Samp | QC | RPD %	LCS %
Thermotolerant Coliforms	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]
E.coli	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]

Analyte	Units	PQL	Blank	DUP5 BEG2085-DUP5# Samp | QC | RPD %	DUP6 BEG2085-DUP6# Samp | QC | RPD %	LCS %
Thermotolerant Coliforms	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]
E.coli	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]

Analyte	Units	PQL	Blank	DUP7 BEG2085-DUP7# Samp | QC | RPD %	DUP8 BEG2085-DUP8# Samp | QC | RPD %	LCS %
Thermotolerant Coliforms	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]
E.coli	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]

Analyte	Units	PQL	Blank	DUP9 BEG2085-DUP9# Samp | QC | RPD %	DUPA BEG2085-DUPA# Samp | QC | RPD %	LCS %
Thermotolerant Coliforms	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]
E.coli	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

QC Comments

Identifier	Description
[1]	Spike recovery is not applicable due to the relatively high analyte background in the sample (>3* spike level). However, the LCS recovery is within acceptance criteria.
[2]	Duplicate %RPD may be flagged as an outlier to routine laboratory acceptance, however, where one or both results are <10*PQL, the RPD acceptance criteria increases exponentially.
[3]	The laboratory duplicate RPD acceptance criteria has been exceeded. Sample heterogeneity suspected. 3 sets of data have been provided to help demonstrate the degree of non-homogeneity within the sample as well as assessing the analytical precision.

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Certificate of Analysis PEK1352

Client Details

Client	Hyd2O
Contact	Andre Righetti
Address	Suite 6B, 103 Rokeby Rd, SUBIACO, WA, 6008

Sample Details

Your Reference	H21064 - East Wanneroo Monitoring
Number of Samples	4 Groundwater
Date Samples Received	17/11/2023
Date Instructions Received	17/11/2023

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date Results Requested by	27/11/2023
Date of Issue	24/11/2023

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Authorisation Details

Results Approved By	Heram Halim, Operations Manager Jessica Miller, Microbiological Supervisor Lien Tang, Assistant Operations Manager Todd Lee, Group Operations Manager
Laboratory Manager	Michael Kubiak

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Samples in this Report

Envirolab ID	Sample ID	Matrix	Date Sampled	Date Received
PEK1352-01	EW01	Groundwater	17/11/2023	17/11/2023
PEK1352-02	EW02	Groundwater	17/11/2023	17/11/2023
PEK1352-03	EW03	Groundwater	17/11/2023	17/11/2023
PEK1352-04	WM42	Groundwater	17/11/2023	17/11/2023

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Acid Extractable Metals (Groundwater)

Envirolab ID	Units	PQL	PEK1352-01	PEK1352-02	PEK1352-03	PEK1352-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			17/11/2023	17/11/2023	17/11/2023	17/11/2023
Phosphorus	mg/L	0.050	<0.050	<0.050	<0.050	<0.050

Certificate of Analysis PEK1352

Dissolved Low Level Metals (Groundwater)

Envirolab ID	Units	PQL	PEK1352-01	PEK1352-02	PEK1352-03	PEK1352-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			17/11/2023	17/11/2023	17/11/2023	17/11/2023
Aluminium	µg/L	10	63	39	<10	<10
Arsenic	µg/L	1.0	<1.0	<1.0	<1.0	<1.0
Cadmium	µg/L	0.10	<0.10	<0.10	<0.10	<0.10
Chromium	µg/L	1.0	<1.0	<1.0	<1.0	<1.0
Copper	µg/L	1.0	<1.0	2.5	<1.0	<1.0
Iron	µg/L	10	2700	170	16	<10
Mercury	µg/L	0.050	<0.050	<0.050	<0.050	<0.050
Nickel	µg/L	1.0	<1.0	1.2	<1.0	<1.0
Lead	µg/L	1.0	<1.0	<1.0	<1.0	<1.0
Zinc	µg/L	1.0	14	51	2.2	42

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Inorganics - Ionic Balance and Indexes (Groundwater)

Envirolab ID	Units	PQL	PEK1352-01	PEK1352-02	PEK1352-03	PEK1352-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			17/11/2023	17/11/2023	17/11/2023	17/11/2023
Chloride	mg/L	1.0	84	130	11	160
Sulfate	mg/L	1.0	64	130	4.2	170

Certificate of Analysis PEK1352

Inorganics - Nutrients (Groundwater)

Envirolab ID	Units	PQL	PEK1352-01	PEK1352-02	PEK1352-03	PEK1352-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			17/11/2023	17/11/2023	17/11/2023	17/11/2023
Ammonia as N	mg/L	0.0050	0.030	<0.0050	<0.0050	<0.0050
Nitrate as N	mg/L	0.0050	0.23	75	0.97	0.67
Nitrate as NO3 by calculation	mg/L	0.020	1.0	330	4.3	2.9
Nitrite as N	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite as NO2 by calculation	mg/L	0.020	<0.020	<0.020	<0.020	<0.020
NOx as N	mg/L	0.0050	0.23	75	0.97	0.67
TKN as N by calculation	mg/L	0.10	0.27	11	<0.10	<0.10
Organic Nitrogen by calc.	mg/L	0.10	0.24	11	<0.10	<0.10
Total Nitrogen	mg/L	0.10	0.50	85	1.0	0.72
Phosphate as P	mg/L	0.0050	0.0079	0.0072	<0.0050	0.0075

Certificate of Analysis PEK1352

Microbiological Suite (Groundwater)

Envirolab ID	Units	PQL	PEK1352-01	PEK1352-02	PEK1352-03	PEK1352-04
Your Reference			EW01	EW02	EW03	WM42
Date Sampled			17/11/2023	17/11/2023	17/11/2023	17/11/2023
Thermotolerant Coliforms	cfu/100mL	1	<1	2	<1	<1
E.coli	cfu/100mL	1	<1	<1	<1	<1

Method Summary

Method ID	Methodology Summary
Calc	Calculation
Calc - TKN	TKN determined by calculation (Total Nitrogen - NOx).
INORG-055	Nitrate/Nitrite/NOx/TKN - determined colourimetrically. Waters samples are filtered on receipt prior to analysis. Soils/solids are analysed following a water extraction.
INORG-057	Ammonia - determined colourimetrically. Water samples are filtered on receipt prior to analysis. Soils and OHS media are analysed following a water extraction. Alternatively, Ammonia can be extracted from soil using 1M KCl.
INORG-060	Phosphate - determined colourimetrically using APHA latest edition 4500 P E. Water samples are filtered on receipt prior to analysis. Soils are analysed from a water extract.
INORG-081	Anions determined by Ion Chromatography. Waters samples are filtered on receipt prior to analysis. Solids are analysed from a water extract. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
INORG-127	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Organic Carbon forms (inorganic, organic, total) determined using a TOC/NDIR analyser via combustion. Dissolved forms require filtering prior to determination.
METALS-020	Determination of various metals by ICP-OES.
METALS-021	Determination of Mercury by Cold Vapour AAS.
METALS-022	Determination of various metals by ICP-MS. Please note for Bromine and Iodine, any forms of these elements that are present are included together in the one result reported for each of these two elements.
MICRO-001B	E. coli/Thermotolerant coliforms: Microbial Water Analysis - in accordance with MICRO-001 (AS4276.5-latest edition). Recommended maximums based on NHMRC Australian Drinking Water Guidelines. Please note that results for this test derived from counts outside of the range 10-100 are considered approximate as per AS4276.1.

Result Definitions

Identifier	Description
NR	Not reported
NEPM	National Environment Protection Measure
NS	Not specified
LCS	Laboratory Control Sample
RPD	Relative Percent Difference
>	Greater than
<	Less than
PQL	Practical Quantitation Limit
INS	Insufficient sample for this test
NA	Test not required
NT	Not tested
DOL	Samples rejected due to particulate overload (air filters only)
RFD	Samples rejected due to filter damage (air filters only)
RUD	Samples rejected due to uneven deposition (air filters only)
##	Indicates a laboratory acceptance criteria outlier, for further details, see Result Comments and/or QC Comments

Quality Control Definitions

Blank

This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, and is determined by processing solvents and reagents in exactly the same manner as for samples.

Surrogate Spike

Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

LCS (Laboratory Control Sample)

This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Matrix Spike

A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

Duplicate

This is the complete duplicate analysis of a sample from the process batch. The sample selected should be one where the analyte concentration is easily measurable.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria. Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction. Spikes for Physical and Aggregate Tests are not applicable. For VOCs in water samples, three vials are required for duplicate or spike analysis.

General Acceptance Criteria (GAC) - Analyte specific criteria applies for some analytes and is reflected in QC recovery tables.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% - see ELN-P05 QAQC tables for details (available on request); <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase. Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was typically insufficient in order to satisfy laboratory QA/QC protocols.

Miscellaneous Information

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached. We have taken the sampling date as being the date received at the laboratory.

Two significant figures are reported for the majority of tests and with a high degree of confidence, for results <10*PQL, the second significant figure may be in doubt i.e. has a relatively high degree of uncertainty and is provided for information only.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS where sediment/solids are included by default.

Urine Analysis - The BEI values listed are taken from the 2022 edition of *TLVs and BEIs Threshold Limits by ACGIH*.

Air volume measurements are not covered by Envirolab's NATA accreditation.

Data Quality Assessment Summary PEK1352

Client Details

Client	Hyd2O
Your Reference	H21064 - East Wanneroo Monitoring
Date Issued	24/11/2023

Recommended Holding Time Compliance

Recommended holding time exceedances exist - See detailed list below

Quality Control and QC Frequency

QC Type	Compliant	Details
Blank	Yes	No Outliers
LCS	Yes	No Outliers
Duplicates	No	Duplicate Outliers Exist - See detailed list below
Matrix Spike	No	Matrix Spike Outliers Exist - See detailed list below
Surrogates / Extracted Internal Standards	Yes	No Outliers
QC Frequency	Yes	No Outliers

Surrogates/Extracted Internal Standards, Duplicates and/or Matrix Spikes are not always relevant/applicable to certain analyses and matrices. Therefore, said QC measures are deemed compliant in these situations by default. See Laboratory Acceptance Criteria for more information

Data Quality Assessment Summary PEK1352

Recommended Holding Time Compliance

Analysis	Sample Number(s)	Date Sampled	Date Extracted	Date Analysed	Compliant
Total Phosphorus | Water	1-4	17/11/2023	20/11/2023	23/11/2023	Yes
Dissolved Metals (LL) | Water	1-4	17/11/2023	20/11/2023	22/11/2023	Yes
Dissolved Metals (LL)-Hg | Water	1-4	17/11/2023	21/11/2023	22/11/2023	Yes
Chloride | Water	1-4	17/11/2023	20/11/2023	21/11/2023	Yes
Sulfate | Water	1-4	17/11/2023	20/11/2023	21/11/2023	Yes
Nitrogen - Ammonia | Water	1-4	17/11/2023	21/11/2023	21/11/2023	Yes
Nitrogen - Nitrate | Water	1-4	17/11/2023	21/11/2023	21/11/2023	Yes
Nitrogen - Nitrite | Water	1-4	17/11/2023	21/11/2023	21/11/2023	No
Nitrogen - NOx | Water	1-4	17/11/2023	21/11/2023	21/11/2023	Yes
Nitrogen - Total N | Water	1-4	17/11/2023	20/11/2023	21/11/2023	Yes
Phosphate as P | Water	1-4	17/11/2023	21/11/2023	21/11/2023	No
TKN as N calc | Water	1-4	17/11/2023	20/11/2023	23/11/2023	Yes
E. coli & T.T.coli | Water	1-4	17/11/2023	17/11/2023	17/11/2023	Yes

Outliers: Duplicates

METALS-022|Dissolved Low Level Metals (Water)| Batch BEK2324

Sample ID	Duplicate ID	Analyte	% Limits	RPD
BEK2324-DUP2#	DUP2	Zinc	20.00	200[2]

Outliers: Matrix Spike

METALS-022|Dissolved Low Level Metals (Water)| Batch BEK2324

Sample ID	Analyte	% Limits	% Recovery
BEK2324-MS1#	Aluminium	70 - 130	##[1]

Quality Control PEK1352

METALS-020 | Acid Extractable Metals (Water) | Batch BEK2253

Analyte	Units	PQL	Blank	DUP1 BEK2253-DUP1# Samp | QC | RPD %	DUP2 BEK2253-DUP2# Samp | QC | RPD %	LCS %	Spike % BEK2253-MS1#
Phosphorus	mg/L	0.050	<0.050	<0.050 | <0.050 | [NA]	0.574 | 0.572 | 0.283	104	102

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

METALS-022 | Dissolved Low Level Metals (Water) | Batch BEK2324

Analyte	Units	PQL	Blank	DUP1 BEK2324-DUP1# Samp | QC | RPD %	DUP2 BEK2324-DUP2# Samp | QC | RPD %	LCS %	Spike % BEK2324-MS1#
Aluminium	µg/L	10	<10	232 | 241 | 3.69	<10 | <10 | [NA]	116	##[1]
Arsenic	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	112	104
Cadmium	µg/L	0.10	<0.10	<0.10 | <0.10 | [NA]	<0.10 | <0.10 | [NA]	113	105
Chromium	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	111	103
Copper	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	109	103
Iron	µg/L	10	<10	68.1 | 69.0 | 1.31	<10 | <10 | [NA]	114	98.7
Lead	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	109	104
Nickel	µg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	<1.0 | <1.0 | [NA]	108	99.7
Zinc	µg/L	1.0	<1.0	5.17 | 5.42 | 4.74	1.02 | <1.0 | 200 [2]	107	102

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

METALS-021 | Dissolved Low Level Metals (Water) | Batch BEK2404

Analyte	Units	PQL	Blank	DUP1 PEK1352-01 Samp | QC | RPD %	DUP2 BEK2404-DUP2# Samp | QC | RPD %	LCS %	Spike % PEK1352-02
Mercury	µg/L	0.050	<0.050	<0.050 | <0.050 | [NA]	<0.050 | <0.050 | [NA]	96.8	96.4

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

INORG-081 | Inorganics - Ionic Balance and Indexes (Water) | Batch BEK2175

Analyte	Units	PQL	Blank	DUP1 BEK2175-DUP1# Samp | QC | RPD %	DUP2 BEK2175-DUP2# Samp | QC | RPD %	LCS %	Spike % BEK2175-MS1#
Chloride	mg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	33.9 | 33.9 | 0.0280	91.8	118
Sulfate	mg/L	1.0	<1.0	<1.0 | <1.0 | [NA]	1.02 | 1.03 | 0.788	96.7	112

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

INORG-127 | Inorganics - Nutrients (Water) | Batch BEK2264

Analyte	Units	PQL	Blank	DUP1 PEK1352-01 Samp | QC | RPD %		LCS %	Spike % PEK1352-02
Total Nitrogen	mg/L	0.10	<0.10	0.501 | 0.459 | 8.77		108	103

Quality Control PEK1352

INORG-057 | Inorganics - Nutrients (Water) | Batch BEK2447

Analyte	Units	PQL	Blank	DUP1 BEK2447-DUP1# Samp | QC | RPD %	DUP2 BEK2447-DUP2# Samp | QC | RPD %	LCS %	Spike % BEK2447-MS1#
Ammonia as N	mg/L	0.0050	<0.0050	0.141 | 0.146 | 3.80	<0.0050 | <0.0050 | [NA]	93.4	101
Nitrate as N	mg/L	0.0050	<0.0050	3.18 | 3.17 | 0.516	2.23 | 2.25 | 1.18	115	119
Nitrate as NO3 by calculation	mg/L	0.020	<0.020			[NA]	[NA]
Nitrite as N	mg/L	0.0050	<0.0050	<0.0050 | <0.0050 | [NA]	<0.0050 | <0.0050 | [NA]	[NA]	[NA]
Nitrite as NO2 by calculation	mg/L	0.020	<0.020			[NA]	[NA]
NOx as N	mg/L	0.0050	<0.0050	3.18 | 3.17 | 0.515	2.23 | 2.26 | 1.18	115	119
Phosphate as P	mg/L	0.0050	<0.0050	0.0334 | 0.0336 | 0.702	0.0468 | 0.0478 | 2.20	100	104

Analyte	Units	PQL	Blank	LCS %	Spike % BEK2447-MS2#
Nitrite as N	mg/L	0.005		91.7	129

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

MICRO-001B | Microbiological Suite (Water) | Batch BEK2150

Analyte	Units	PQL	Blank	DUP1 BEK2150-DUP1# Samp | QC | RPD %	DUP2 BEK2150-DUP2# Samp | QC | RPD %	LCS %
Thermotolerant Coliforms	cfu/100mL	1	<1	<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]
E.coli	cfu/100mL	1	<1	<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]

Analyte	Units	PQL	Blank	DUP3 BEK2150-DUP3# Samp | QC | RPD %	DUP4 BEK2150-DUP4# Samp | QC | RPD %	LCS %
Thermotolerant Coliforms	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]
E.coli	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]

Analyte	Units	PQL	Blank	DUP5 BEK2150-DUP5# Samp | QC | RPD %	DUP6 BEK2150-DUP6# Samp | QC | RPD %	LCS %
Thermotolerant Coliforms	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]
E.coli	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]

Analyte	Units	PQL	Blank	DUP7 BEK2150-DUP7# Samp | QC | RPD %	DUP8 BEK2150-DUP8# Samp | QC | RPD %	LCS %
Thermotolerant Coliforms	cfu/100mL	1		<1 | <1 | [NA]	15.0 | 16.0 | 6.45	[NA]
E.coli	cfu/100mL	1		<1 | <1 | [NA]	7.00 | 13.0 | 60.0	[NA]

Analyte	Units	PQL	Blank	DUP9 BEK2150-DUP9# Samp | QC | RPD %	DUPA BEK2150-DUPA# Samp | QC | RPD %	LCS %
Thermotolerant Coliforms	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]
E.coli	cfu/100mL	1		<1 | <1 | [NA]	<1 | <1 | [NA]	[NA]

The QC reported was not specifically part of this workorder but formed part of the QC process batch.

QC Comments

Identifier	Description
[1]	Spike recovery is not applicable due to the relatively high analyte background in the sample (>3* spike level). However, the LCS recovery is within acceptance criteria.
[2]	Duplicate %RPD may be flagged as an outlier to routine laboratory acceptance, however, where one or both results are <10*PQL, the RPD acceptance criteria increases exponentially.

APPENDIX H

Water Register Extracts

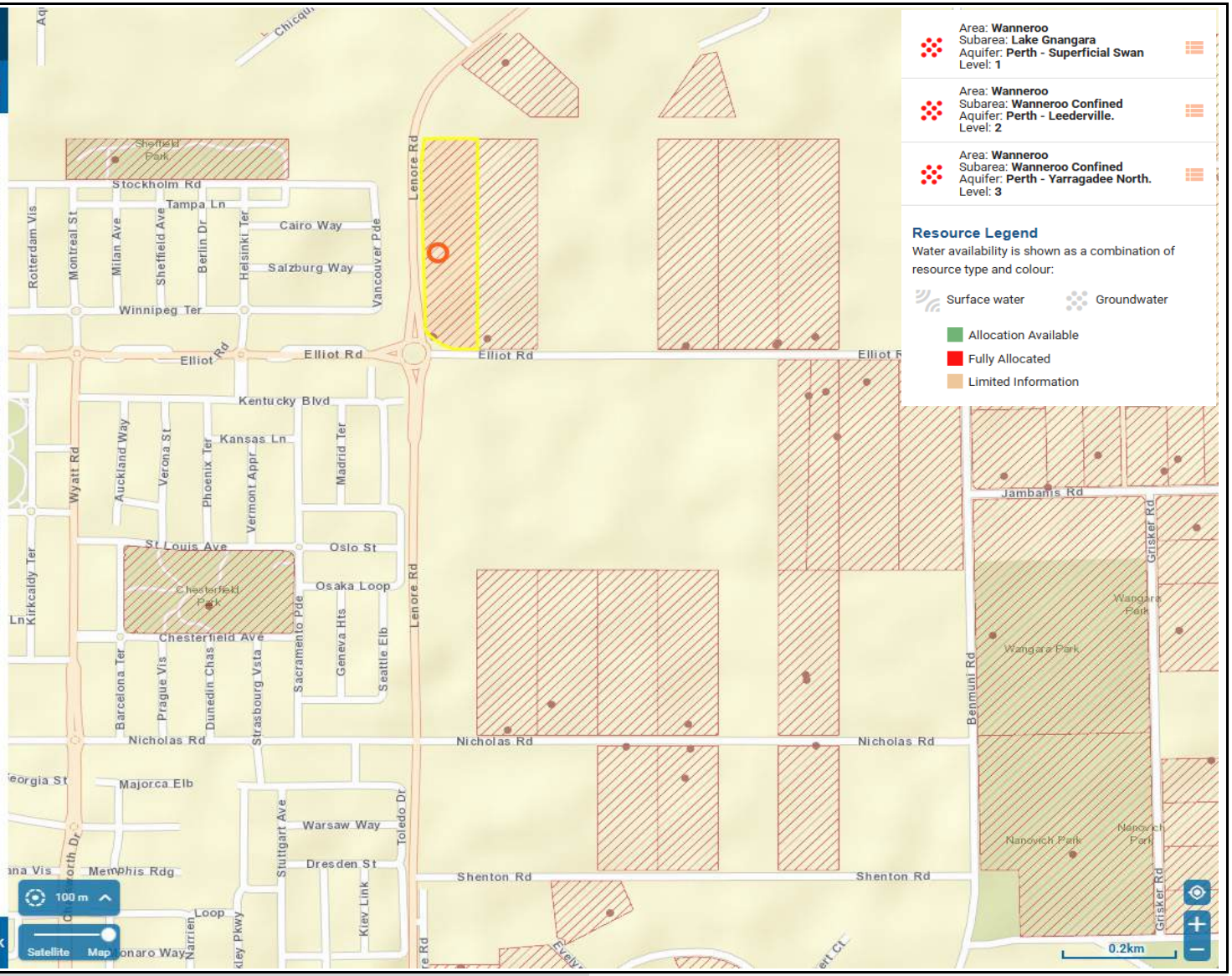
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	53795
Licence Type:	Groundwater Licence
Issue Date:	17/4/2020
Expiry Date:	16/4/2030
Licence Allocation:	35000 KL
Parties:	Hoang, Tan Minh, Vuong, Lanh Thi
Postal Address:	18 Grosvenor Rd Mount Lawley WA 6050 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	Lot 700 On Plan 71494 Volume/Folio 2779/365 Lot 700 Elliot Rd Wanneroo
Security Interests:	No
Convictions:	No
Agreements:	Yes
Notations:	No
Directions:	No

Instrument number: 53795 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H1

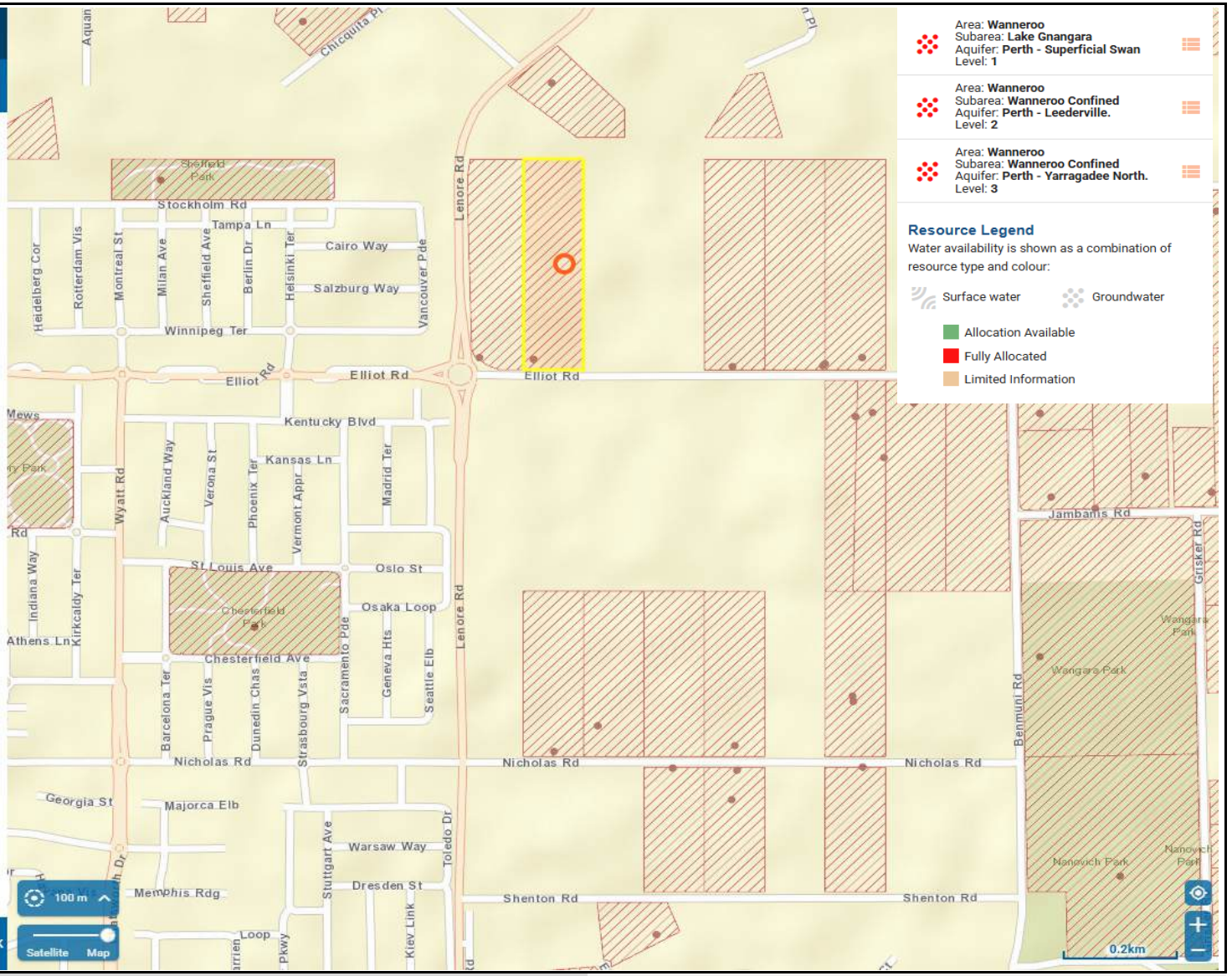
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	96251
Licence Type:	Groundwater Licence
Issue Date:	28/3/2018
Expiry Date:	28/3/2028
Licence Allocation:	12950 KL
Parties:	Mori, Luciano
Postal Address:	179 Elliot Rd Wanneroo WA 6065 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	Lot 29 On Plan 6292 Volume/Folio 1174/500 Lot 29 Elliot Rd Wanneroo
Security Interests:	No
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 96251 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H2

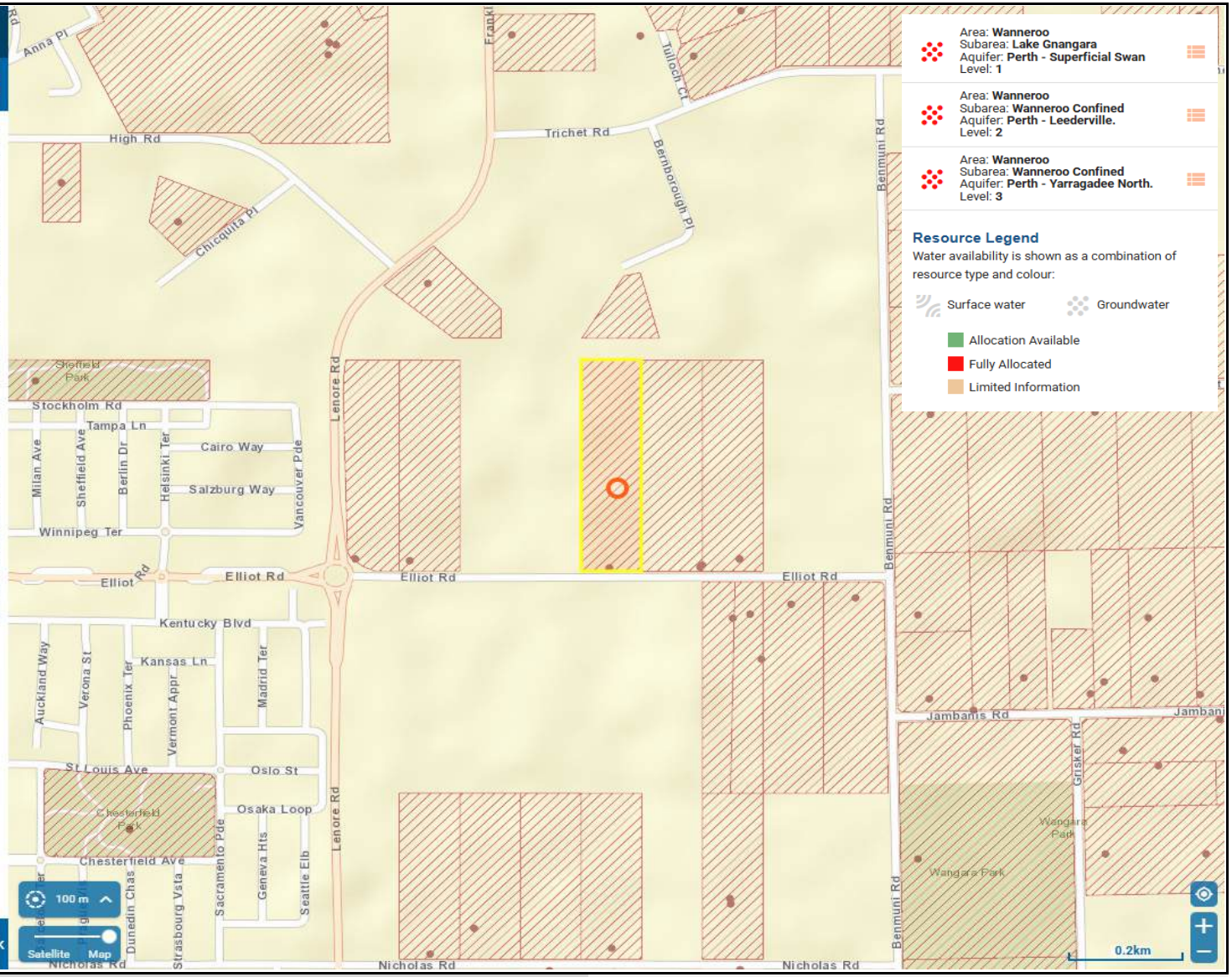
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	71191
Licence Type:	Groundwater Licence
Issue Date:	30/10/2019
Expiry Date:	29/10/2029
Licence Allocation:	49500 KL
Parties:	Do, Trung Duy
Postal Address:	215 Elliot road Wanneroo WA 6065 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	Lot 32 On Plan 6292 Volume/Folio 1164/832 Lot 32 Elliot Rd Wanneroo
Security Interests:	Yes
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 71191 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H3

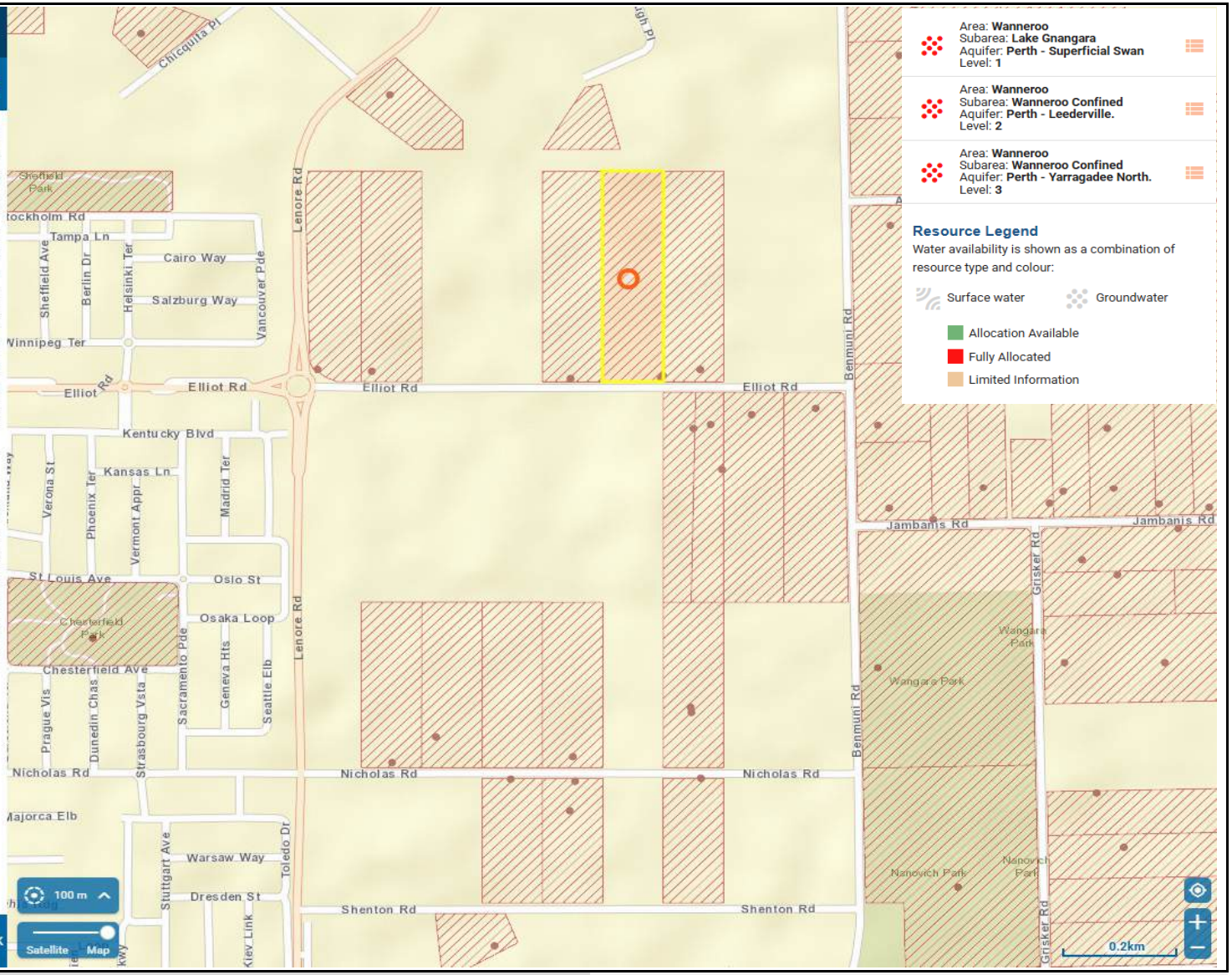
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	169281
Licence Type:	Groundwater Licence
Issue Date:	1/5/2019
Expiry Date:	30/4/2029
Licence Allocation:	42008 KL
Parties:	Nguyen, Tuyen Thi, Dang, My-Quyen Thi; Thanh Ngoc Dang; Nguyen, Tuan Cuong; Dang, Vinh Ngoc; Lam, Le Ngoc Chau
Postal Address:	98 Benmuni Road Wanneroo WA 6065 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	Lot 33 On Plan 6292 Volume/Folio 1168/406 Lot 33 Elliot Rd Wanneroo
Security Interests:	No
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 169281 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H4

