

This report only relates to the advertising of the Hatch Court Light Industrial Area, all references contained in this report to the Stirling Crescent Precinct should therefore be disregarded.



Hatch Court and Stirling Crescent, High Wycombe

LOCAL WATER MANAGEMENT REPORT

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1 EXECUTIVE SUMMARY

The Hatch Court and Stirling Crescent, High Wycombe Local Water Management Report (LWMR) has been developed to accompany the Local Structure Plan of the precinct to industrial and residential lots.

The subject land is composed of Lots 1, 8 – 16, 51- 53 Hatch Court, Lots 1 – 11 Stirling Crescent and Lots 200 – 201 Kalamunda Road. It also takes into account the Hatch Court and Stirling Crescent Road reserves that front these lots. The subject land, lot boundaries and drainage easements can be seen in Figure 2.

The subject land is bordered by existing commercial/industrial development to the northwest and northeast. To the southeast is predominately existing residential lots, while the southwest borders residential lots and a retirement village. The subject land is noted in Figure 2 with its association to surrounding areas can be seen in Figure 1.

The subject land is currently composed of a mix of land uses. Lots 200-201 Kalamunda Rd are already developed for large laydown industrial activities. The Lots associated with Hatch Court are composed of residential dwellings on 1ha+ lots, with associated lifestyle uses. Stirling Crescent lots are generally residential lots of 4000m2, with one lot of 2ha.

There is a drainage line that traverses the Hatch court portion from east to west, with this also intersecting 2 wetland areas at the eastern and western ends. The drainage line begins within the subject land; however it does receive pipe drainage from the upstream catchments. The end of the drainage line is just outside the subject land in Lewis Road, where it enters an underground drainage network managed by the Perth Airport. There are some excavations that have been dug to a depth that they have open water for at least a portion of the year.

The soil is generally composed of a free draining grey sand (where not previously filled). Groundwater is at/close to the surface around the drainage line, with separation increasing to more than 3m in the higher portion. Further details on the current subject land conditions can be found in Sections 3 – 7.

The objective of this LWMR is to detail the best management practices approach to water management that will be undertaken for this development. This will include managing, protecting and conserving the total water cycle of the local environment and the greater catchment. The practices will involve:

- Stormwater management that incorporates water sensitive urban design practices;
- Management of stormwater flows prior to discharge;
- Flood protection from localised floods;
- Groundwater resource management;
- Creation of new riparian habitat as part of creating a Living Stream
- Protection and enhancement of wetland ecosystems within the subject land; and
- Sustainable water servicing

The effectiveness, efficiency and benefits provided by the best management practices require a collaborative effort between the City of Kalamunda (City), land owners/developers and relevant regulatory authorities. The City is committed to consultation on the concepts and outcomes outlined within the LWMR for the subject land. This includes the implementation, monitoring and maintenance of the best management practices for stormwater designed specifically for this site.

1.1 PLANNING SUMMARY

This LWMR has been prepared to accompany the Local Structure Plan. The subject land is to be developed for a combination of industrial lots and R25/R30 residential lots, with these two land uses divided into 2 precincts, either side of Stirling Cres.

A Public Open Space/Drainage reserve or easement is to be created to the south of Stirling Cres that incorporates the current area of open water. The 2 Resource Enhancement wetland areas and Living Stream are to be contained within easements. The layout can be seen in Figure 3.

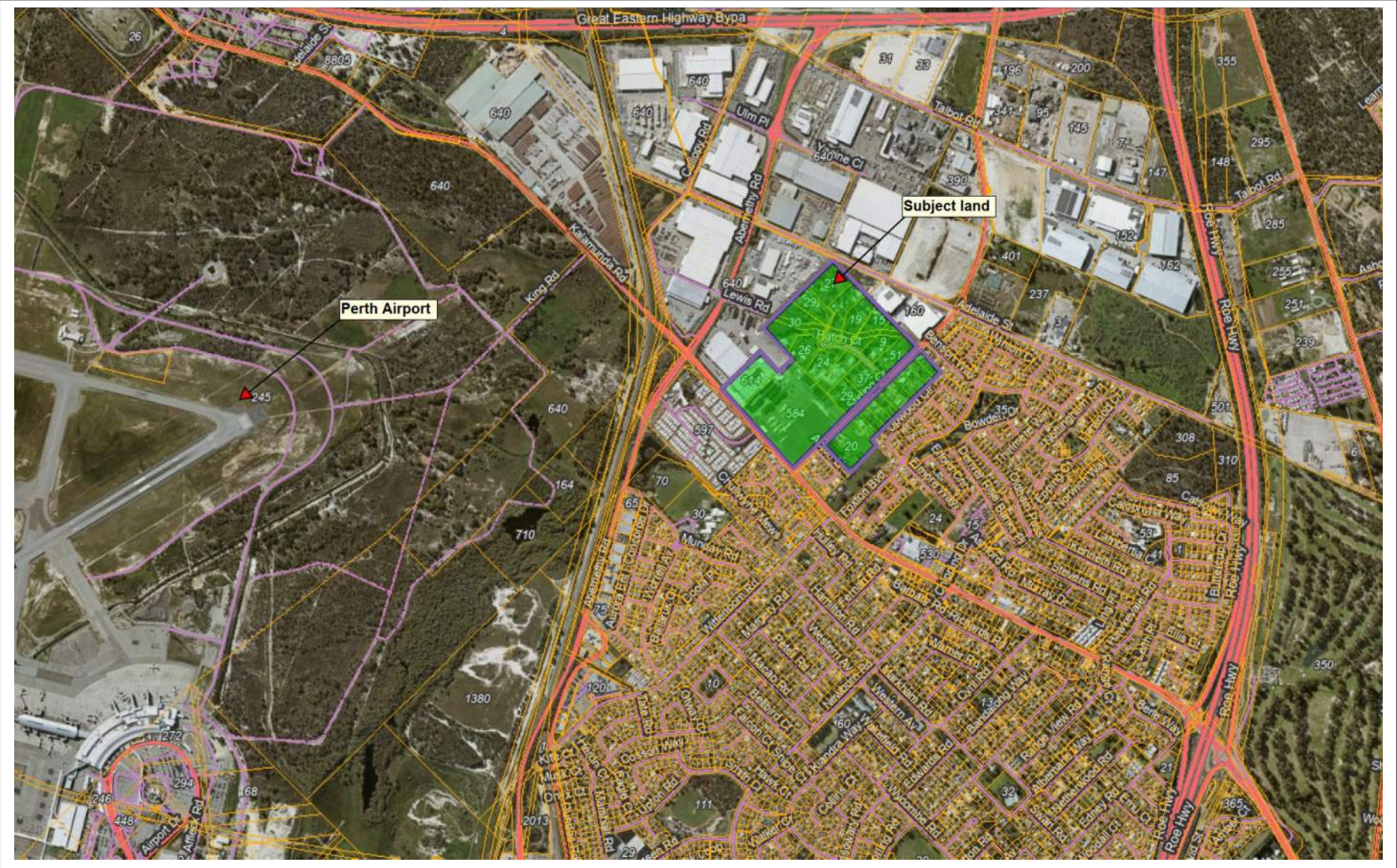
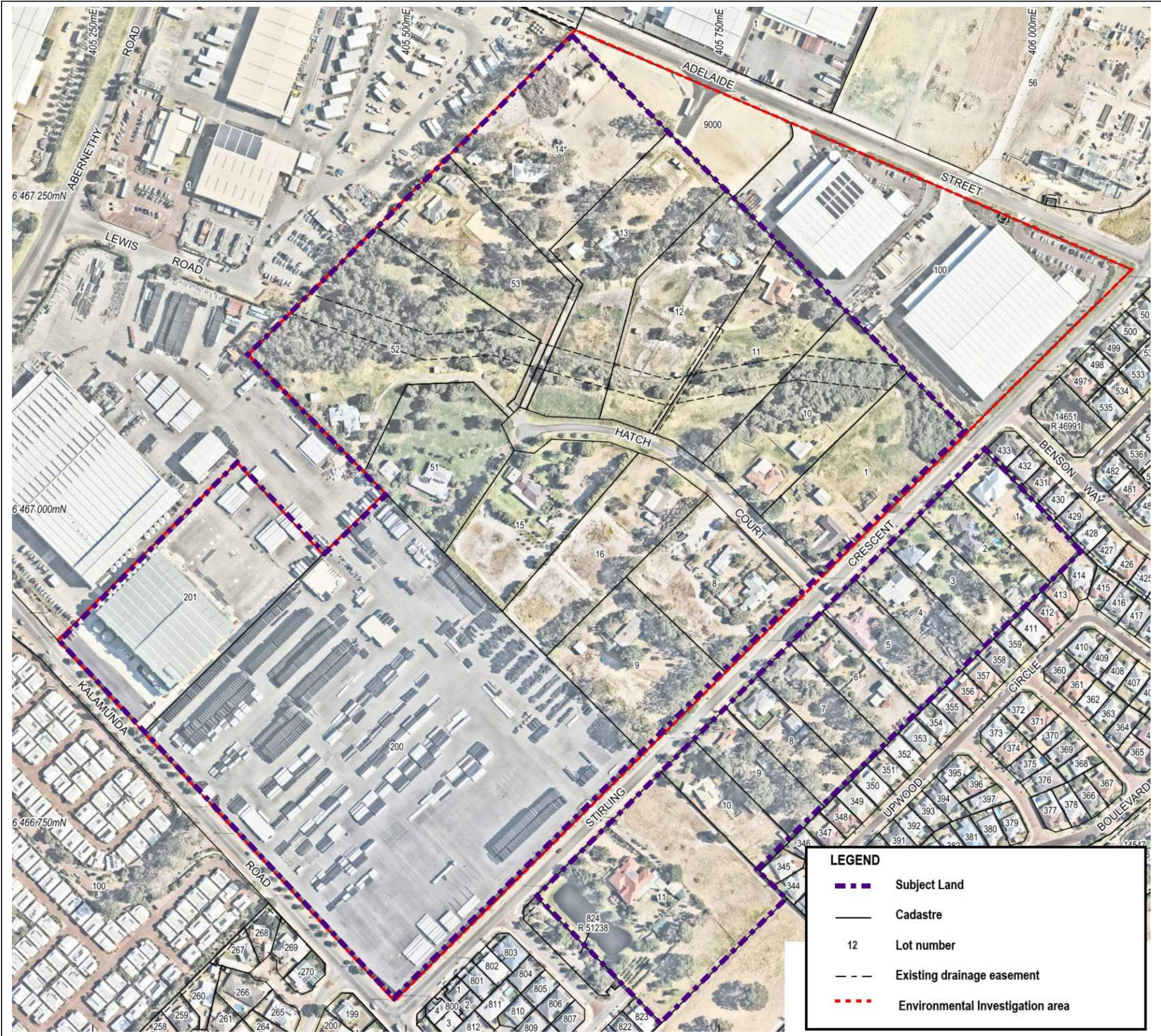


Figure 1 Location Plan

Figure 2 Subject land



2 KEY ELEMENTS PLAN

Water management strategies for the subject land are based on best practice water sensitive urban designs that integrate sustainability and the provision of attractive communities. The strategies will be achieved through the synthesis of planning and designs to manage, protect and conserve the total water cycle. The plans and designs for the development are appropriate for the subject land's proposed industrial and residential development as well as the local environment and drainage characteristics.

A summary of the WSUD elements that will be implemented within the development to achieve best management practices are outlined below. These are also represented visually in Figure 3.

Water Conservation and Servicing

- All lots are to be connected to a potable reticulated water main to provide security of supply.
- All residential lots are to be connect to mains sewerage.
- All industrial lots are to utilise suitable on-site effluent management including secondary treatment, compliant with the approved Site and Soil Evaluation.
- The Living Stream landscaping is to be primarily irrigated via stormwater and the shallow natural groundwater.
- The residential POS areas may receive irrigation, depending on detailed design.

Stormwater management

- All new residential lots will detain and infiltrate the 5% AEP on site, as per the City of Kalamunda's guidelines.
- All new industrial lots will detain and infiltrate stormwater so that their 1% AEP runoff is in keeping with the requirements of the downstream Perth Airport drainage network.
- Bioretention systems and/or soakwells assist with treatment of stormwater with the new road networks.
- The Living Stream and retained Wetlands assist with treatment and detention of stormwater from the subject land and upstream catchments.
- The Southern POS basin will retain and infiltrate all stormwater discharged into it up to and including the 1% AEP.
- The lot detention, POS basins and Living Stream / Wetland network detain all peak flows to at / below pre development rates as well as meeting the Perth Airport discharge rate.

Flood management

- All lot levels will be designed to maintain a minimum separation clearance of 300mm between the habitable floor levels and the 1% Annual Exceedance Probability (AEP) flood levels generated on site.
- All lot levels will be designed to maintain a minimum separation clearance of 500mm between the habitable floor levels and the 1% Annual Exceedance Probability (AEP) flood levels of the Living Stream and main POS detention basin.
- The Living Stream and Wetland network allows for 1% AEP flood flows to traverse the subject land site as well as providing safe storage.

Groundwater Management

- Inflow to the groundwater is to be treated in bioretention gardens and Living Stream / Wetland network.
- Where necessary the subject land is to be lifted using clean fill to maintain necessary separation to the groundwater.
- Subsoil systems are to be installed to control groundwater rise in areas with groundwater less than 1.5m from the surface.
- Mains sewerage will remove potential pollutants from the residential lots for treatment off site.
- Secondary treatment of industrial lot wastewater will assist with minimising pollutants moving into the groundwater.
- Removal of stock and large gardens is likely to reduce nutrient loads to the groundwater.

Ecosystem Protection and Enhancement

- The stormwater system will assist with capturing sediments, large debris, nutrients and other pollutants from stormwater runoff, protecting the subject land wetlands.
- New riparian ecosystems creation will be undertaken through converting the current degraded drainage line into a Living Stream.
- Bioretention systems will provide some limited habitat to fauna throughout the subject land.
- The wetlands are to be enhanced through weed control and revegetation as well as being protected in reserves with appropriate buffers.

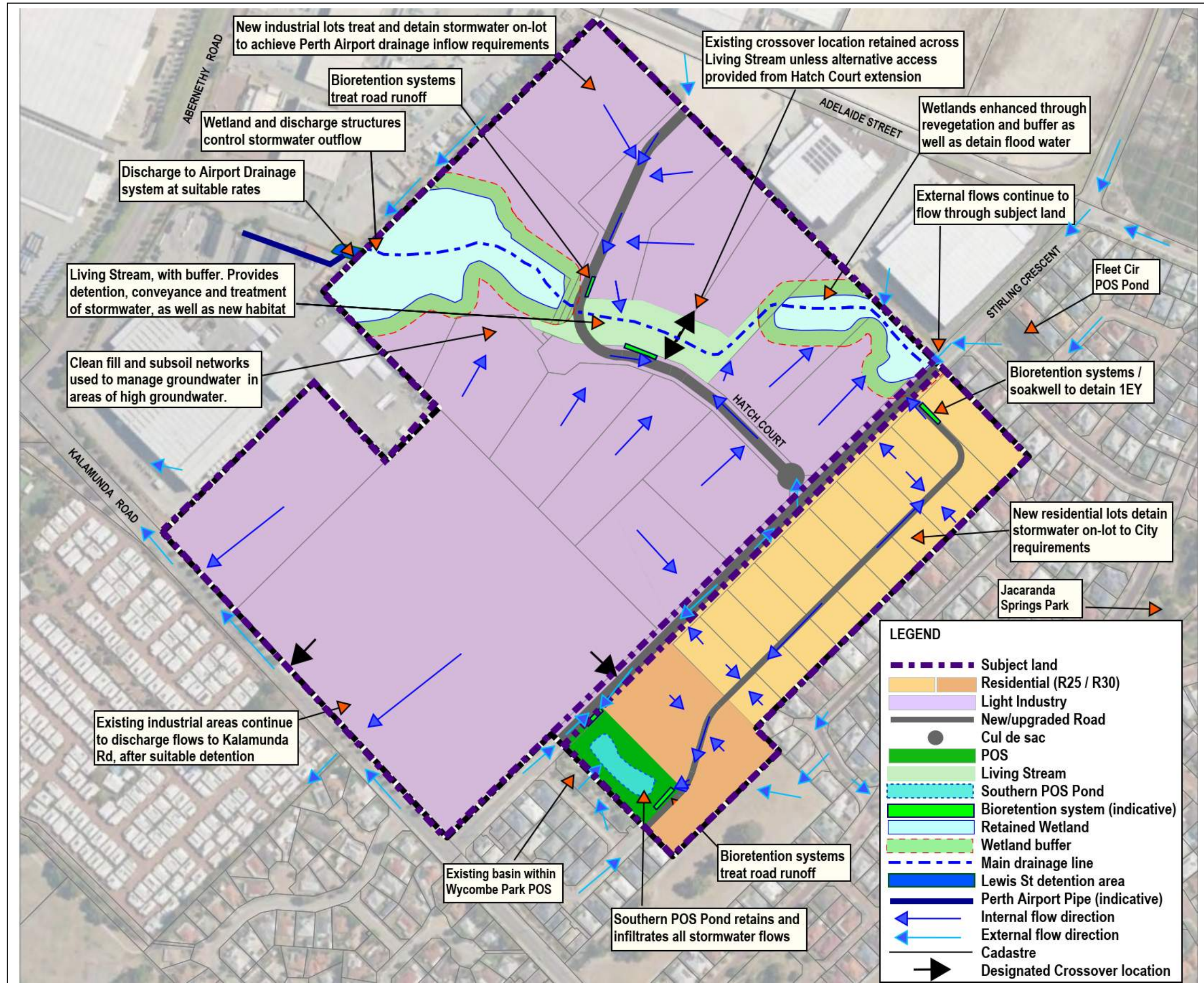


Figure 3 Key Elements Plan

3 LANDFORM

3.1 LANDFORM

The subject area is composed of low undulating Bassendean Sand Dunes, with wetlands between the dunal peaks.

In the current residential portion to the south of Stirling Cres, the land undulates between RL25 and RL 23, with the surface previously earthworked as part of the residential development. There is also an excavation into the groundwater at the south western end of the residential potion. This extends down below RL22, with the exact depth unknown due to being permanently under water. Lots 200 & 201 Kalamunda Rd have been recently filled to create flat pads at approximately RL 24.

The large rural residential lots around Hatch Court generally fall towards the central wetland and drainage system. In the southern portion the ground falls in a general northerly direction from a series of low peaks ranging from RL23.4 to RL 24. In the north, the land falls in a south/south-westerly direction from sand dune peaks ranging from RL21.4 to RL22.7.

The far eastern corner is composed of a seasonally waterlogged wetland at RL 20.7 – RL 21.3. A drain has been created from this wetland, with an invert level of RL20.76, that flows westward across the subject land before entering and traversing another wetland in the western corner. This wetland is also seasonally waterlogged and ranges from approximately RL 19.4 – RL19.9. There are also some excavations within this wetland to create small ponds.