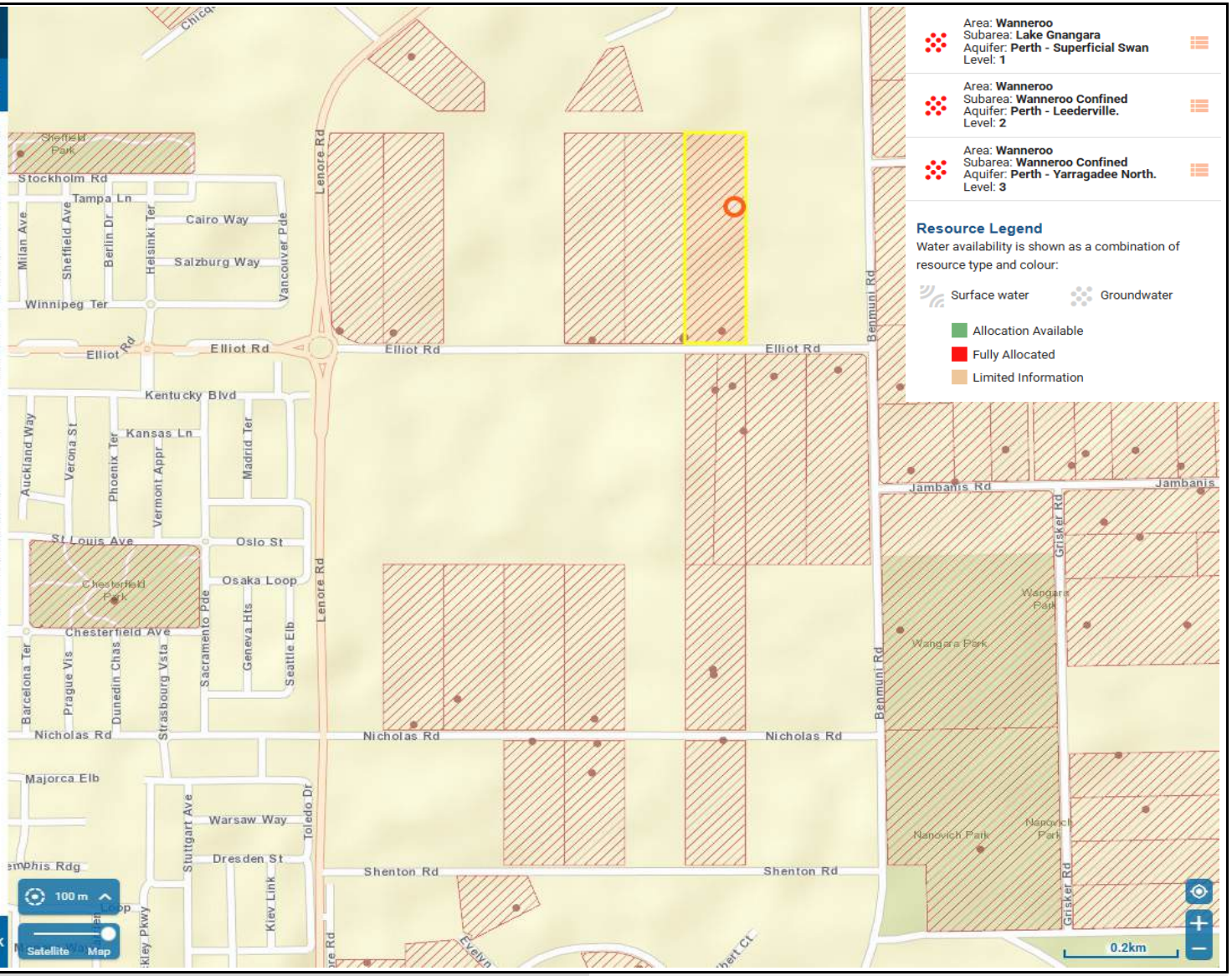
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	76456
Licence Type:	Groundwater Licence
Issue Date:	3/9/2019
Expiry Date:	2/9/2029
Licence Allocation:	4150 KL
Parties:	Carbone, Mario
Postal Address:	129 Telford Cres Stirling WA 6021 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	Lot 34 On Plan 6292 Volume/Folio 1464/818 Lot 34 Elliot Rd Wanneroo
Security Interests:	No
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 76456 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H5

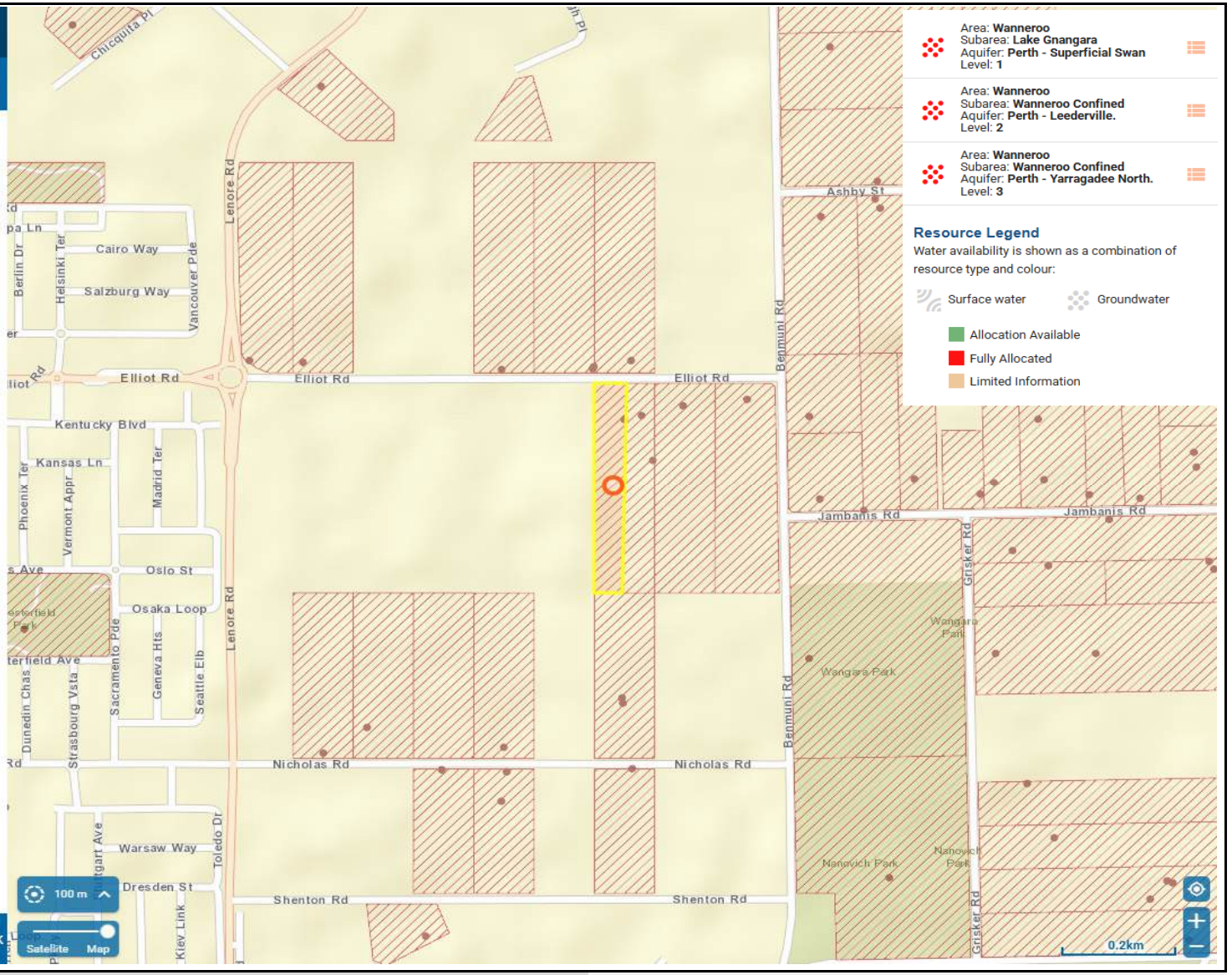
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	107897
Licence Type:	Groundwater Licence
Issue Date:	11/10/2024
Expiry Date:	13/3/2029
Licence Allocation:	10270 KL
Parties:	Tarom Pty Ltd
Postal Address:	10 Bowes Court Kingsley WA 6026 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	Lot 10 On Diagram 47892 Volume/Folio 1438/244 Lot 10 Elliot Rd Wanneroo
Security Interests:	No
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 107897 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H6

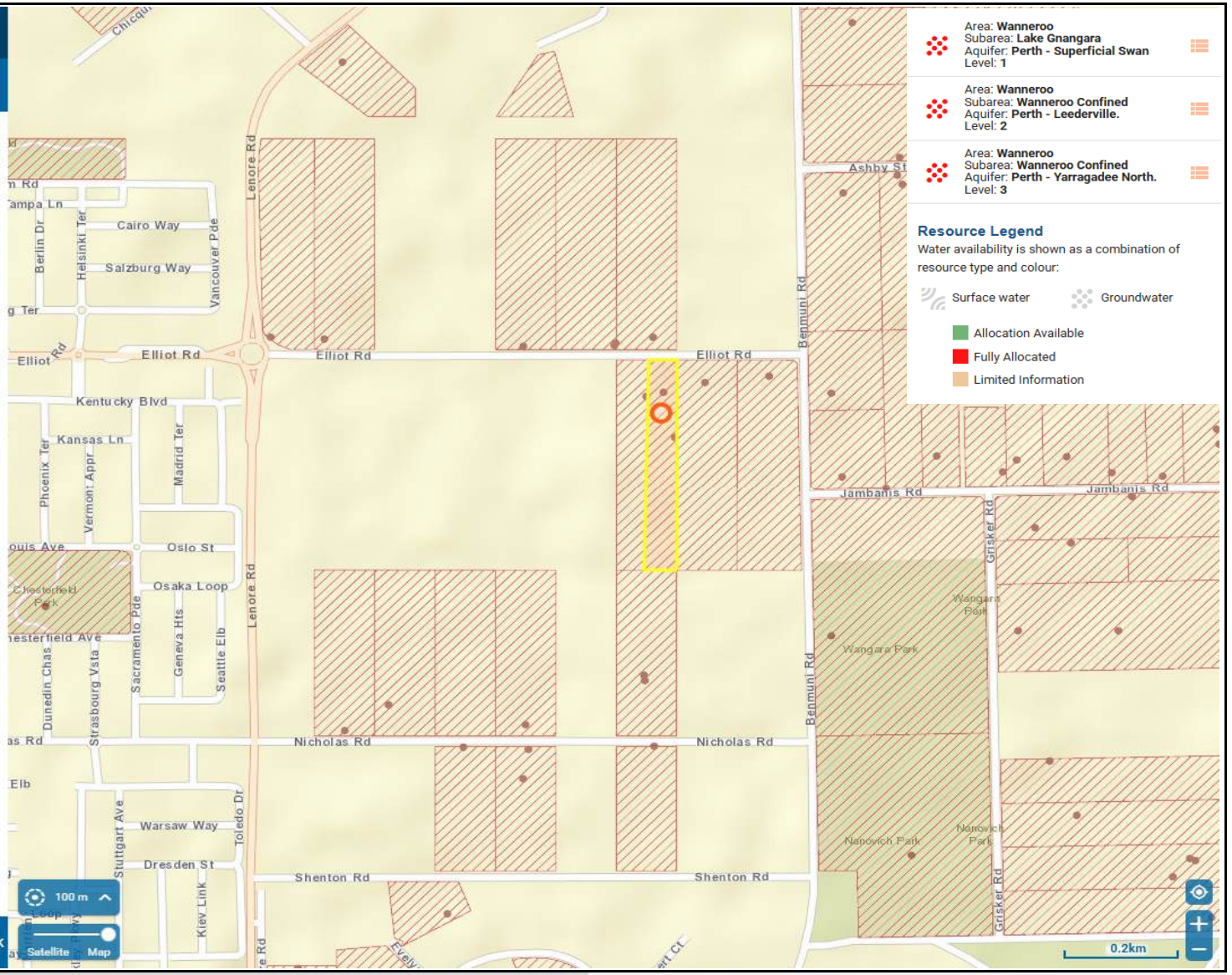
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	153256
Licence Type:	Groundwater Licence
Issue Date:	21/1/2020
Expiry Date:	20/1/2030
Licence Allocation:	9815 KL
Parties:	St Mark & St George Coptic Orthodox Church Perth WA Inc
Postal Address:	238 Elliot Rd Wanneroo WA 6065 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	Lot 11 On Diagram 47892 Volume/Folio 1438/245 Lot 11 Elliot Rd Wanneroo
Security Interests:	No
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 153256 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H7

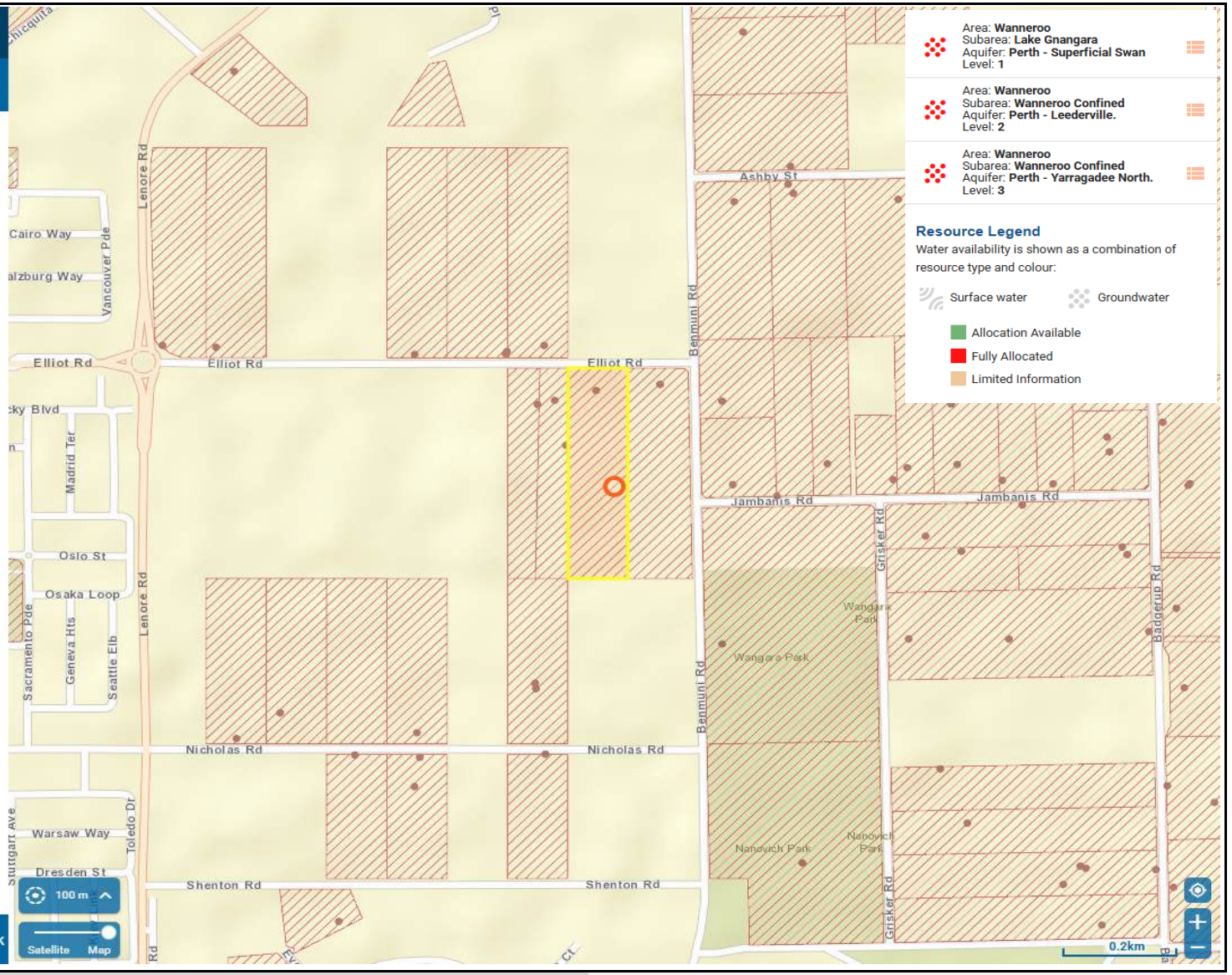
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	203361
Licence Type:	Groundwater Licence
Issue Date:	12/9/2019
Expiry Date:	11/9/2029
Licence Allocation:	57650 KL
Parties:	Nguyen, Van Nam
Postal Address:	248 Elliot Rd Wanneroo WA 6065 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	LOT 38 ELLIOT ROAD WANNEROO 6065
Security Interests:	No
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 203361 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H8

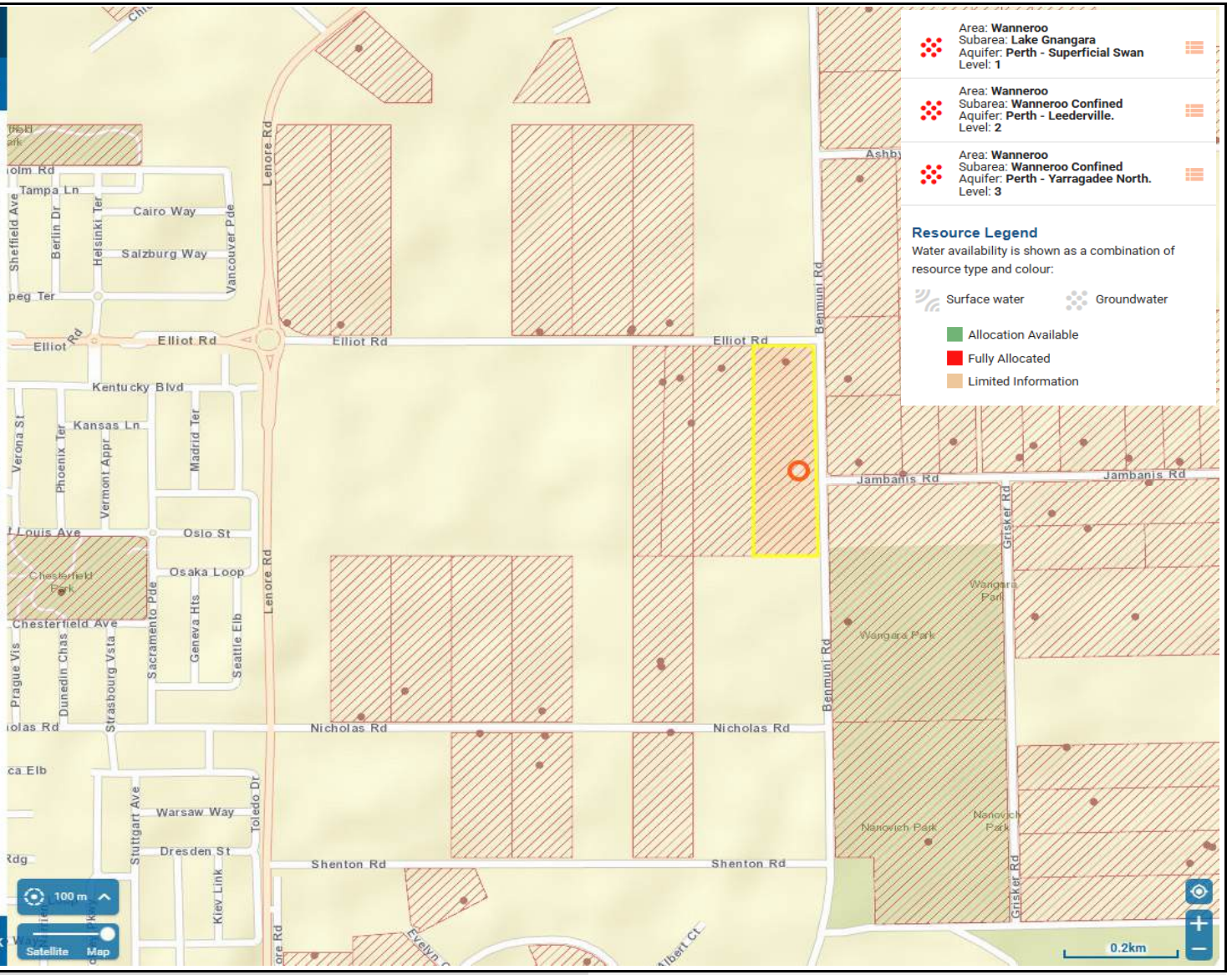
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	207394
Licence Type:	Groundwater Licence
Issue Date:	20/5/2022
Expiry Date:	19/5/2032
Licence Allocation:	60000 KL
Parties:	Thanh Ngoc Dang
Postal Address:	98 Benmuni Road Wanneroo WA 6065 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	LOT 37 BENMUNI ROAD WANNEROO 6065
Security Interests:	No
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 207394 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H9

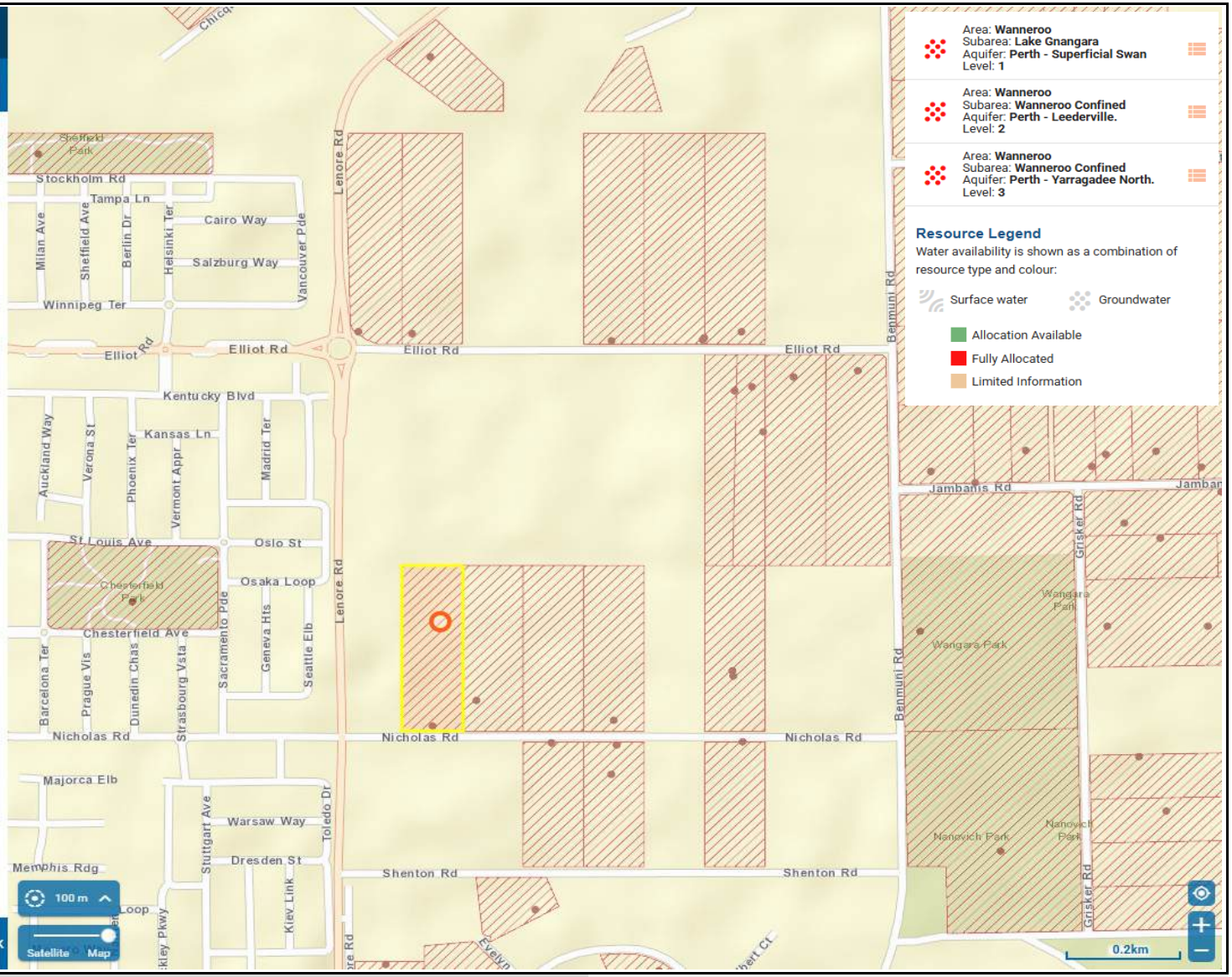
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	98646
Licence Type:	Groundwater Licence
Issue Date:	4/2/2020
Expiry Date:	3/2/2030
Licence Allocation:	48650 KL
Parties:	Tran, Duc Van
Postal Address:	84 Nicholas Road Wanneroo WA 6065 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	60, NICHOLAS RD, WANNEROO
Security Interests:	No
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 98646 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H10

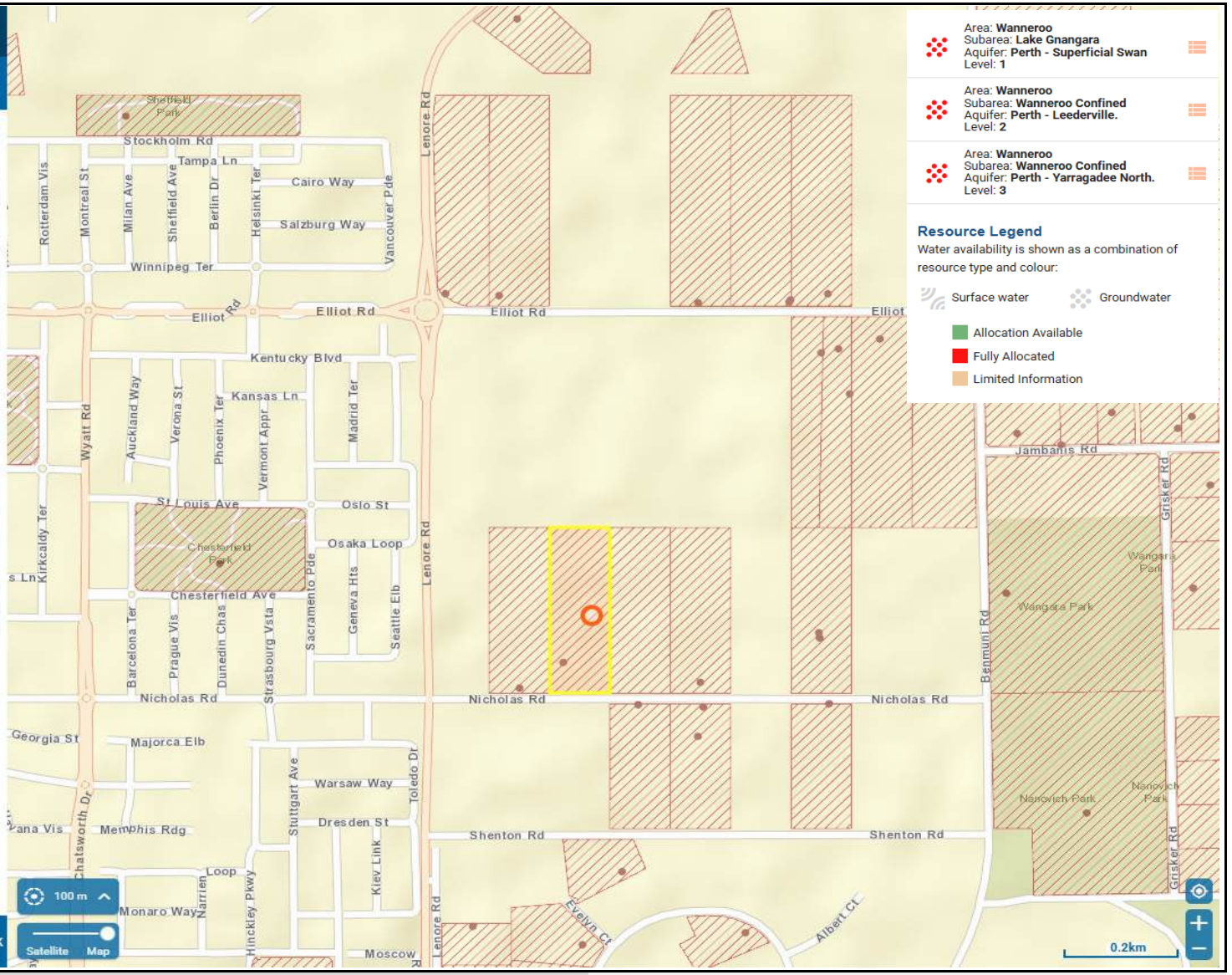
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	152615
Licence Type:	Groundwater Licence
Issue Date:	31/3/2020
Expiry Date:	30/3/2030
Licence Allocation:	43400 KL
Parties:	Skroza, Helena Mary, Skroza, Nenad Ivan
Postal Address:	78 Nicholas Rd Wanneroo WA 6065 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	Lot 61 on Plan 6962; Certificate of Title Volume 1250 Folio 943 Lot 61 Nicholas Road Wanneroo
Security Interests:	No
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 152615 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H12

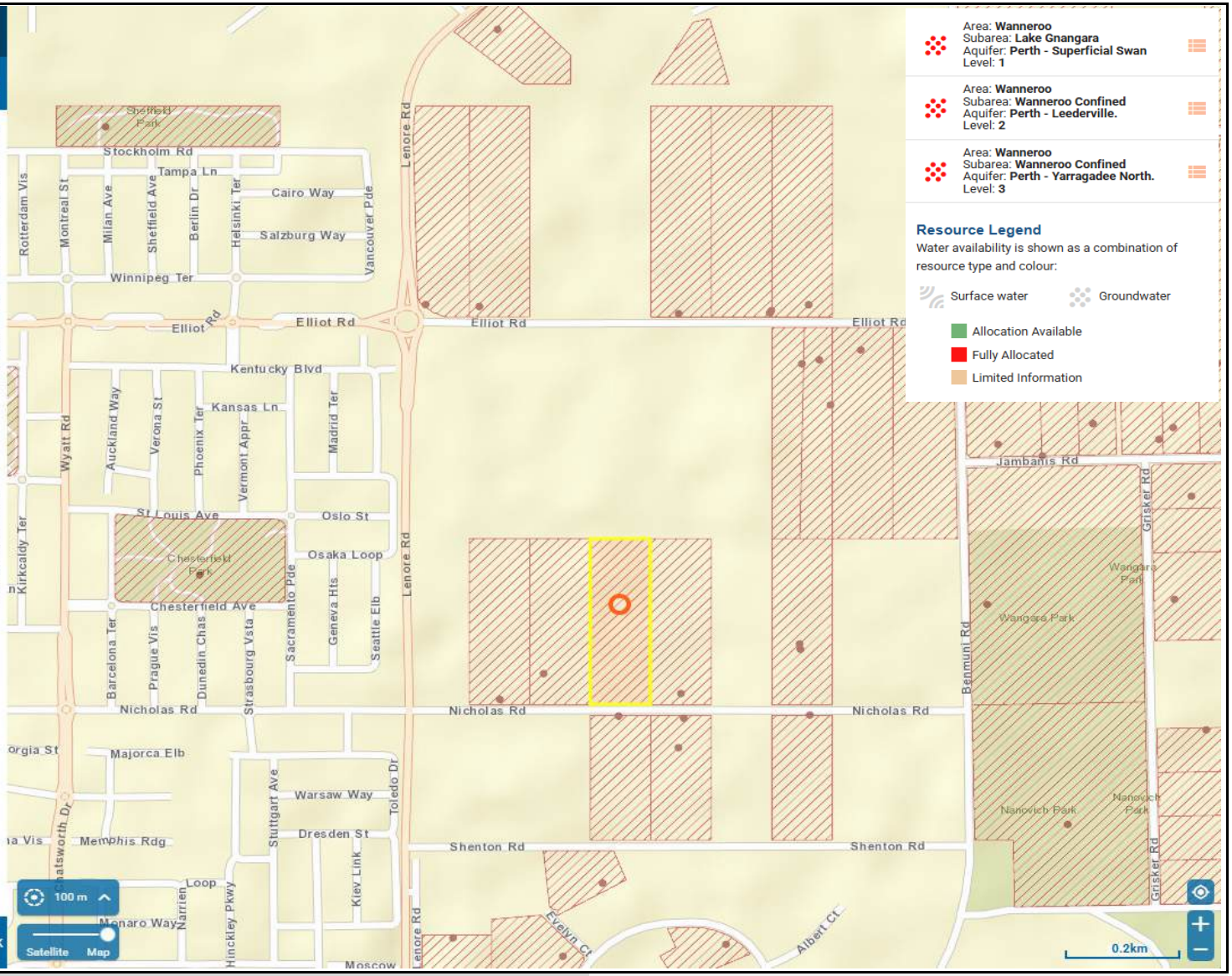
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	66050
Licence Type:	Groundwater Licence
Issue Date:	5/11/2019
Expiry Date:	4/11/2029
Licence Allocation:	5000 KL
Parties:	Strugnell, Stephen Raymond
Postal Address:	62 Nicholas Rd Wanneroo WA 6065 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	62, NICHOLAS RD, WANNEROO
Security Interests:	No
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 66050 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H13

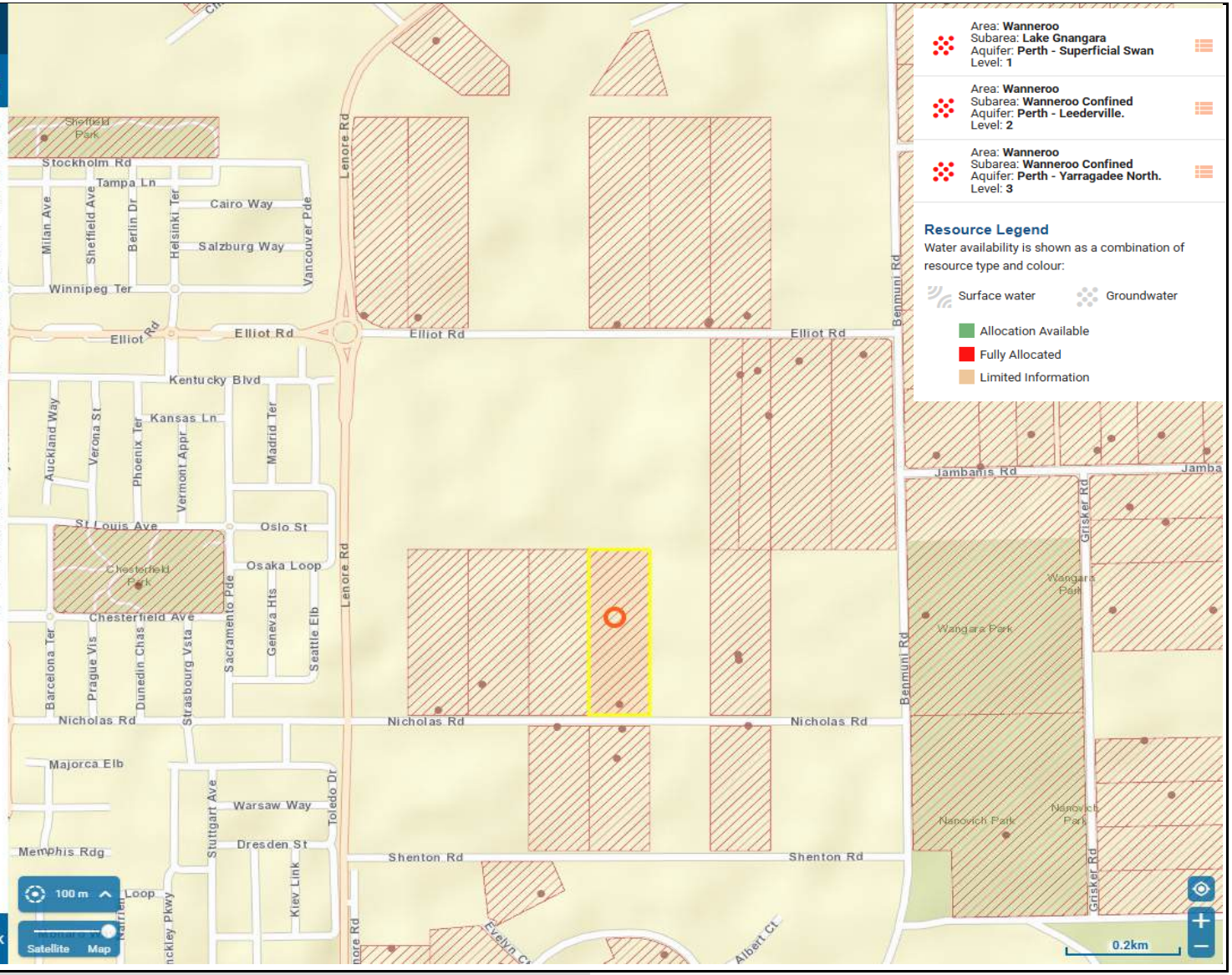
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	76617
Licence Type:	Groundwater Licence
Issue Date:	16/7/2015
Expiry Date:	15/7/2025
Licence Allocation:	49950 KL
Parties:	Ma, Thuc Hue, Tran, Van Hua
Postal Address:	117 Elliot Rd Wanneroo WA 6065 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	Lot 63 On Plan 6962 Volume/Folio 1237/860 Lot 63 Nicholas Rd Wanneroo
Security Interests:	Yes
Convictions:	No
Agreements:	No
Notations:	No
Directions:	Yes

Instrument number: 76617 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H14

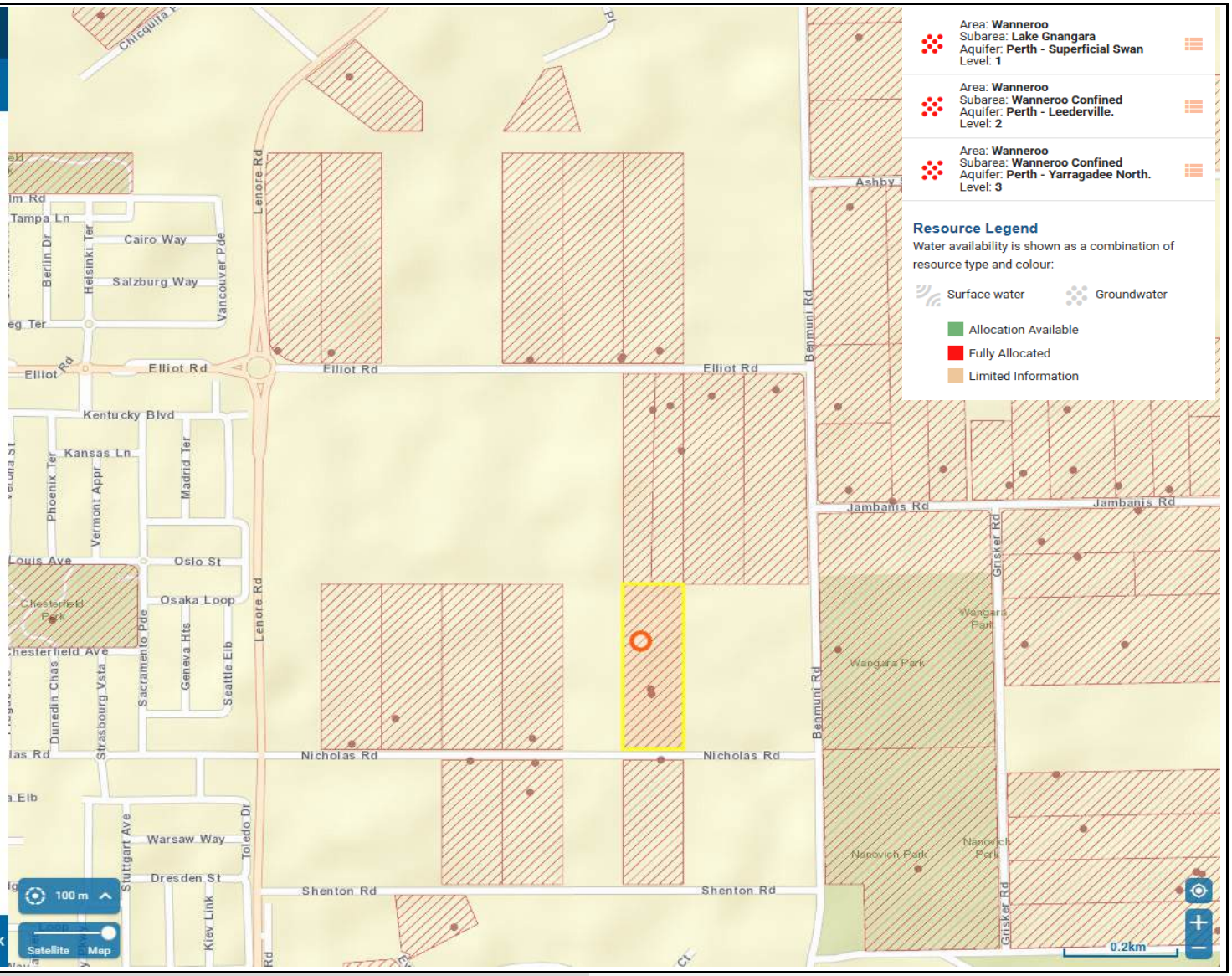
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	71195
Licence Type:	Groundwater Licence
Issue Date:	11/11/2019
Expiry Date:	10/11/2029
Licence Allocation:	48000 KL
Parties:	Hoang, Tiep Van
Postal Address:	30 Nicholas Road Wanneroo WA 6065 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	Lot 65 on Plan 6962 Volume/Folio 1785/655 Lot 65 Nicholas Rd Wanneroo
Security Interests:	No
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 71195 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H15

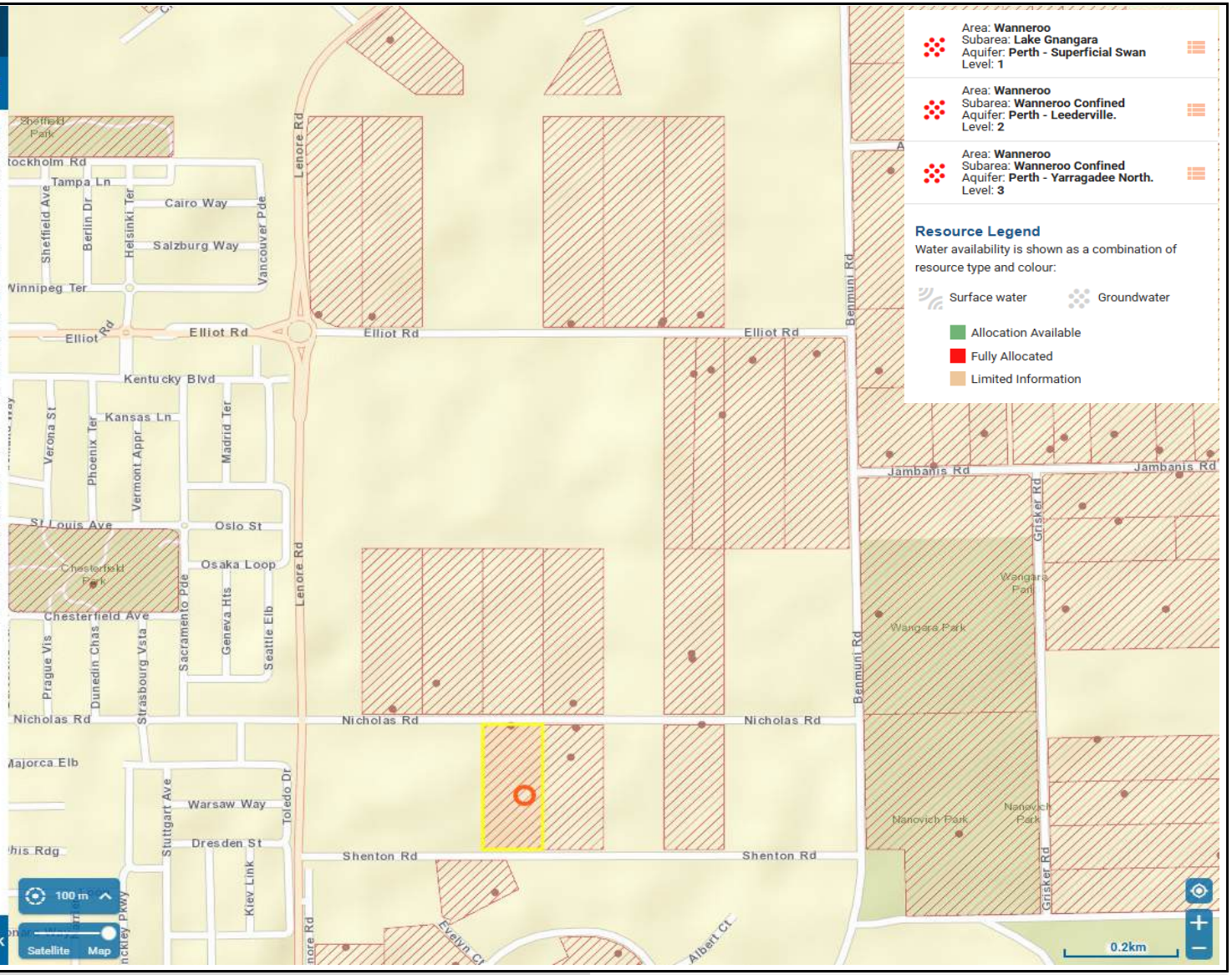
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	63494
Licence Type:	Groundwater Licence
Issue Date:	10/2/2023
Expiry Date:	9/2/2033
Licence Allocation:	12575 KL
Parties:	Cott One Pty Ltd, Carlo Cottone Superannuation Fund Pty Ltd
Postal Address:	60 Distinction Rd Wangara WA 6065 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	73, NICHOLAS RD, WANNEROO
Security Interests:	No
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 63494 Track



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East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H16

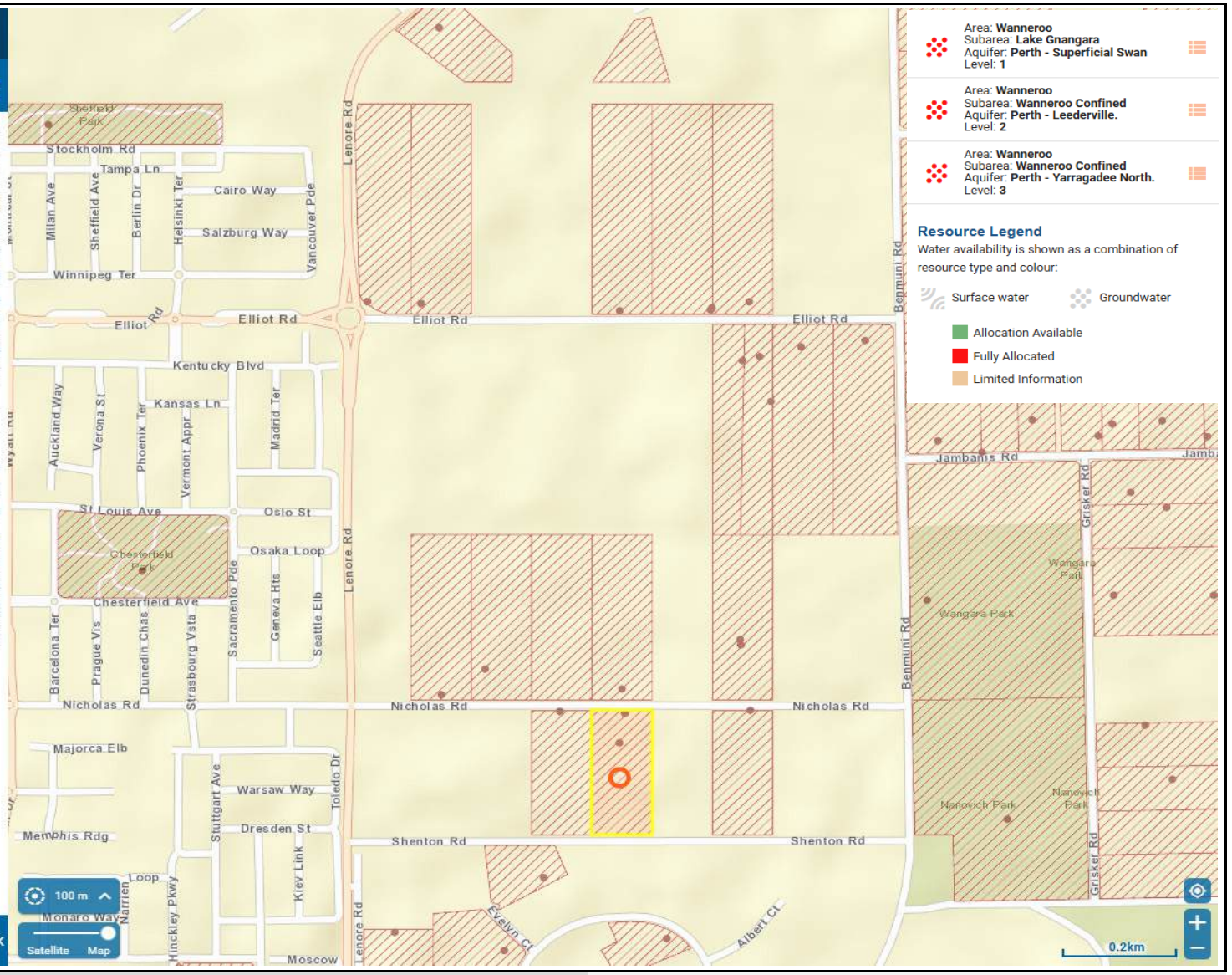
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	95232
Licence Type:	Groundwater Licence
Issue Date:	16/1/2024
Expiry Date:	15/1/2034
Licence Allocation:	5150 KL
Parties:	Calautti, Peter John
Postal Address:	51 Nicholas Rd Wanneroo WA 6065 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	Lot 72 on Plan 6962 ; Certificate of Title Volume 1639 Folio 376 Lot 72 Nicholas Road Wanneroo
Security Interests:	No
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 95232 Track



hyd2o

East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H17

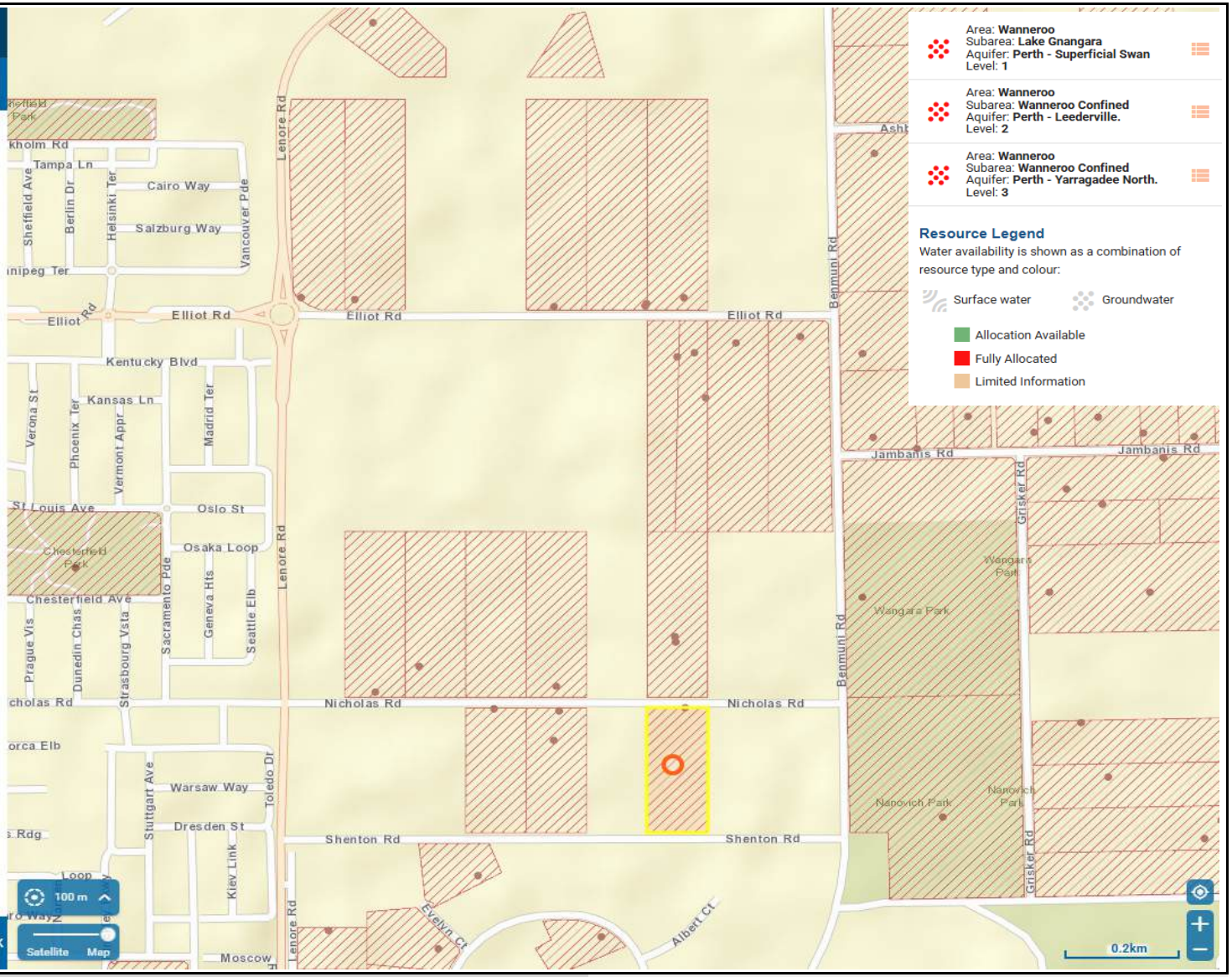
Date : 09/01/2025 Job No H24054

Licence details

Selected 1 of 1

Licence Number:	168640
Licence Type:	Groundwater Licence
Issue Date:	21/1/2020
Expiry Date:	20/1/2030
Licence Allocation:	6420 KL
Parties:	Mahony, Gerard Michael
Postal Address:	17 Cowper Rd Sorrento WA 6020 Australia
Groundwater Area:	Wanneroo
Groundwater Subarea:	Lake Gnangara
Aquifer:	Perth - Superficial Swan
Surface Water Area:	
Surface Water Subarea:	
Surface Water Resource:	
Licence Address:	Lot 70 on Plan 6962; Certificate of Title Volume 1266 Folio 118 Lot 70 Nicholas Road Wanneroo
Security Interests:	No
Convictions:	No
Agreements:	No
Notations:	No
Directions:	No

Instrument number: 168640 Track



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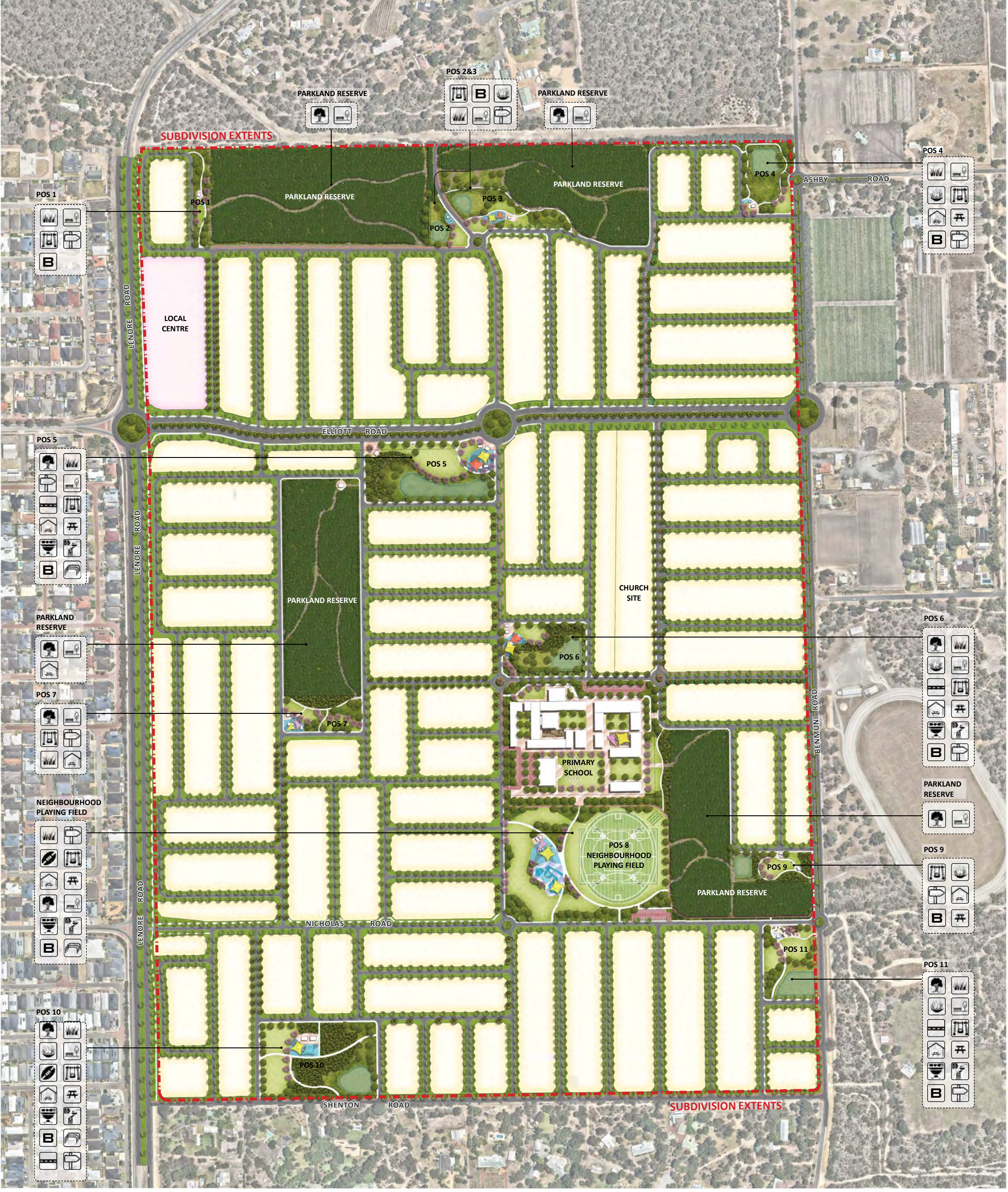
East Wanneroo Precinct 3 LWMS

DWER Water Register Extracts : Existing Licences

Appendix H18

APPENDIX I

Landscape Concept Plan



POS SPATIAL ACTIVITY PLAN

LEGEND

- EXTENT OF WORK
- EXISTING TREES
- OPEN TURF
- BASIN & SWALES
- BENCH SEAT
- PLAYING FIELD
- DUAL USE PATH
- BIN
- PLAYGROUND
- PARK SHELTER
- BBQ
- PICNIC SETTING
- PARK SIGN
- BIKE RACK
- DRINK FOUNTAIN

EAST WANNEROO PRECINCT 3

PRELIMINARY LANDSCAPE MASTERPLAN

DWG **EW01-1**
REV **C**
DATE **APRIL 2025**

0 25 50 75 100 m

SCALE **1 : 2500 @ A1**

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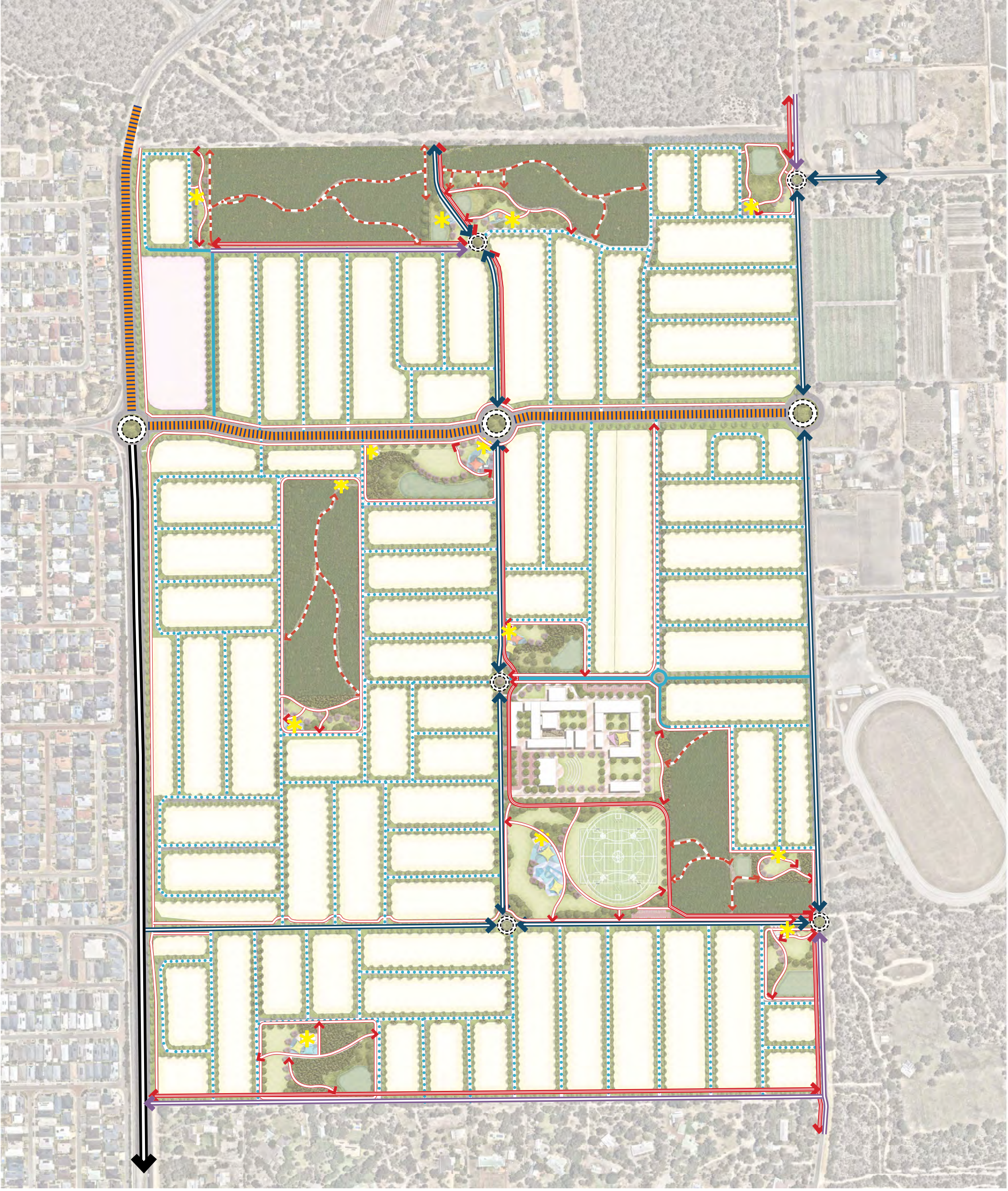

CIRCULATION PLAN

LEGEND

- TRANSPORT CORRIDOR (45M)
- INTEGRATOR A (35M)
- NEIGHBOURHOOD CONNECTOR A (25M)
- NEIGHBOURHOOD CONNECTOR B (20M)
- ACCESS STREET B (17.9M)
- ACCESS STREET D (15.4M)
- DUAL USE PATH
- CONCRETE FOOTPATH CONNECTION
- CRUSHED LIMESTONE TRACK TO EXISTING CLEARING
- PROPOSED ROUNDABOUT
- SHADE STRUCTURE

EAST WANNEROO PRECINCT 3

LANDSCAPE CIRCULATION PLAN

DWG **EW01-2**
REV **C**
DATE **APRIL 2025**

0 25 50 75 100 m

SCALE **1 : 2500 @ A1**

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STREET TREE PLAN

TRANSPORT CORRIDOR

Olea europea
Swan Hill (Fruitless Olive)

NEIGHBOURHOOD CONNECTOR

Lagerstroemia indica
Crepe-myrtle

Jacaranda mimosifolia
Jacaranda

ACCESS STREET

Callistemon 'KPS'
Kings Park Special

Cupaniopsis anacardioides
Tuckeroo

Agonis flexuosa
WA Peppermint

Callistemon viminalis
Weeping Bottlebrush

GREEN STREET

Eucalyptus marginata
Jarrah

EAST WANNEROO PRECINCT 3
LANDSCAPE STREET TREE PLAN

DWG **EW01-3**
REV **C**
DATE **APRIL 2025**
SCALE **1 : 2500 @ A1**

0 25 50 75 100 m

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POS 1, 2 & 3

POS 1 TYPOLOGY
- Pocket POS

SIZE
- 0.2382 ha excl Parkland Reserve

POS 2 TYPOLOGY
- Pocket POS

SIZE
- 0.2339 ha excl Parkland Reserve

POS 3 TYPOLOGY
- Pocket POS

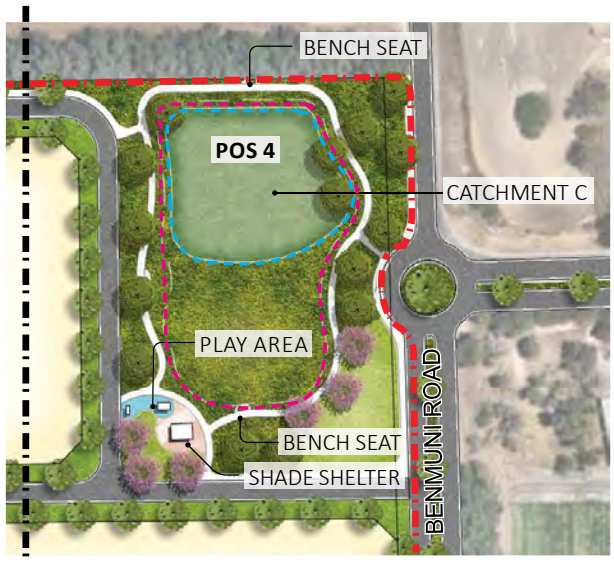
SIZE
- 0.6817 ha excl Parkland Reserve

POS 1, 2 & 3 CONCEPT
- Footpath connections through the POS to improve connectivity and walkability
- Provide informal tracks through existing vegetation
- Picnic areas, bench seats, shade structures and play space

FUNCTIONS / MATERIALS
- Open grassed areas for passive recreation
- Shade sails to feature playground
- Shelter & picnic settings
- Bench seats to provide rest point
- Water-wise native planting and planting
- Drainage areas per LWMS

ENVIRONMENTAL CONSIDERATIONS
- Significant existing trees to be retained where possible
- Carnaby black cockatoo habitat
- Source local materials where possible to minimise transport requirements and provide local employment.
- Consider long-term maintenance requirements.
- No management or modification to Parkland Reserve vegetation except 3m wide perimeter firebreaks. Where existing, firebreak to be maintained.
- POS Landscape design to achieve low threat as per AS 3959 and will include low fuel planting, as required

LOCATION PLAN



DRAINAGE LEGEND - CATCHMENT F

FIRST 15mm EVENT

Depth(m):	0.3
Base Area(m^2):	1,260
Volume(m^3):	377
Slope:	1:6

1% AEP EVENT

Depth(m):	1.17
TWL Area(mAHD):	2,221
Volume(m^3):	2,646
Slope:	1:6

POS 4

POS 4 TYPOLOGY
- Local POS

SIZE
- 0.6734 ha

FUNCTIONS / MATERIALS
- Footpath connection to the broader network
- Open grassed areas for passive recreation
- Shade sails to feature playground
- Shelter & picnic settings
- Bench seats to provide rest point
- Drainage areas per LWMS

POS 4 CONCEPT
- Open turf to provide passive recreation
- Picnic areas, bench seats, shade structures and play space
- Footpath connections through the POS to improve connectivity and walkability
- Shade trees to be planted along footpath connections

ENVIRONMENTAL CONSIDERATIONS
- Significant existing trees to be retained where possible
- POS Landscape design to achieve low threat as per AS 3959 and will include low fuel planting, as required
- Water-wise native planting and planting
- Source local materials where possible to minimise transport requirements and provide local employment.
- Consider long-term maintenance requirements.