The exception to the area that falls to the central drainage network is an area in the most southern corner, which is composed of a trapped low, at approximately RL 22. A portion has also been excavated into the groundwater. A small catchment area from the subject land and adjoining Stirling Cres Rd feed into this area.

The landforms of the subject land can be seen in Figure 4, with a survey of the key areas in Appendix D. A plan of LiDAR contours can also be seen in Appendix D, noting that some areas have been filled since the LiDAR information was collected.

4 ENVIRONMENTAL CONDITIONS

An Environmental Assessment Report of the subject land was prepared by PGV in May 2026

It assessed and identified vegetation types and condition and the presence of fauna as well as the characteristics of the drainage line and wetlands. The following is a summary of this information as well as site visits by Oversby Consulting.

4.1 WETLANDS

The majority of the subject land has been classified as having wetland characteristics (*DBCA Geomorphic Wetlands of the Swan Coastal Plain*). The wetlands are predominately classified as Multiple Use (MU) wetland (6 wetlands) with there also being 2 Resource Enhancement (RE) wetlands with the Identifiers 15939 (western wetland) and 15940 (eastern wetland). Some of the areas eg Lots 200 and 201 have been filled, removing their wetland characteristics since the mapping was undertaken. There are no Conservation Category wetlands within 200m of the subject land. The subject land wetlands are predominately Sumpland and Dampland types. The areas that have been excavated below the groundwater provide permanent/semi-permanent open water conditions within the mapped wetland types. A summary of the relevant wetlands can be seen in Table 1. The DBCA wetland mapping can be seen in Figure 7.

Table 1 Subject land wetlands

Wetland Classification	Wetland Type	UFI Number	Location
Resource Enhancement	Sumpland	16226	Western part of the creekline drainage line.
Resource Enhancement	Sumpland	15940	Eastern part of the creekline drainage line.
Multiple Use	Sumpland	16225	To the north of the western REW
Multiple Use	Sumpland	15898	Traverses the centre of the northern part site from east to west along the creekline.
Multiple Use	Dampland	15267	South of the creekline.
Multiple Use	Sumpland	15777	Northern part of Lot 200
Multiple Use	Dampland	15779	Central part of Lot 200
Multiple Use	Sumpland	15780	The southern part of Lot 200.

The two RE wetlands exhibit characteristics consistent with their classification, with both having some native vegetation and a water level that supports general wetland functions.

4.2 WATERWAYS

There are no defined natural waterways remaining within the subject land, although historically there was a natural waterway associated with a wetland chain (now located within MU wetland UFI15898). By 1985 a constructed open drain had been installed through the subject land and downstream. The broader floodplain has also been partially filled, and some small dams are located along it. It is also intersected by a number of driveways and associated culverts, which restrict larger flows.

This open drain is considered a first order stream due to no defined other waterways entering it. The flow is seasonal, with a base flow from groundwater for much of winter and spring.

The open drain is predominately covered in pasture weeds and kikuyu, with some isolated *Melaleuca raphiophylla* and *Melaleuca preissiana* on its banks. It is generally considered to be in a Degraded to Completely Degraded condition, with a small area at the eastern end rated as Degraded to Good (the portion within RE Wetland UFI 15940). The surrounding floodplain is also generally Degraded to Completely Degraded. More details can be found in the EAR.

There are also no other natural waterways within 200m of the subject land.

4.3 RIPARIAN FLORA

No Threatened or Priority flora species have been recorded within the subject land and none were recorded during PGV’s survey. The native flora recorded on the drainage line and wetland includes:

- *Eucalyptus rudis* (Flooded Gum);
- *Melaleuca raphiophylla* (Paperbark);
- *Astartea fascicularis*;
- *Typha orientalis* (Bulrush);
- *Juncus pallidus* (Pale Rush);
- *Hypocalymma angustifolium* (Pink-flowered Myrtle);
- *Lepidosperma longitudinale* and
- *Dielsia stenostachya*.

The majority of the riparian areas were dominated by weed species including

- *Cenchrus clandestinus* (Kikuyu);
- *Zantedeschia aethiopica* (Arum Lily) – a Declared Pest and Weed of National Significance (WoNS);
- *Washingtonia filifera* (Cotton Palm);
- *Gomphocarpus fruticosus* (Cotton Bush), a Declared Pest; and
- *Arundo donax* (False Bamboo).

4.4 VEGETATION

The vegetation within the subject land is part of the Southern River Vegetation Complex (Heddle *et al.*, 1980) and is described as “open woodland of *Corymbia calophylla*-*Eucalyptus marginata*-*Banksia* species with fringing woodland of *Eucalyptus rudis* -*Melaleuca raphiophylla* along creek beds”. Due to the subject land being predominantly cleared with isolated native and introduced trees over weeds, the subject land’s vegetation is too degraded to be a good example of this vegetation complex.

Five vegetation types have been described on the site in 2014 and the 2025. The vegetation previously recorded on Lot 200 Kalamunda Road, Lot 100 and Lot 9000 Adelaide Street has since been cleared from earlier observations. The remaining vegetation types are:

- **Cleared Areas** that contain no, or very few, native plants and are vegetated by exotic species (majority of subject land).
- **ErMr** *Eucalyptus rudis* Woodland to Low Forest over *Melaleuca raphiophylla* Low Forest over Arum Lily.
- **Er** *Eucalyptus rudis* Woodland to Low Forest over Pasture.
- **Mr** *Melaleuca raphiophylla* Low Woodland over Typha and Arum Lily.
- **MrAf** *Melaleuca raphiophylla* / *Astartea fascicularis* Thicket to Low Woodland

All of the remaining vegetation types, that still contain a range of native species, are riparian in nature.

A large area of the site has been cleared for rural purposes or contains only introduced species and is Completely Degraded. The northern area is considered to be Degraded to Completely Degraded and consists of native trees over bare sand and weeds. The small eastern area of remnant vegetation associated with the RE wetland is considered to be in Degraded to Good Condition and consists of a native tree and sedge species with a number of weed species present. The western area of wetland vegetation is considered to be in Degraded Condition with native trees over weeds. The vegetation types and conditions can be seen in Figures 5 and 6.

4.5 FAUNA

There are four fauna habitats within the subject land, which are listed below. The last to are riparian in nature:

- Upland Banksia sp. and *Eucalyptus todtiana* scattered over cleared understorey;
- Cleared paddocks with scattered exotic trees.
- Wetland with *Melaleuca raphiophylla* and *Eucalyptus rudis* over weedy understorey;
- Wetland with weeds

As well as the native vegetation being relatively degraded within the subject land, the quality of the fauna habitat is limited due to it being fragmented from other areas of native vegetation, the closest being Munday Swamp approximately 1km to the south-west. The scattered parkland trees are considered to be Highly Degraded Fauna Habitat due to the cleared understorey.

The wetland areas on the site containing native trees are considered to be Disturbed Fauna Habitat. The understorey consists completely of weeds apart from a small section in the eastern area containing *Lepidosperma longitudinale*. The eastern section has been invaded by Japanese Pepper trees and the western section contains an abundance of Arum Lily. The drainage line with weeds such as False Bamboo and Bulrushes is considered to be Highly Degraded Fauna Habitat due to the absence of any native flora species.

The drainage line is disturbed fauna habitat but provides habitat for some frog and waterbird species and there is anecdotal evidence that it supports a population of Oblong Turtles (*Chelodina oblonga*). It is possible that the subject land could provide some limited habitat for the Rakal or Water Rati (*Hydromys chrysogaster*), which is listed as a Priority 4 species.