DRAINAGE LEGEND - CATCHMENT C

FIRST 15mm EVENT

Depth(m):	0.3
Base Area(m^2):	1,680
Volume(m^3):	501
Slope:	1:6

1% AEP EVENT

Depth(m):	1.19
TWL Area(mAHD):	3,443
Volume(m^3):	3,020
Slope:	1:6

LANDSCAPE MASTERPLAN

LEGEND

EXTENT OF WORK	CONCRETE FOOTPATH	PROPOSED BASINS	STREET TREES
PROPOSED LOTS	CRUSHED LIMESTONE TRACK	RETAINED VEGETATION	PROPOSED TREES
SHELTER & PICNIC AREA	TURF	VERGE TREATMENT	BIORETENTION BASIN TWL
PLAYGROUND	SHRUB PLANTING	GREEN STREET	FLOOD STORAGE AREA

EAST WANNEROO PRECINCT 3
LANDSCAPE DETAILED PLAN POS 1, 2, 3 & 4

DWG EW01-4
REV C
DATE APRIL 2025
0 10 20 30 40 50 m
SCALE 1 : 1000 @ A1

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LOCATION PLAN

POS 5

POS 5 TYPOLOGY
- Neighbourhood POS

SIZE
- 1.3850 ha

POS 5 CONCEPT
- Footpath connections through the POS to improve connectivity and walkability
- Provide informal tracks through existing vegetation
- Picnic areas, bench seats, shade structures and play space
- Bike track to improve connectivity and cyclability

FUNCTIONS / MATERIALS
- Open grassed areas for passive recreation
- Shade sails to feature playground
- Shelter & picnic settings
- Bench seats to provide rest point
- Drainage areas per LWMS

ENVIRONMENTAL CONSIDERATIONS
- Significant existing trees to be retained where possible
- Carnaby black cockatoo habitat
- POS Landscape design to achieve low threat as per AS 3959 and will include low fuel planting, as required
- Water-wise native planting and planting

POS 6

POS 6 TYPOLOGY
- Local POS

SIZE
- 0.8030 ha

POS 6 CONCEPT
- Footpath connections through the POS to improve connectivity and walkability
- Provide informal tracks through existing vegetation
- Picnic areas, bench seats, shade structures and play space
- Bike track to improve connectivity and cyclability
- Ensure pedestrian and bike connections are provided to the primary school for safe and convenient access

FUNCTIONS / MATERIALS
- Open grassed areas for passive recreation
- Shade sails to feature playground
- Shelter & picnic settings
- Bench seats to provide rest point
- Drainage areas per LWMS

ENVIRONMENTAL CONSIDERATIONS
- Significant existing trees to be retained where possible
- Carnaby black cockatoo habitat
- POS Landscape design to achieve low threat as per AS 3959 and will include low fuel planting, as required
- Water-wise native planting and planting

DRAINAGE LEGEND - CATCHMENT A

FIRST 15mm EVENT

Depth(m):	0.3
Base Area(m^2):	3,550
Volume(m^3):	1,067
Slope:	1:6

1% AEP EVENT

Depth(m):	1.17
TWL Area(mAHD):	6,675
Volume(m^3):	6,115
Slope:	1:6

DRAINAGE LEGEND - CATCHMENT B

FIRST 15mm EVENT

Depth(m):	0.3
Base Area(m^2):	1,770
Volume(m^3):	530
Slope:	1:6

1% AEP EVENT

Depth(m):	1.19
TWL Area(mAHD):	3,701
Volume(m^3):	3,287
Slope:	1:6

LANDSCAPE MASTERPLAN

LEGEND

- EXTENT OF WORK
- PROPOSED LOTS
- SHELTER & PICNIC AREA
- PLAYGROUND
- CONCRETE FOOTPATH
- CRUSHED LIMESTONE TRACK
- TURF
- SHRUB PLANTING
- PROPOSED BASINS
- RETAINED VEGETATION
- VERGE TREATMENT
- GREEN STREET
- STREET TREES
- PROPOSED TREES
- BIORETENTION BASIN TWL
- FLOOD STORAGE AREA

EAST WANNEROO PRECINCT 3
LANDSCAPE DETAILED PLAN POS 5 & 6

DWG EW01-5
REV C
DATE APRIL 2025
0 10 20 30 40 50 m
SCALE 1 : 1000 @ A1

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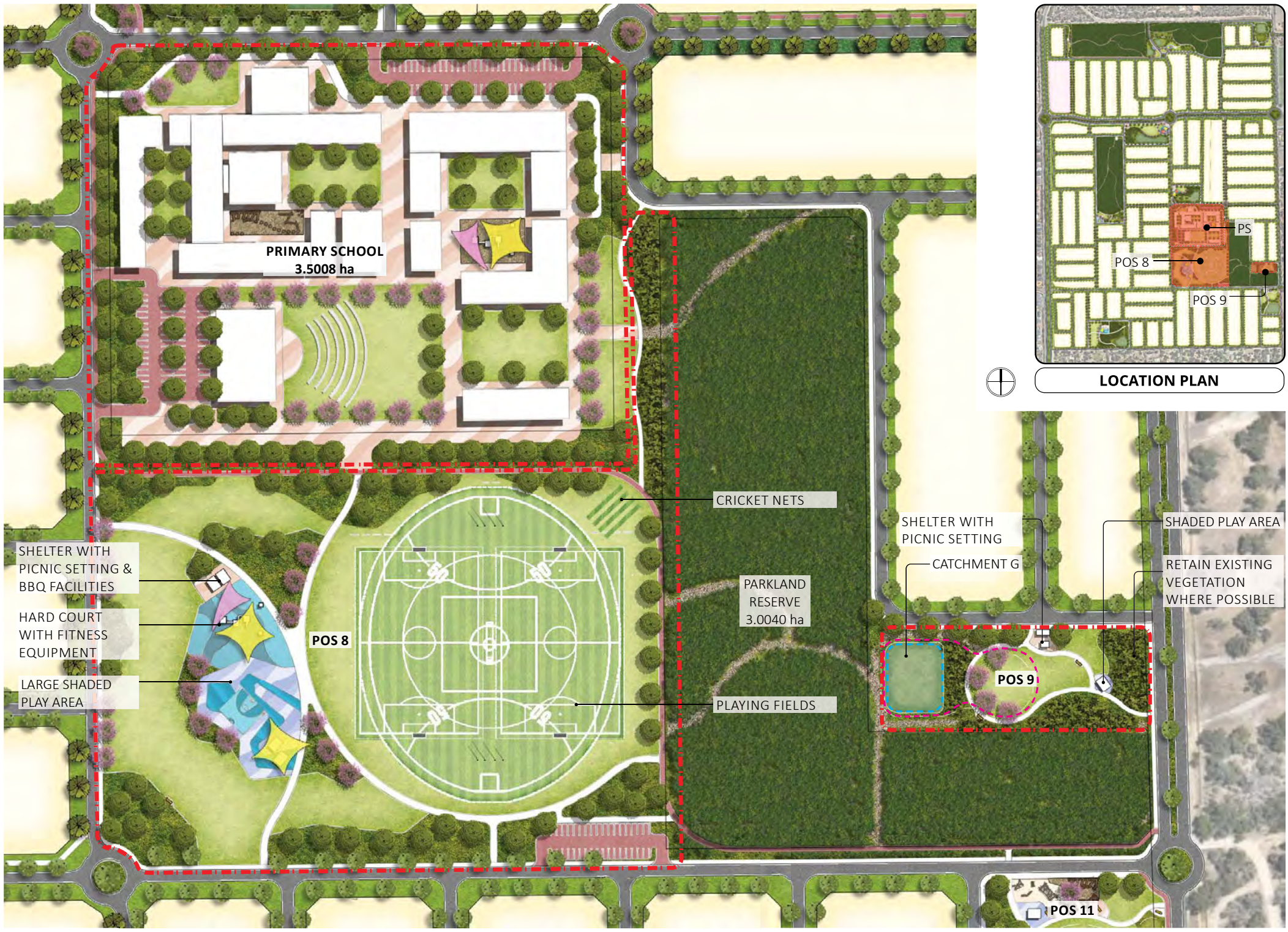

LOCATION PLAN

NEIGHBOURHOOD PLAYING FIELD (POS 8), POS 9 & PRIMARY SCHOOL

NEIGHBOURHOOD SPORTS POS
- Sport POS

SIZE
- 4.5003 ha excl Parkland Reserve

NEIGHBOURHOOD PLAYING FIELDS CONCEPT
- Playing field providing activity area for residents & adjacent Primary School
- Be collocated with primary school facilities
- Multi-goal half court to provide basketball hoop, hit-up wall and opportunity of murals
- Dual use path to provide cyclists and pedestrian connection
- All age playground
- Shade structures & BBQ facilities
- Bench seats to provide rest point

FUNCTIONS / MATERIALS
- Significant existing trees to be retained
- Playing fields inc 1x AFL Senior Oval & Cricket Pitches
- Open turf spaces for outdoor activity
- Connected path to open space perimeter, with connections to the broader path network
- Drainage areas per LWMS

ENVIRONMENTAL CONSIDERATIONS
- Significant existing trees to be retained where possible
- Carnaby black cockatoo habitat
- POS Landscape design to achieve low threat as per AS 3959 and will include low fuel planting, as required
- Water-wise native planting and planting
- Consider long-term maintenance requirements.
- No management or modification to Parkland Reserve vegetation except 3m wide perimeter firebreaks. Where existing, firebreak to be maintained.

POS 9 TYPOLOGY
- POCKET PARK

SIZE
- 0.4809 ha excl Parkland Reserve

POS 9 CONCEPT
- Footpath connections through the POS to improve connectivity and walkability
- Provide informal tracks through existing vegetation
- Picnic areas, bench seats, shade structures and play space

FUNCTIONS / MATERIALS
- Open grassed areas for passive recreation
- Shade sails to feature playground
- Shelter & picnic settings
- Bench seats to provide rest point
- Provide informal tracks through existing vegetation
- Drainage areas per LWMS

DRAINAGE LEGEND - CATCHMENT G

FIRST 15mm EVENT

Depth(m):	0.3
Base Area(m^2):	750
Volume(m^3):	225
Slope:	1:6

1% AEP EVENT

Depth(m):	1.17
TWL Area(mAHD):	1,823
Volume(m^3):	1,448
Slope:	1:6

LANDSCAPE MASTERPLAN

LEGEND

- EXTENT OF WORK
- PROPOSED LOTS
- SHELTER & PICNIC AREA
- PLAYGROUND
- CONCRETE FOOTPATH
- CRUSHED LIMESTONE TRACK
- TURF
- SHRUB PLANTING
- PROPOSED BASINS
- RETAINED VEGETATION
- VERGE TREATMENT
- GREEN STREET
- STREET TREES
- PROPOSED TREES
- BIORETENTION BASIN TWL
- FLOOD STORAGE AREA

EAST WANNEROO PRECINCT 3
LANDSCAPE DETAILED PLAN POS 8, 9 & PRIMARY SCHOOL

DWG **EW01-6**
REV **C**
DATE **APRIL 2025**

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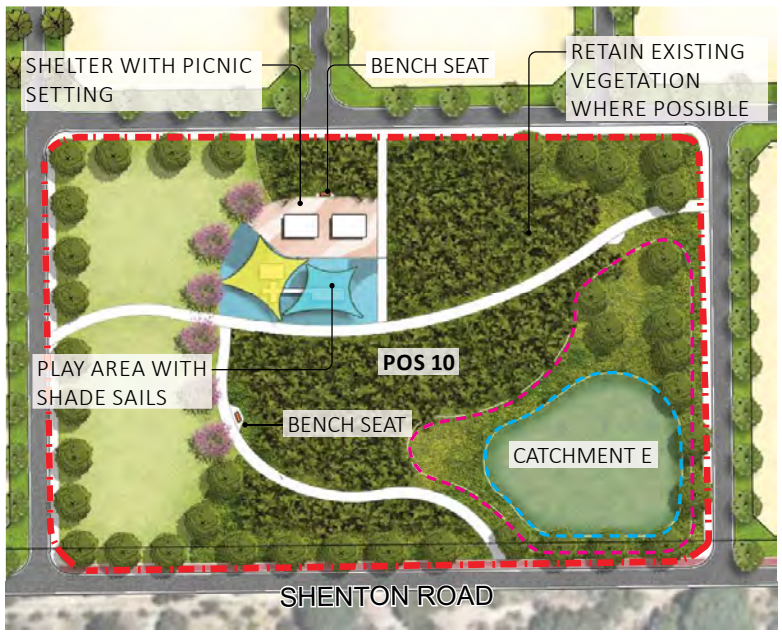


POS 10 & 11

POS 10 TYPOLOGY
- Neighbourhood POS

SIZE
- 1.7317 ha

FUNCTIONS / MATERIALS
- Open grassed areas for passive recreation
- Shade sails to feature playground
- Shelter & picnic settings
- Bench seats to provide rest point
- Drainage areas per LWMS

POS 10 CONCEPT
- Footpath connections through the POS to improve connectivity and walkability
- Provide informal tracks through existing vegetation
- Picnic areas, bench seats, shade structures and play space
- Bike track to improve connectivity and cyclability

LOCATION PLAN

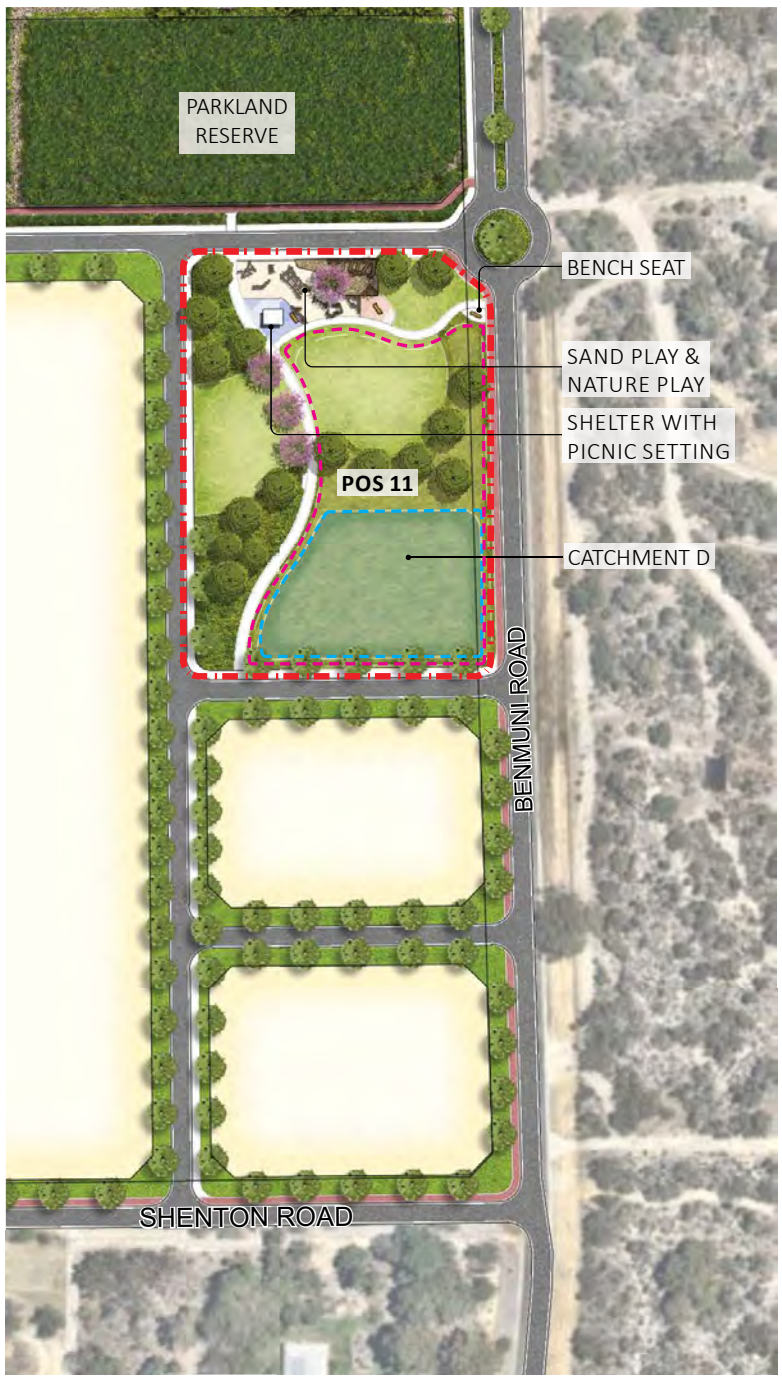
DRAINAGE LEGEND - CATCHMENT E

FIRST 15mm EVENT

Depth(m):	0.3
Base Area(m^2):	1,260
Volume(m^3):	375
Slope:	1:6

1% AEP EVENT

Depth(m):	1.18
TWL Area(mAHD):	2,578
Volume(m^3):	2,175
Slope:	1:6



DRAINAGE LEGEND - CATCHMENT D

FIRST 15mm EVENT

Depth(m):	0.3
Base Area(m^2):	2,030
Volume(m^3):	609
Slope:	1:6

1% AEP EVENT

Depth(m):	1.18
TWL Area(mAHD):	4,399
Volume(m^3):	3,837
Slope:	1:6

POS 11 TYPOLOGY
- Local POS

SIZE
- 0.7101 ha excl Parkland Reserve

ENVIRONMENTAL CONSIDERATIONS
- Significant existing trees to be retained where possible
- POS Landscape design to achieve low threat as per AS 3959 and will include low fuel planting, as required
- Water-wise native planting and planting

POS 11 CONCEPT
- Footpath connections through the POS to improve connectivity and walkability
- Provide informal tracks through existing vegetation
- Picnic areas, bench seats, shade structures and play space
- Bike track to improve connectivity and cyclability

FUNCTIONS / MATERIALS
- Open grassed areas for passive recreation
- Shade sails to feature playground
- Shelter & picnic settings
- Bench seats to provide rest point
- Drainage areas per LWMS

LANDSCAPE MASTERPLAN

LEGEND

EXTENT OF WORK	CONCRETE FOOTPATH	PROPOSED BASINS	STREET TREES
PROPOSED LOTS	CRUSHED LIMESTONE TRACK	RETAINED VEGETATION	PROPOSED TREES
SHELTER & PICNIC AREA	TURF	VERGE TREATMENT	BIORETENTION BASIN TWL
PLAYGROUND	SHRUB PLANTING	GREEN STREET	FLOOD STORAGE AREA

EAST WANNEROO PRECINCT 3
LANDSCAPE DETAILED PLAN POS 10 & 11

DWG **EW01-7**
REV **C**
DATE **APRIL 2025**
0 10 20 30 40 50 m
SCALE **1 : 1000 @ A1**

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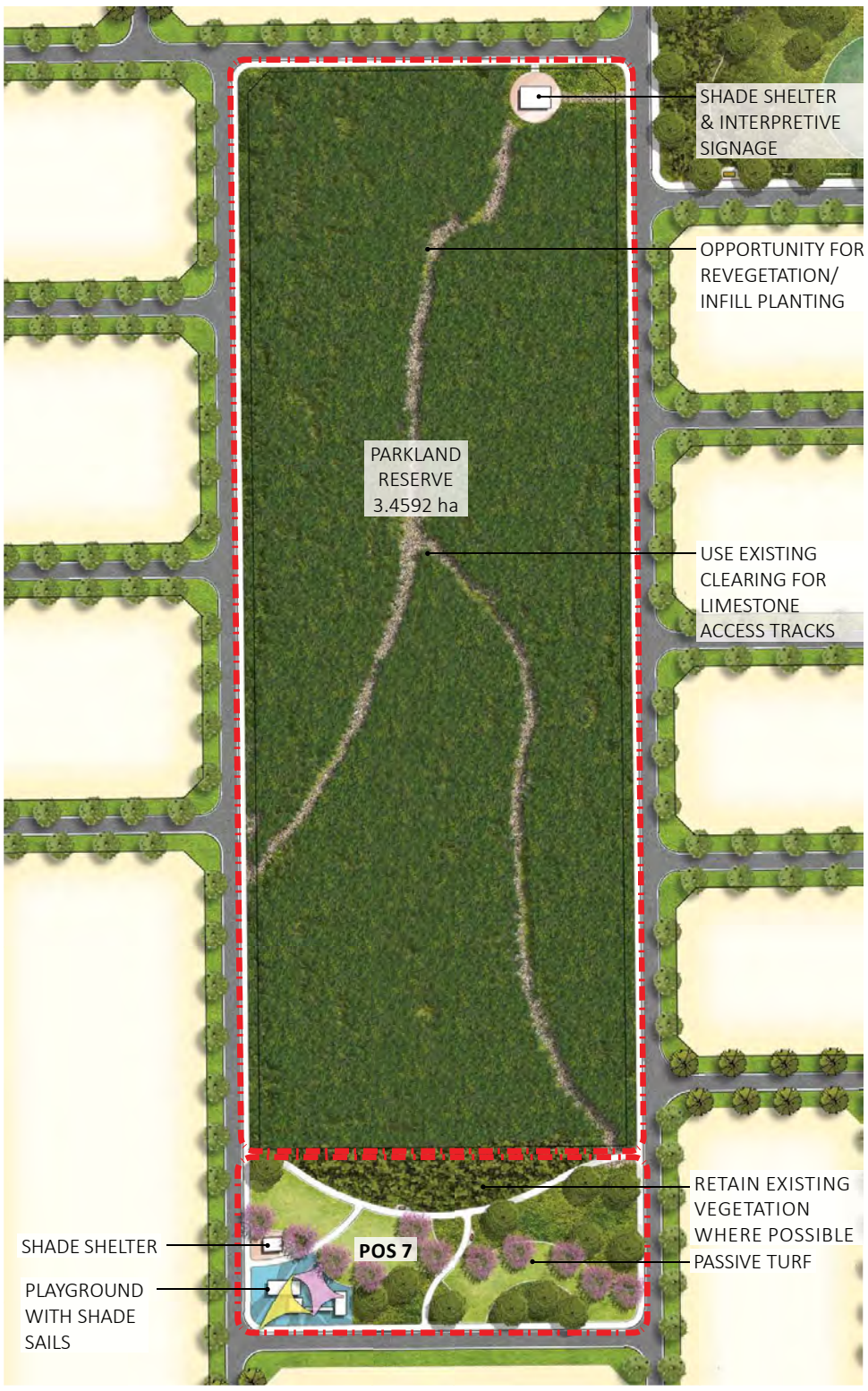
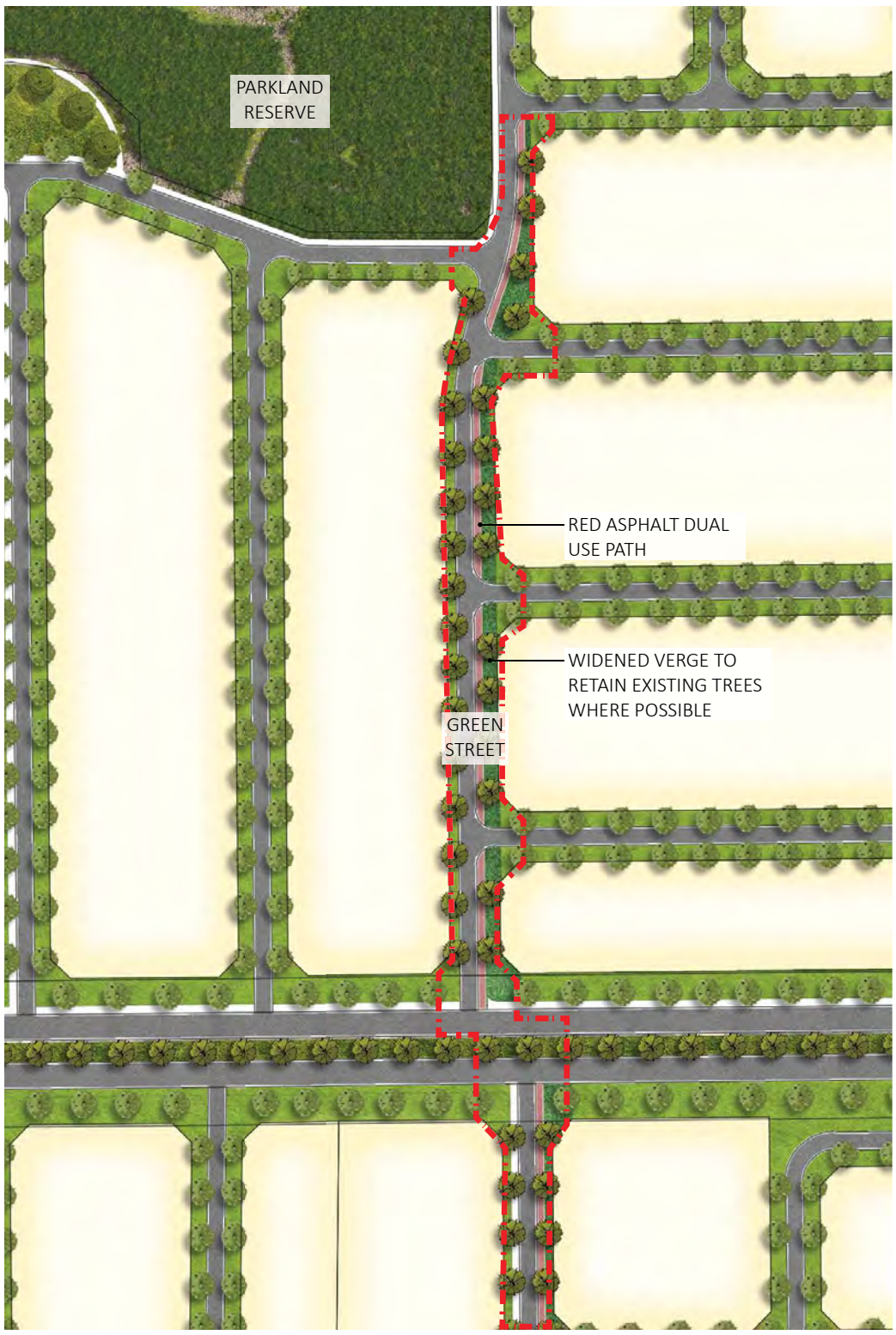
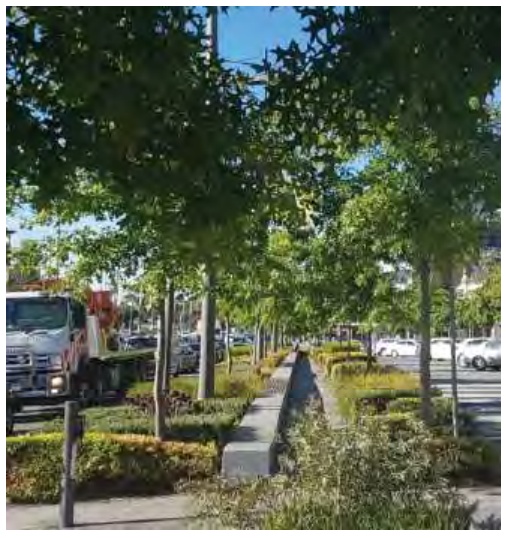


POS 7 & PARKLAND RESERVE



GREEN STREET EXAMPLES

LOCATION PLAN



GREEN STREET

GREEN STREET TYPOLOGY
- Road Reserve

GREEN STREET CONCEPT
- D.U.P through verge to provide safe & comfortable pedestrian connection throughout Estate
- Widened verges to retain existing significant trees & vegetation in streetscapes
- Provide seating & rest nodes

FUNCTIONS / MATERIALS
- Bench seats & feature hardstand areas
- Dual use path connections
- Shade trees to line pedestrian pathways

ENVIRONMENTAL CONSIDERATIONS
- Significant existing trees to be retained
- Carnaby black cockatoo habitat
- Source local materials where possible to minimise transport requirements and provide local employment.
- Consider long-term maintenance requirements.
- No management or modification to Parkland Reserve vegetation except 3m wide perimeter firebreaks. Where existing, firebreak to be maintained.
- POS & Green Street Landscape design to achieve low threat as per AS 3959 and will include low fuel planting, as required

POS 7 CONCEPT
- POS 7

SIZE
- 0.5397 ha excl Parkland Reserve

POS 7 CONCEPT
- Footpath connections through the POS to improve connectivity and walkability
- Provide access to informal tracks through existing vegetation
- Picnic areas, bench seats, shade structures and play space
- Playground on rubber softfall with shade sails

FUNCTIONS / MATERIALS
- Open grassed areas for passive recreation
- Shade sails to feature playground
- Shelter & picnic settings
- Bench seats to provide rest point
- Drainage areas per LWMS

EAST WANNEROO PRECINCT 3
LANDSCAPE DETAILED PLAN POS 7 & GREEN STREET

DWG **EW01-8**
REV **C**
DATE **APRIL 2025**
0 10 20 30 40 50 m
SCALE **1 : 1000 @ A1**

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POS 1 (0.2382ha)
(POCKET PARK) INCLUDES: NATURAL TRACKS THROUGH PARKLAND RESERVE. DUAL USE PATH CONNECTIONS, BENCH SEATING, OPEN TURF WITH SMALL PLAYGROUND & SHADE STRUCTURE

POS 2 (0.2339ha)
(POCKET PARK) INCLUDES: NATURAL TRACKS THROUGH PARKLAND RESERVE. DUAL USE PATH CONNECTIONS, BENCH SEATING, OPEN TURF WITH SMALL PLAYGROUND & SHADE STRUCTURE. DRAINAGE BASIN AS PER LWMS DESIGN

POS 3 (0.6817ha)
(LOCAL POS INCLUDES: NATURAL TRACKS THROUGH PARKLAND RESERVE. DUAL USE PATH CONNECTIONS, BENCH SEATING, OPEN TURF WITH SMALL PLAYGROUND & SHADE STRUCTURE. DRAINAGE BASIN AS PER LWMS DESIGN

POS 4 (0.6734ha)
(LOCAL POS) INCLUDES: PEDESTRIAN NETWORK WHICH CONNECTS INTO BROADER DEVELOPMENT. OPEN TURF AREA FOR PASSIVE RECREATION. BUFFER PLANTING BETWEEN ROAD. DRAINAGE BASIN AS PER LWMS DESIGN

POS 5 (1.3850ha)
(NEIGHBOURHOOD POS) INCLUDES: DUAL-USE PATH FOR BOTH PEDESTRIANS AND CYCLISTS, FEATURE OPEN TURF SPACE FOR ACTIVE / PASSIVE RECREATION. PARK SHELTER WITH PICNIC SETTING & BBQ FACILITIES. PLAYGROUND WITH SHADE SAILS.

POS 6 (0.8030ha)
(LOCAL POS) INCLUDES: PEDESTRIAN NETWORK WHICH CONNECTS INTO BROADER DEVELOPMENT. OPEN TURF AREA TO PROVIDE PASSIVE RECREATION. PARK SHELTER WITH PICNIC SETTING. PLAYGROUND WITH SHADE SAILS. DRAINAGE BASIN AS PER LWMS DESIGN

POS 7 (0.5397ha)
(LOCAL POS) INCLUDES: NATURE PLAYGROUND FOR KIDS, SHADE SHELTER WITH PICNIC SETTINGS, TURF AREA FOR PASSIVE RECREATION. DRAINAGE BASIN AS PER LWMS DESIGN

POS 8 NEIGHBOURHOOD SPORTS POS (4.5003ha)
(SPORT POS) INCLUDES: RED ASPHALT DUAL USE PATH AROUND SPORTING FIELD, BENCH SEATING, OPEN TURF FOR ACTIVE RECREATION, NATURAL TRACKS THROUGH PARKLAND RESERVE, FITNESS EQUIPMENT, MULTIPURPOSE SENIOR SPORTS OVAL, CAR PARKING.

POS 9 (0.4809ha)
(POCKET PARK) INCLUDES: NATURAL TRACKS THROUGH PARKLAND RESERVE. DUAL USE PATH CONNECTIONS, BENCH SEATING, OPEN TURF WITH SMALL PLAYGROUND & SHADE STRUCTURE. DRAINAGE BASIN AS PER LWMS DESIGN

POS 10 (1.7317ha)
(NEIGHBOURHOOD POS) INCLUDES: DUAL-USE PATH FOR BOTH PEDESTRIANS AND CYCLISTS, FEATURE OPEN TURF SPACE FOR ACTIVE / PASSIVE RECREATION. PARK SHELTER WITH PICNIC SETTING. PLAYGROUND WITH SHADE SAILS. DRAINAGE BASIN AS PER LWMS DESIGN

POS 11 (0.7101ha)
(LOCAL POS) INCLUDES: DUAL-USE PATH FOR BOTH PEDESTRIANS AND CYCLISTS, FEATURE OPEN TURF SPACE FOR ACTIVE / PASSIVE RECREATION. PARK SHELTER WITH PICNIC SETTING. PLAYGROUND WITH SHADE SAILS. DRAINAGE BASIN AS PER LWMS DESIGN

ESTIMATED IRRIGATION USAGE
- No irrigation to drainage basins
- 2 year establishment period
*- TURF: **6750** kl/ha/yr (Permanent)*
*-GARDEN BED: **3750** kl/ha/yr (Establishment)*

POS 1	
Permanent:	610 kl/yr
Establishment:	678 kl/yr
POS 2:	
Permanent:	600 kl/yr
Establishment:	665 kl/yr
POS 3:	
Permanent:	1,746 kl/yr
Establishment:	1,940 kl/yr
POS 4:	
Permanent:	1,725 kl/yr
Establishment:	1,916 kl/yr
POS 5:	
Permanent:	3,548 kl/yr
Establishment:	3,942 kl/yr
POS 6:	
Permanent:	1,890 kl/yr
Establishment:	2,940 kl/yr
POS 7:	
Permanent:	2,057 kl/yr
Establishment:	2,285 kl/yr
POS 8(PLAYING FIELDS):	
Permanent:	20,960 kl/yr
Establishment:	12,809 kl/yr
POS 9:	
Permanent:	1,134 kl/yr
Establishment:	1,764 kl/yr
POS 10:	
Permanent:	4,436 kl/yr
Establishment:	4,929 kl/yr
POS 11:	
Permanent:	1,819kl/yr
Establishment:	2,021kl/yr

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POS TREES

Melaleuca leucadendron
Weeping Paperbark

Eucalyptus gomphocephala
Tuart

Lagerstroemia indica
Crepe-myrtle

Jacaranda mimosifolia
Jacaranda

Olea europea
Swan Hill (Fruitless Olive)

Callistemon 'KPS'
Kings Park Special

Eucalyptus torquata
Coral Gum

Agonis flexuosa
WA Peppermint

Cupaniopsis anacardioides
Tuckeroo

Banksia ashbyii
Ashby Banksia

REVEGETATION PLANTING

Anigozanthos manglesii

Adenanthos cygnorum

Banksia grandis

Baumea juncea

Beaufortia squarrosa

Darwinia citriodora

Juncus pallidus

Kennedia prostrata

Verticordia densiflora

LOW FUEL PLANTING

Anigozanthos manglesii

Austrostipa compressa

Conostylis aculeata

Dampiera linearis

Juncus pallidus

Kennedia prostrata

Kunzea recurva

Melaleuca thymoides

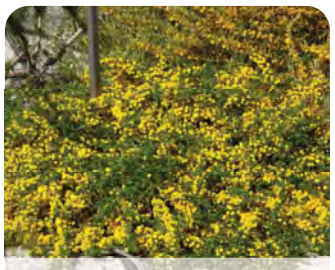
Patersonia occidentalis

SHRUB PLANTING

Olearia axillaris

Rhagodia baccata

Darwinia citriodora


Acacia lasiocarpa

Conostylis aculeata ssp. preissii

Dianella revoluta

Dianella cassa blue

Eremophila glabra

Lepidosperma calcicola

Dampiera linearis

Eremophila maculata

Grevillea crithmifolia

Lepidosperma gladiatum

Lomandra longifolia

Meeboldina scariosa

Grevillea thelemanniana

Hemiandra pungens

Patersonia occidentalis

EAST WANNEROO PRECINCT 3
PLANTING PALETTE

DWG **EW01-10**
REV **C**
DATE **APRIL 2025**

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emerge ASSOCIATES

APPENDIX J

CURRV Runoff Rate Calculator

CURRV

Calculator for Urban Runoff Rates & Volumes
7/04/2025

Project: East Wanneroo Precinct 3 LWMS

	Land Use Description	Area (ha)	Use in Calc	Imperv Initial Loss mm	Perv Initial Loss mm	Perv Continue Loss mm/hr	On Site Soak (mm)	Empty (days)	AR&R EIA/TIA System Connect Ratio	Roof %	Ext Imp %	Ext Perv %	Comment
1	Residential Lots	65.90	Yes	1.5	20.0	4.0	15.0	0.20	60%	62	18	20	soakwells
2	Local Roads	38.55	Yes	1.5	20.0	4.0	0.0	0.20	100%	0	70	30	no soakwells assumed
3	Active POS/Playing Field	12.03	Yes	1.5	20.0	4.0	0.0	0.20	30%	0	5	95	assume similar EIA/TIA to rural residential
4	Vegetated POS	14.32	No	1.5	20.0	4.0		0.20	0%				retained onsite
5	Local Centre	2.08	No	1.5	20.0	4.0		0.20	0%				retained onsite
6	Church	1.96	No	1.5	20.0	4.0		0.20	0%				retained onsite
7	Primary School	3.52	No	1.5	20.0	4.0		0.20	0%				retained onsite
8			No	1.5	20.0	4.0		0.20					
9			No	1.5	20.0	4.0		0.20					
10			No	0.0	20.0	4.0		0.20					