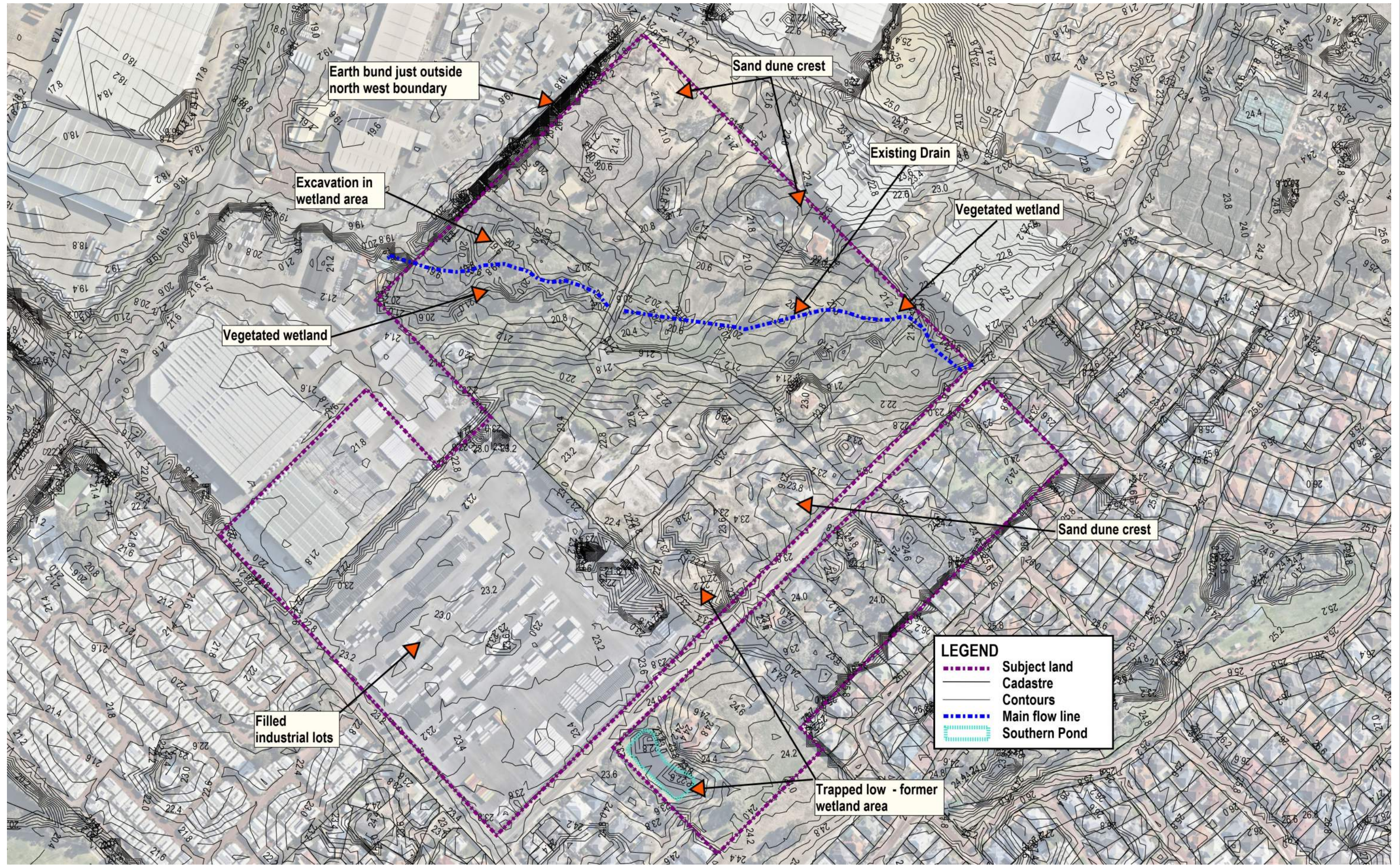


Figure 4 Landform characteristics

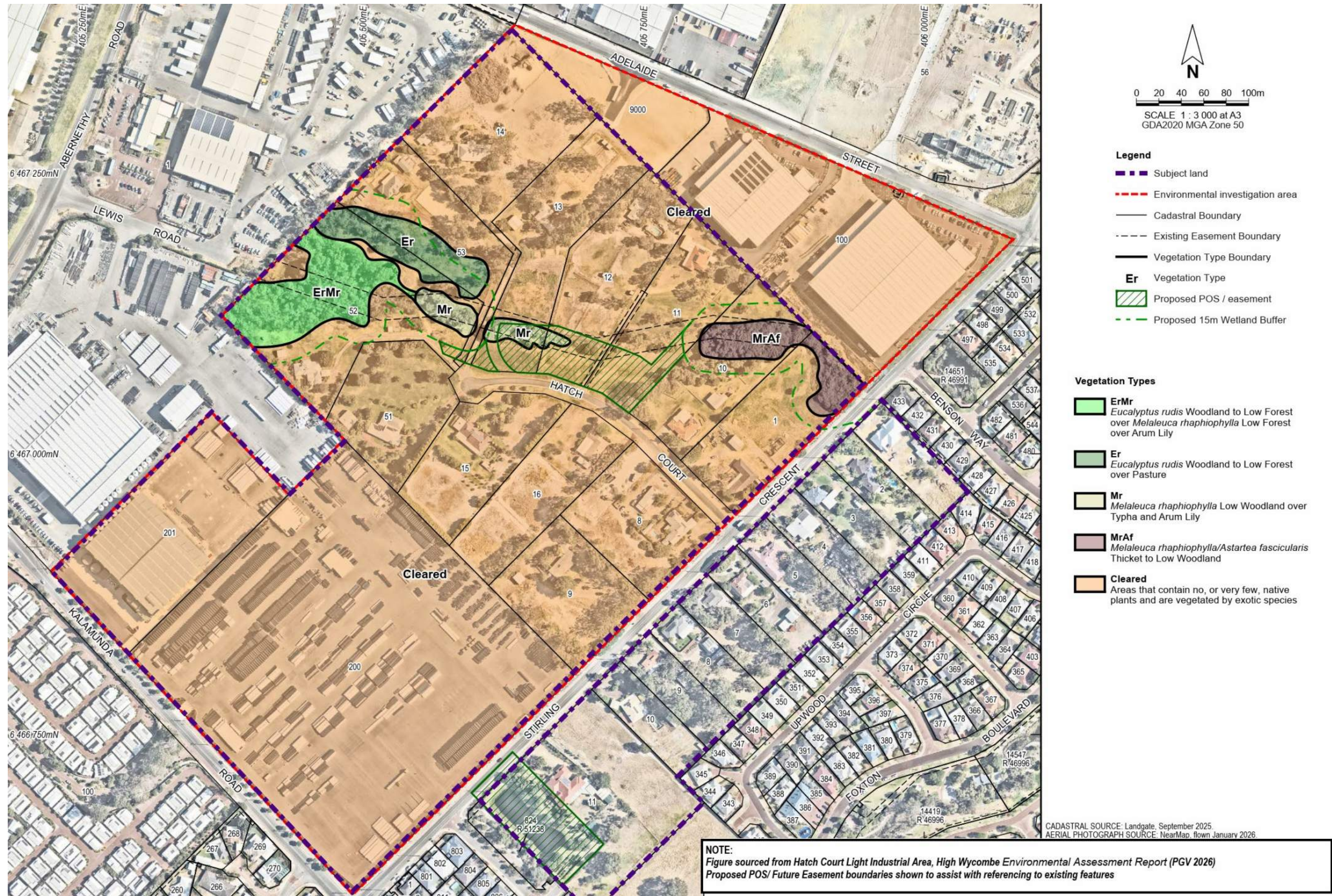


Figure 5 Mapped vegetation types

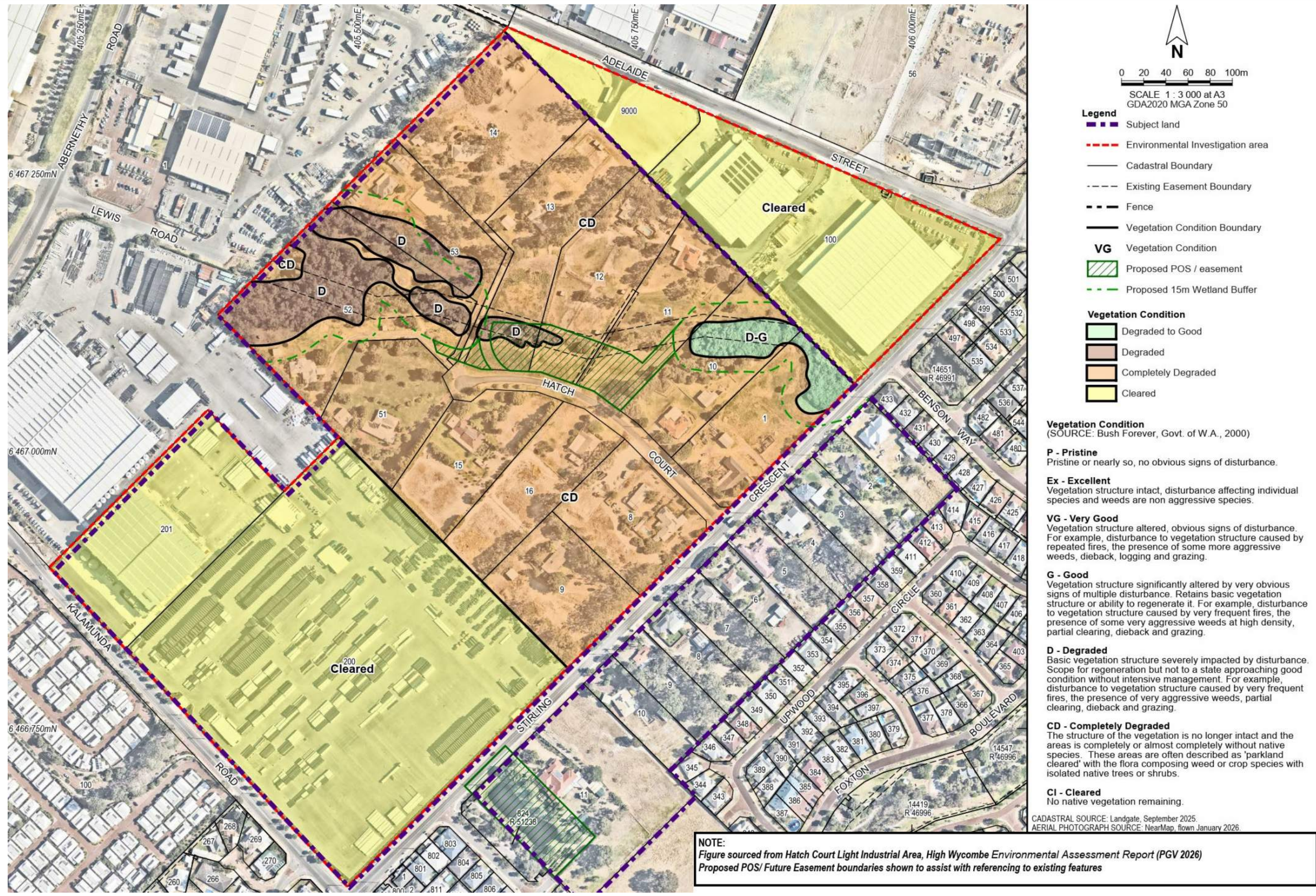


Figure 6 Vegetation condition

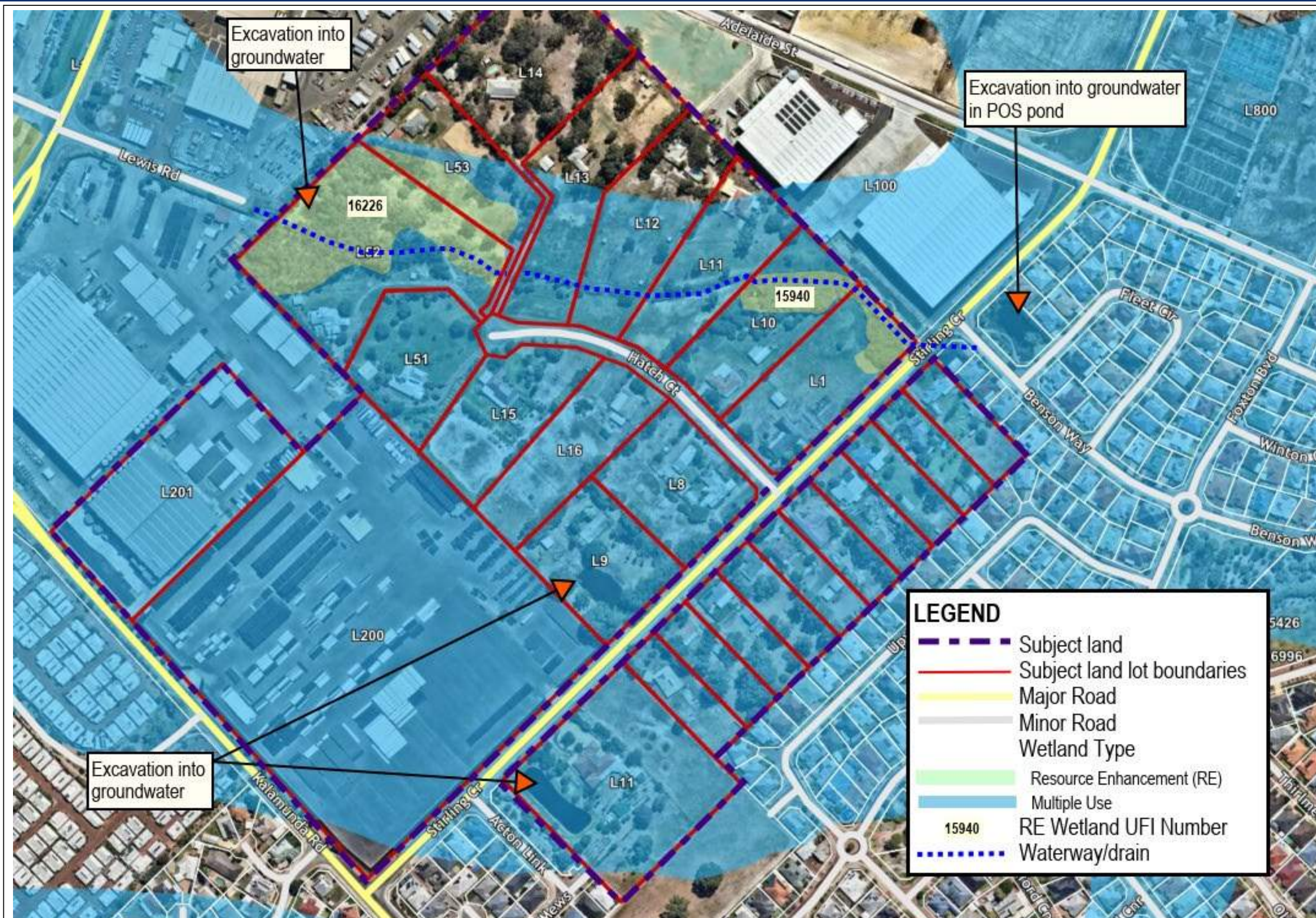


Figure 7 Historical wetland mapping

5 GEOTECHNICAL

Galt Geotechnics undertook a range of geotechnical assessments across the subject land in August and September 2025. They have also undertaken several other historical investigations for sub areas of the subject land. This information was compiled in the report titled *Geotechnical and ASS Study Hatch Court Light Industrial Area and Stirling Crescent Precinct Hatch Court And Stirling Crescent, High Wycombe, WA (2025)*. The following is a summary of the information gathered as part of these investigations. The testing locations can also be seen in Figure 8.

5.1 GEOLOGICAL MAPPING

The geological map for the area shows the site to be composed of the following units:

- **Cps:** Peaty CLAY: “dark grey and black with variable sand content of lacustrine origin [Swamp Deposits (Qhw)]”
- **S8:** Bassendean SAND: “very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted of eolian origin”
- **S10:** “Thin Bassendean Sand over Guildford formation”

5.2 SUBSURFACE CONDITION

The following is a description of the soil types found.

Over most of the subject land SAND extending to depths of 2.0 m to over 6.2 m, overlying Guildford Formation (interbedded stiff to hard cohesive soils and medium dense granular soils) at some locations extending beyond investigated depths. The sand is characterised as a medium grained, sub angular to sub rounded, typically grey, typically trace fines, typically loose to depths of about 0.5 m to 2.5 m and then becomes typically medium dense, extending to depths of 2.0m to over 6.2 m. Where encountered, the Guildford Formation was composed of interbedded CLAY / Clayey SAND / Sandy CLAY / SAND Layers (SP/SC/CL-CH) and was typically composed of stiff to hard cohesive layers and medium dense sand layers.

In addition:

- The surficial sand is interbedded with Cemented sand / ‘Coffee Rock’ layers (about 0.3 m to 1.0 m thick) below about 2.0 m to 3.4 m depth. Associated uncemented zones of discoloured brown / black sand with a higher fines content were also encountered in some locations.
- Peat / organic soils were encountered within / adjacent the drainage line in the northern part of the subject land and within the wetland area near Lewis Road. Similar zones of organic soils could be present in open water bodies.
- Surficial uncontrolled fill about 1.1 m thick was encountered in the northern corner of subject land

5.3 ACID SULPHATE SOILS (ASS)

According to the DWER online ASS risk database, the subject land is generally mapped as being within an area of ‘moderate to low’ ASS risk (highlighted in yellow in In-line Image 4 below), with part of the site identified as having ‘high to moderate’ risk (highlighted in red in In-line Image 4 below) within the upper 3 m of the soil profile. High risk areas are judged to be associated with potential organic soils mapped in some areas (see Section 5.2).

Based on the findings of the study and previous experience with ASS identification, coffee rock and organic soils at the site are considered to be ASS. It was also noted that the groundwater had mildly elevated inherent acidity along with high to very high alkalinity concentrations at both monitoring locations indicating that groundwater will likely have sufficient self-buffering capacity to maintain an acceptable pH in the event of ASS generation. A summary of the soil pH can be seen in Table 2 and 3.

Table 2 pH of soil samples – all studies

Test Name	pH
Subject Land. August/ September 2025	
BH02	8.4
BH04	4.8
BH06	7.3
G07	7.8
G10	7.7
27 Hatch Court. May 2025	
G01	6.6
G03	6.6
Lots 8 and 16 Stirling Crescent. November 2024	
G01	5.8
BH16	6.2
G02	0.2 to 0.6

Table 3 Summary of Soil field ASS testing

Field pHf range	Field pHfox range	pH change	Laboratory pH range	Maximum Net Acidity (%S)
4.7 – 8.5	2.6 – 6.5	1.0 – 5.8	4.0 – 9.5	<0.02 – 0.14

5.4 PHOSPHORUS RETENTION INDEX

The phosphorus retention index’s values for the site show that the natural soil is generally poorly absorbing near the surface, with a greater ability to absorb phosphorus at depth. The results can be seen in Table 4.

Table 4 Phosphorous Retention Index Results

Test Name	Phosphorus Retention Index
Subject Land. August/ September 2025	
BH02	21
BH04	200
BH06	4.0
G07	0.5
G10	1.5
27 Hatch Court. May 2025	
G01	-0.14
G03	-0.48
Lots 8 and 16 Stirling Crescent. November 2024	
G01	-0.11
BH16	-0.25
Part of Lot 1499 Stirling Crescent. September 2023	
BH04	0.62
G02	1.2

5.5 CONTAMINATED SITES

The DWER contaminated sites database indicates that the site is not registered as a contaminated site. It is noted that the public database only shows sites classified as ‘Remediated for restricted use’, ‘Contaminated – restricted use’, ‘Contaminated – remediation required’.

During geotechnical fieldwork there were no visual or olfactory indicators of potential contamination. There are some areas of uncontrolled fill in the northern corner of the subject land. This may require investigation if anthropogenic waste is encountered within the material and/or it is proposed to be reused onsite.

5.6 PERMEABILITY

Outside of areas of high groundwater, the permeability of the sand material is moderate to high (3.8m/day – 31.3m/day – Falling head method) (1.6m/day – 25.01m/day) – Constant head method). These results can be seen in Tables 5 and 6 respectively. Permeability may be lower in areas where high groundwater is present, with results in high groundwater areas shown to be between 0.44m/day and 0.94m/day. The sampling locations can be seen in Figures 6.

Table 5 Permeability Test Results – Falling Head

Test Location	Soil Description	Depth (m)	Minimum Saturated Hydraulic Conductivity, ksat (m/day)
27 Hatch Court. May 2025			
BH02 / IT01	SAND (SP)	0.84	3.9
BH07 / IT02	SAND (SP)	0.90	3.8
BH08 / IT03	SAND (SP)	0.84	31.3
BH05 / IT04	SAND (SP)	0.84	4.7
Lots 8 and 16 Stirling Crescent. November 2024			
BH07 / IT01	SAND (SP)	0.88	> 15
BH08 / IT02	SAND (SP)	0.86	6.3
BH10 / IT03	SAND (SP)	0.82	3.9
BH16 / IT04	SAND (SP)	0.77	7.1
BH06 / IT06	SAND (SP)	0.77	> 15
Part of Lot 1499 Stirling Crescent. September 2023			
IT01	SAND (SP)	0.95	10.6
IT02	SAND (SP)	1.00	9.4

Table 6 Permeability Test Results – Constant Head

Test Location	Soil Description	Depth (m)	Minimum Saturated Hydraulic Conductivity, ksat (m/day)
G01/BH01	SAND (SP)	0.38	25.01
G02/BH02	SAND (SP-SM)	0.42	0.94 *
G03/BH03	SAND (SP)	0.57	9.05
G05/BH05	SAND (SP)	0.44	0.44 *
G07/BH15	SAND (SP)	0.53	9.82
G09/BH09	SAND (SP)	0.52	3.94
G10/BH10	SAND (SP)	0.47	3.53
27 Hatch Court in May 2025			
G01	SAND (SP)	0.33	3.56
G02	SAND (SP)	0.41	2.82
G03	SAND (SP)	0.40	3.31
71 Stirling Crescent in March 2023			
IT01	SAND (SP)	0.50	1.6
IT02	SAND (SP)	0.50	2.1
IT03	SAND (SP)	0.55	3.3
IT04	SAND (SP)	0.60	2.8
Lots 8 and 16 Stirling Crescent in November 2024			
G01	SAND (SP)	0.44	5.11
G02	SAND (SP)	0.50	3.17
G03	SAND (SP)	0.39	3.26
G04	SAND (SP)	0.40	10.95
Part of Lot 1499 Stirling Crescent in September 2023			
G01	SAND (SP)	1.00	3.9
G01A	SAND (SP)	0.80	2.3
G01B	SAND (SP)	0.53	> 15
G02	SAND (SP-SM)	0.90	0.07 #
G02A	SAND (SP)	0.70	1.74
G02B	SAND (SP)	0.70	1.67
G02C	SAND (SP)	0.50	>15

NOTES: 1. Constant head Guelph Permeameter tests were carried out in hand-auger boreholes in accordance with Appendix G of AS1547 (2012) “On-site domestic wastewater management”.

* = Test results likely to have been influenced by shallow groundwater

= Result considered spurious.

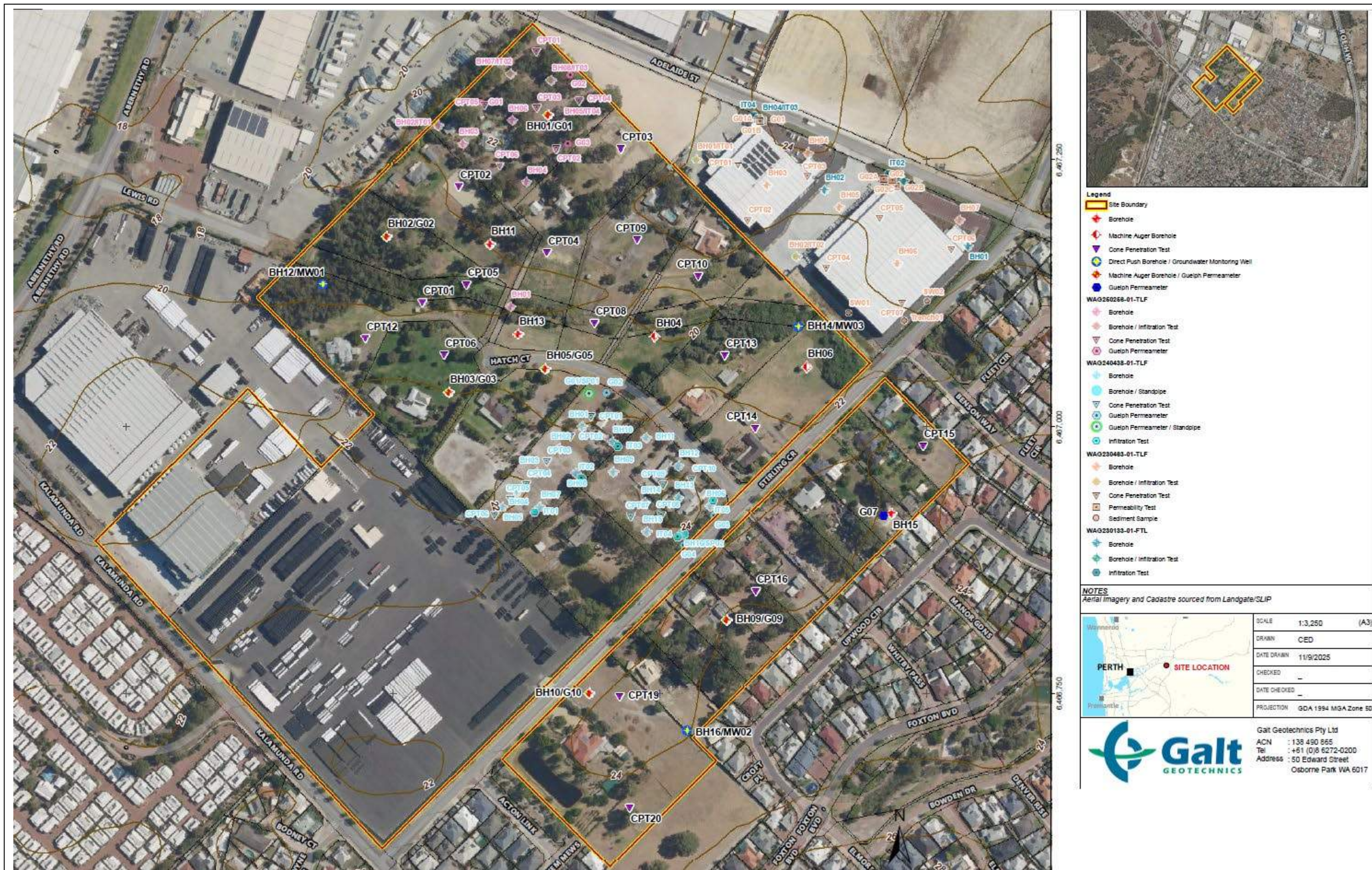


Figure 8 Test pit locations – current and former investigations

6 GROUNDWATER (PRE DEVELOPMENT)

The following is a summary of the current groundwater characteristics of the site, taken from the geotechnical investigations, the DWMS, Perth Airport investigations and online resources.

It is also noted that the site is not within a Public Drinking Water Source Area (PDWSA).

6.1 SUPERFICIAL GROUNDWATER LEVELS

The groundwater levels within the online Perth Groundwater Atlas (DWER) show that groundwater is generally moving in a north westerly direction. The maximum groundwater levels are noted as dropping from approximately 19.9mAHD to 17.2mAHD. These contours can be seen in Figure 9.

A groundwater contour map was also undertaken as part of a broader assessment for the Perth Airport. The levels found are similar to the Perth Groundwater map, with levels dropping across the subject land from 24mAHD to 21mAHD.

Furthermore, a 12-month groundwater monitoring program was undertaken as part of the District Water Management Strategy investigations (ENV, 2009), which covers the subject area. Bores MW1 – MW4 are located within the current subject land, with DWER Bore 4849 to the east. Based on the 12 months of monitoring the average annual maximum groundwater level (AAMGL) was determined, with the results outlined in Table 7 and shown on Figure 10. The general flow, as determined by the broad scale groundwater investigation, was in a northerly direction. Further details of the DWMS monitoring can be seen in Appendix C.

Table 7 DWMS groundwater level results

Bore	Maximum Recorded Groundwater Level (mAHD)	Depth to maximum Recorded Groundwater Level (m)	AAMGL (mAHD)	Depth to AAMGL (m)
MW1	22.273	1.02	22.136	1.157
MW2	21.484	0.248	21.320	0.412
MW3	21.451	1.555	21.314	1.692
MW4	21.173	0.695	21.016	0.852
DoW 4849	14.937	-	14.720	-

Groundwater monitoring was also undertaken as part of the geotechnical investigation (see Section 5). As 2025 had high rainfall during the test period, the groundwater levels are likely to be close to the maximum. Groundwater was also noted to be discharging into the drainage line that traverses the subject land, which effectively controls further rise in levels. The general groundwater characteristics can be seen in Figure 11. This shows that the groundwater is generally shallowest around the wetlands and drainage line. The depth extends to over 2m in the higher sand dunes. There are also some other localised areas where groundwater was noted as being within 1m of the surface during August/September 2025. Groundwater is also noted as being present in the areas of excavation both within the subject land and the adjoining POS pond. Discussions with local lot owners suggests that the groundwater in the most southern open waterbody drops approximately 1 – 1.5m annually.

Based on the levels within the open ponds and geotechnical investigations, a more refined groundwater contour map was developed. From this groundwater falls in a north/north westerly direction from RL23 to RL19. There localised lowering influenced of the drainage line can be seen in Figure 11 and 12. There are also some small areas of mounding associated with areas where the subsurface soils impedes downward flow of groundwater. The localised influences will tend to reduces as the peak groundwater levels drop below the invert of the drainage line, and the mounded groundwater flows off the less impervious areas.

Groundwater monitoring was also undertaken as part of the geotechnical investigation. As 2025 had high rainfall during the test period, the groundwater levels are likely to be close to the maximum. Groundwater was also noted to be discharging into the drainage line that traverses the subject land, which effectively controls further rise in levels.