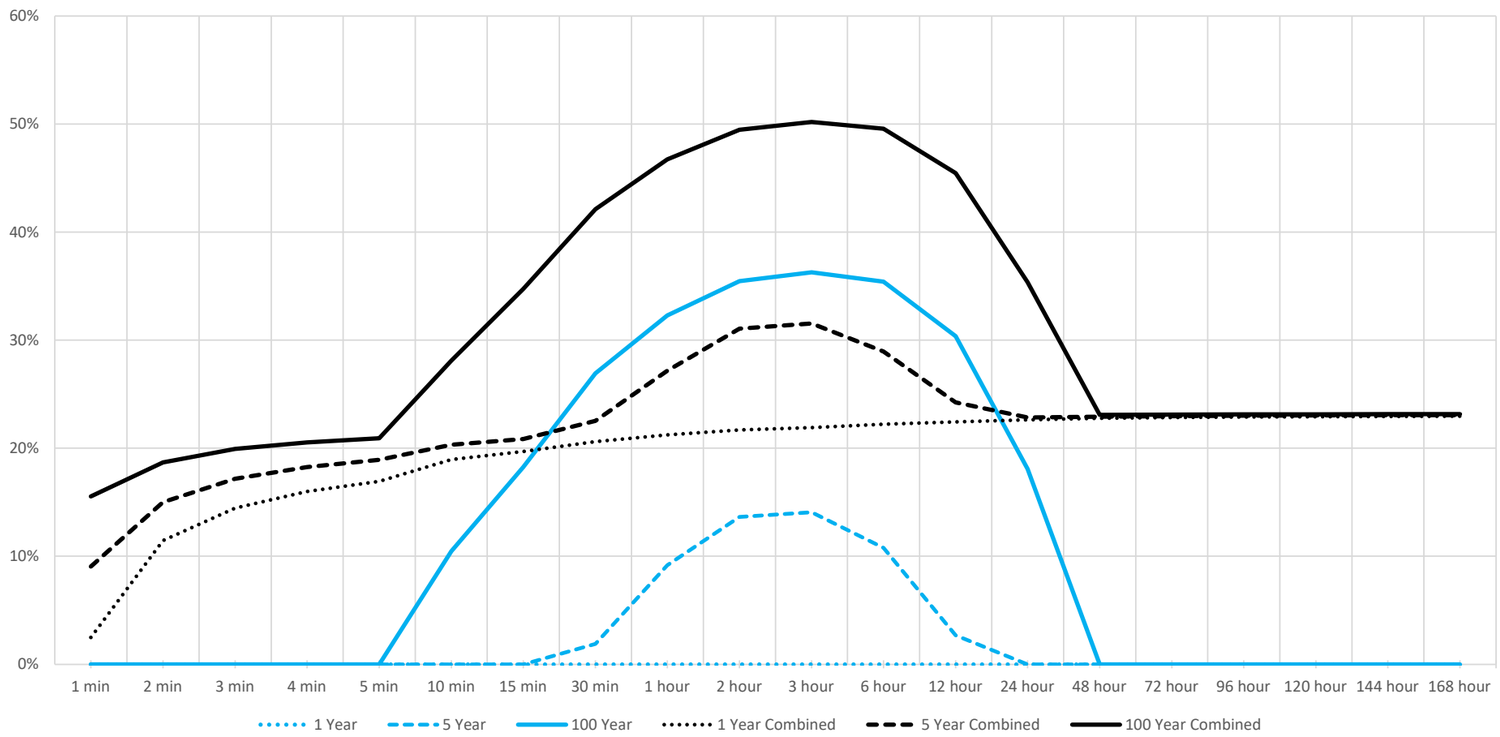
EIA : Effective Impervious Area, TIA : Total Impervious Area

Land Use Graph Selector: **1**

(11 - combined total)

Residential Lots

Estimated Runoff Rates for Various Land Use and ARI



Rainfall IFD Data
Annual Exceedence Probability

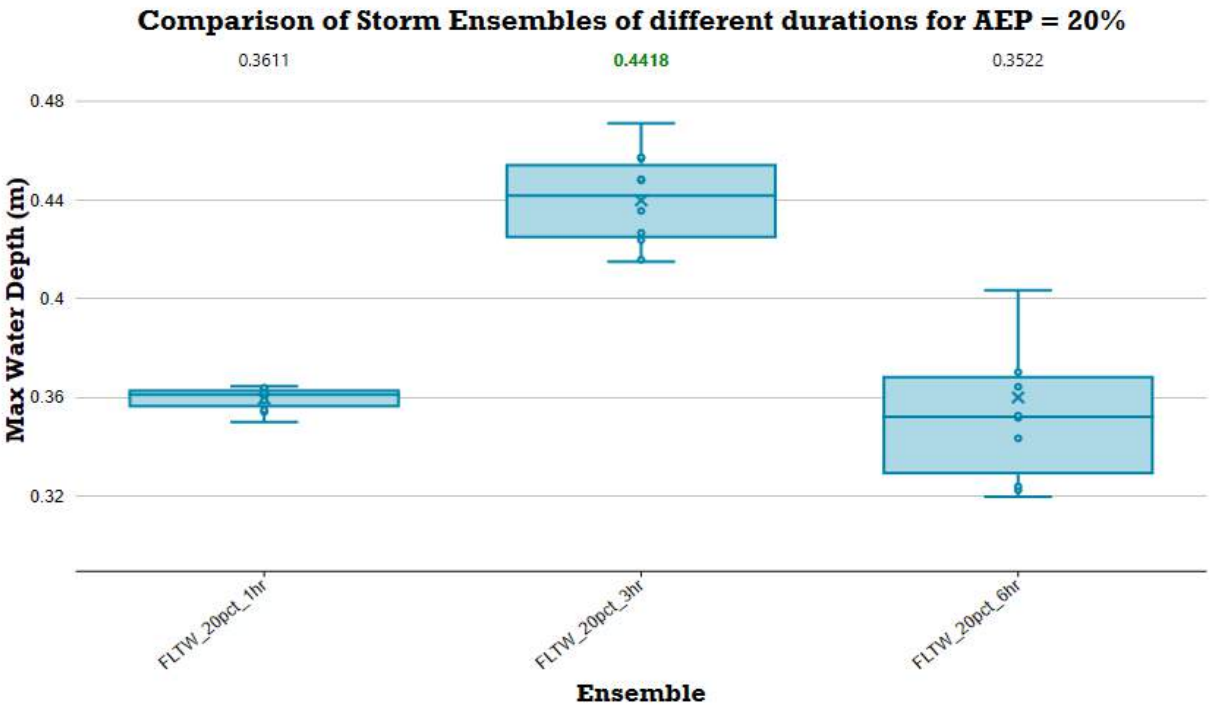
	Duration	63.2% 1.00	50% 1.44	20% 4.48	10% 10	5% 20	2% 50	1% 100
1	1 min	1.7	1.9	2.5	2.9	3.3	4.0	4.5
2	2 min	3.0	3.2	4.2	4.9	5.6	6.7	7.6
3	3 min	4.0	4.4	5.7	6.6	7.6	9.1	10.3
4	4 min	4.8	5.3	6.9	8.1	9.4	11.1	12.6
5	5 min	5.5	6.1	8.0	9.4	10.8	12.9	14.6
6	10 min	8.0	8.9	11.7	13.8	16.0	19.0	21.5
7	15 min	9.7	10.7	14.2	16.7	19.3	23.0	25.9
8	30 min	12.9	14.3	18.8	22.1	25.5	30.3	34.2
9	1 hour	16.8	18.5	24.2	28.4	32.8	39.2	44.4
10	2 hour	21.5	23.6	30.8	36.3	42.1	50.8	58.2
11	3 hour	24.8	27.1	35.4	41.9	48.9	59.4	68.5
12	6 hour	31.5	34.5	45.1	53.6	63.1	77.6	90.3
13	12 hour	39.9	43.7	57.2	68.1	80.1	98.8	115.0
14	24 hour	50.3	55.1	71.7	84.4	98.0	119.0	138.0
15	48 hour	63.0	69.1	88.5	102.0	115.0	137.0	154.0
16	72 hour	72.1	79.0	100.0	114.0	127.0	148.0	164.0
17	96 hour	79.7	87.3	110.0	124.0	138.0	158.0	174.0
18	120 hour	86.6	94.7	119.0	134.0	149.0	170.0	187.0
19	144 hour	93.2	102.0	128.0	145.0	161.0	184.0	202.0
20	168 hour	99.5	109.0	137.0	156.0	175.0	200.0	220.0

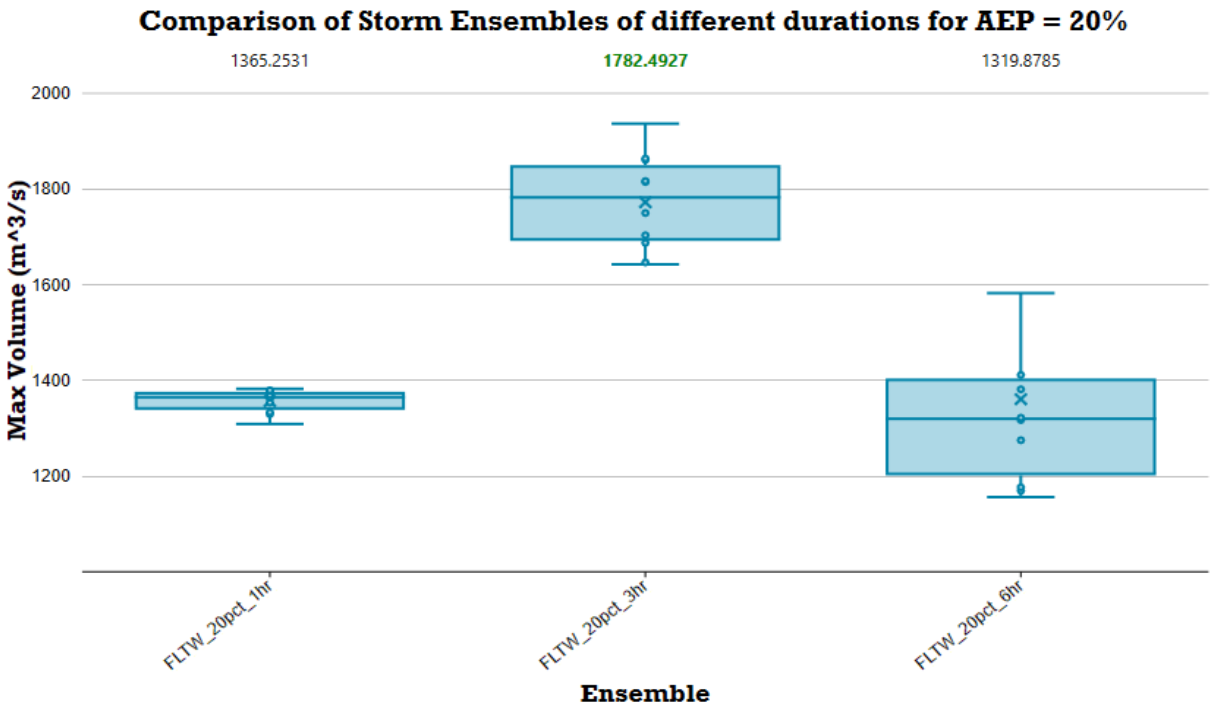
Estimated Runoff Rates
Annual Exceedence Probability

	63.2%	50%	20%	10%	5%	2%	1%
Maximum of All Events	1.00	1.44	4.48	10	20	50	100
Residential Lots	0%	2%	14%	21%	27%	33%	36%
Local Roads	69%	69%	70%	75%	78%	82%	84%
Active POS/Playing Field	1%	1%	4%	8%	11%	15%	17%
Vegetated POS	0%	0%	0%	0%	0%	0%	0%
Local Centre	0%	0%	0%	0%	0%	0%	0%
Church	0%	0%	0%	0%	0%	0%	0%
Primary School	0%	0%	0%	0%	0%	0%	0%
0	0%	0%	0%	0%	0%	0%	0%
0	0%	0%	0%	0%	0%	0%	0%
0	0%	0%	0%	0%	0%	0%	0%
combined total	23%	23%	32%	38%	42%	47%	50%

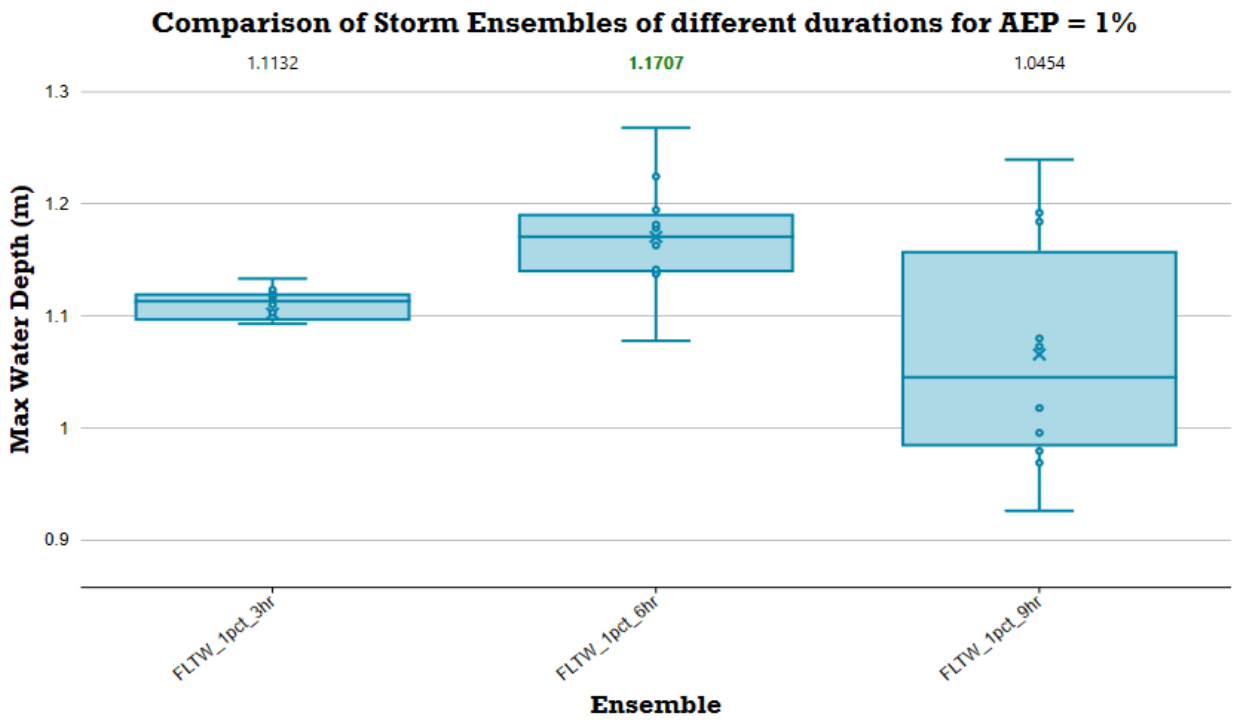
Event Selector	9	1 hour					
Residential Lots	0%	0%	9%	17%	23%	29%	32%
Local Roads	64%	64%	66%	71%	75%	79%	81%
Active POS/Playing Field	1%	1%	2%	6%	9%	12%	15%
Vegetated POS	0%	0%	0%	0%	0%	0%	0%
Local Centre	0%	0%	0%	0%	0%	0%	0%
Church	0%	0%	0%	0%	0%	0%	0%
Primary School	0%	0%	0%	0%	0%	0%	0%
0	0%	0%	0%	0%	0%	0%	0%
0	0%	0%	0%	0%	0%	0%	0%
0	0%	0%	0%	0%	0%	0%	0%
combined total	21%	21%	27%	34%	38%	44%	47%

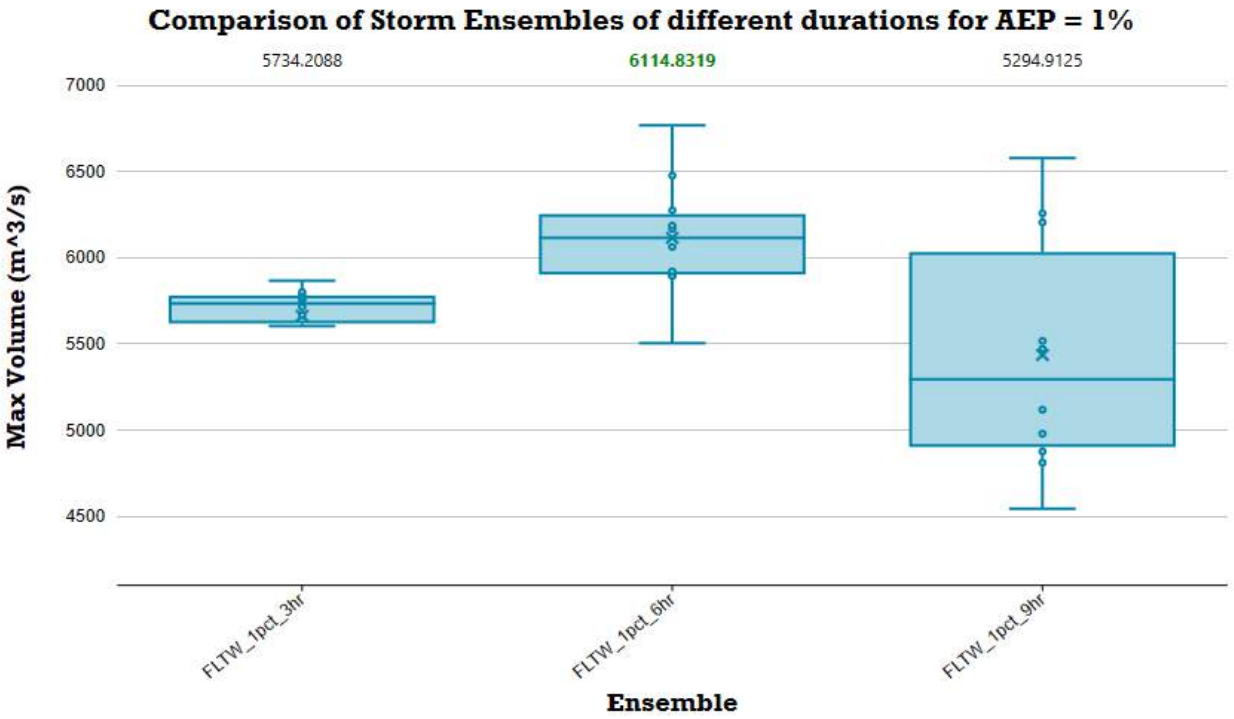
APPENDIX K
Stormwater Modelling Outputs


Comparison of Storm Ensembles of different durations for AEP = 20%
0.3611
0.4418
0.3522
0.48
0.44
0.4
0.36
0.32
Max Water Depth (m)
FLTW_20pct_1hr
FLTW_20pct_3hr
FLTW_20pct_6hr
Ensemble


Comparison of Storm Ensembles of different durations for AEP = 20%
1365.2531
1782.4927
1319.8785
2000
1800
1600
1400
1200
Max Volume (m^3/s)
FLTW_20pct_1hr
FLTW_20pct_3hr
FLTW_20pct_6hr
Ensemble

Date: 24/03/2025 Job No. H24054





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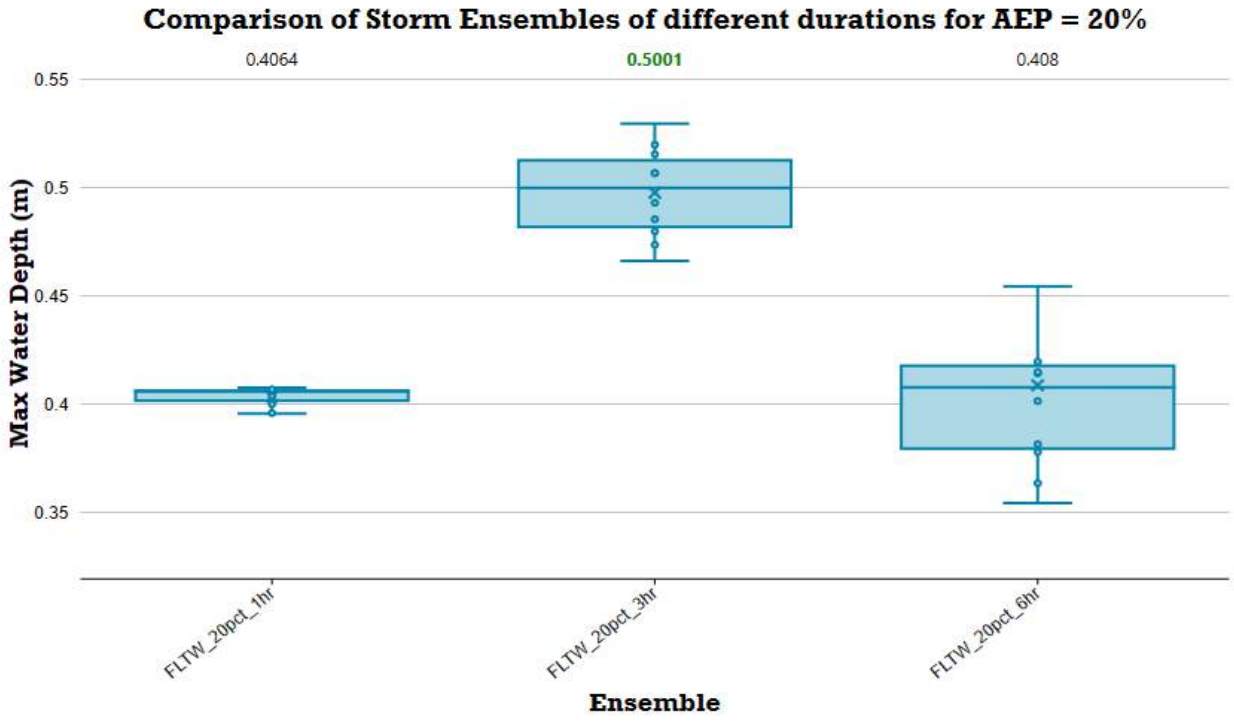

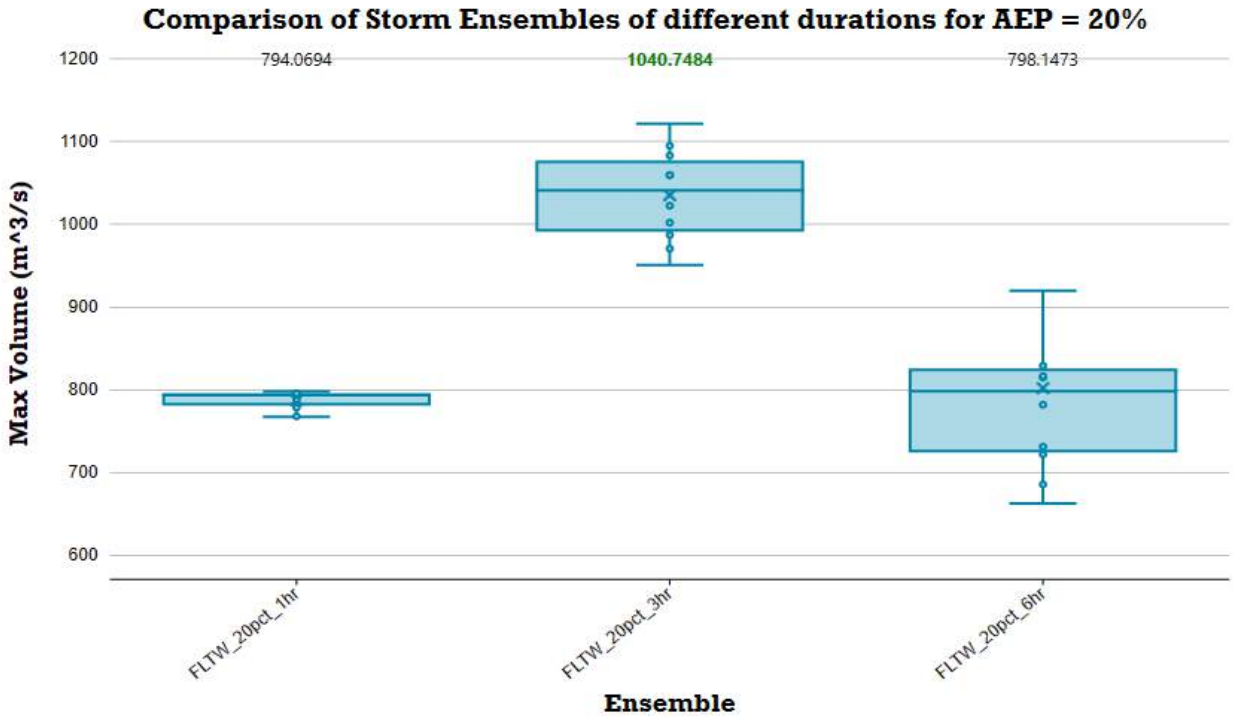

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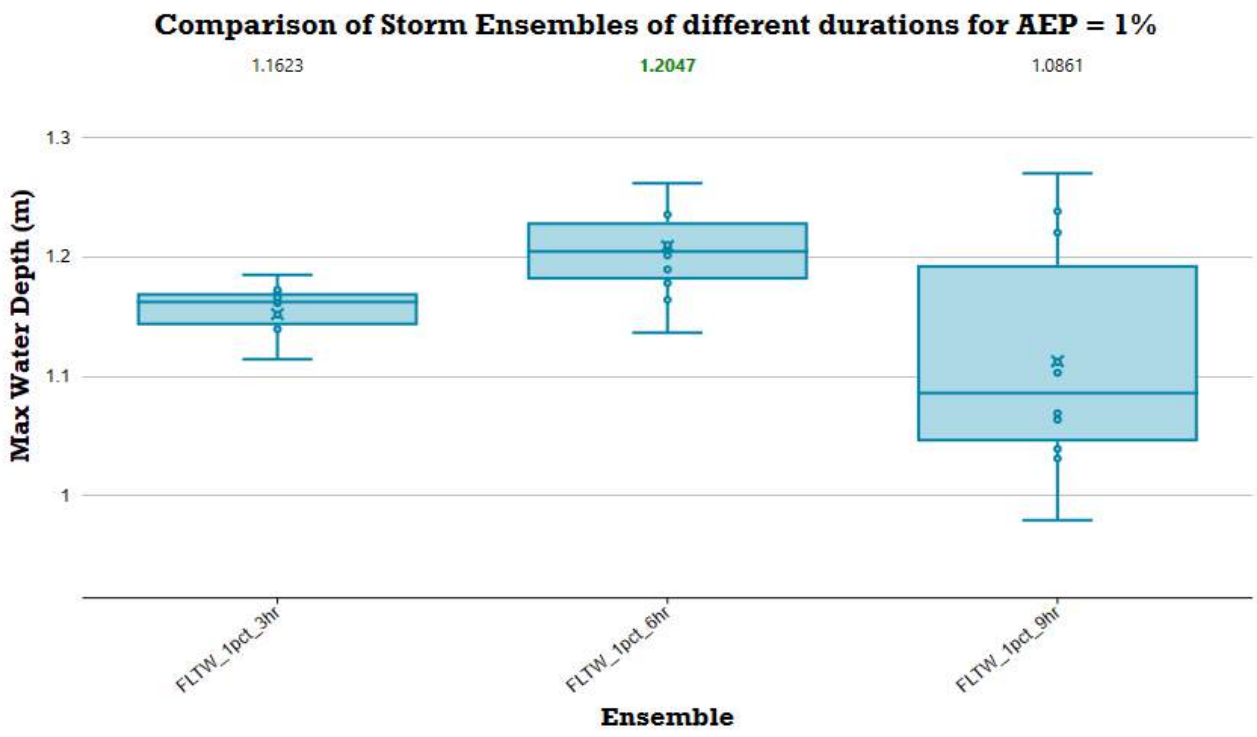

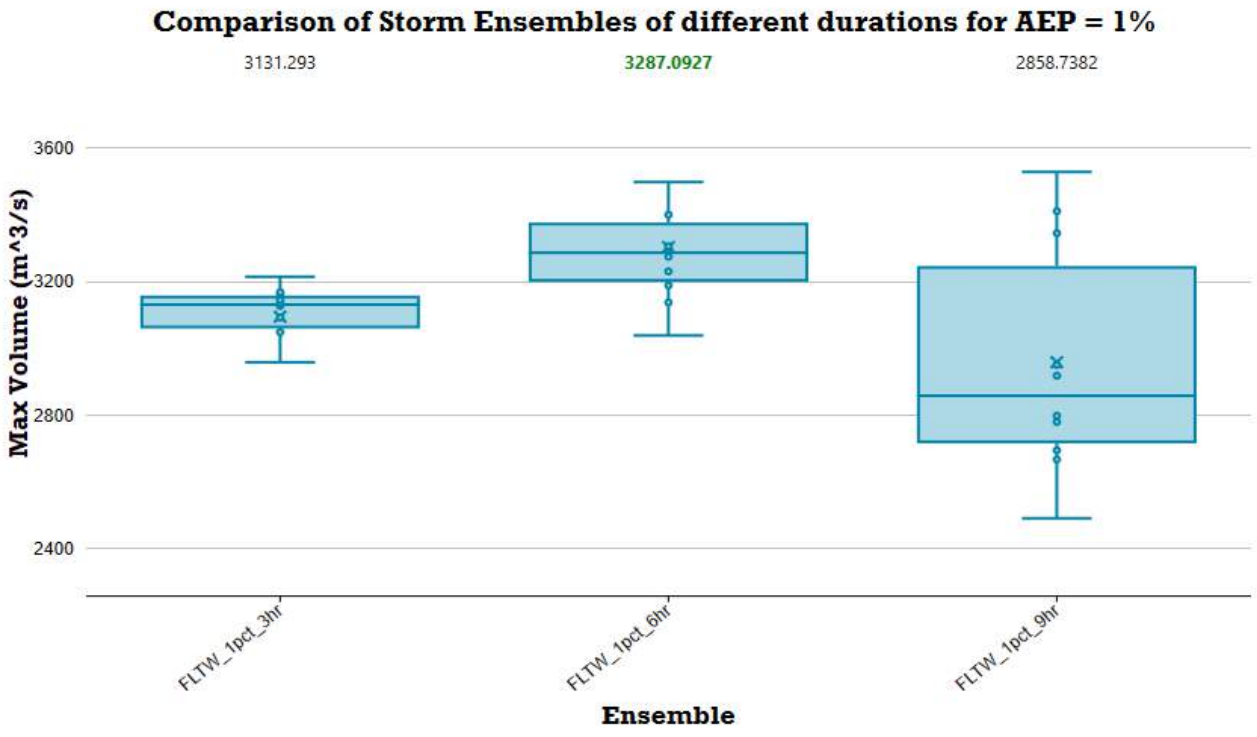

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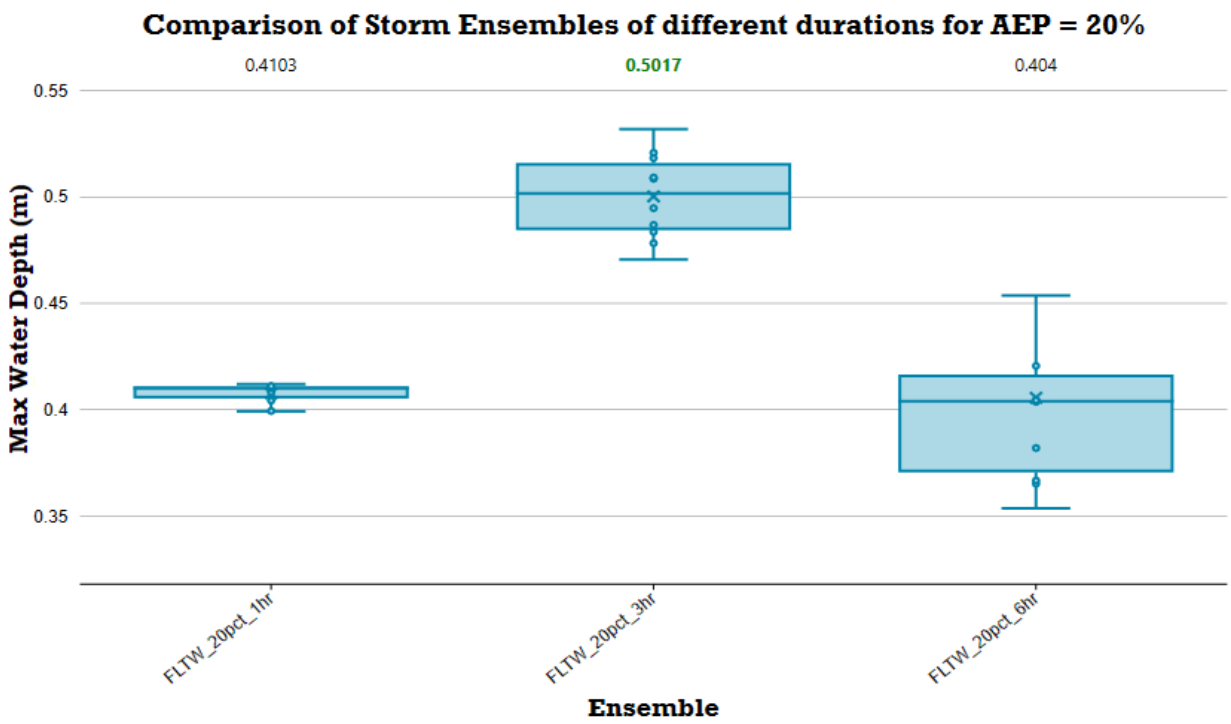

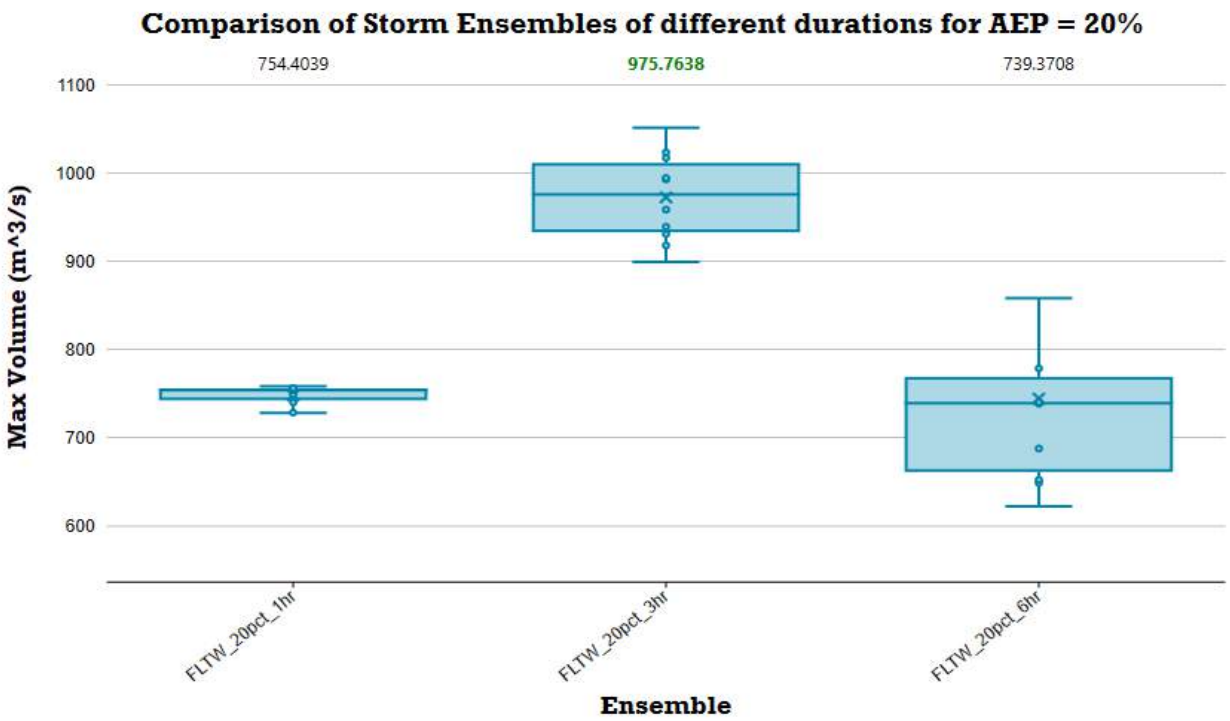

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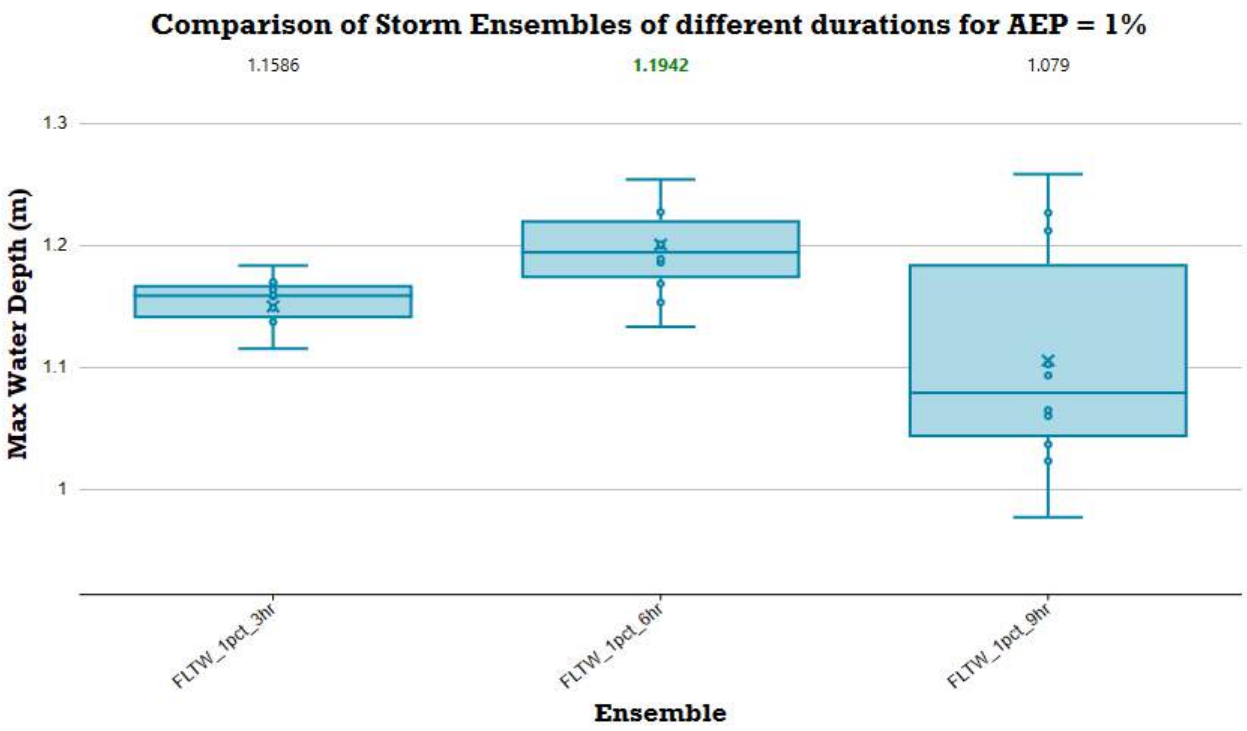

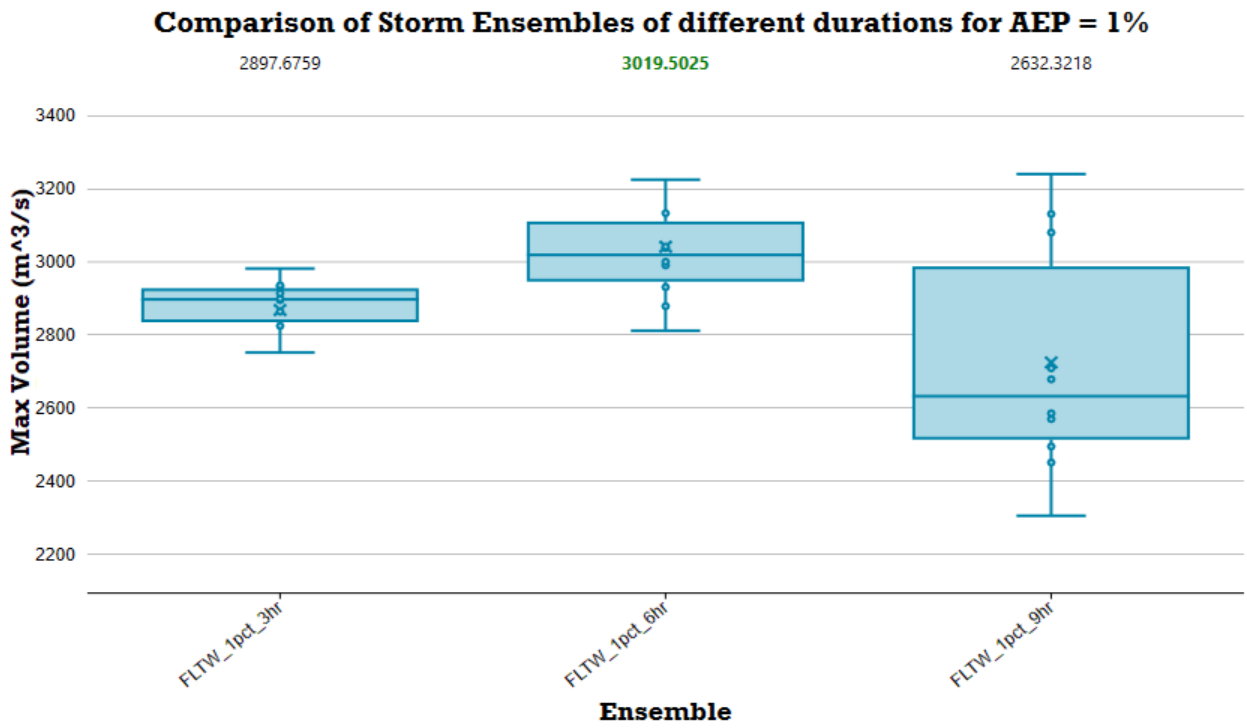

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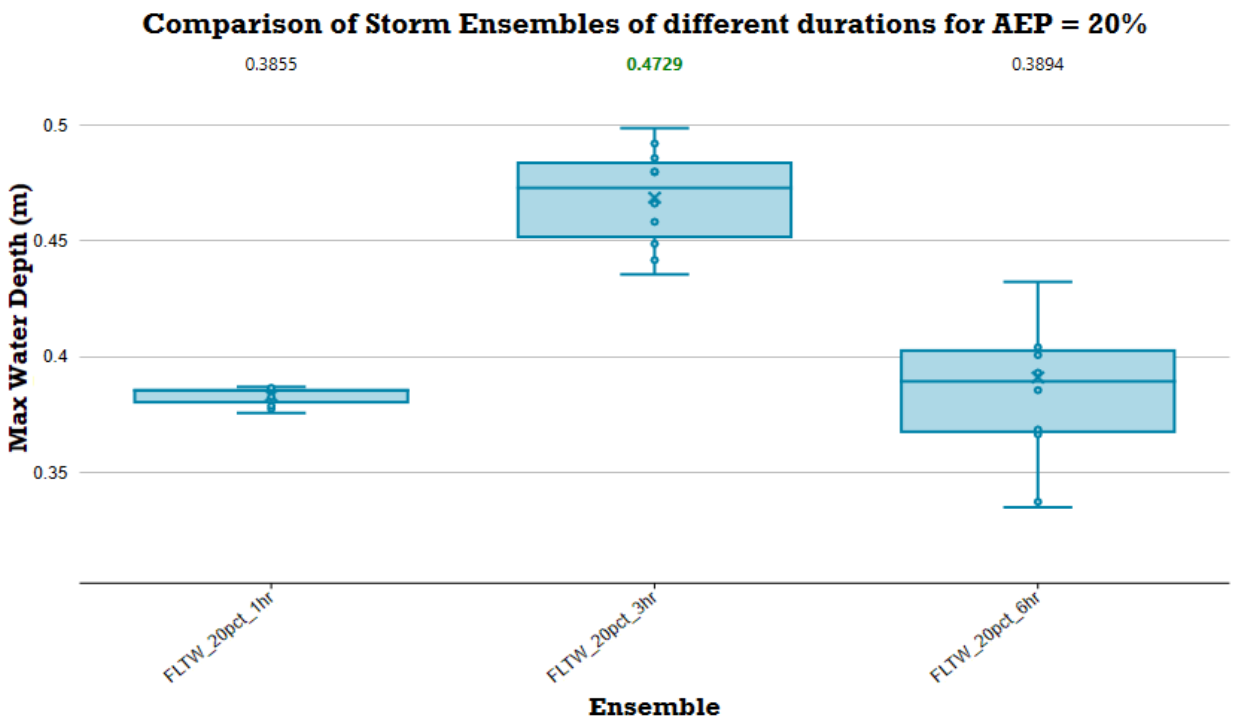

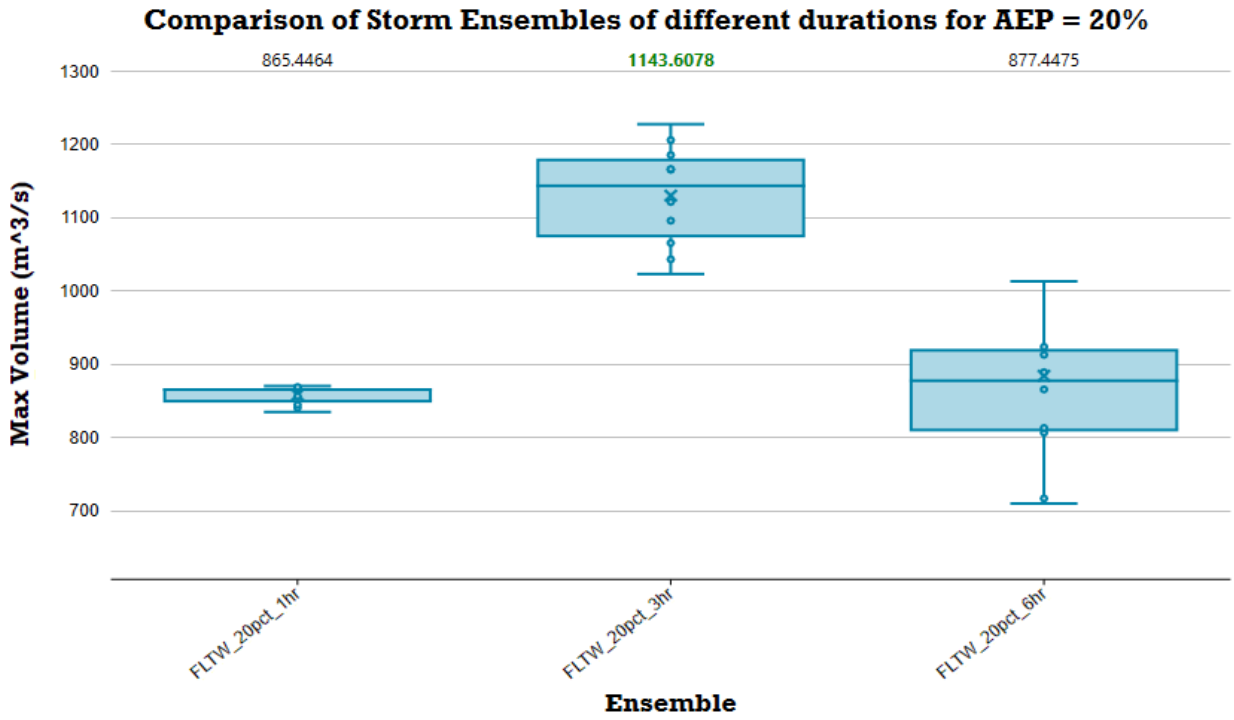

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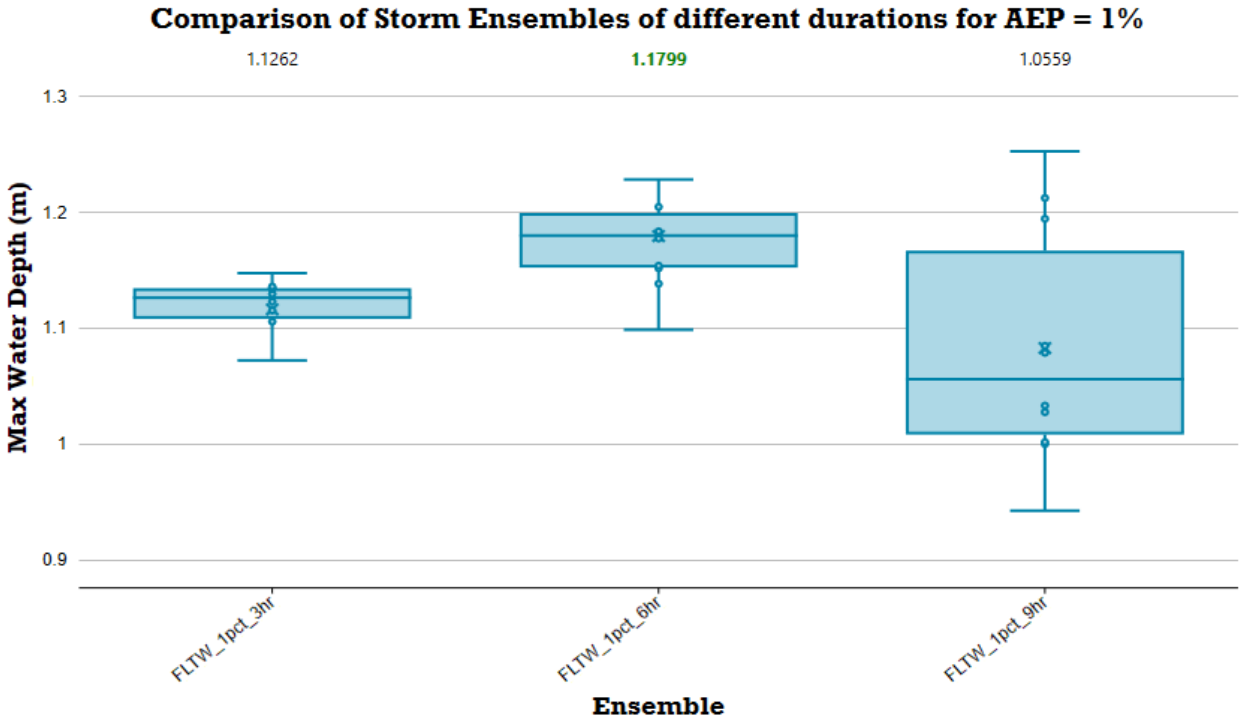

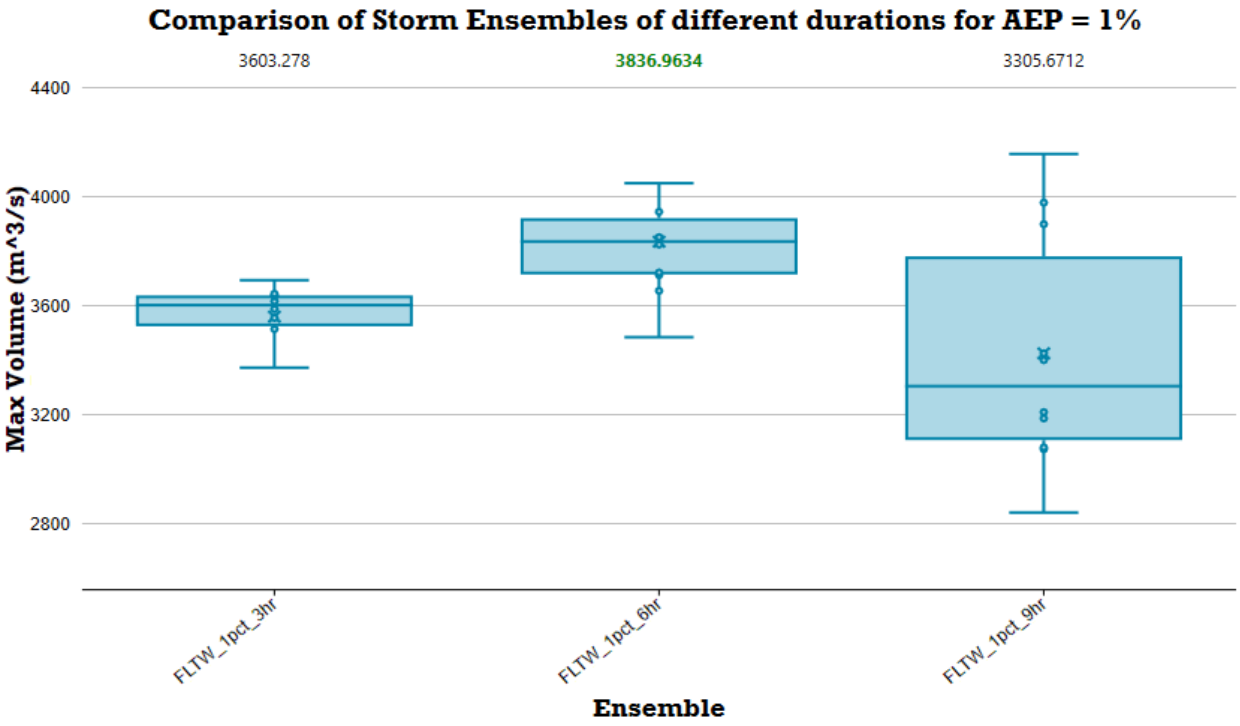

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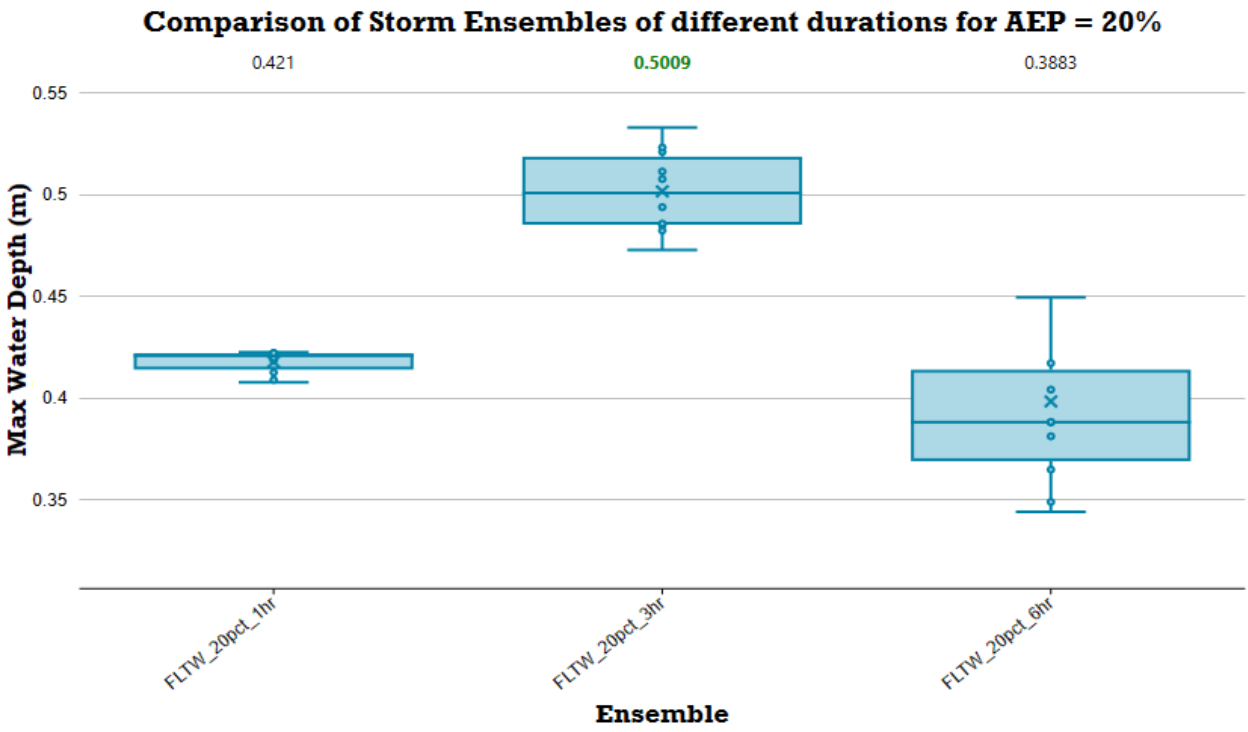

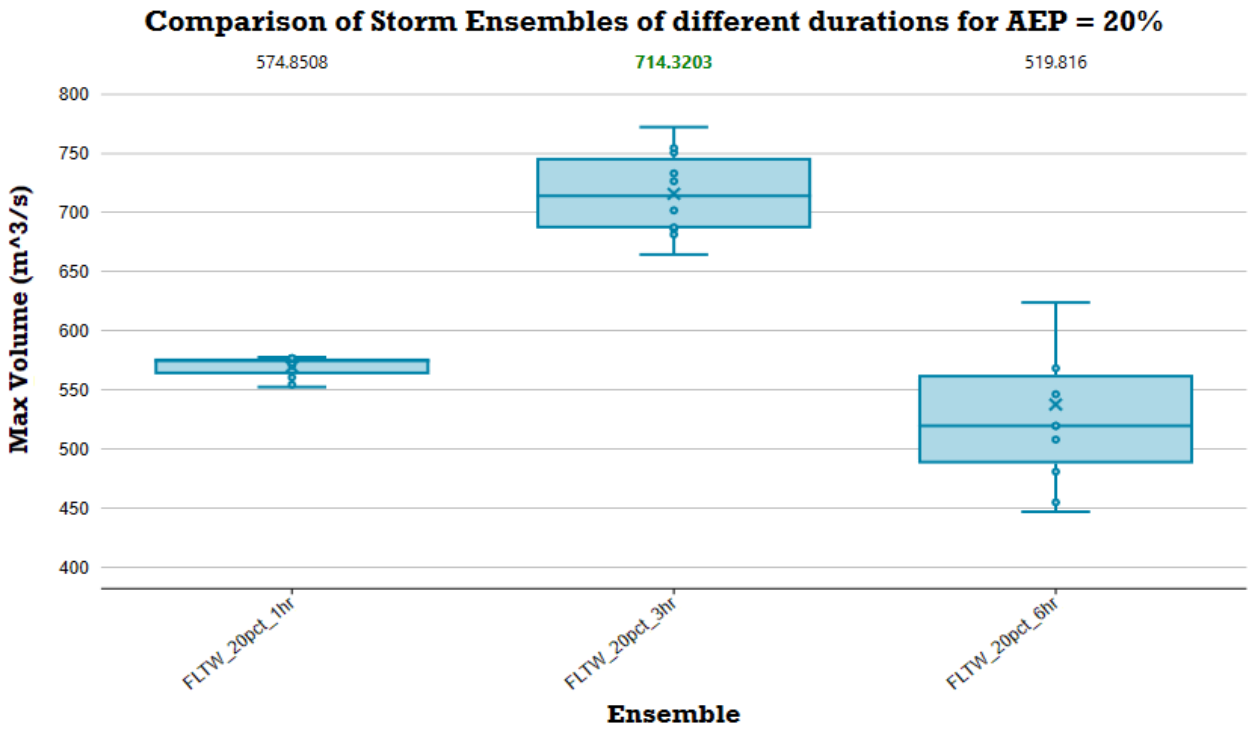

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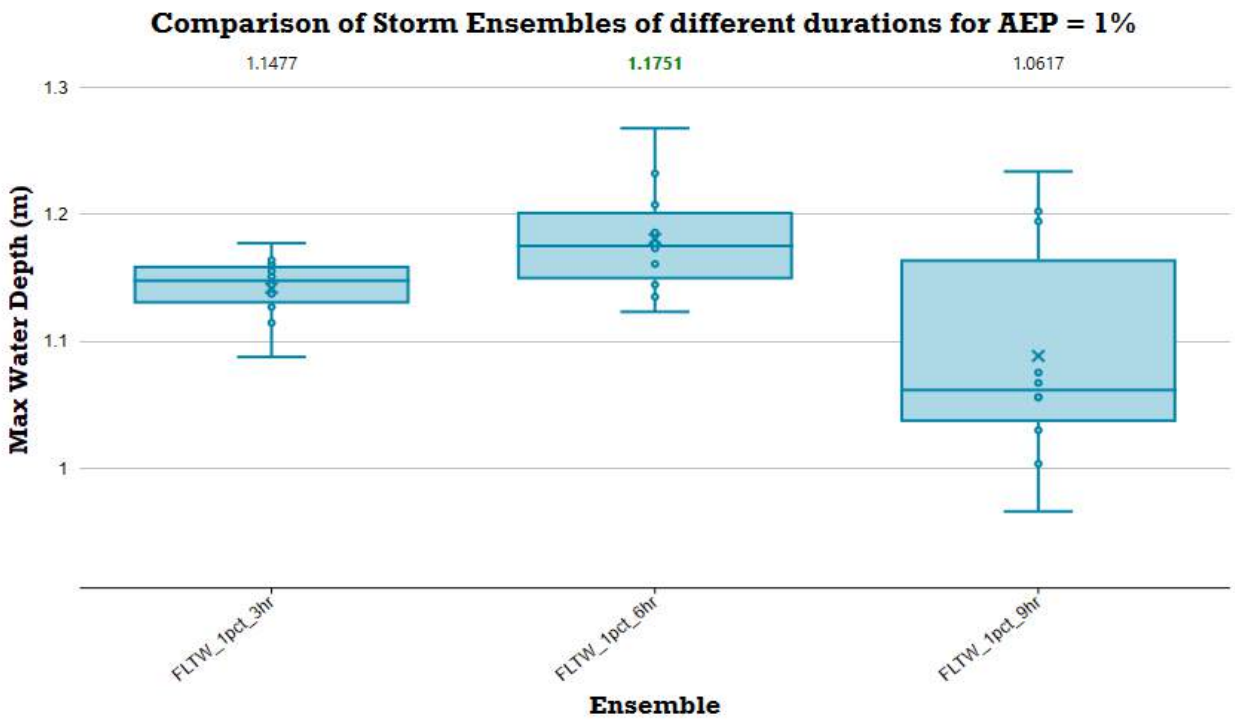

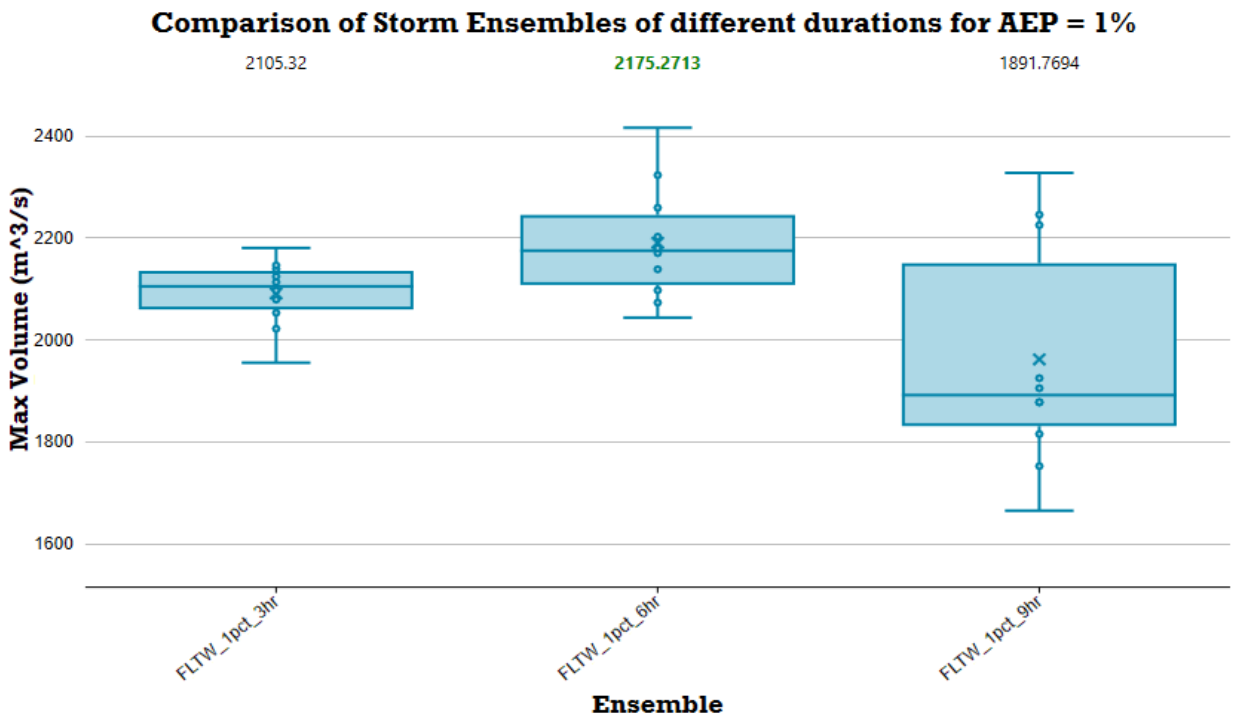

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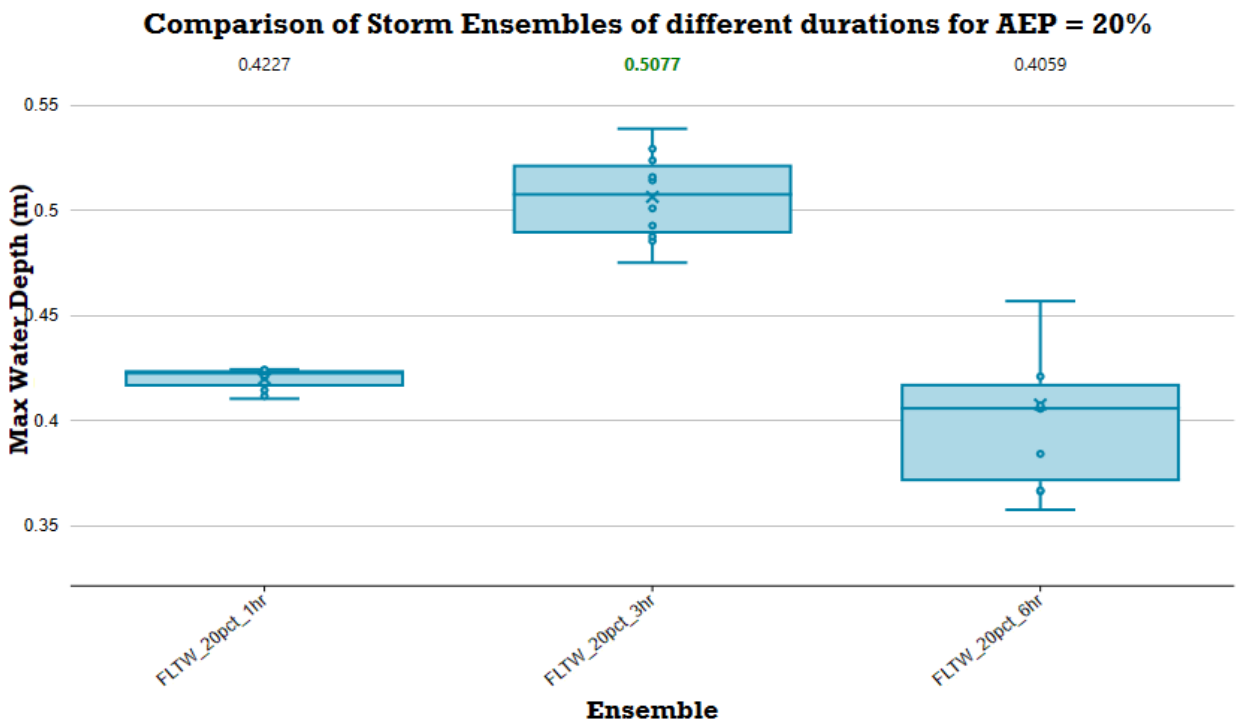