These levels are in keeping with the levels found as part of the DWMS investigations, while noting the more refined scale of investigations highlights the localised impact of the subject land's drainage line.

6.2 GROUNDWATER QUALITY

Groundwater sampling as part of the geotechnical investigations was undertaken. The results showed indicate a pH ranging from 6.18 – 7.16. Mildly elevated inherent acidity along with high to very high alkalinity concentrations were noted, indicating that groundwater will likely have sufficient self-buffering capacity to maintain an acceptable pH in the event of ASS generation.

Elevated concentrations of aluminium and iron indicate that historical oxidation of ASS may have occurred at the site. The metal concentrations are similar to much of the eastern Swan Coastal Plan. Concentrations of chloride were found to exceed non-potable use of groundwater guidelines in MW01 (330 mg/L). A summary of the results can be seen in Table 8. Further details can be found in the Geotechnical report (Appendix B).

Table 8 Groundwater quality

Test Name	Electric Conductivity (us/cm)	pH
Subject Land. August/ September 2025		
BH02	300	8.4
BH04	1000	4.8
BH06	110	7.3
G07	14	7.8
G10	73	7.7
27 Hatch Court. May 2025		
G01	66	6.6
G03	60	6.6
Lots 8 and 16 Stirling Crescent. November 2024		
G01	32	5.8
BH16	36	6.2

Groundwater quality sampling was also undertaken as part of the DWMS. A summary of these results is as follows:

- Groundwater is generally fresh;
- Groundwater is slightly acidic with typical pH values less than 6.25;
- Total Nitrogen (TN) exceeds the ANZECC (2000) guideline of 1.2 mg/L and the Swan Canning Cleanup Program Long Term Target of 1 mg/L ranging from 1.5 mg/L to 3.2 mg/L; and
- Total Phosphorus (TP) is above and below the ANZECC (2000) guideline of 0.065 mg/L and the Swan Canning Cleanup Program Long Term Target of 0.1 mg/L ranging from 0.05 mg/L to 2.75 mg/L

6.3 AQUIFERS AND ALLOCATIONS

The Water Register indicates the Site lies within the Perth groundwater area (DWER, 2021). Groundwater below the Site is a multilayered system comprised of the following:

- Perth – Superficial Swan Aquifer. Sub area – Shire of Kalamunda
- Perth – Leederville Aquifer. Sub area – Perth South Confined
- Perth – Yarragadee South Aquifer. Sub area – Perth South Confined

As of December 2025, there is allocation available in the Superficial, while the Yarragadee and Leederville Aquifers are fully allocated.

There are no current water licences noted within the subject land, however the City of Kalamunda does have an active licence allocation for the adjoining POS (Licence number 158077, Perth Superficial Swan – 952,475kl).

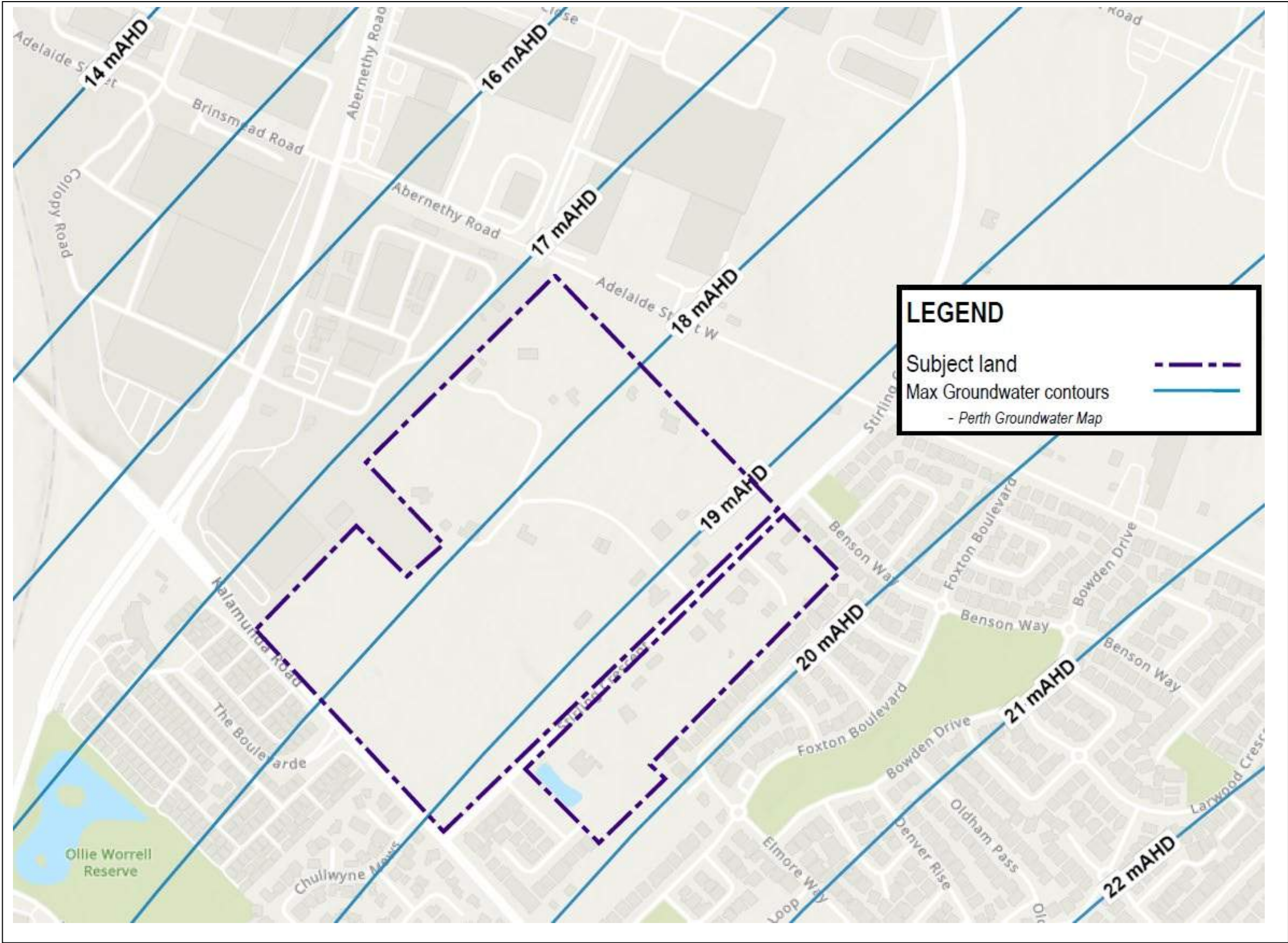


Figure 9 Perth Groundwater Map – 2019 Maximum groundwater levels

Figure 10 DWMS groundwater and surface water monitoring details

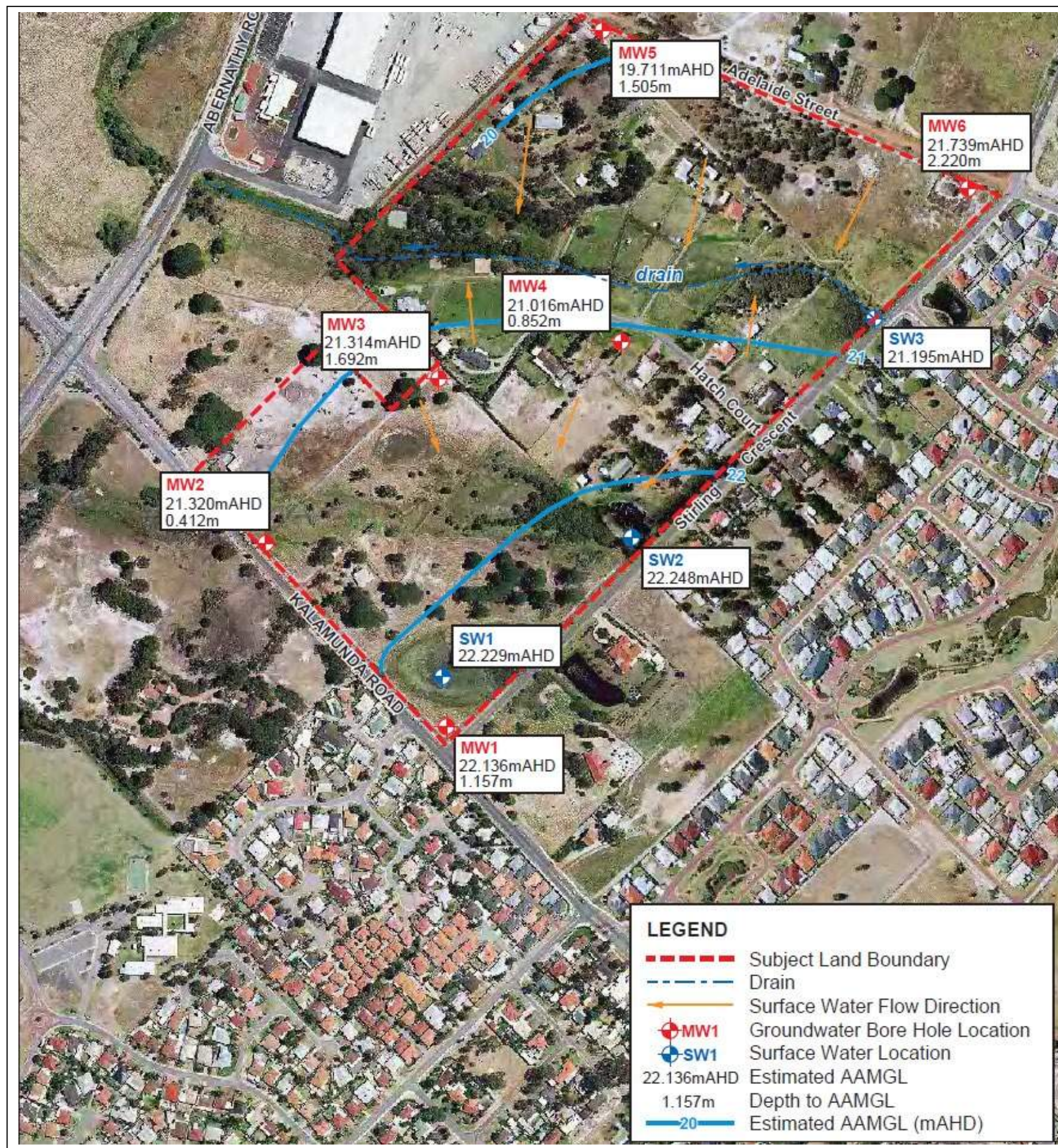




Figure 11 General groundwater characteristics

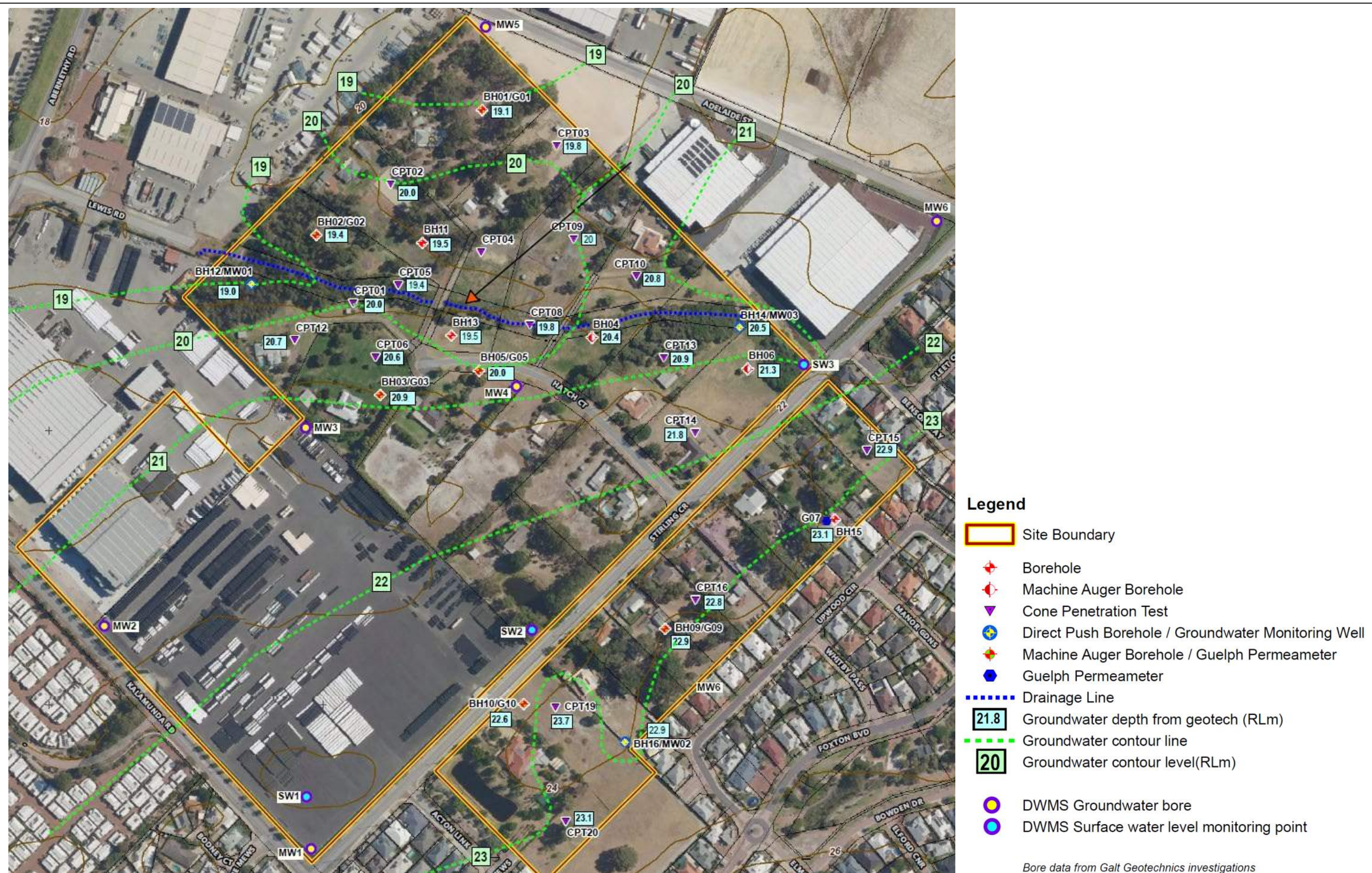


Figure 12 Pre development groundwater contours

7 PRE DEVELOPMENT SURFACE WATER

7.1 GENERAL

The subject land's surface water predominately infiltrates into the sandy soils except during intense heavy rain events. The exception is for those areas of the subject land where the groundwater comes to or close to the surface eg within 0.3m of the surface. This means that the runoff is generally greatest during large thunderstorms or in late winter when groundwater is highest.

The subject land has multiple catchments where water either discharges off site or is infiltrated within the trapped lows. Furthermore, there are significant upstream catchments that feed into the subject land. The following provides more information on both the internal and external catchments and the corresponding surface water characteristics.

7.1.1 Subject land features and catchments

The following is a summary of the main features and characteristics of the actual subject land. The characteristics can also be seen in Figure 13, which outlines the current landform for comparison to historical characteristics. Figures 14 and 15 shows the subject land and surrounding external catchments in 1995 and 1953 respectively. The catchment delineation for the current site and surrounds was derived from LiDAR contours and site survey. For the historical catchments, historical aerials used to interpret likely catchment boundaries. Due to the uncertainty with the historical catchments, some boundaries have been aligned with the edge of subject land or current external catchments to allow for ease of pre and post comparisons.

Hatch Court Drain Discharge system

The main drain feature of the subject land is the wetland and constructed open drain network that traverses in a west north-westerly direction from Stirling Crescent to Lewis Street. The majority of this flow path is contained within a drainage easement (Lots 10 – 14, 52, 53 – see Figure 2 for easement). At the downstream edge of the subject land, the outflow is controlled by a 375mm pipe set at RL19.02 (also taken as the effective base of wetland water level in winter). Once the capacity of this pipe is exceeded, the water is assumed to fill to the top over point of RL19.4, with an effective overflow width of 5m wide. Both the pipe and weir flow discharge directly into an open drain within the Lewis St road reserve, which contains a wide drain, with an effective base of RL 19.08 (this being the level of the pit into which water leaves this drain). Here the flow is captured by the Perth Airport Drainage network with water discharging into twin 750mm drainage pipes (invert RL 18.04). These pipes are set within a box chamber of approximately 4.5m², with a grate over the top (invert RL19.08).

Surface water monitoring through the central drain was undertaken as part of the DWMS. This included bi-monthly recoding of levels for a period of 12 months from July 2008 to May 2009. The maximum recorded level was 21.385m AHD from monitoring point SW3 (See Figure 10).

Due to groundwater rising to the base of the wetland and drainage line during winter and spring, there is a small base flow through this network. This base flow is assumed to fill the wetland network to the invert of the discharge structure (natural ground lip or pipe) downstream of each wetland along the Hatch Court wetland and open drain network.

The internal catchments that feed this network are predominately Int Pre A and Int Pre B, which are assumed to be rural in nature, with some buildings and driveways (in the 1997 scenario modelling – see Section 7.2) It also includes Int Pre G R, which represents the Hatch Court road reserve, with its associated pit and pipe network that discharges to the wetland and open drain network.

The large lot residential area to the south of Stirling Cres (Catchment Int Re E) also feeds through to the Hatch Court wetland and open drain network. This is via sheet flow onto Stirling Cres, which then discharges to the wetland and open drain network (see External catchment below for further information).

The total Internal and external assumed catchment feeding through to the final discharge point (Lewis St) is 42.974ha.

Kalamunda Road Discharging systems

In 1995 and prior, Catchment Int Pre C was characterised by a wetland and broad sheet flow path that discharges to Kalamunda Road. Within this, there is a shallow, pond located just to the north of Stirling Cres.

Catchment Int Pre D also historically contained a wetland system within it. The size of this wetland and its associated storage effectively captured the majority of flows within it. In extreme event the discharge direction was to Kalamunda Rd.

It is noted that most of these 2 catchments have now been filled and are used for industrial purposes.

The total Internal and external assumed catchment feeding through to the final discharge point (Kalamunda Rd) is 11.997ha.

Sump to south of Stirling Cres system

There is a large, constructed pond to the south of Stirling Crescent. This has been labelled as the Southern Stirling Cres pond as part of the pre development analysis. This has been created in a historical trapped low wetland area. As such it acts as a detention and infiltration system. The internal catchment that feeds this (Int Pre F) is mainly open farmland with some buildings.

The total Internal and external assumed catchment feeding through to the infiltration point (Stirling Cres) is 6.859ha.

7.1.2 External features and catchments

The external feeding catchments are predominately located to the east and south. Historically these were areas of low dunes with interdunal wetland depressions that created wetlands and broad shallow flow paths. While the exact detention systems within the upstream areas are unknown, it is assumed that they were similar to the wetland areas evident in the 1995 aerial. The following is a summary of the main catchments and their associated sub catchments.

Hatch Court Drain Discharge system

Catchment Ex AL is farmland that feeds through to the E9R and EX 10R road catchments, which then flowing into the EX 8R road catchment, with the pipe flow from these roads going to the wetland depression created behind the constriction caused by Stirling Cres. Catchment EX BL feeds directly to this wetland depression as well. Flows out of this depression discharge into the Hatch Court wetland and open drain network through an assumed 375mm pipe and overtopping of the road. There is also some assumed discharge directly from the EX8R road catchment to the wetland and open drain network, for flows that are in excess of the road pit and pipe system. EX 7R flows directly to the top of the Hatch Court wetland and open drain network, while EX6R's pipe network flows to Hatch Court.

EX CL, EX FL and EX CL discharge to the Int Pre A catchment directly as sheet flow. These catchments areas have low runoff characteristics in most storm events due to the high porosity of the sandy soils and lack of any wetland features.

Kalamunda Road Discharging systems

The only external catchment feeding through to Kalamunda Rd analysed was the road catchment of EX 5R. This discharges its flow into the Int Pre C catchment sump and wetland system.

Sump to south of Stirling Cres system

To be conservative, it is assumed that Catchment Ex DL and EX EL would have flow through to the Southern Stirling Cres Pond. It is also assumed that the road catchment Ex4R would also have flown to the Stirling Cres Pond.

7.2 DRAINAGE MODELLING

An analysis was undertaken of the pre development situation under 2 scenarios. The first assumed partially cleared paddocks with the existing major roads in place (as requested by the City of Kalamunda). An aerial photograph from 1953 was used as the likely landuse situation as well as areas of likely inundation and flow. This can be seen in Figure 15.

The second is the subject land and relevant feeding catchments as they likely appeared in 1997. This date is the assumed pre development situation for the Perth Airport drainage analysis, into which the subject land ultimately discharges to. This is the pre development situation that the Perth Airport has requested that peak flows are discharged into their drainage network. An aerial of the subject land in 1995 (assumed to be similar to the 1997 landuse) can be seen in Figure 14, which shows that both Hatch Court and Stirling Cres were effectively in their current form with approximately 80% of the current driveways and buildings present. The lots fronting Kalamunda Rd were in a rural residential state. The majority of the upstream catchments were in a rural state of cleared paddocks.

The main difference between the 2 scenarios modelled is summarised as follows;

- Scenario 1. The early rural option allows for flows to move through the drainage line with no restrictions downstream of Stirling Cres, plus no constructed impervious areas outside of road reserves. There are however large areas of effectively impervious surfaces created by areas of winter inundation which contribute discharge directly to the main flow channel. The informal flow path through the Hatch Court area was assumed to be a 4m wide 'V' channel generally 0.2 – 0.3m deep with low vegetation (retardance 0.035 - 0.03). Wetland storage is assumed to be as per Table 20. Assumed catchments can be seen in Table 9.

The outlet for the Scenario 1 is assumed to have no effective restriction, with flows continuing as an informal 4m wide vegetated flow channel.

- Scenario 2. The 1997 landuse option incorporates the restriction to flow generated by the driveways and culverts across the open drain, plus an increase in impervious areas due to driveways, houses, etc. It also takes into

account filling of some low areas. The main drainage line is assumed to have a flat base of 3.45m, widening to 5m by the last driveway (just upstream of the western wetland). The initial portion of the main channel is also approximately 0.45m deep with 1:3.6 sides, with a further 0.3m of depth when the channel floods to approximately 31m wide. The lower 5m wide portion is modelled with a 0.5m depth for the main channel, with 1:3 sides. The floodplain is assumed to be 25m wide within a total water depth (including the actual main channel of 0.9m wide). The channel is assumed to be vegetated (retardance 0.04 on base and 0.03 on sides). Wetland storage is assumed to be as per Table 20. Assumed catchments can be seen in Table 10.

The outlet at the edge of the subject land for the Scenario 2 is assumed to be as per the current situation surveyed (see Section 7.1.1). This includes a 375mm pipe set at RL19.02 (effective base of wetland water level in winter). Once the capacity of this pipe is exceeded, the water is assumed to fill to the top over point of RL19.4, with an effective overflow width of 5m wide. Both the pipe and weir flow discharge directly into an open drain that would have flow across cleared paddocks.

Previous advice from the Perth Airport also stated that an allowable 1% AEP flow rate of 0.041m³/s/ha was allowed for catchments feeding into their system from the subject land and relevant surrounding catchments. This rate for each of the relevant discharge points can be seen in Table 11 to 13 as a comparison to the modelled pre development rates. The total allowable discharge based on this rate, including all relevant external catchments is 2.533m³/s.

Modelling Assumptions

These 2 scenarios were modelled in DRAINS. The modelling used the following assumptions:

- Horton/ ILSAX drainage modelling method used.
- ARR 2019 methodology and rainfall figures used.
- A soil factor of 1 was applied (High infiltration) to reflect the sandy soil and recorded hydraulic conductivities.
- Antecedent Moisture Condition 3 used (12-25mm of rainfall in preceding 5 days)
- Available storage was based on the current survey and LiDAR with modifications to reflect the likely landforms at the time (from historical aerals).
- Catchments were based on survey, LiDAR and historical photographs. Due to the age and quality of the data, the historical (1997 and farmland) catchments are a best estimate and where there was uncertainty, the catchment has been aligned to current catchments. Catchments are as per Table s 9 and 10 and Figures 14 and 15.
- A retardance coefficient of 0.15 was used to reflect a ground surface of rough grass and tree vegetated areas.
- Areas of inundation were assumed to be effectively impervious. Waterlogged areas were treated as supplementary impervious areas. The areas were based on the recorded groundwater investigations and historical photographs.
- Discharge from the central drainage lines was assumed to be to an open channel of the same dimensions as the drainage channel within the subject land.
- Tail water effects were added for larger storm events (20% AEP and great) to replicate potential restriction to flows due to downstream flooding.
- The main drainage line shape is as per notes above.

The initial storms modelled were the 5min,10min,15min, 20min, 25min, 30min, 45, 1 hr, 1.5hr, 2hr, 3hr, 4.5hr, 6 h, 9hr, and 12hr. Longer events were not modelled as the events peaked at 4.5hr or less. These were modelled for the 1EY, 20% AEP, 10% AEP and 1%AEP.

Table 9 Catchment Details – Farmland conditions (1953)

Catchment	Area (ha)	Final Discharge location	Comments
Internal			
Int Pre Af	13.4055	Hatch Court drainage line / wetland chain	
Int Pre Cf	10.165	Kalamunda Rd	Contains wetland storage
Int Pre Df	2.8346	Kalamunda Rd / None	Contains wetland storage with no overtopping
Int Pre Ef	2.4412	Small wetland south of Stirling Crs	
Int Pre E2f	1.4735	Hatch Court drainage line / wetland chain	Initially drains to wetland in EXBLf south of Stirling Crs
Int Pre Ff	2.1413	Wetland south of Stirling Crs	Contains wetland storage
Existing External Roads			
Pre E4Rf	0.2835	Wetland south of Stirling Crs	Road Pipe and gutter flows assumed to be as per current situation
Pre E5Rf	0.3266	Hatch Court drainage line / wetland chain	
Pre Ex6Rf	0.1431	Hatch Court drainage line / wetland chain	
Pre Ex7Rf	0.2835	Hatch Court drainage line / wetland chain	
Pre E8Rf	0.2772	Hatch Court drainage line / wetland chain	
Pre E9Rf	1.1083	Hatch Court drainage line / wetland chain	
E10Rf	1.6534	Hatch Court drainage line / wetland chain	
External lots			
ExALf	12.5345	Hatch Court drainage line / wetland chain	Initially flows to Stirling Crs
ExBLf	6.6897	Hatch Court drainage line / wetland chain	Contains wetland storage with drain under Stirling Crs
ExCLf	3.5823	Hatch Court drainage line / wetland chain	Overland flow into site
EX DLf	2.6076	Wetland south of Stirling Crs	Overland flow into site
Ex ELf	1.2942	Wetland south of Stirling Crs	Overland flow into site
Ex FLf	0.8704	Hatch Court drainage line / wetland chain	Overland flow into site
Ex GLf	0.6669	Hatch Court drainage line / wetland chain	Overland flow into site

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Table 10 Catchment Details - 1997 Conditions (Airport required Pre date)

Catchment	Area (ha)	Final Discharge location	Comments
Internal			
Int Pre A	11.8013	Hatch Court drainage line	
Int Pre B	2.3765	Hatch Court drainage line	
Int Pre C	9.5039	Kalamunda Rd	Contains wetland storage
Int Pre D	2.1667	Kalamunda Rd / None	Contains wetland storage
Int Pre E	3.9587	Hatch Court drainage line	
Int Pre F	2.1083	Pond south of Stirling Crs	Contains wetland storage
Int Pre G Rd	0.6109	Hatch Court drainage line	
Existing External Roads			
Pre E4R	0.2835	Pond south of Stirling Crs	Road Pipe and gutter flows assumed to be as per current situation
Pre E5R	0.3266	Hatch Court drainage line	
Pre Ex6R	0.1431	Hatch Court drainage line	
Pre Ex7R	0.2835	Hatch Court drainage line	
Pre E8R	0.2772	Hatch Court drainage line	
Pre E9R	1.1083	Hatch Court drainage line	
E10R	1.6534	Hatch Court drainage line	
External lots			
ExAL	12.5345	Hatch Court drainage line	Initially flows to Stirling Crs
ExBL	6.6897	Hatch Court drainage line	Contains wetland storage
ExCL	3.5823	Hatch Court drainage line	Overland flow into site
EX DL	2.6076	Pond south of Stirling Crs	Overland flow into site
Ex EL	1.8599	Pond south of Stirling Crs	Overland flow into site
Ex FL	0.8704	Hatch Court drainage line	Overland flow into site
Ex GL	0.6669	Hatch Court drainage line	Overland flow into site

7.3 PREDEVELOPMENT DISCHARGE RESULTS

The modelling has been determined for the 2 pre development scenarios.

The results for both scenarios for the different discharge points can be seen in Tables 11 to 13. It is noted that the introduction of the driveways and associated restrictions imposed has impacted the flow through the Hatch Court Drain, especially in the larger events. This is due to the restricting pipes holding flow back, with the associated additional flood storage provided.

For the other 2 main catchment areas, there was minimal change under the 2 scenarios, with a slight increase in storage levels / discharge rates for flows directed to Kalamunda Road in the 1% AEP due to the increase in impervious areas.

The farmland conditions more closely represent discharge rates in line with the Perth Airport standardised agreed discharge rate. The Allowable rate for all contributing catchments is 2.533m³/s. The rates for each sub area can be seen in Tables 11 to 13.

7.4 SURFACE WATER QUALITY

No dedicated surface water quality readings have been undertaken for the subject land. Given the historical farmland, nurseries and residential gardens within the contributing catchment the nutrient levels are likely to be elevated. This is also supported by the raised levels found as part of the groundwater monitoring and reported in the DWMS (see Section 6.2). There is also the potential for some industrial pollutants due to more recent industrial activities.

Table 11 Hatch Court Drain Results

Event	Discharge flows		Final West Wetland results		Comments
	Peak flow (m³/s)	Critical Storm	Storage height (mRL)	Storage depth above low flow (m)	Comments
Scenario 1: Farmland conditions					
1EY	0.033	3hr	19.32	0.02	Assumes 0.1m of storage depth before discharging
20% AEP	0.06	3hr	19.33	0.03	Assumes water at tipping point at start of storm
10% AEP	0.075	3hr	19.34	0.04	Assumes water at tipping point at start of storm
1%AEP	1.17	20min	19.61	0.51	Assumes water at tipping point at start of storm
Scenario 2: 1997 Conditions					
1EY	0.076	1.5hr	19.07	0.05	
20% AEP	0.110	1.5hr	19.09	0.07	
10% AEP	0.134	3hr	19.1	0.08	Drain upstream of last driveway floods to RL19.84
1%AEP	0.741	20min	19.29	0.27	Drain upstream of last driveway floods to RL20.39. Perth Airport Allowable rate: 1.76m³/s

Table 12 Kalamunda Road Drain Results

Event	Catchment Ex DL		Catchment Ex CL		Total	Comments
	Peak flow (m³/s)	Critical Storm	Peak flow (m³/s)	Critical Storm		
Scenario 1: Farmland conditions						
1EY	0	12hr	0.005	4.5hr	0.005	No discharge due to significant storage. Cat D Peak relates to maximum storage timing
20% AEP	0	12hr	0.011	3hr	0.011	
10% AEP	0	18hr	0.015	3hr	0.017	
1%AEP	0	4.5hr	0.202	1.5hr	0.202	Low /no outflow for Catchment D is due to significant storage
Scenario 2: 1997 Conditions						
1EY	0	30min	0.003	2hr	0.003	No discharge due to significant storage. Cat D Peak relates to maximum storage timing
20% AEP	0	30min	0.012	1.5hr	0.012	
10% AEP	0	30min	0.017	45min	0.017	
1%AEP	0.002	20 min	0.389	20min	0.341	Low outflow for Catchment D is due to significant storage. Perth Airport Allowable rate: 0.492m³/s

Table 13 Southern Stirling Cres Pond Results

Event	Peak flow (m³/s)	Critical Storm	Storage height (mRL)	Comments
Scenario 1: Farmland conditions				
1EY	0	1.5hr	22.52	No discharge due to significant storage. Peak relates to maximum storage timing.
20% AEP	0	12hr	22.62	
10% AEP	0	18hr	22.66	
1%AEP	0	4.5hr	23.15	
Scenario 2: 1997 Conditions				
1EY	0	1.5hr	22.52	No discharge due to significant storage. Peak relates to maximum storage timing.
20% AEP	0	3hr	22.54	
10% AEP	0	4.5hr	22.55	
1%AEP	0	2hr	23.13	Perth Airport Allowable rate: 0.281m³/s

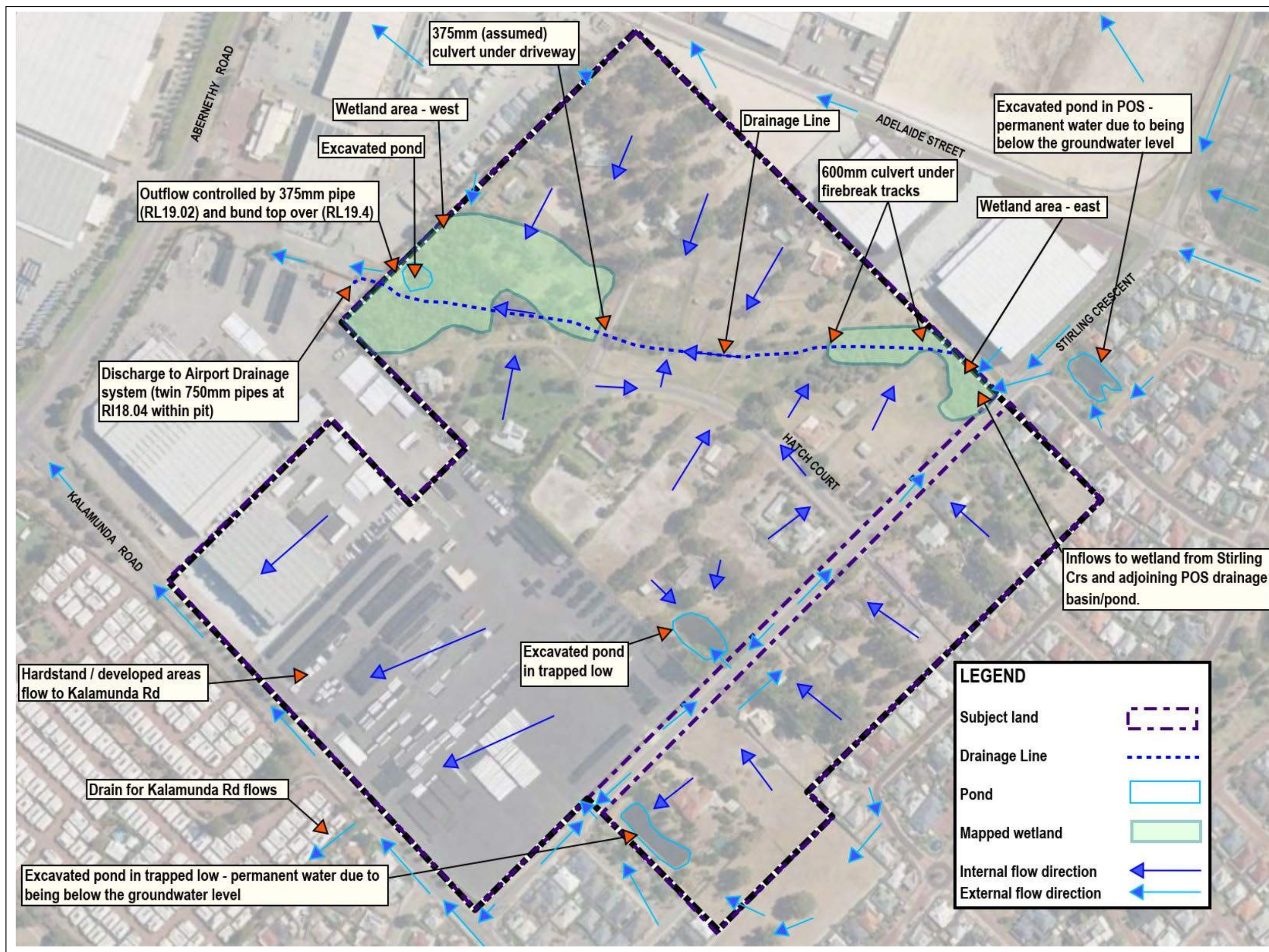


Figure 13 Predevelopment surface water characteristics – current landuse

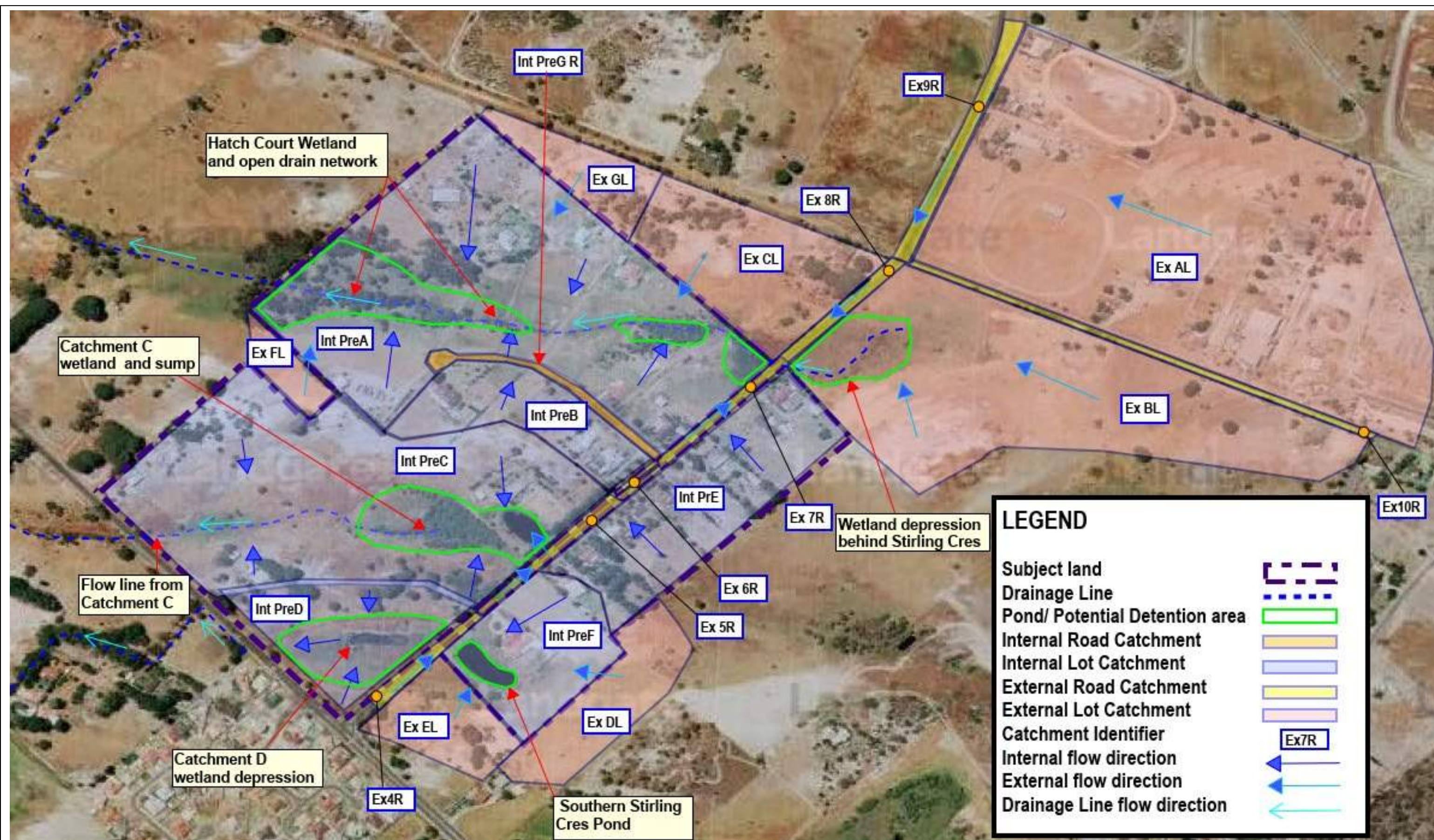


Figure 14 1997 Catchments and general surface water characteristics.