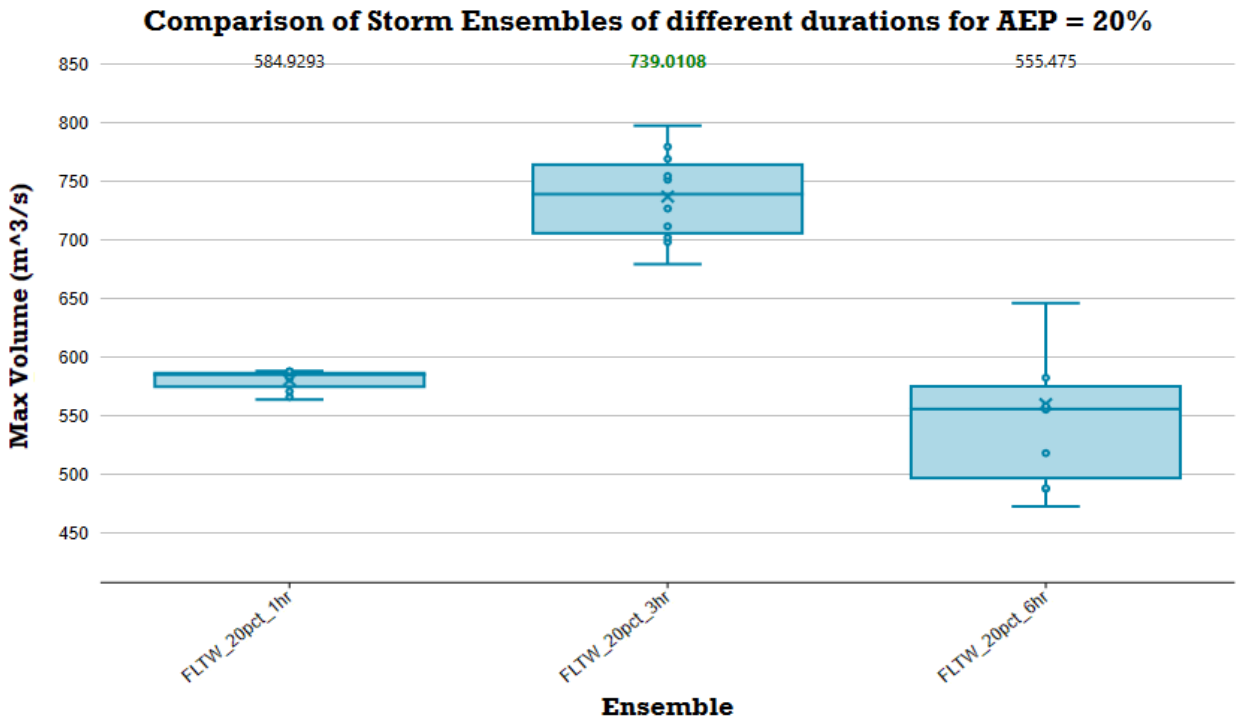

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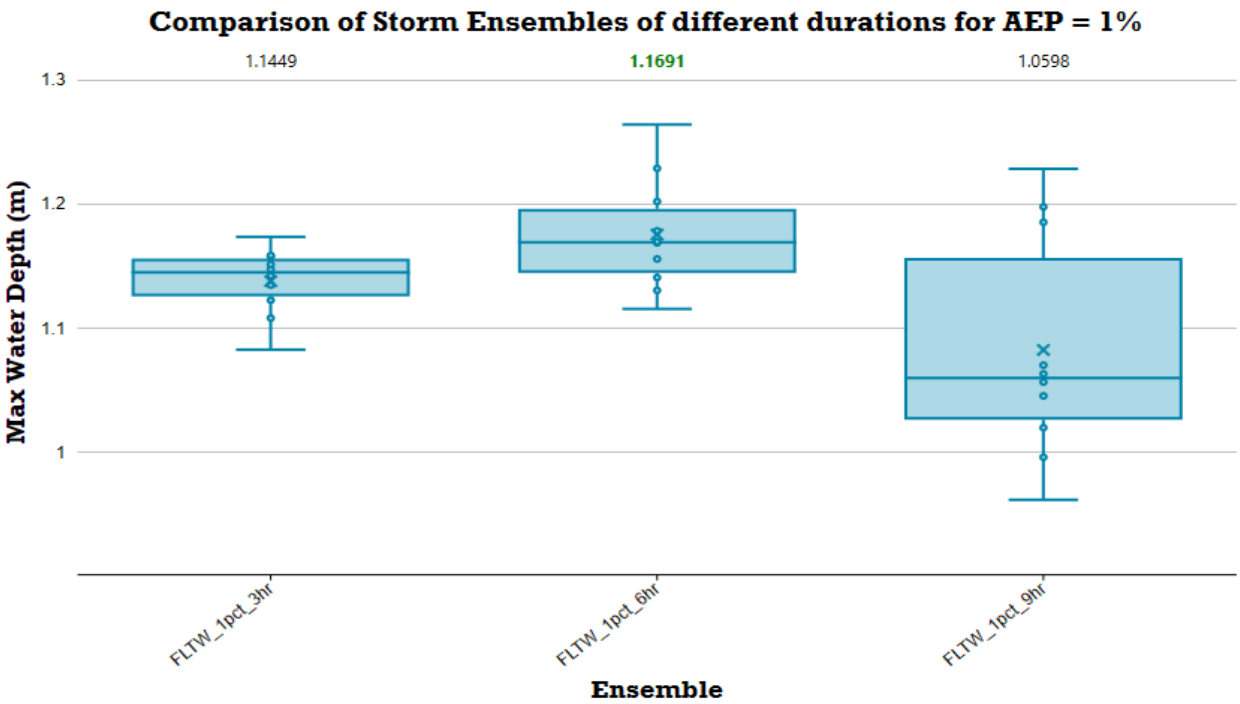
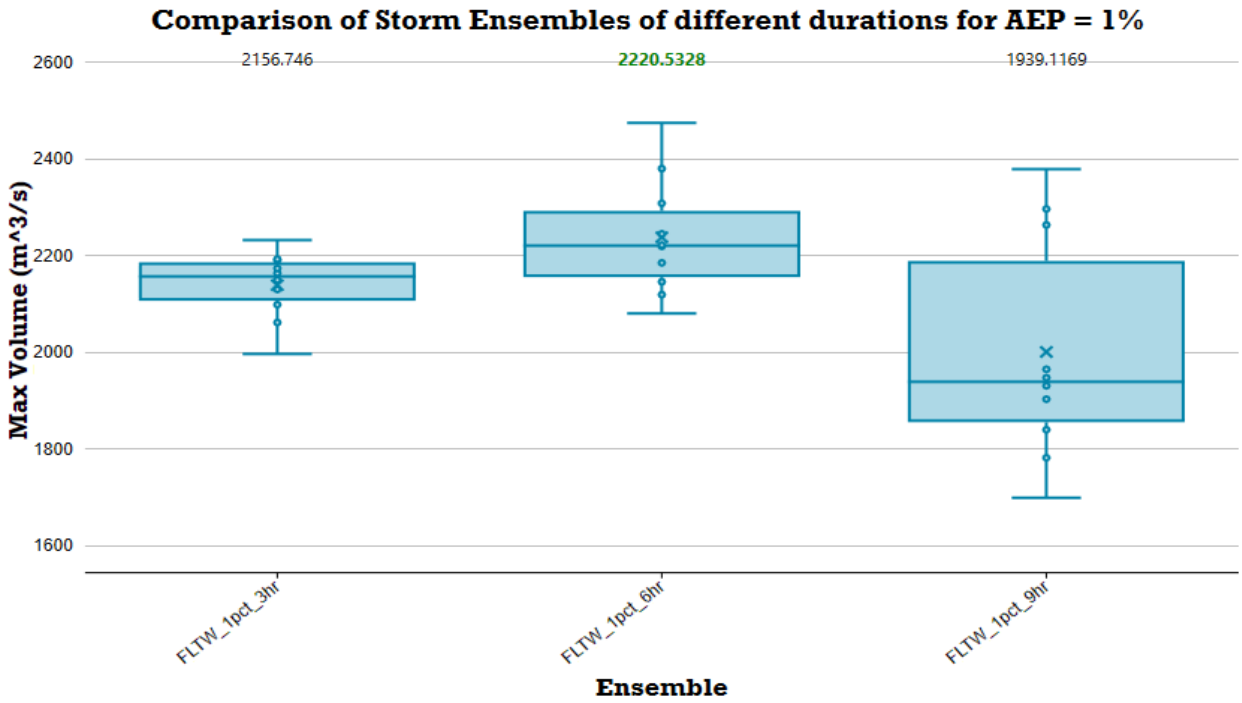
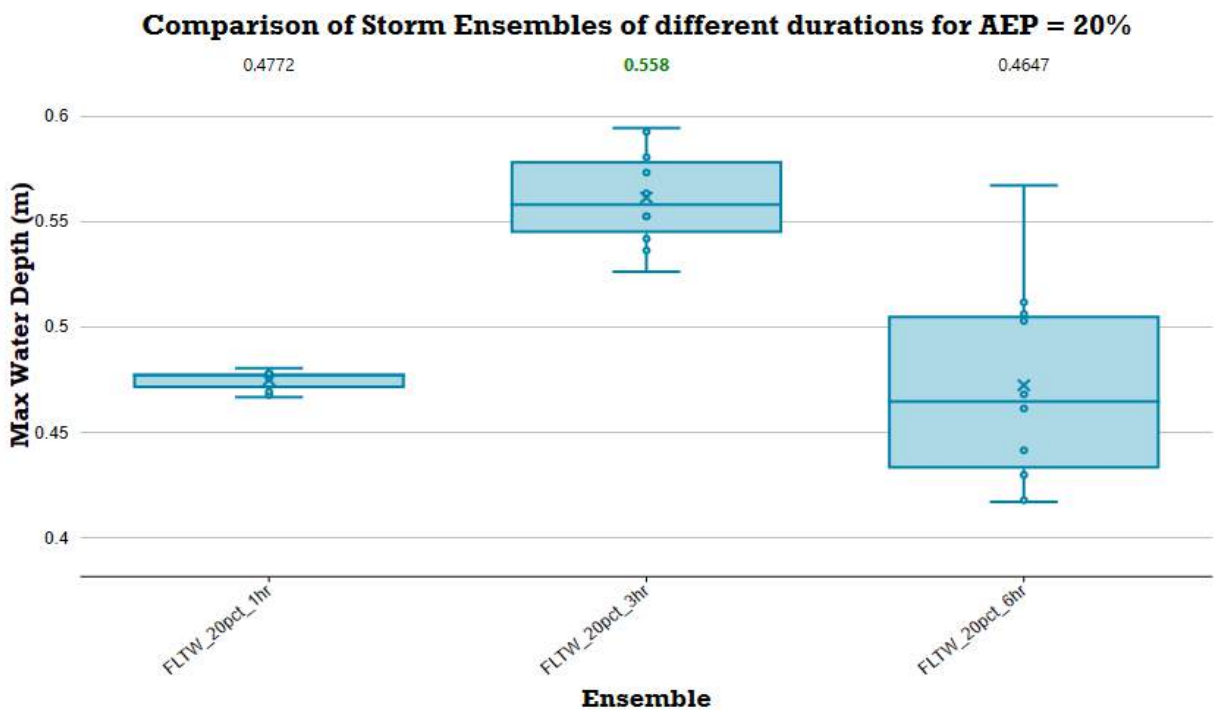
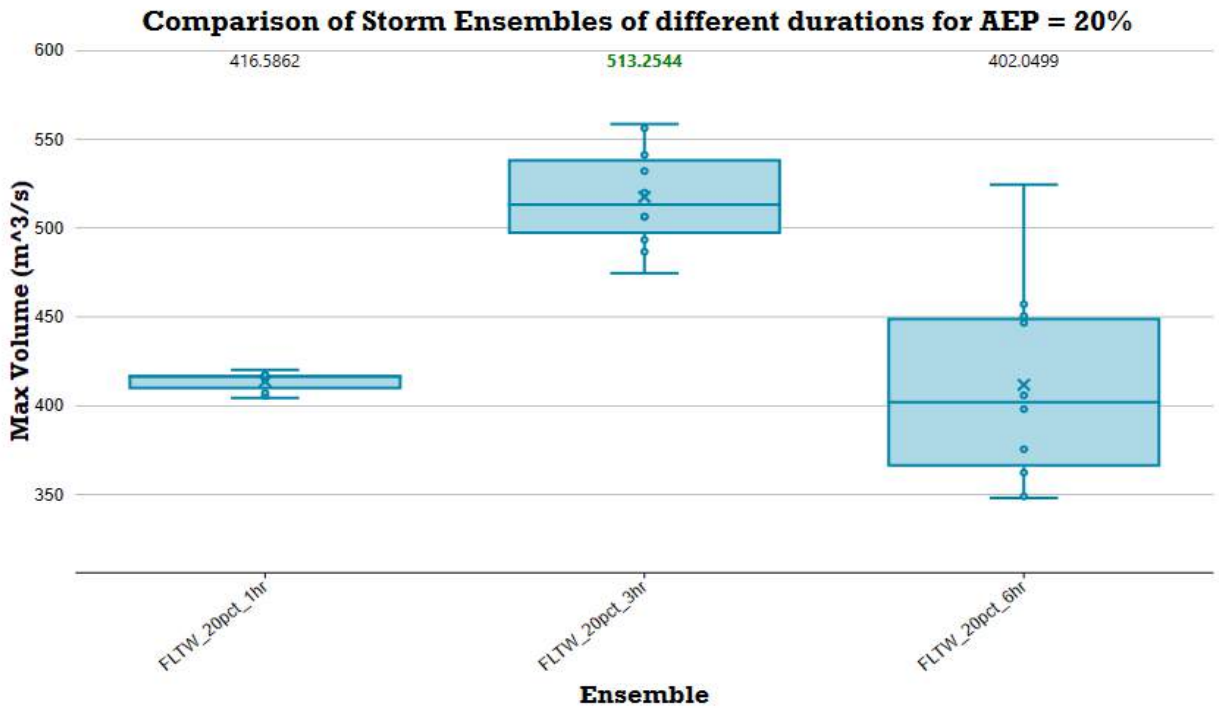
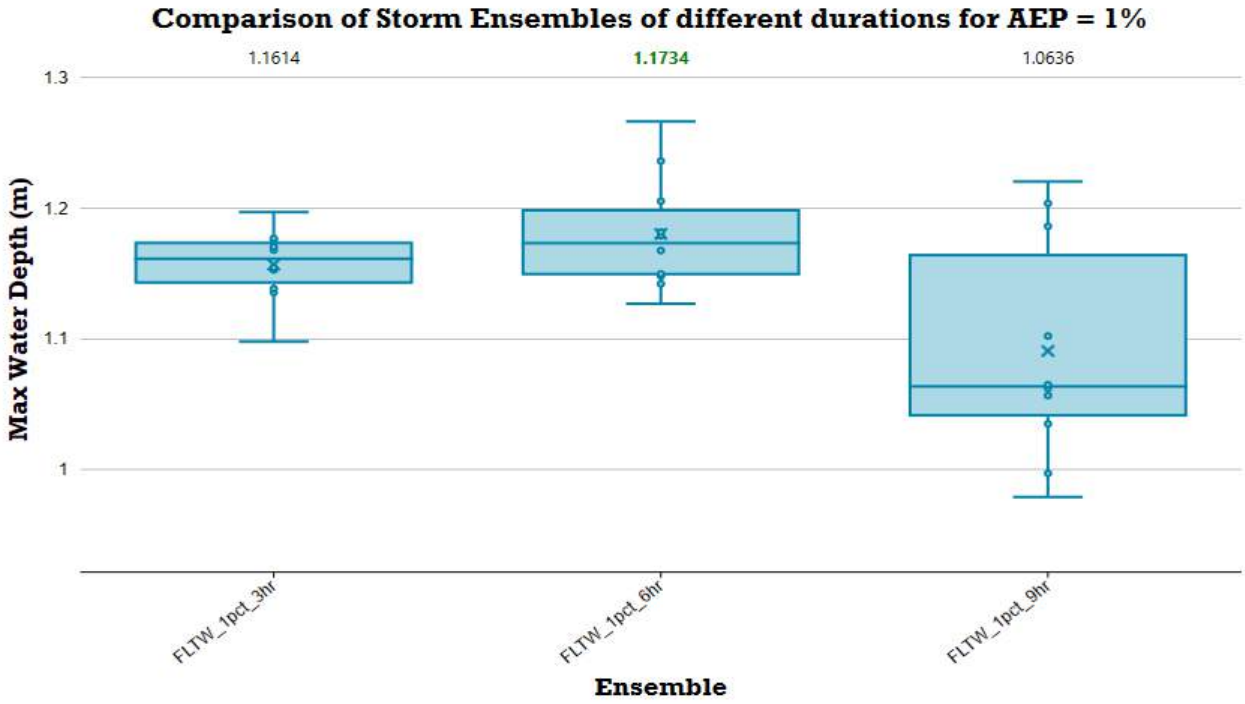
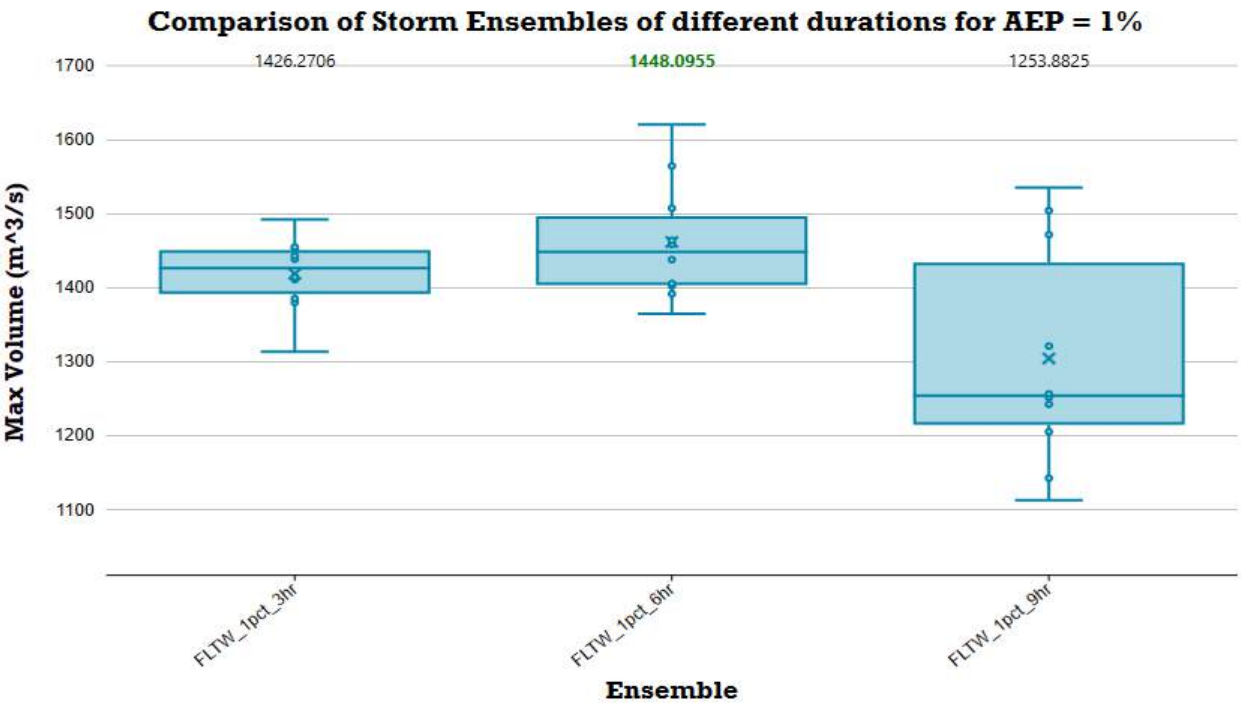





Comparison of Storm Ensembles of different durations for AEP = 20%
0.4772
0.558
0.4647
Max Water Depth (m)
0.6
0.55
0.5
0.45
0.4
FLTW_20pct_1hr
FLTW_20pct_3hr
FLTW_20pct_6hr
Ensemble


Comparison of Storm Ensembles of different durations for AEP = 20%
416.5862
513.2544
402.0499
Max Volume (m^3/s)
600
550
500
450
400
350
FLTW_20pct_1hr
FLTW_20pct_3hr
FLTW_20pct_6hr
Ensemble


Comparison of Storm Ensembles of different durations for AEP = 1%
1.1614
1.1734
1.0636
1.3
1.2
1.1
1
Max Water Depth (m)
FLTW_1pct_3hr
FLTW_1pct_6hr
FLTW_1pct_9hr
Ensemble


Comparison of Storm Ensembles of different durations for AEP = 1%
1426.2706
1448.0955
1253.8825
1700
1600
1500
1400
1300
1200
1100
Max Volume (m^3/s)
FLTW_1pct_3hr
FLTW_1pct_6hr
FLTW_1pct_9hr
Ensemble

APPENDIX L
Engineering Servicing Report

Cossill & Webley
CONSULTING ENGINEERS

EAST WANNEROO PRECINCT 3

ENGINEERING SERVICING REPORT

March 2025

Level 2, 431 Roberts Road,
Subiaco WA 6008.
PO Box 680 Subiaco, WA 6904

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E admin@cosweb.com.au
W cosweb.com.au

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APPENDIX A – EAST WANNEROO PRECINCT 3 LOCAL STRUCTURE PLAN

1. EXECUTIVE SUMMARY

This report has been prepared by Cossill & Webley (CW) for East Wanneroo Precinct 3. It summarises the results of a review of the engineering aspects which have informed and support the Local Structure Plan.

This report provides details on each major infrastructure type and a servicing strategy for the development of the precinct. The level of detail is preliminary, and acknowledges further work will be required as the planning for the precinct progresses and there is greater certainty on the proposed development.

The engineering review has covered siteworks, roadworks, stormwater drainage, sewerage, water supply and utility services.

The investigation has confirmed the land is capable of supporting the proposed development in accordance with the Local Structure Plan with a logical progressive extension of infrastructure and base capacity.

The existing ground conditions and past land uses will not limit the proposed development.

Road access to the development will be provided via existing roads which bound the Precinct.

Sewerage will be provided for the majority of the Precinct by constructing a permanent wastewater pump station on Elliot Road and supplemented by two temporary pump stations at low points on the eastern boundary, as development progresses.

There is adequate existing water infrastructure to service the Site.

Initial power supply can be provided by connection to the existing high voltage (HV) infrastructure in Elliot and Nicholas Roads. Western Power has advised that ultimately the East Wanneroo Precinct 3 residential development will require a new distribution feeder from the Wangara Substation, to provide the required capacity.

Telecommunications and gas are available from existing services on Lenore Road.

The investigations and preparation of this report is largely based on preliminary advice from the various service authorities. The information is current as of March 2025, and is subject to change as development progresses.

2. INTRODUCTION

This report has been prepared by Cossill & Webley Pty Ltd (CW) for the East Wanneroo Precinct 3 Local Structure Plan (LSP). It summarises the results of a review of the engineering aspects which have informed and support the Local Structure Plan and are related to the future servicing of the developed land.

The preparation of East Wanneroo Precinct 3 Local Structure Plan (LSP) has been carried out by a team of consultants, led by Burgess Design Group and covers an area of approximately 130.8 hectares. The East Wanneroo Precinct 3 LSP is presented in Appendix A for reference.

The East Wanneroo Precinct 3 area is identified by the red boundary presented below in Figure 1.

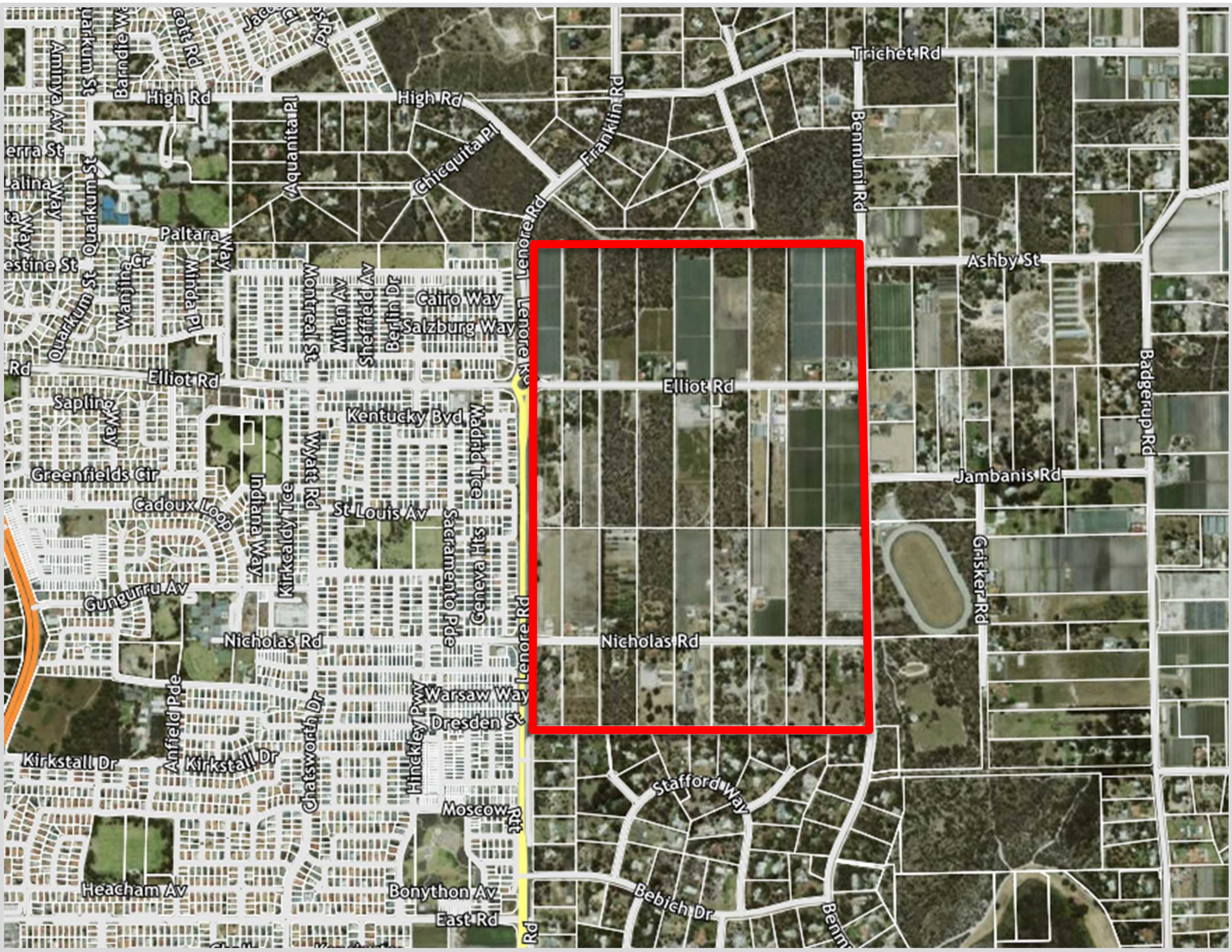


Figure 1 - Site Plan (MetroMap, December 2024)

3. SITE DESCRIPTION

East Wanneroo Precinct 3 is 130.76 hectares in area and is situated within the City of Wanneroo, approximately 25 kilometres north of the Perth city centre, and 11 kilometres east of the Joondalup city centre. The Site is bound by an undeveloped road reserve to the south, which is gazetted and to be named Shenton Road in the future, Lenore Road to the west, bushland and undeveloped access way to the north and Benmuni Road to the east.

As presented in Figure 1 above, majority of the site has been cleared historically, with portions of vegetation remaining on the Site. Approximately half the cleared area is market gardens, with the majority of the remainder being used for grazing, or laydown purposes.

3.1 Acid Sulphate Soils

A desk top review of the Department of Environment and Conservation's ASS Risk Map for the Northern Metropolitan Region for potential for Acid Sulphate Soils (ASS) indicates the entire Site has no recorded risk of ASS. There is a pocket of land north of the northeast corner of the site which shows high to moderate risk occurring within 3m of the natural soil surface (or deeper) which may impact the development of a boundary road and services and treatment may be required in that area. Treatment of ASS soil and groundwater is a well known process and does not pose a significant cost or development risk.

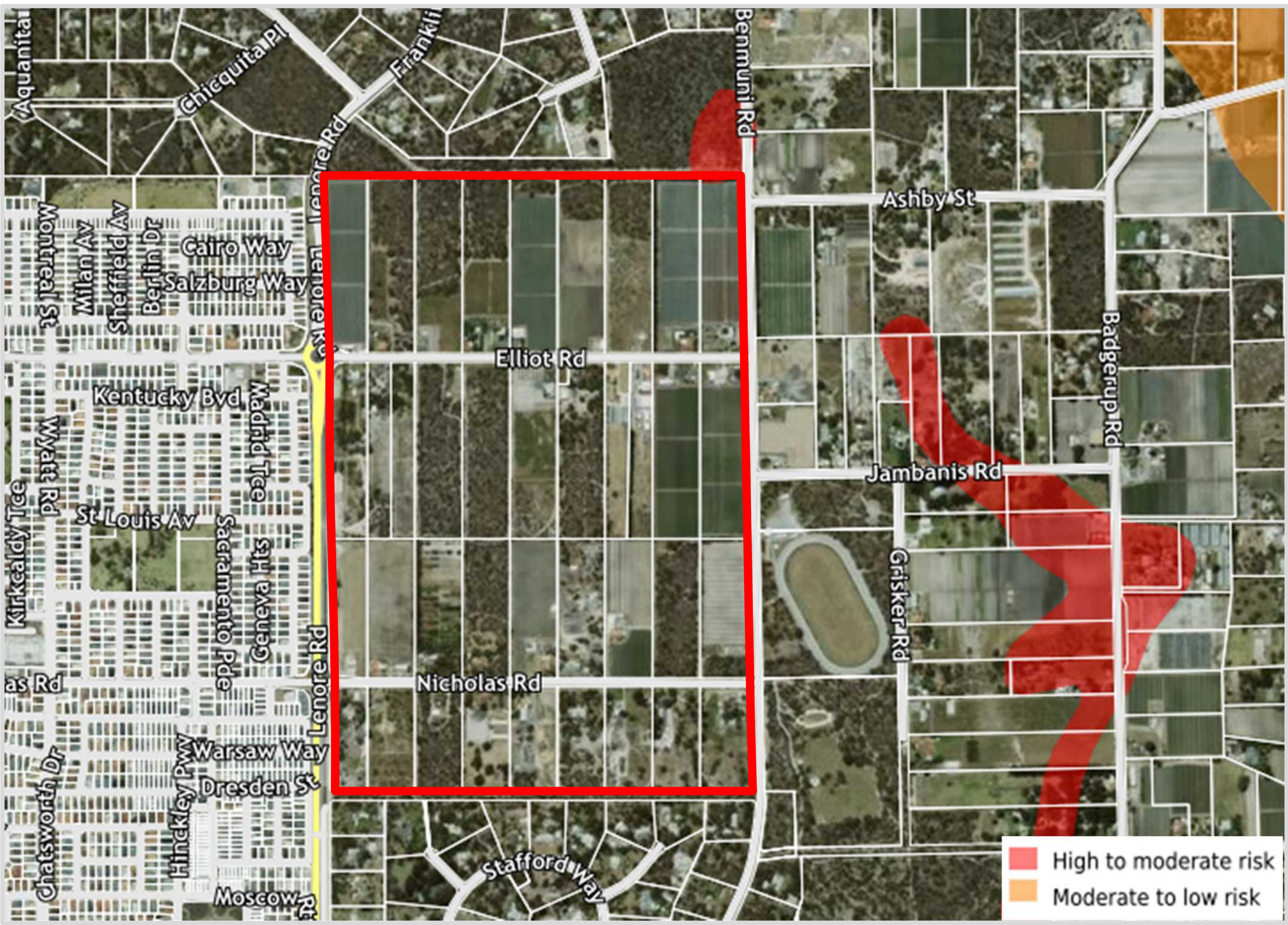


Figure 2 – Acid Sulfate Soils Risk Mapping (MNG Access, December 2024)

3.2 Existing Topography

The Site generally grades down from west to east, from RL86m AHD on the boundary in the vicinity of the intersection of Lenore Road and Nicholas Road, to RL51m AHD at the northeastern corner, and RL50m AHD at the southeastern corner of the Site. Figure 3 below shows the contours across the Site.

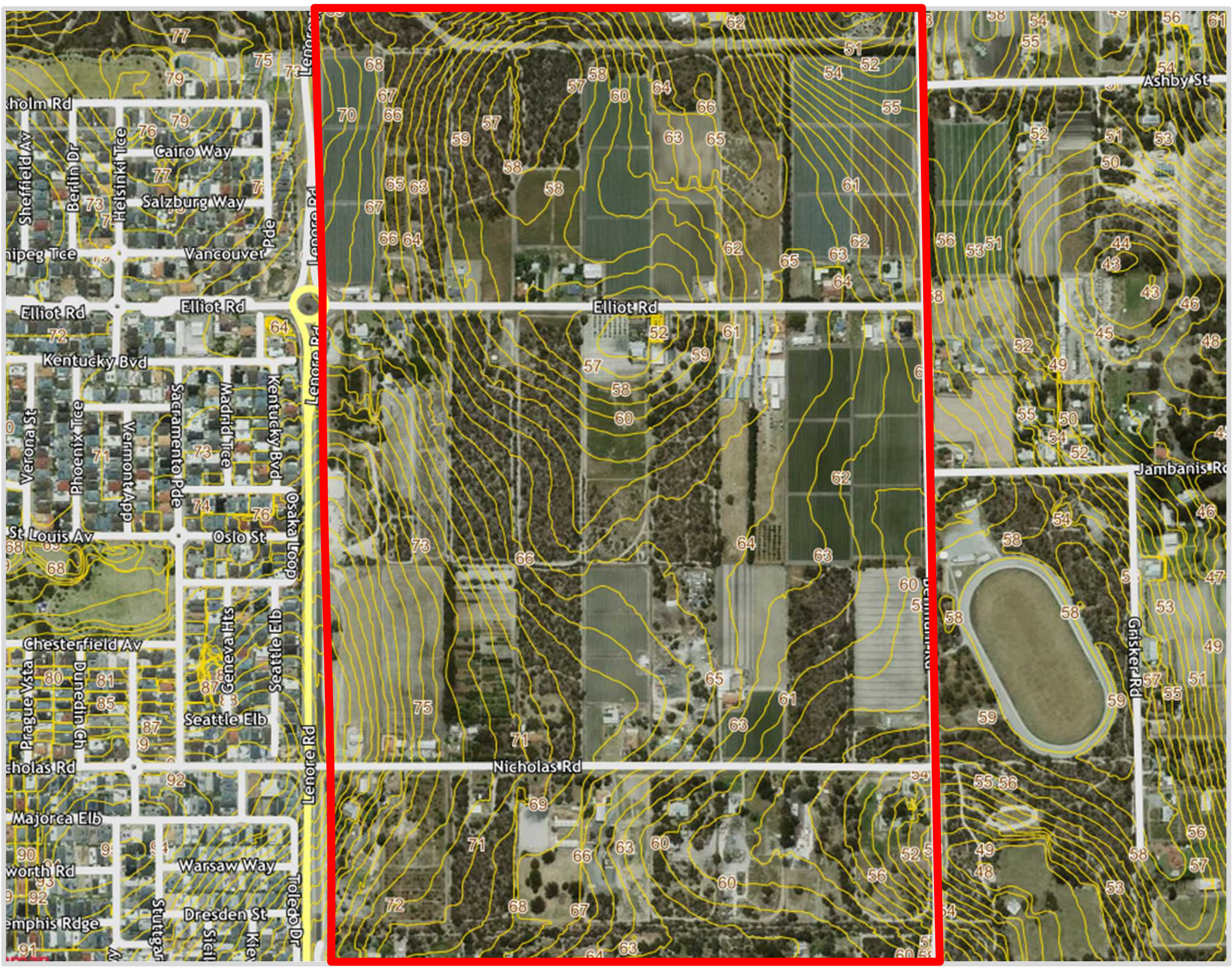


Figure 3 – Site Contours (MNG Maps, December 2024)

3.3 Geology and Landform

An excerpt from the Geological Survey of Western Australia Perth Metropolitan Region soils map for Perth (part 2034 III & 2134 III) is presented below in Figure 4. This indicates the site is underlain by sand (Tamala Limestone, S7) extending through the entire Site area, and is described as “pale and olive yellow, medium to coarse-grained, sub angular to sub-rounded, quartz, trace of feldspar, moderately sorted of residual origin”.

Sand derived from Tamala limestone is generally free draining, with medium permeability, and well-suited to development.