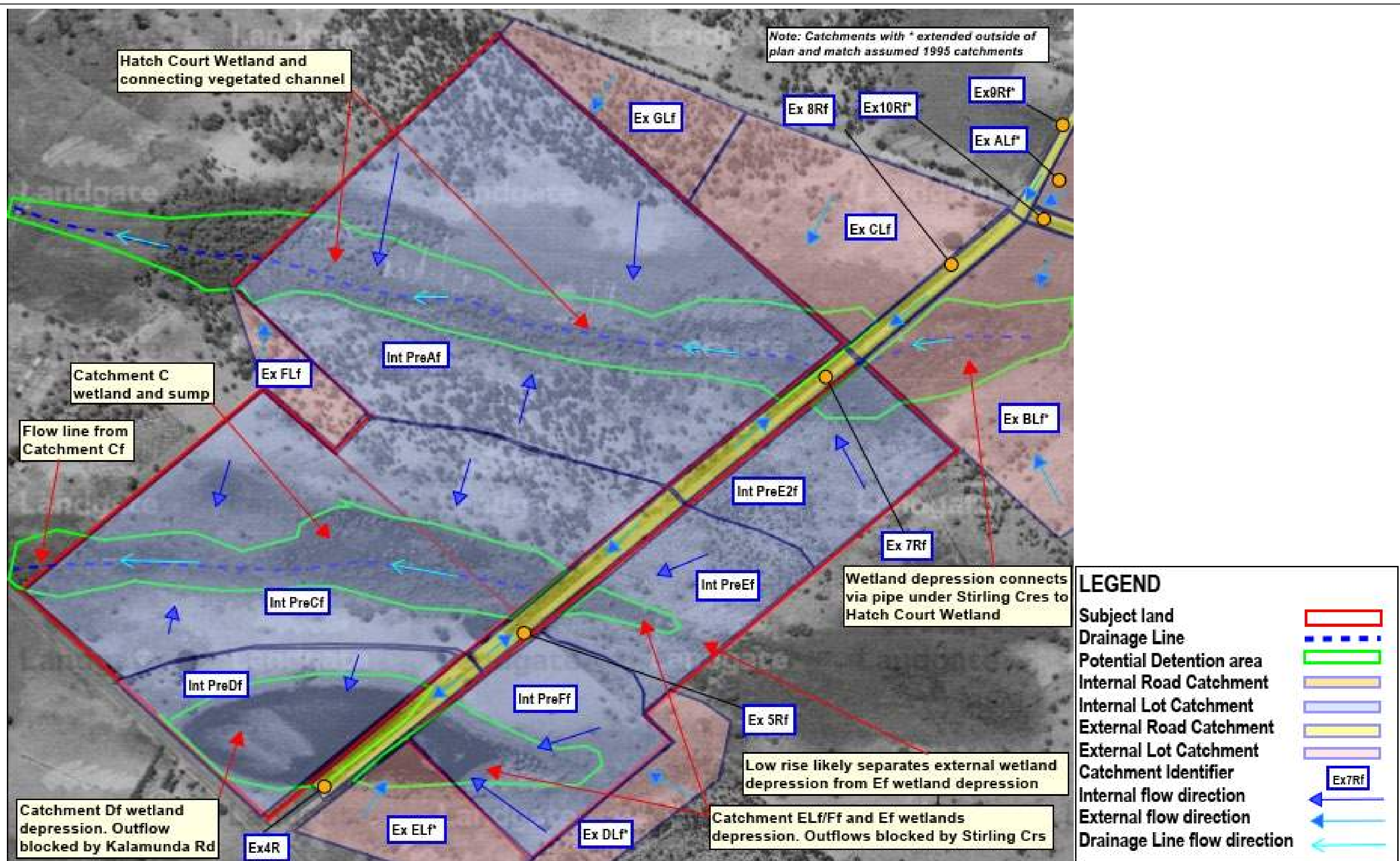


Figure 15 Historical Farmland Catchments and general surface water characteristics (1953 aerial)

8 8 DRAINAGE MANAGEMENT STRATEGY

8.1 OVERVIEW

The aim of drainage management for the site is to generally manage the water flows so that water treatment is achieved and that the major storms are controlled prior to release. As the subject land's proposed development contains both industrial and residential areas, the strategies have been designed to accommodate the particular land use within the relevant catchment. Furthermore, the proposed design accommodates the upstream flows that are likely to enter the subject land, while keeping the total discharge rates at or below the Perth Airport stormwater requirement of 0.041m³/s/ha.

The existing wetland and open drain system is also to be enhanced into an eastern and western rehabilitated wetland system and a connecting Living Stream. The Living Stream replaces the existing degraded drainage line that currently connects the 2 wetland systems. The initial eastern section of the Living Stream is to be composed of a rock lined channel, with planting pockets to direct the flow southward towards Hatch court. At this point the Living Stream will turn in a west North-westerly direction, with the systems sides reducing to a 1:6 slope, planted with native riparian vegetation. Further information can be found in Section 8.2.1

The following is a summary of how the overall system is to be designed and the outcomes of the drainage modelling is to be achieved. The referenced catchments can be seen in Appendix E, with details on each catchment outlined in Tables 14 and 15.

8.1.1 Hatch Court Industrial zone

Within all proposed industrial lots, all paved and building surface flows up to the 1EY are to be captured, treated and infiltrated. This will assist with removing potential pollutants from the stormwater as it infiltrates through the soil profile. This treatment is to preferentially be undertaken in bioretention gardens or similar for general hard ground surface stormwater runoff. The bioretention gardens are to be landscaped with vegetation suitable for stormwater management systems, including species recommended in the Vegetation guidelines for stormwater biofilters in the south-west of Western Australia (Monash 2014). Where other pollutants may be present, additional treatment systems may be required. This includes but is not limited to sediment forebays, oil separators and gross pollutant traps. Guidance on suitable systems is found in the Stormwater Management Manual for WA (DWER) and DWER's Water Quality Protection Note series. The appropriate treatment system is to be determined as part of the detailed design for each lot, with final approval being granted from the City.

Each industrial lot is to also retain and infiltrate its stormwater so that their 1% AEP flow rate is at or below the Perth Airport requirement (41L/ha/s). This equates to an approximate total storage rate including the 1EY detention of 1m³ of storage per 25m² of total lot area (assuming 90% impervious surfaces within the lot and suitable infiltration system). In doing so the entire 10% AEP is totally infiltrated.

The existing Hatch Court road reserve and the new proposed road through to Adelaide St are assumed to treat the 1EY and reduce the 10% AEP, most likely via a combination of bioretention gardens and soakwells. It is noted that significant storage provided by the proposed Living Stream means that there is not a need for a separate 10% AEP storage within the road reserve. The 1EY is treated and infiltrated in roadside bioretention gardens, to assist with water quality management, prior to the Living Stream. An indicative bioretention garden for the old and new road sections is outlined in Table 20. These are to be refined at detailed design stage.

The proposed Living Stream is designed to replace the degraded current drain, while also providing a significant ecological improvement and landscaping outcome. The Living Stream is to be aligned to swing closer to the existing Hatch Court. It will incorporate a channel as per Section 8.2.1 and Figures 17 - 19. The Living Stream is to also incorporate a buffer from the main channel line. Through the creation of the Living Stream, significant storage is created to accommodate both the internal stormwater and the feeding external catchments. The 2 RE wetlands are to be retained with 15m buffers. These also assist with enhanced ecological improvement and stormwater storage in larger events. The location of the wetlands and their buffers can be seen in Figure 16 and 19. While not specifically designed for water quality treatment of upstream stormwater inflows, the slowing down of the flows and biological processing through vegetation and associated microbial communities within the Living Stream and wetlands, will provide opportunity for treatment.

As can be seen in Figure 16 and the catchments mapping in Appendix E, while the majority of the lots surround Hatch Court are assumed to flow through to the Wetland and Living Stream network (Catchments IN1L – IN5L, IN1P – IN3P), there is a portion which is assumed to discharge through to the Southern POS pond, via Striling Cres (Catchment IN6L). This is due to the current catchments of Stirling Cres, which has the area fronting this portion falling back to the Southern POS pond.

These design strategies will manage the flow going to the Lewis Street pit and pipe network, which is the start of the Perth Airport drainage network.

8.1.2 Southern Stirling Crescent Residential zone

This zone is defined as the lots to the south of Stirling Cres between the existing Wycombe Park POS through to Benson Way. Approximately 40% of this zone is assumed to flow north east through to the Hatch Court Wetland and Living Stream network (Catchments IN9L, IN10L and IN6R). The remainder is assumed to flow south west through to the proposed Southern POS and its associated basin/pond (Catchments IN4P, IN11L - IN13L and IN7R).

For both portions, the residential lots were assumed to detain their stormwater within their own lot for the 5%AEP event. To achieve this, the lots had an assumed storage rate of 1m³ of storage for every 35m² of lot area based on the lot being conservatively 70% impervious. The new residential roads are assumed to have bioretention gardens and / or soakwells to treat the 1EY. These may be located within the road reserve and Southern POS. Kalamunda Road Industrial area

The 2 lots facing Kalamunda Road that have already been converted to industrial uses, are assumed to have been developed to the required standards (discharge rate of 0.041m³/ha/s), before discharging to Kalamunda Road. They have been modelled with an underground storage system design to achieve this. This area is covered by Catchments IN7L and IN8L.

8.1.3 Kalamunda Road Industrial area

The 2 lots facing Kalamunda Road that have already been converted to industrial uses, are assumed to have been developed to the required standards (discharge rate of 0.041m³/ha/s), before discharging to Kalamunda Road. They have been modelled with an underground storage system design to achieve this. This area is covered by Catchments IN7L and IN8L.

8.1.4 External feeding catchments

External areas were modelled either as they appear today if already developed, or as they will likely be developed. The following is a summary of the different external areas as included in the post drainage assessment.

Residential catchments discharging to the Hatch Court Wetland and Living Stream network

This area is composed of catchments E11L, E11R, E13L, E13R, E14L, E14R, E15L, E15R, E20L and E20R with the L and R referring to the lot and road portions of each zone.

All existing residential lots were conservatively assumed to detain the 20% AEP event, before discharging to the adjoining road network. The existing pit and pipe network was incorporated into the analysis, as well as overland flow paths along the road reserve. This allowed for routing of flows in excess of the pit and pipe network to the suitable location. While for most of the area, the overland flow route was the same as the pit and pipe network, for Catchment E15R, the pipe network discharges to the external landscaped lake in Jacaranda Springs Park, while the overall flow is directed through to the Fleet Circuit POS pond. From here stormwater then discharge under Striling Crescent to the east wetland of the Hatch Court Wetland and Living Stream network.

Industrial catchments discharging to the Hatch Court Wetland and Living Stream network

The area covered by Catchment E12L is assumed to be developed for future industrial uses, with water detained in line with the Perth Airport inflow requirements. The flow is assumed to discharge to Stirling Cres before flowing south to the top of the Fleet Circuit POS pond.

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Catchment E2La is a new industrial development, which detains water to City and Perth Airport guidelines then discharges directly into the Wetland and Living Stream network.

Catchment E2Lb has conservatively been assumed to discharge to the new proposed road connecting Hatch Court to Adelaide St, with the stormwater being directed to the Wetland and Living Stream network. The lot water is to be detained discharged to City and Perth Airport guidelines.

There is also a small linear area (Catchment E1B) associated with the noise bund, directly to the northwest of the subject land, within the current industrial area. It is assumed that post development that the runoff from the bund will migrate through to the depression within Lewis St and therefore contribute to the flow into the Perth Airport drainage network.

Residential catchments discharging to the Southern POS pond

There are some minor external catchments which have been assumed to discharge through to the Southern POS pond until such time as development closes the overland flow path.

Catchment E16C is predominately still paddock and in extreme events will likely discharge water to the Pond. Furthermore, when the pit and pipe network capacity in Catchment E17R is exceeded, water also enters Catchment E16C and will contribute to its overland flow to the pond. It is likely that flow from Catchment E16C will be restricted once development of Catchment I12L is complete, with this water assumed to be detained in external areas, before potentially discharging to either Kalamunda Road or the Jacaranda Springs POS.

The Wycombe Park area has also been included in the drainage assessment. Catchments E18L and E18R (lots and roads) and Catchment E19C (the associated POS with an infiltration basin) is assumed to overflow into the Southern POS Pond during extreme events. Lot storage is assumed to cater for the entire 20% AEP event. Before overtopping to the internal road. The POS basin was sized from visual inspections and aerial photos and assumed to function similar to a bioretention basin, with it effectively containing the entire 20% AEP.

Table 14 Internal catchment Summary

Major Catchment zone	Sub catchment name	Landuse	Discharges to	Area (ha)	Directly connected impervious (%)	Indirectly connected impervious (%)	Pervious (%)
Wetland/ Living Stream	Cat IN3P	Wetland and buffer	Wetland	0.8379	20	20	60
	Cat IN2P	Living Stream	Living Stream	0.636	40	15	45
	Cat IN1P	Wetland and buffer	Wetland	2.1284	25	20	55
	Cat IN1L	Industrial Lot	Lot Storage then road	2.3323	85	5	10
	Cat IN3La	Industrial Lot	Lot Storage then road	0.8482	85	5	10
	Cat IN3Lc	Industrial Lot	Lot Storage then road	0.8482	85	5	10
	Cat IN3Lb	Industrial Lot	Lot Storage then road	0.8482	85	5	10
	Cat IN2L	Industrial Lot	Lot Storage then road	1.6298	85	5	10
	Cat IN4L	Industrial Lot	Lot Storage then road	1.2916	85	5	10
	Cat IN5L	Industrial Lot	Lot Storage then road	2.7893	85	5	10
	Cat IN3R	Existing Road	Bio garden	0.7045	75	5	20
	Cat IN9La	Residential Lot	Lot Storage then road	0.5164	65	5	30
	Cat IN9Lb	Residential Lot	Lot Storage then road	0.5164	65	5	30
	Cat IN10L	Residential Lot	Lot Storage then road	0.8986	65	5	30
	Cat IN6R	New Residential Road	Bio garden	0.5036	75	5	20
	Cat IN1R	New Industrial Road	Bio garden	0.402	75	5	20
Southern POS	Cat 1N4P	POS and basin	Direct to basin	0.5027	45	15	40
	Cat IN6L	Industrial Lot		1.031	85	5	10
	Cat IN11Lb	Residential Lot	Lot Storage then road	0.5273	85	5	10
	Cat IN11La	Residential Lot	Lot Storage then road	0.5273	85	5	10
	Cat IN12L	Residential Lot	Lot Storage then road	0.9982	85	5	10
	Cat IN13L	Residential Lot	Lot Storage then road	0.5065	85	5	10
Kalamunda Road	Cat INR7	New Residential Road	Bio garden	0.5672	75	5	20
	Cat IN8L	Existing Industrial Lot	Lot Storage then road	2.0248	85	5	10
	Cat 1N7L	Existing Industrial Lot	Lot Storage then road	8.0664	85	5	10

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Table 15 External catchment Summary