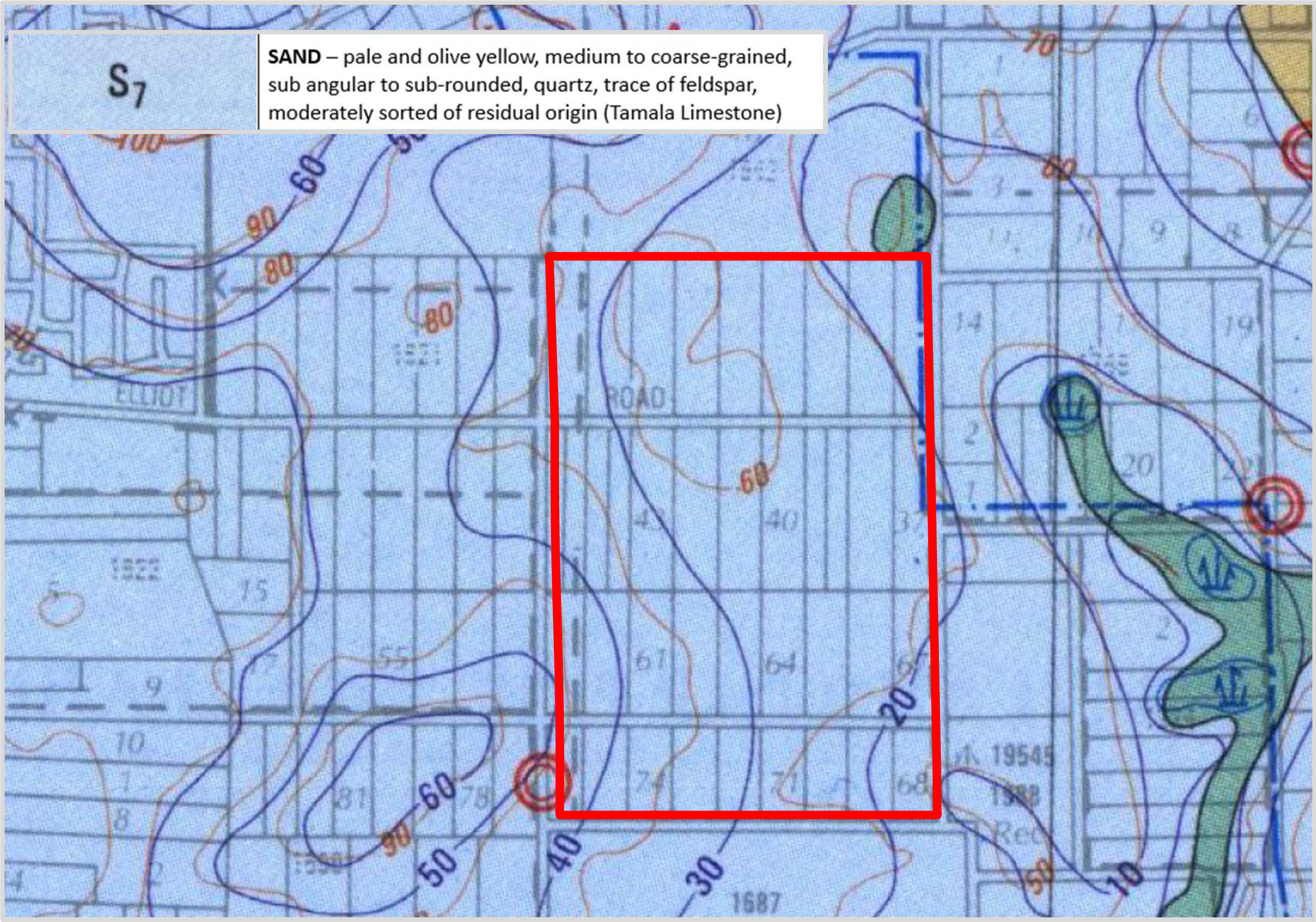


Figure 4 - Geotechnical Information (Geological Survey of WA)

Based on our experience on similar projects within the area, the Site is well suited for future development in terms of topography and geotechnical conditions and will provide a suitable foundation for roads, infrastructure and proposed development. It is anticipated an AS 2870 Classification of "Class A". A geotechnical investigation will be required to confirm the classification.

3.4 Groundwater

A review of Groundwater mapping shows that the Site has good clearance to groundwater, with the minimum clearance being at least 5m at the Site low points on the eastern boundary.

4. SITEWORKS & EARTHWORKS

Siteworks and Earthworks for the Site will need to accomodate the exisitng topogrophy, areas of vegetation identified for conservation, and several existing homesteads.

The principle of the earthworks deign is to achieve positive outcomes, which include the following:

- Reduction in total home building cost.
- Rationalisation of retaining wall layouts, consistent with the City of Wanneroo specifications.
- Terrace lots up the natural slopes to maintain natural topography.
- Grading roads to follow the existing topography where possible, while catering for proposed gravity services and meet the standards of the required approval agencies.
- Accommodating drainage swales/basins in areas of local public open space.
- Matching existing levels of existing roads and homesteads, POS, and conservation bushland in the area.

The retention of homestead lots will influence the earthworks strategy, and accommodating their existing levels may not necessarily suit the most efficient subdivision earthworks design. This also applies to tying into existing ground levels along neighbouring boundaries of properties. Level differences will require walls, and approval from neighbouring landowners is required to build on the common boundary.

Siteworks and earthworks will generally consist of the following:

- Demolish buildings and hardstands.
- Remove trees including grubbing out roots and stumps.
- Strip the topsoil, all organic material, roots and other unsuitable or deleterious material from the Site. The history of market gardening within the Site may required a deeper than average top soil strip.
- Topsoil unsuitable for re-use may be retained for use on-site as non-structural fill (eg in planted areas outside building areas and sports ovals).
- Proof compact the exposed surface to achieve the level of compaction determined by a Geotechnical Engineer. If weak areas are idenfiied during proof compaction, or the level of compaction is not achieved, further compaction or over-excavation and backfilling with compacted, approved fill of these zones will be required.
- Where fill is required to achieve the required levels, place and compact approved free draining granular fill.

5. DRAINAGE

5.1 Urban Water Management

Stormwater drainage management is a major component of an overall water strategy. Water Sensitive Urban Design (WSUD) techniques are incorporated during planning, design and construction of urban development projects to achieve the desired outcomes.

An Urban Water Management Plan will be required for the site, which will provide the following:

- Defines land area requirements for conveyance of flood flows and protection of future urban development from peak flood events.
- Proposes a drainage strategy appropriate for the local conditions, and outlines potential WSUD initiatives at the inter-allotment and POS scale. The location of areas within Public Open Space (POS) for the WWPS and drainage infrastructure will need to be considered in the subdivision design and POS calculations.
- Prescribes the design criteria for water quantity and quality for each sub-catchment.
- Outlines hydrologic and hydraulic framework parameters and develops the overall drainage network concept.
- Defines an implementation plan for the drainage design strategy.

5.2 Water Quality Management

The sandy soil on Site will allow for onsite storage and dissipation of stormwater. Recharge water quality will be improved through the adoption of 'Best Management Practices' which promote the disposal of runoff via water pollution control facilities (including vegetated swales and basins, detention storages and gross pollutant traps) and the implementation of non-structural source controls (including urban design, street sweeping, community education, low fertiliser landscaping regimes, etc)

5.3 Stormwater Collection and Disposal

Drainage from public roads and lanes would be collected via conventional pit and pipe systems. The drainage collection and conveyance system will be designed to cater for the runoff from storms with up to a 20% annual exceedance probability (AEP) event.

A series of detention basins would be designed to store runoff for the 20%, 10% and 1% AEP events. In all cases, roads and POS would be designed to cater for the surface overflow for more severe storms with building pad levels set at least 300 millimetres above the 1% AEP flood level in roadways and 500 millimetres above the 1% AEP flood level for storage detention basins.

The dispersion of stormwater disposal throughout the site (via soakwells, swales and basins) will maximise the area of recharge down through the soil profile to the shallow aquifer, thereby maximising the potential for nutrient stripping and water quality improvements. The basins will also assist nutrient removal in conjunction with other measures such as suitable vegetation planting and the use of modified soils with high phosphorous retention capacity.

Hyd2o has been engaged as the consulting hydrologist to prepare a Local Water Management Strategy. This includes the identification of drainage catchments and the location of proposed basins within POS areas.

6. ROADS

Lenore Road forms the western boundary of the Site and has direct connection to the Regional Road, Ocean Reef Road (the future Ocean Reef Upper Swan Highway) to the south. Lenore Road is a paved two-lane bidirectional road which is currently being upgraded to four lanes. It has been upgraded to an urban standard from the southern boundary of the Site to the Lenore Road/Elliot Road round-a-bout with kerbs, footpaths, drainage and line markings.

North of the round-a-bout, Lenore Road is constructed to a lower standard, with line markings, but without kerbs, footpaths or drainage.

It is expected that the existing roundabout at the Lenore Road/Elliot Road intersection will ultimately need to be upgraded to accommodate the wider road reserve on Elliot Road.

At the time of writing this report, the intersection of Lenore Road and Nicholas Road is being upgraded.

Benmuni Road on the eastern boundary is a paved two-lane bidirectional road constructed to a rural standard, and is currently classified as a 'Local Distributor'. Benmuni Road will need to be upgraded to a 'Neighbourhood Connector Type A' boulevard road, with a median strip, kerbs, footpaths, drainage and line markings. Round-a-bouts are expected to be required at the Benmuni Road, Ashley St and Nicholas Road intersections.

6.1 Internal Roads and Footpaths

The LSP comprises a network of development roads including neighbourhood connectors and local access roads.

The main internal road within East Wanneroo Precinct 3 will be Elliot Road, which bisects the Site, east to west connecting Lenore and Benmuni Roads. Elliott Road will need to be upgraded to a 45m wide road reserve to accommodate future traffic and public transport needs. There are several existing homesteads abutting Elliott Road, which impact the road layout, creating a slight meandering of the road. The specific cross section of the road reserve will be resolved as the planning process progresses. Elliot Road is expected to be funded as a District DCP item.

Nicholas Road, which crosses Site from east to west, will provide a secondary entrance, and will need to be upgraded to a 'Neighbourhood Connector Road Type B'. The tee intersection with Lenore Road is currently being constructed and will facilitate full movement, with the exception of the western leg which is left-in-left-out only.

A north-south Neighbourhood Connector road will connect Elliott Road to Nicholas Road through the centre of the development.

Lower order roads will connect to the main east-west roads to provide access to land uses.

In all cases the road cross-sections will be designed to cater for utility services on standard verge alignments, street trees, parking embayments where appropriate, off-street and on-street cycling lanes in accordance with the overall pedestrian and cycling network.

The engineering design of roads will be carried out to comply with the Department of Planning's Liveable Neighbourhoods recommendations for design speeds and sight distances and with the requirements of the City of Wanneroo. We anticipate roadworks will generally consist of kerbed and asphalted pavements.

Footpaths will be provided in accordance with Liveable Neighbourhoods and the City of Wanneroo standards.

6.2 Public Transport

The Site is immediately east of Lenore Road Transit Link, which is anticipated to have exclusive bus lanes constructed within the road reserve in the future, as East Wanneroo is developed. An existing bus route on Chatsworth Drive is available, which is within 650m of Site.

7. WASTEWATER

The Water Corporation has provided advice regarding provision of Wastewater to the Site confirming a permanent wastewater pump station (WWPS) is required adjacent to Elliot Road at the low point, known as Jandabup Pump Station S. This pump station is part of the Jandabup Sewer District Plan, as shown in Figure 5. This permanent WWPS will service a significant portion of Precinct 3 and in the ultimate sense will likely discharge via a pressure main and gravity sewer to the south of Ocean Reef Road once the area is more fully developed. The area that can be served by the Jandabup Pump Station S is outlined by the light green line below, and comprises approximately half of the LSP area in the north-west.

The Water Corporation has indicated that Jandabup WWPS S can discharge into the existing DN305 sewer near the intersection of Prindiville Drive and Hartman Drive south of the development, south of Ocean Reef Road. The alignment of the pressure main is yet to be determined, and will be progressed as development occurs. CW understands the permanent Jandabup WWPS S will be funded by the Water Corporation, although it is not currently on Water Corporation's Capital Investment Program.

The remainder of the site does not fall into the catchment for Jandabup WWPS S and in the ultimate sense is reliant on downstream gravity sewer being constructed by others. The timing of this downstream infrastructure is unknown, and likely to be after development of Precinct 3 has occurred. In this scenario two temporary WWPS will be required in order to serve the balance of the LSP area. The most efficient locations for the WWPS is in the north-east and south-east corners at natural low points as noted below. The discharge for these temporary WWPS is dependent on available sewer infrastructure at the time. The temporary WWPS and pressure mains are likely to be at the Developer's cost.

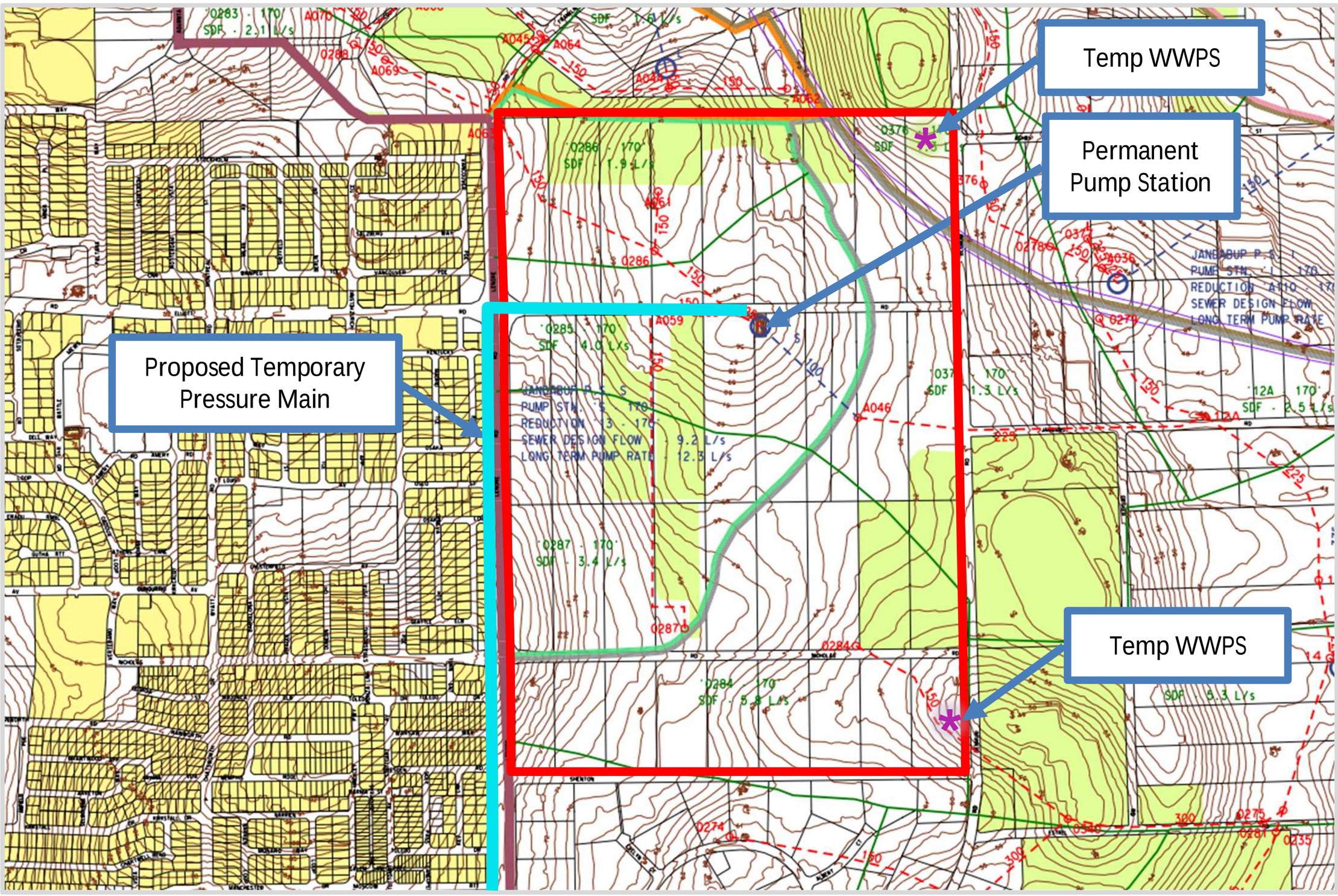


Figure 5 - Conceptual Long Term Wastewater Scheme Planning - Overview (Water Corporation, 2020)

8. WATER RETICULATION

The Site has existing water infrastructure available for connection, as depicted in Figure 6. There is a 610mm steel distribution pipe in the western verge of Lenore Road and a 300mm distribution main in Benmuni Road. In addition, there is a a 100mm main in Nicholas Road.

The Water Corporation has advised that the initial frontal stages of East Wanneroo Precinct 3 can be serviced via an extension of reticulation mains from Lenore Road. However, future areas and some areas of elevated land will need to be serviced by extension off the high-level mains. The extent of these areas is not yet confirmed, and The Water Corporation will confirm this at a later stage of the development process.

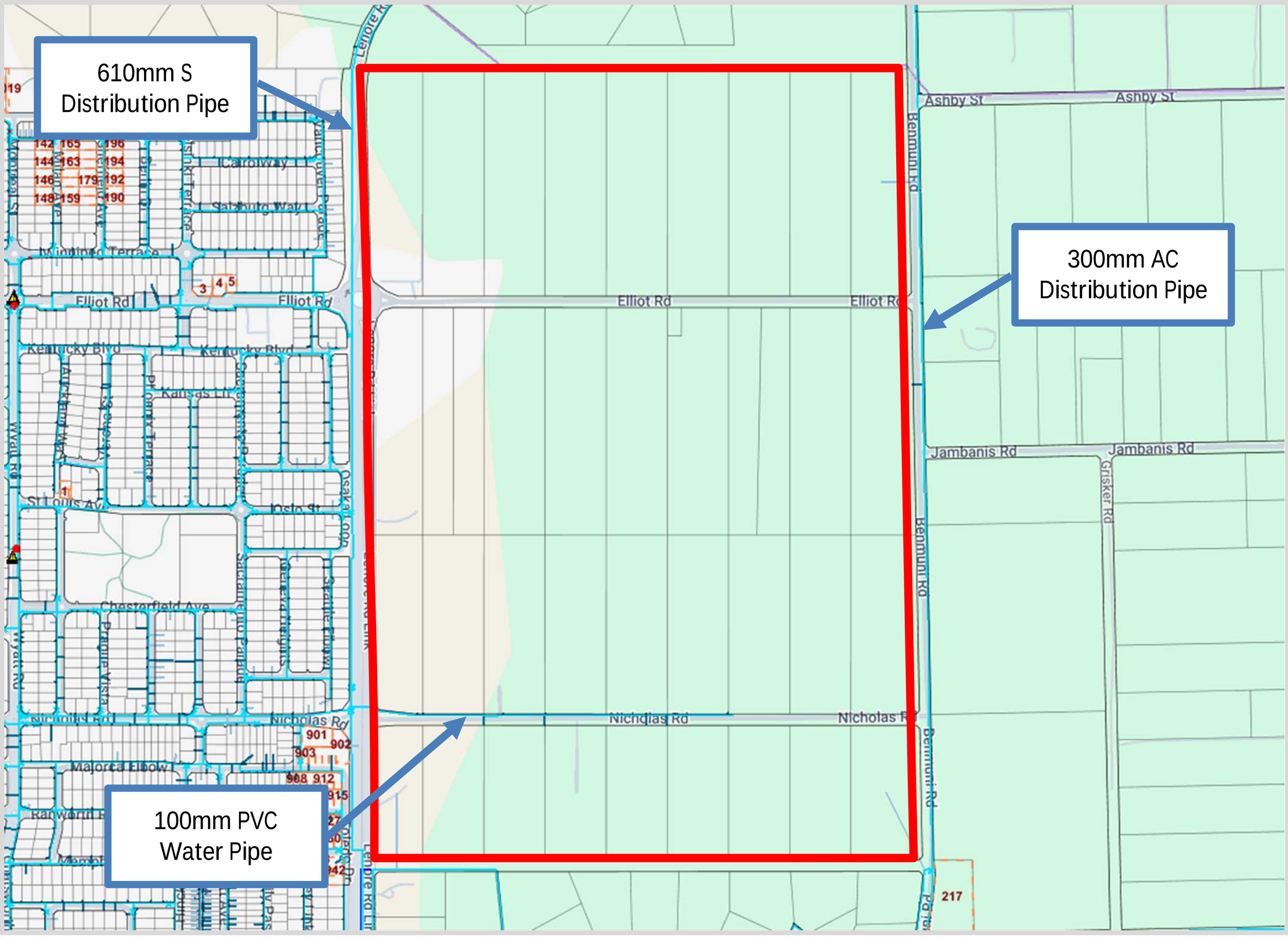


Figure 6 – Water Reticulation Infrastructure (Water Corporation Esinet, Dec 2024)

9. GAS SUPPLY

There are existing DN160, DN110 and DN63 high pressure steel gas mains located in various segments of Lenore Road adjacent to the Site. The DN160 stub at the intersection of Elliot Road and Lenore Road likely can be extended to service the development. Confirmation of gas capacity from ATCO of will be required.

10. POWER SUPPLY

Western Power's Network Mapping Tool confirms there is currently limited spare electricity capacity in the East Wanneroo corridor, and a high voltage feeder to the Wangara substation to the west will ultimately be required to increase capacity to service the Site. Based on R20-R40 zoning, the Site is expected to require approximately 7.9MVA.

There are existing high voltage overhead power lines in Elliot Road, Nicholas Road and Benmuni Road. The lines on Elliot Road and Nicholas Road have been undergrounded under Lenore Road on the western boundary. The remaining overhead lines on Elliot Road and Nicholas Road will require undergrounding. Existing power is shown in Figure 7.

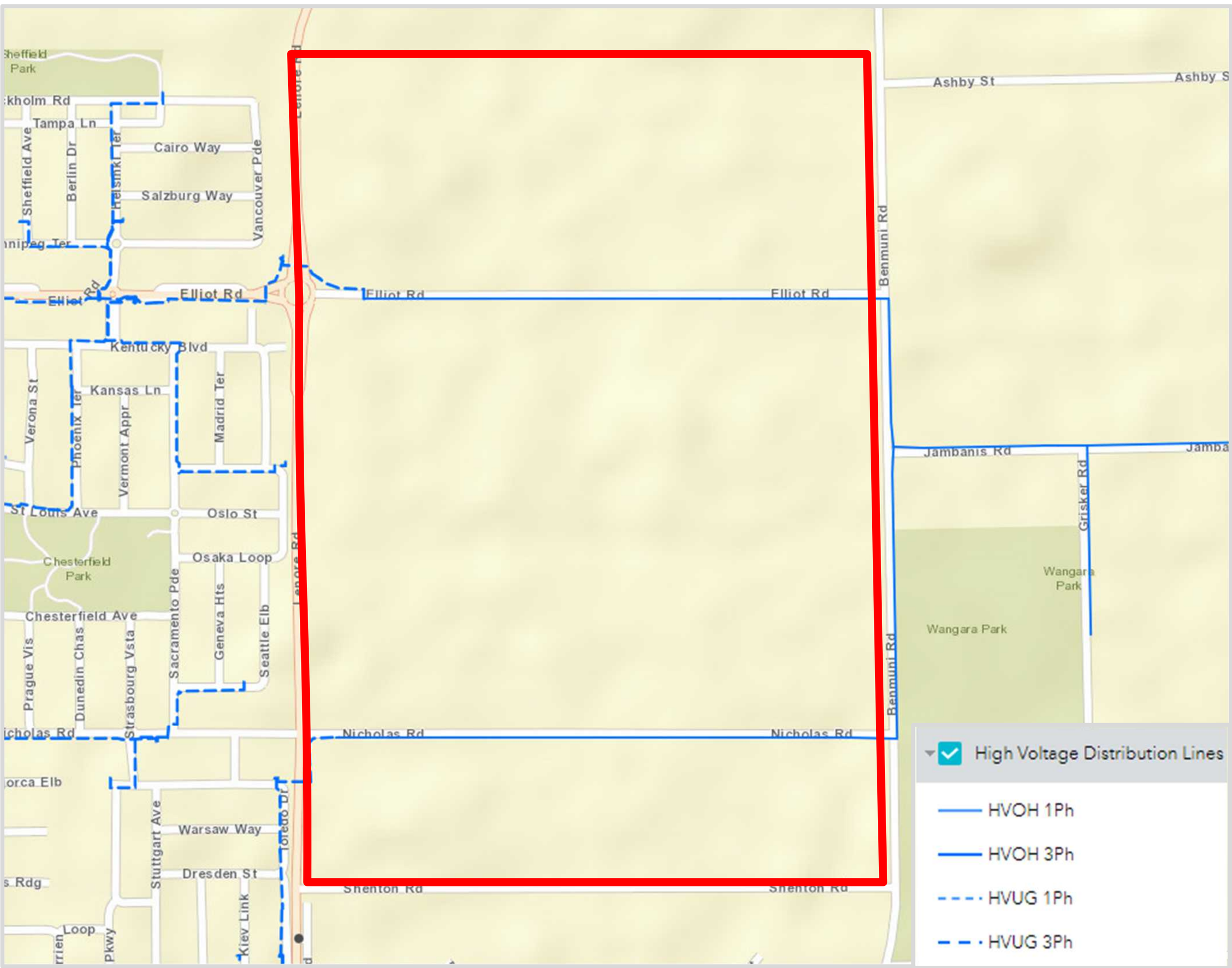


Figure 7 – Existing Power Network (Western Power, 2024)

11. TELECOMMUNICATIONS

The Site is within NBN's fixed line footprint, and can be serviced with optic fibre via a headworks extension from their existing network. There are existing NBN pit and pipe services within Lenore Road, Nicholas Road, Elliot Road, and Benmuni Road that can serve as connections. Some lot connections will require removal by NBN to allow for subdivision.

The current design practice for road reserves, pavement and verge provisions will make adequate allowance for services including broadband in accordance with the agreed Utilities Service Providers handbook. There will be some local land requirements for telecommunications equipment sites which will be accommodated at detailed subdivision stage.

12. CONCLUSION

The Site is well suited for the proposed development outlined in the Local Structure Plan.

The ground conditions are suitable for the proposed development, and will likely achieve a Class A classification.

The drainage concept is likely to be straight forward, as there is permeable soil and good clearance to groundwater.

There are known sewer and water strategies to support the development, and the Water Corporation will further progress the sewer supply strategy as the planning becomes more certain.

Power can be connected to the Site, and development can begin to the extent that power capacity is available for initial stages.

APPENDIX M

Pre and Post Development
UNDO Nutrient Modelling

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Project: East Wanneroo Precinct 3 Pre Development **Date: 08 April, 2025**

Subregion : East Wanneroo Precinct 3 — Area : 136 ha

Landuse	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)
Residential	0.00	0.00	0.0	0.00
Industrial, commercial & schools	0.00	0.00	0.0	0.00
Rural living	100.00	136.00	9,533.6	1,795.20
Public Open Space	0.00	0.00	0.0	0.00
Road reserve	0.00	0.00	0.0	0.00

10,244.9 (kg/yr) Nitrogen input	1,815.60 (kg/yr) Phosphorus input	809.7 (kg/yr) Nitrogen export	12.14 (kg/yr) Phosphorus export

Rural living

Landuse	Percent (%)	Area (ha)
Unrestricted	100.00	136.00
No livestock	0.00	0.00
No clearing apart from the housing pad	0.00	0.00

Note: Commercial horticulture is not permitted in the rural living zone, due to spray drift buffers.

Nitrogen input(kg/yr)	9,533.6

Phosphorus input(kg/yr)	1,795.20

Soil and drainage information

Type of drainage	**Infiltration**
Soil type	**Bassendean**
Depth to groundwater	**9**
Groundwater slope (%)	**0.15**
Soil PRI	**5**

Does it contain imported fill? **No**

Does subregion contain onsite sewage disposal system? **Yes**

Type of system installed	**Septic tank**
No. of units installed	**38**

Summary : Nutrient stripping devices

Treatment	Name	Size (m2)	Treated area (ha)	Treating	N removed (kg/ha/yr)	P removed (kg/ha/yr)
Load removed (kg/yr)					0.0	0.00
Net export (kg/yr)					809.7	12.14

Summary : Nutrient load exports

Region	Area (ha)	N export (kg/yr)	P export (kg/yr)
East Wanneroo Precinct 3	136	809.7	12.14

Pre-treatment load		Load removed		Net load export	
809.7 (kg/yr) Nitrogen	12.14 (kg/yr) Phosphorus	0.0 (kg/yr) Nitrogen	0.00 (kg/yr) Phosphorus	809.7 (kg/yr) Nitrogen	12.14 (kg/yr) Phosphorus

Treatment Diagram

Government of Western Australia
Department of Water and Environmental Regulation

Project: East Wanneroo Precinct 3 Post Development **Date: 08 April, 2025**

Subregion : Lots & POS — Area : 99.80569 ha

Landuse	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)
Residential	67.99	67.86	2,022.9	567.58
Industrial, commercial & schools	5.61	5.60	410.5	84.08
Rural living	0.00	0.00	0.0	0.00
Public Open Space	26.40	26.35	565.6	20.44
Road reserve	0.00	0.00	0.0	0.00

3,521.0 (kg/yr) Nitrogen input	687.08 (kg/yr) Phosphorus input	265.5 (kg/yr) Nitrogen export	4.59 (kg/yr) Phosphorus export

Residential

Size (m^2)	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)
<400 m^2	85.00	57.68	1,355.1	396.98
400-500 m^2	15.00	10.18	667.8	170.60
501-600 m^2	0.00	0.00	0.0	0.00
601-730 m^2	0.00	0.00	0.0	0.00
>730 m^2	0.00	0.00	0.0	0.00
Multiple dwellings	0.00	0.00	0.0	0.00

Nitrogen input(kg/yr)	2,022.9

Phosphorus input(kg/yr)	567.58

Commercial, Industry and Schools

Landuse	Percent (%)	Area (ha)
Light Industrial	0.00	0.00
Heavy Industrial	0.00	0.00
Commercial / Offices	37.10	2.08
Schools	62.90	3.52
Public buildings	0.00	0.00

Nitrogen input(kg/yr)	410.5

Phosphorus input(kg/yr)	84.08

Public Open Space (POS)

Landuse	Percent (%)	Area (ha)
Native gardens	14.65	3.86
Non-native gardens	0.00	0.00
Not fertilised	0.00	0.00
Nature	58.10	15.31
Sport	5.05	1.33
Recreation	17.05	4.49
Goilf course	0.00	0.00
Bowling green	0.00	0.00
Impervious	5.15	1.36
Water body	0.00	0.00

Nitrogen input(kg/yr)	565.6

Phosphorus input(kg/yr)	20.44

Soil and drainage information

Type of drainage	**Infiltration**
Soil type	**Bassendean**
Depth to groundwater	**9**
Groundwater slope (%)	**0.15**
Soil PRI	**5**

Does it contain imported fill? **No**

Does subregion contain onsite sewage disposal system? **No**

Subregion : Roads — Area : 38.544309999999996 ha

Landuse	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)
Residential	0.00	0.00	0.0	0.00
Industrial, commercial & schools	0.00	0.00	0.0	0.00
Rural living	0.00	0.00	0.0	0.00
Public Open Space	0.00	0.00	0.0	0.00
Road reserve	100.00	38.54	366.9	46.95

568.5 (kg/yr) Nitrogen input	52.73 (kg/yr) Phosphorus input	34.3 (kg/yr) Nitrogen export	2.47 (kg/yr) Phosphorus export

Road reserve

Landuse	Percent (%)	Area (ha)
Roads	40.00	15.42
Road reserve - impervious	30.00	11.56
Road reserve - native garden	5.00	1.93
Road reserve - non-native garden	0.00	0.00
Road reserve - turf	20.00	7.71
Road reserve - not fertilised	5.00	1.93

Nitrogen input(kg/yr)	366.9

Phosphorus input(kg/yr)	46.95

Soil and drainage information

Type of drainage	**Piped drainage**
Soil type	**Bassendean**
Depth to groundwater	**9**
Groundwater slope (%)	**0.15**
Soil PRI	**5**

Does it contain imported fill? **No**

Does subregion contain onsite sewage disposal system? **No**

Summary : Nutrient stripping devices

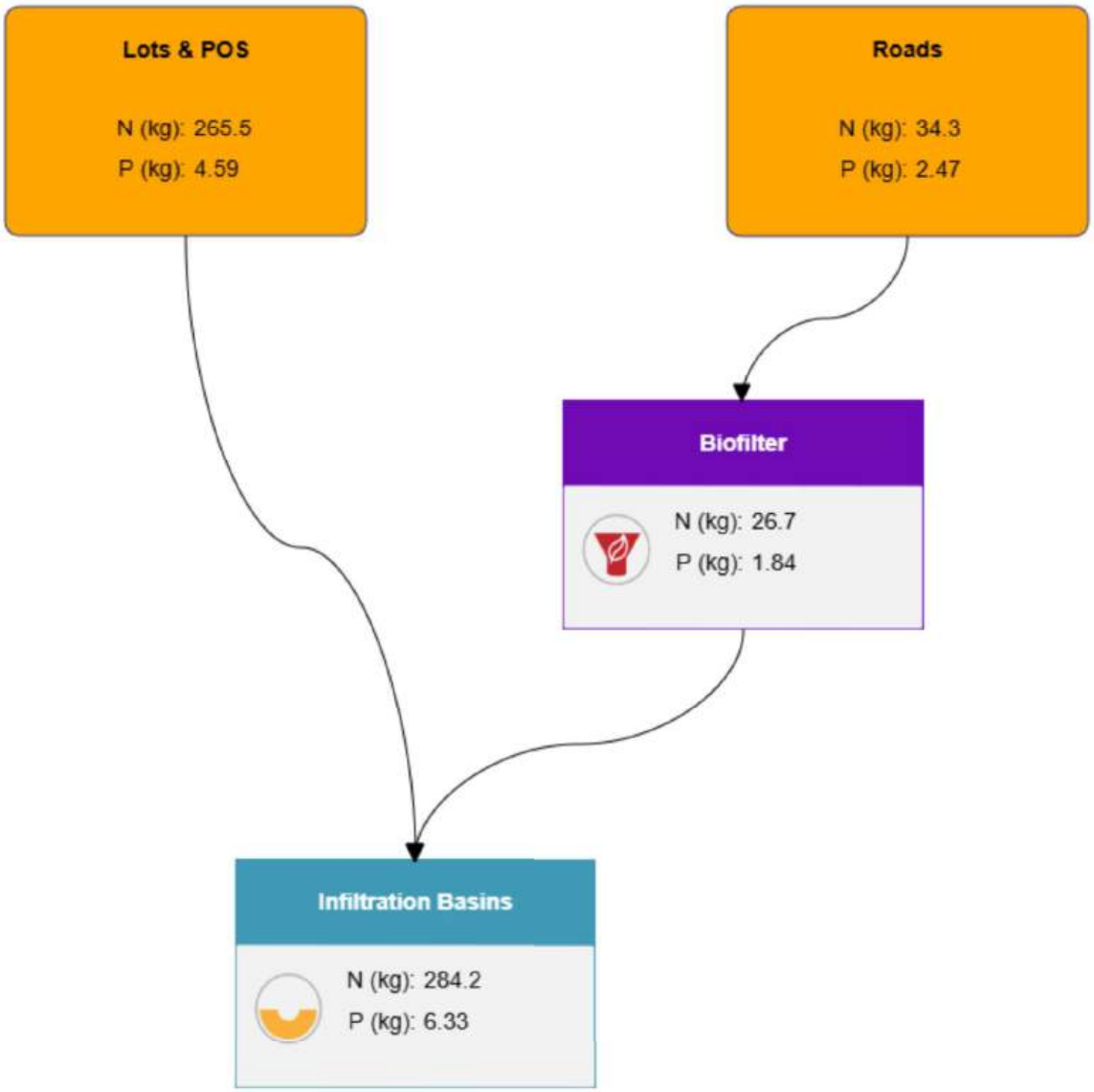
Treatment	Name	Size (m2)	Treated area (ha)	Treating	N removed (kg/ha/yr)	P removed (kg/ha/yr)
Biofilter	Biofilter	12300	38.54	Sandy soils - Runoff only (infiltration on lots)	7.6	0.63
Detention infiltration basin	Infiltration Basins	25265	138.35	Sandy soils - Runoff only (infiltration on lots)	8.0	0.10
Load removed (kg/yr)					**15.6**	**0.73**
Net export (kg/yr)					**284.2**	**6.33**

Summary : Nutrient load exports

Region	Area (ha)	N export (kg/yr)	P export (kg/yr)
Lots & POS	99.80569	265.5	4.59
Roads	38.544309999999996	34.3	2.47

Pre-treatment load		Load removed		Net load export	
299.8 (kg/yr) Nitrogen	7.06 (kg/yr) Phosphorus	15.6 (kg/yr) Nitrogen	0.73 (kg/yr) Phosphorus	284.2 (kg/yr) Nitrogen	6.33 (kg/yr) Phosphorus

Treatment Diagram



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