Major Catchment zone	Sub catchment name	Landuse	Discharges to	Area (ha)	Directly connected impervious (%)	Indirectly connected impervious (%)	Pervious (%)
Wetland/ Living Stream	Cat E5R	Stirling Crs Road	Existing pit	0.3266	75	5	20
	Cat E20R	Residential Road	Existing pit	0.855	75	5	20
	Cat E20POS	POS and Pond	POS pond	0.2173	10	5	85
	Cat EXR	Drain and surrounds	Direct to Lewis St drain	0.1153	15	45	40
	Cat E15R	Stirling Crs Road	Existing pit	0.3211	60	10	30
	Cat E14R	Residential Road	Existing pit	0.531	75	5	20
	Cat E13R	Residential Road	Existing pit	0.7254	75	5	20
	Cat E10R	Residential Road	Existing pit	0.397	75	5	20
	Cat E8R	Stirling Crs Road	Existing pit	0.2772	75	5	20
	Cat E4R	Stirling Crs Road	Existing pit	0.2835	75	5	20
	Cat E2La	Existing Industrial Lot	Lot Storage then road	3.5823	85	5	10
	Cat E6R	Stirling Crs Road	Existing pit	0.1431	75	5	20
	Cat E7R	Stirling Crs Road	Existing pit	0.2835	75	5	20
	Cat E9R	Stirling Crs Road	Existing pit	1.1083	75	5	20
	Cat E20 L	Existing Residential Lots	Lot Storage then road	2.3045	50	10	40
	Cat E11L	Existing Residential Lots	Lot Storage then road	0.4484	50	10	40
	Cat E3L	Existing Residential Lots	Lot Storage then road	0.3296	50	10	40
	Cat E13L	Existing Residential Lots	Lot Storage then road	1.3115	50	10	40
	Cat E14L	Existing Residential Lots	Lot Storage then road	1.0127	50	10	40
	Cat E15L	Existing Residential Lots	Lot Storage then road	0.8116	50	10	40
	Cat E12L	Proposed Industrial Lot	Assumed Lot storage then road	12.5345	80	10	10
Southern POS	Cat E1B	Soil noise bund	Informal flow path to Lewis St	0.3185	0	5	95
	Cat E2Lb	Proposed Industrial Lot	Assumed Lot storage then road	0.6669	85	5	10
	Cat E16C	Farm Paddock	Informal overland flow to new road	1.2333	0	0	100
	Cat E17R	Residential Road	Existing pit	0.5636	60	10	30
	Cat E17L	Existing Residential Lots	Lot Storage then road	0.5636	50	10	40
	Cat E18L	Existing Residential Lots	Lot Storage then road	1.2688	50	10	40
	Cat E19R	Residential Road	Existing pit then current POS basin	0.34	75	5	20
	Cat E19P	Existing POS	Direct to current POS basin	0.2511	5	15	80

8.2 MODELLING AND DRAINAGE NETWORK SUMMARY

A detailed stormwater analysis was undertaken using DRAINS modelling software, that takes into account the final layout and storage requirements. The modelling assumed the following:

Lots

- The commercial/industrial developed portions were assumed to be 90% impervious.
- R25 and R30 Residential lots were assumed to be 70% impervious
- The drainage modelling assumed that the entire 10% AEP is fully retained. It also assumes that the discharge from industrial lots in the 1%AEP is suitable to meet the Perth Airport guidelines for discharge to their system. For new industrial/commercial lots, all stormwater is therefore modelled as being stored at a rate of 1m³ per 25m² of total lot area (Modelled as a 1m deep box storage with 2m/day infiltration from side and 1.6m/day from base – actual detention system to be refined for each lot at detailed design. Storage rate determined through modelling until detention met outflow requirements). Alternative storage options may be utilised, provided the discharge rate in the 1%AEP does not exceed the Perth Airport guidelines for the lot area eg 41l/s/ha.
- Existing industrial lots are assumed to detain water as per the provided design or where not available, it was assumed they captured and infiltrated the entire 10% AEP.
- Infiltration from underground systems within lots is assumed to be at 2m/day, based on geotechnical permeability from site testing.
- For new residential lots, the 5% AEP is retained detained (Approximately 1m³ per 35m² of total lot area. Storage rate determined through modelling until detention met City detention requirements).
- Existing residential lots are assumed to have a detention system capable of infiltrating the entire 20% AEP.

Roads

- Roads were assumed to be 80% impervious.
- New residential roads and assumed to initially drain to bioretention systems. Sizing for entire road catchment is modelled as per Table 22. Bio gardens are then assumed to discharge to a standard road pit and pipe network for discharge to either the Southern POS or the existing pipe network within Stirling Crs.
- Entire Hatch Court industrial roads assumed to initially drain to bioretention systems. Sizing for entire road catchment is modelled as per Table 22. Bio gardens are then assumed to discharge to a standard road pit and pipe network for discharge to the Living Stream.
- Infiltration within bioretention gardens assumed from base only at 3.6m/day (conservative bioretention media infiltration rate).

Living Stream and Wetland Network

- The Wetland and Living Stream network was included in the calculations of contributing catchment areas.
- The wetland detention areas were as mapped via LiDAR and/or site feature survey.
- The Living Stream and Wetland Network is as per Figure 17 – 19 and Tables 18 - 20, with the modelling taking into account the storage provided within the channel. Further details also outlined in Section 8.2.1. The Living Stream was modelled as a channel, while the wetland areas were modelled as basins.
- To be conservative no infiltration is assumed from the Wetland and Living Stream systems. The system was also assumed to be full to the invert of the downstream discharging control structure for each portion, due to a groundwater base flow.
- Flows within each section are controlled by outlet pipes and weirs as per Tables 19 - 20.

Stirling Crs / Southern POS Drainage area

- The Stirling Crs / Southern POS basin (for events above the 1EY) is assumed to be constructed as per Table 21.
- No infiltration assumed from base due to being at the water table, with side infiltration of 0.3m/ day assumed. The conservative side infiltration is derived from the Geotechnical investigation, with this rate below all recorded rates.

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- The modelled shape approximately matches the current open basin, noting that the final basin location can be moved and shape modified to suit the detailed design of this area. The basin will be constructed entirely within the final designated POS.

General

- Internal and External catchments are logical localised drainage areas as per the catchment layout in Appendix E. External catchments were further divided between lot areas and road areas. This is to allow for storage to be applied to lot areas. A summary of the internal and external catchments can also be seen in Tables 14 and 15.
- Existing external detention systems were included.
- The existing road reserve pit and pipe network was included where data was available, with some simplification within external catchments.
- The configuration of the Perth Airport pipe network inlet was included as twin 750mm pipes, with its associated large pit (based on site survey data).
- Soil factor 1 was used for pervious areas to reflect the likely fill sand infiltration rate (both fill sand and insitu sand).
- The final storms modelled were the 5min,10min,15min, 20min, 25min, 30min, 45min, 1 hr, 1.5hr 2hr, 3hr, 4.5hr, 6hr, 9hr, 12hr 18hr and 24hr. Longer events were not modelled in the final runs as the peak events were all 12hours or less.
- These were modelled for the 1EY, 20% AEP, 10%AEP and 1%AEP, storm events.

8.2.1 Wetland and Living Stream Network

The following is a summary of the Wetland and Living Stream Network at a concept level. The parameters outlined were used to model how stormwater would flow and be stored within this system. Further details are also outlined in Figures 17-19 as well as Tables 16 to 18. The proposed design builds on the current situation where the wetlands and open drain both transport flows through the subject land as well as provide considerable storage and water treatment. The two RE wetlands are to be retained with 15m buffers. The ground surface within the wetland will remain in a similar manner, with weed control and revegetation of the wetland and likely buffer areas.

The degraded open drain is to be partially rerouted to allow for a more efficient overall layout as well as providing a better opportunity to create a drainage line for stormwater management and ecological improvement. By bringing the Living Stream south, the proposed industrial land area to the north is maximised. It also allows for effectively unusable land currently between Hatch Cort and the existing drain to be used for flood storage, stormwater conveyance and ecological enhancement. Earth working the new Living Stream will provide a new weed free channel that can be planted out with riparian species while still allowing flows to move through.

There are 2 main channel types within the Living Stream, with the first section being a rock lined channel, with planting pockets for riparian species. The second portion incorporates a channel 1:6 batters, with flatter slopes above this. Both are to be planted with native riparian vegetation. The actual shape of the channel can be modified as part of detailed design, with the current design allowing for their storage to be included within the drainage modelling. Modifications as part of detailed design may include introducing some minor meanders (current buffer width allows for a approx. 2m swing), rock boulders, pools and riffles. The planting of the channel and buffer will also provide an increase in the riparian vegetation present within the subject land. The channel also provides significant storage for stormwater generated during the 1% AEP, both from within the subject land and from upstream catchments.

To control flows through the network, a series of pipes and bunds/road crossings have been included. The 2 pipes associated with the East Wetland, replicate the current pipes and firebreak track crossings. These may be formalised to include a rocked weir to accommodate the overflow. The pipe at the end of the Living Stream is located in approximately the same location as the final current driveway crossing, which is just upstream of the final Western Wetland. The exact size of this current pipe under the driveway crossing is unknown (as encased in dense weed covering) but is likely to be a 375mm. This is to be upgraded to a 600mm pipe to match the upstream pipes, which will assist with minimising the risk of flooding over the top of the new proposed road.

The final modelled pipe out from the West Wetland is a 375mm, laid at the same invert as the current pipe (RL19.02). Once the capacity of this pipe is exceeded, the water is assumed to fill to the top over point of RL19.7, with an effective overflow width of 5m wide. Both the pipe and weir flow discharge directly into an open drain within the Lewis St road reserve, which contains a wide drain, with an effective base of RL 19.08 (this being the level of the pit into which water leaves this drain). Here the flow is captured by the Perth Airport Drainage network with water discharging into twin 750mm drainage pipes (invert RL 18.04). These pipes are set within a box chamber of approximately 4.5m², with a grate over the top (invert RL19.08).

In combination with the bund and weir plus the significant storage area of the current wetland, this detains flows back to rates similar to pre development flows and in keeping with the Perth Airport requirements for the peak 1% AEP flow rate. Further details can be seen in Table 20.

The Eastern lot access crossing alignments (for Lots 11 and 12) will be effectively retained across the Living Stream, noting that the modelling has assumed twin 600mm pipes, so they have minimal effect on water detention (in case the crossing is ultimately not installed). Should future detailed design of these lots allow for access to the northwest and onto the proposed Hatch Court extension, then these cross-overs will be removed/not installed (depending on timing).

The current western cross-over that services Lots 13-15 will effectively be replaced by the proposed extension to the Hatch Court road reserve.

As part of modifying the existing flow path, the new channel is to be fully constructed and stabilised before the existing flow path is removed. The existing flow path will have all organic material removed, then backfilled with suitable free draining soil material. This work should be undertaken after the seasonal base flow has ceased, where possible and outside of the June to October winter flow period. This is to minimise potential flooding or scouring issues. Compared to the current pre development situation, the base of the vegetated section Living Stream will generally be narrower (1.4m vs 5m) but the side are flatter (1:6 vs 1:3), and the depth has increased from 0.5m to 0.6m. In the Rock lined portion, the width has decreased from 3.45m to 2.4m, while the depth has increased from 0.45m to 1.1m. The side slopes are similar to the pre development scenario.

Piping was reviewed as an option to connect the 2 wetlands. This was ultimately not chosen due to:

- Would still need to provide an easement for 1%AEP flooding, if pipe blocked, effectively minimising the useability of the land within the easement
- Reduces the overall environmental outcome compared to the current situation and significantly reduces the environmental outcome compared to the proposed Living Stream.
- Would likely result in increased flood levels upstream of the piped section and a need for additional flood storage within other portions of the subject land to counter the storage provided within the proposed Living Stream.

Table 16 Living Stream design parameters – cross section: Rock lined

Main Channel			
Base width (m)	Depth (m)	Top Width (m)	Side slope
2.4	1.1m	9	1 in 3

Note: Depth of actual channel in upper portions may be lowered as part of detailed design
No Infiltration from sides or base assumed

Table 17 Living Stream design parameters – cross section: Vegetated sloped

Main Channel				Flood Channel		
Base width (m)	Depth (m)	Top Width (m)	Side slope	Depth (m)	Top Width (m)	Side slope
1.4	0.6m	8.6	1 in 6	0.2m	12.6m approx.	1:10

Note: Actual shape may vary along length to accommodate final development layout and detailed design items. Allowance for approximately 2m meander width within overall Living Stream easement.
No Infiltration from sides or base assumed

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Table 18 Living Stream design parameters – long section: Rock lined

Longitudinal Length (m)	Upstream invert (mRL)	Downstream invert (mRL)	Discharges to:
91.9	20	19.55	1:6 sloped vegetated Living Stream

Table 19 Living Stream design parameters – long section: Vegetated Slope

Sub Section	Longitudinal Length (m)	Upstream invert (mRL)	Downstream invert (mRL)	Discharging pipe size (mm)	Pipe overtopping height (RL / m from base)	Comments
VS 1	41.9	19.55	19.45	Twin 600	20.65 / 1.2	Discharges through crossing to lots 11 & 12
VS 2 & 3	101	19.43	19.3	600	20.6 / 1.3	Inflow from Hatch Crt road at Chainage 29.1

Table 20 Hatch Court wetland details – for modelling

Wetland	Effective base *		Discharge pipe size (mm)**	Weir overtopping height (mRL) / width (m)	Area of inundation at overtopping (m²)	Comments
	Height (RL)	Area (m²)				
East	20.77	10	600	21.5 / 5	2520	East wetland area assumed to be partially split into 2 sections by pipe, as per current conditions. No infiltration assumed.
East - Mid	20.07	30	600	20.8 / 3	1450	
West	19.02	10	375	19.7 / 5	3790	No infiltration assumed.

* Effective base is taken as the height of the outlet invert. Likely to be some water below this level due to groundwater.

**Pipe invert is assumed to be at RL of Effective base

Table 21 Southern POS basin

Basin Level	RI (m)	Length (m)	Width (m)	Area (m²)	Total Depth (m)	Total Volume (m³)	Slope
Assumed base	22.5	72	22.5	1620	NA	NA	NA
Assumed top	23.5	84	34.5	2898	1	2228.2	1:6 from RL 22.5

Note: RL is assumed based on LIDAR but basin not well represented. Base is assumed to be maximum groundwater level
No Infiltration from base and 0.3m/day from sides assumed

Table 22 Road runoff Bioretention garden details

Biogarden	Catchment	Base area (m²)	Depth to overflow pit (m)	Volume to outlet pit (m³)	Depth to top (m)	Volume to top over (m³)
Residential south	IN7R	113.44	0.3	34.032	0.4	45.376
Residential north	IN6R	100.72	0.3	30.216	0.4	40.288
Existing Hatch Crt Rd	IN3R	122.18	0.5	61.09	0.6	73.308
New Hatch Crt extension	IN1R	80.68	0.3	24.204	0.4	32.272

Note: No Infiltration from sides and 3.6m/day from base assumed

8.3 EASEMENTS AND RESERVES FOR FUTURE DRAINAGE MANAGEMENT

It is proposed that the future flow channel and storage areas associated with the Hatch Court industrial area development are protected under drainage easements. The easement areas are to include the full width of the Living Stream and the entire Resource Enhancement wetland areas as well as the associated buffers. The indicative easement boundary can be seen in Figure 16.

The current drainage easement across Lots 10 – 14, 52 and 53 Hatch Court is to remain in place until the new drainage easements are in place as well as the appropriate flow channel being fully constructed.

The drainage basin associated with the Stirling Crs residential area will be contained within the proposed POS reserve. The basin could potentially be located within the footprint of the current pond, or an alternative location within the POS. As a temporary measure, the pond could also be used for drainage under an easement, until such time as a suitable land area for a POS/Drainage Reserve is acquired by the City.

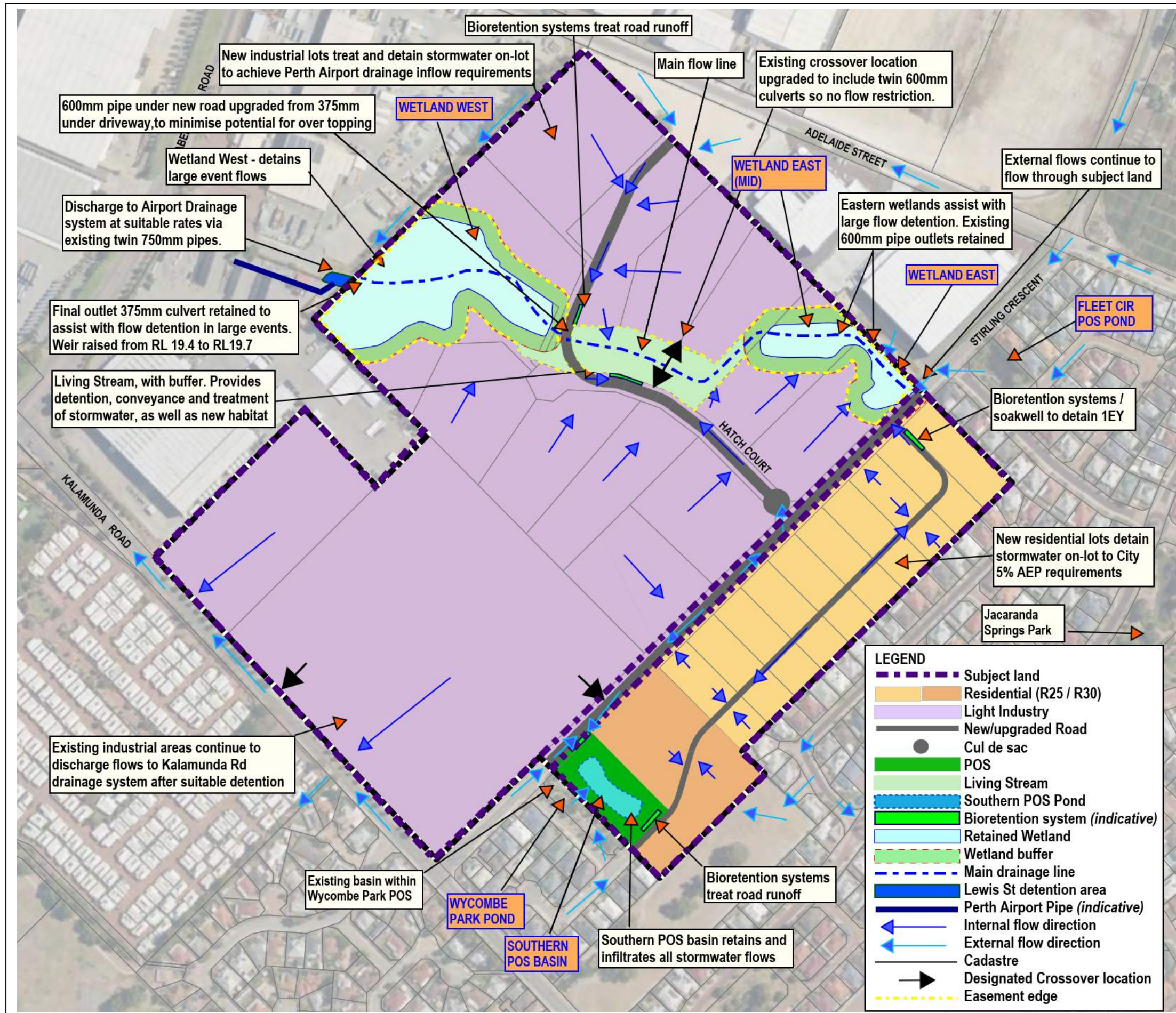


Figure 16 .Post development drainage characteristics – subject land

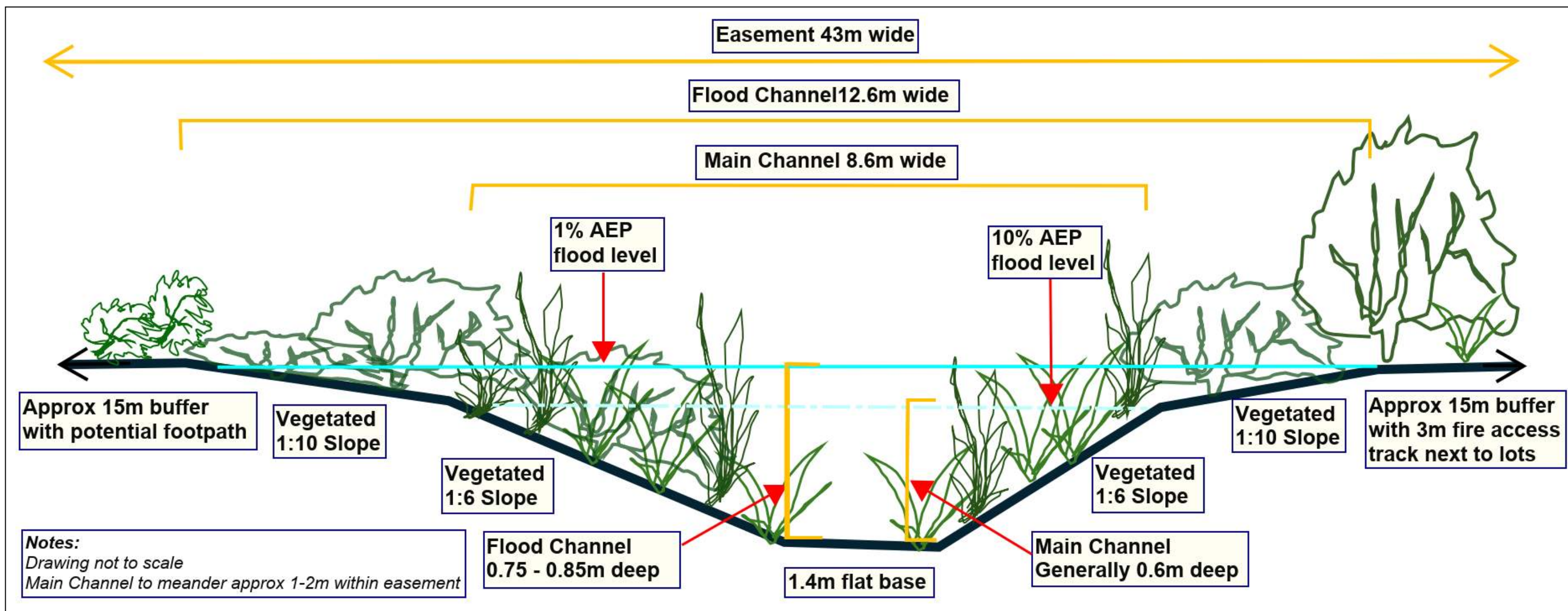


Figure 17 Living Stream cross section concept - Sloped vegetated portion

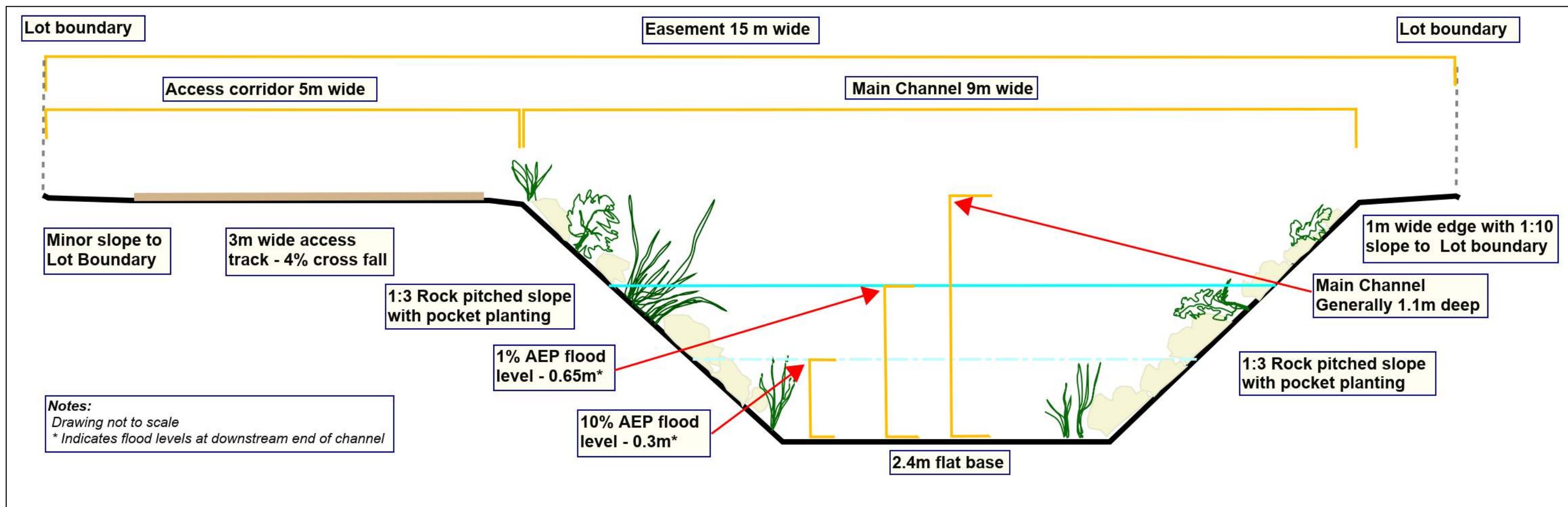


Figure 18 Living Stream cross section concept – Rock pitched portion

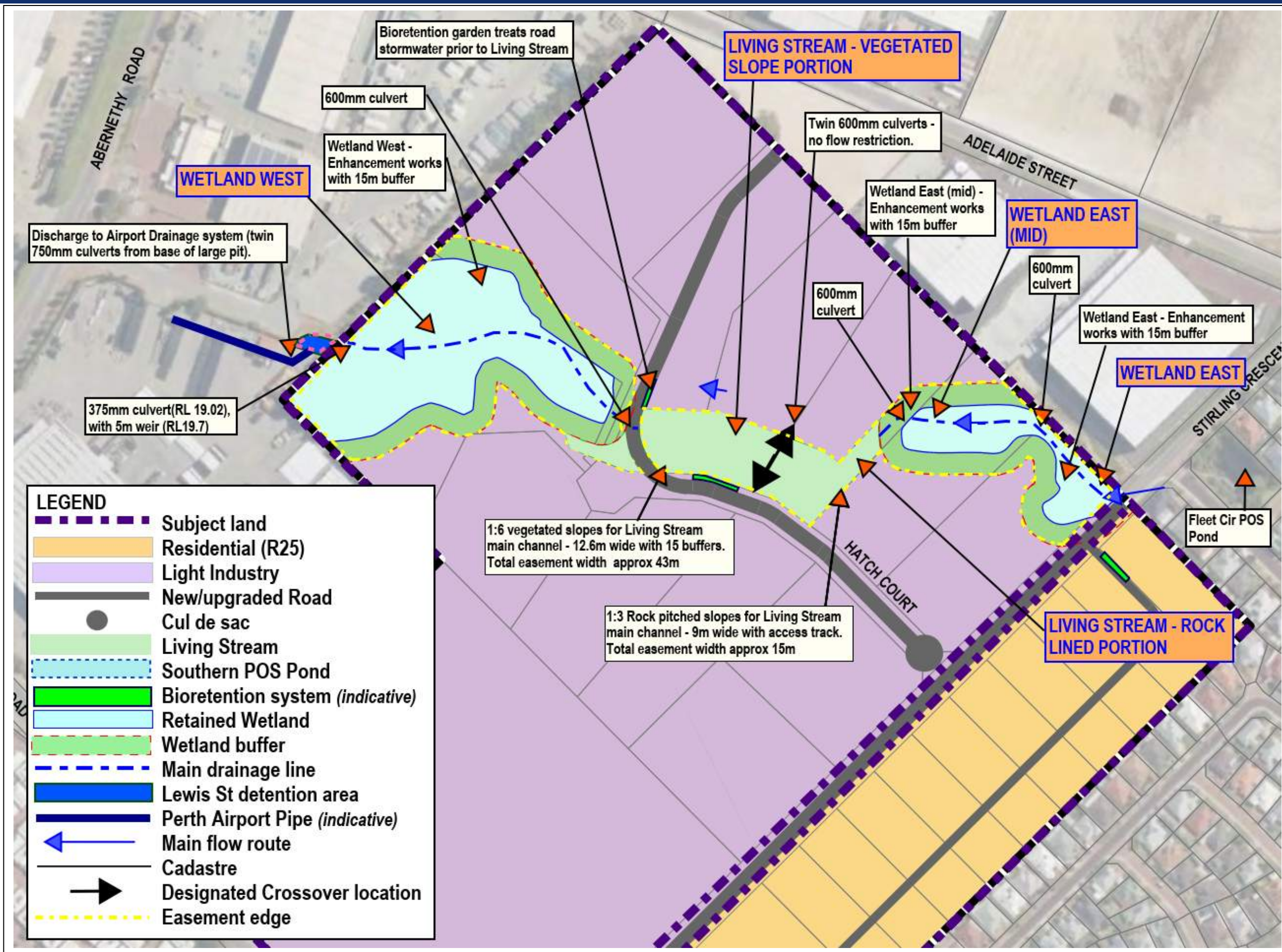


Figure 19 Wetland and Living Stream layout

8.4 1EY/SMALL STORM EVENT AND WATER QUALITY

The drainage management system for the subject land has been designed to capture and provide treatment up to the 1 Exceedance per year event (1EY), which effectively captures approximately 95% of all stormwater flow. The designs will also provide protection of the ecological functions for all receiving natural environments post development.

All stormwater generated within the lot during a 1EY event is to be treated and infiltrated (see Section 8.1.1). Roadside and /or POS bioretention systems that can infiltrate the entire 1EY event for the industrial area are also encouraged, with indicative locations noted on Figure 16. For the residential areas, the road runoff will be treated in bioretention gardens for flows heading towards the Stirling St POS. Flows directed to the Living Stream and Wetland network may discharge into bioretention gardens where possible. Where this cannot be achieved, roadside soakwells or similar are to be utilised to infiltrate the majority of the 1EY.

The Wetland and Living Stream network will provide additional treatment for flows generated from upstream areas. This is achieved through the planting of the network with suitable native riparian species. Further details on this can be seen in Section 8.1.1 and 8.2.1.

The surface discharge from the subject land in the 1EY/Small event is limited to the flow into the Lewis Street Pipe network, with much of this water coming from external upstream catchment areas. During periods of seasonal high groundwater, there is also likely to be a trickle outflow due to discharging groundwater, generated by the internal and external stormwater infiltration. The 1EY post development discharge rates can be seen in Table 23 - 27 with a comparison to the pre development outline in Table 28 and 29.

8.5 20% AEP / MINOR DRAINAGE MANAGEMENT PLAN

Due to the significant on-lot storage as outlined in the City's guidelines of full 5%AEP retention, there is limited discharge in the 20% AEP from the actual subject land. The generated flows are primarily due to upstream road flows and the residential road flows. The results for the 20% AEP can be seen in Table 21 - 25 with a comparison to the pre development outline in Table 28 and 29.

There is no overtopping of the Southern POS Pond and the flows within the Wetland and Living Stream network are all contained within the main channel and main wetland areas.

8.6 10% AEP / MINOR DRAINAGE MANAGEMENT PLAN

Due to the significant on-lot storage to achieve the 1% AEP discharge rates for the discharge to the Perth Airport network (eg1m³ of storage per 25m² of surface area), there is limited discharge in the 10% AEP from the actual subject land. The generated flows are primarily due to upstream road flows and the minor road flows, alongside the overtopping of external residential lot storage. The results for the 10% AEP can be seen in Table 23 - 27 with a comparison to the pre development outline in Table 28 and 29. There is also no overtopping of the Southern POS Pond and the flows within the Wetland and Living Stream network are all contained within the main channel and main wetland areas.

8.7 1% AEP / MAJOR DRAINAGE MANAGEMENT PLAN

The Subject area has been designed to safely manage the 1%AEP flood event so that impacts on the subject land, downstream infrastructure and the environment are minimised while maintaining people's safety.

The Wetland and Living Stream network will work in conjunction with the other onsite infiltration systems to detain flows throughout the development. This results in management of the final flow rates leaving the subject land to below pre development rates and below the Perth Airports requirement of 1.76m³/s. The flows to the Southern POS Pond also match the pre development situation, with no discharge.

The discharge to Kalamunda Rd exceeds the pre development flow, based on the available information and corresponding assumptions. There may potentially be additional detention within these developed lots over and above what has been assumed in the drainage modelling. The City may wish to review the drainage design for these already established lots to determine the final detention and if the actual discharge is suitable to the Kalamunda Road drainage system. It is noted however that the total discharge from the entire subject land is still below the total pre development peak flow rate and the requirements of the Perth Airport.

The post development discharge for each area can be seen in Tables 17 – 19, while the comparisons to pre development can be seen in Table 20.

The peak flood levels along the Wetland and Living Stream Network can be seen in Table 23 - 25 and Figure 20. These have been extracted from long sections of the DRAINS modelled channels and basin depths. All finished floor levels should be a minimum of 500mm above the level adjoining each lot. The flow rate and flood hazard analysis can be seen in Table 30. All flood waters are held within the Living Stream easement and the assumed wetland /wetland buffer areas. As such there is no modelled overtopping of the new road, assuming the pipe network is not blocked.

The discharge at the end of the Wetland and Living Stream Network in the 1% AEP is predominately via weir overflow.

The indicative flood level for the Southern POS Pond can be seen in Table 27 and Figure 20. All relevant buildings around the Southern POS pond should also be a minimum of 500mm, given it is a trapped low. These flood depths are taken from the modelled basins within the DRAINS model peak event.

Table 23 Post development drainage summary – Wetland and Living Stream network discharge to Lewis St

Event	Peak outflow pipe / weir (m ³ /s)	Peak flow total (m ³ /s)	Critical Storm	Comments
1EY	0.129 / 0	0.129	1hr	Outflow due to pipe discharge
20% AEP	0.176 / 0	0.190	1.5hr	Outflow predominately due to pipe discharge
10% AEP	0.191 / 0	0.191	1.5hr	Outflow predominately due to pipe discharge
1%AEP	0.212 / 0.398	0.61	6hr	Outflow due to pipe and weir discharge

Table 24 Post development drainage summary –Living Stream details

Event	Living Stream - vegetated 1:6 portion		Join point between rock and vegetated portions	Living Stream - rock lined portion		Total volume (m ³)
	Downstream water level (mRL/ m from base)	Volume (m ³)*	Water level (mRL / m from base)	Upstream water level (mRL / m from base)	Volume (m ³)*	
1EY	19.66 / 0.36	358	19.76 / 0.23	20.12 / 0.12	46	404
20% AEP	19.74 / 0.44	940	19.82 / 0.27	20.14 / 0.14	74	1014
10% AEP	19.78 / 0.53	1179	19.84 / 0.29	20.15 / 0.15	92	1271
1%AEP	20.13 / 0.83	3244	20.20 / 0.65	20.28 / 0.28	423	3667

Note: * Volumes based on averaged depths within Living Stream Channel

Table 25 Post development drainage summary – Wetland details

Event	West Wetland		East Mid Wetland*		East Wetland		Total Volume (m ³)
	Water level (mRL)	Volume (m ³)	Water level (mRL)	Volume (m ³)	Water level (mRL)	Volume (m ³)	
1EY	19.41	80	20.43	32	21.13	182	294
20% AEP	19.57	216	20.5	42	21.2	263	521
10% AEP	19.64	327	20.53	47	21.23	301	675
1%AEP	19.83	970	20.87	293	21.54	931	2194

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Table 26 Post development drainage summary – Kalamunda Road (assumed)

Event	IN7L Peak flow (m³/s)	Critical Storm	IN8LPeak flow (m³/s)	Critical Storm	Total Peak flow (m³/s)	Comments
1EY	0		0		0	All flows infiltrated within lots
20% AEP	0		0		0	All flows infiltrated within lots
10% AEP	0.007	6hr	0	NA	0.007	Minor flow out in 6hr event, after main Kalamunda Rd flows past.
1%AEP	0.564	1.5hr	0.087	2 +hr	0.651	Direct overflow from lots

Note: Based on assumed standard industrial lot detention

Table 27 Post development drainage summary – Southern POS Pond

Event	Peak inflow (m³/s)	Peak outflow (m³/s)	Critical Storm	Water level (mRL)	Water level from base (m)	Volume (m³)*	Comments
1EY	0.032	0	3hr	22.54	0.04	63	Assumes groundwater at RL 22.5 if using current pond.
20% AEP	0.076	0	3hr	22.6	0.1	165	
10% AEP	0.097	0	4.5hr	22.64	0.15	240	
1%AEP	0.563	0	9hr	23.5	1	2217	Assumes groundwater already at RL 22.8 in 1% AEP event (eg wet year)

Table 28 Comparison of pre and post development flow rate – entire catchment

Location	Event (m³/s)												Allowable Perth Airport discharge (m³/s)
	1EY			20% AEP			10% AEP			1% AEP			
	Pre 1997	Pre Farm	Post	Pre 1997	Pre Farm	Post	Pre 1997	Pre Farm	Post	Pre 1997	Pre Farm	Post	
Lewis St (Hatch Court Drain)	0.085	0.033	0.129	0.127	0.06	0.176	0.149	0.075	0.191	0.564	1.71	0.61	1.76
Kalamunda Rd	0.01	0.005	0	0.024	0.011	0	0.035	0.017	0.007	0.341	0.202	0.651	0.492
Southern POS Pond	0	0	0	0	0	0	0	0	0	0	0	0	0.281
Total	0.095	0.038	0.129	0.151	0.071	0.176	0.184	0.092	0.198	0.905	1.912	1.261	2.533

Note: Flow increase in 20% and 10% AEP is primarily due to external catchment modifications. See Table 29 for change within actually within subject land.

Table 29 Comparison of pre 1997 and post development flow rate – generated within subject land

Precinct	1EY Peak flow (m3/s)		20% AEP Peak flow (m3/s)		10% AEP Peak flow (m3/s)		1% AEP Peak flow (m3/s)	
	Pre 1997	Post	Pre 1997	Post	Pre 1997	Post	Pre 1997	Post
Residential	0.02	0.033	0.037	0.072	0.056	0.091	0.453	0.151
Industrial	0.067	0.022	0.151	0.095	0.202	0.148	1.965	0.212
Total	0.087	0.055	0.188	0.167	0.258	0.239	2.418	0.363

Note: Analysis if for areas discharging to The Living Stream and Wetland network.

Excludes flows to Stirling St Pond, as no discharge generated in any scenarios.

Excludes flows to Kalamunda Rd, as area already developed.

8.8 FLOOD HAZARD

A flood hazard analysis was undertaken for the road system and for the Wetland and Living Stream Network. As all road flow depths are generally 0.3m or lower, the road flood risks are considered to generally be within the H1 category (*generally safe for people, vehicles and buildings*) as detailed in the ARR 2019 Rainfall and Runoff guidelines. This includes the likely tip over point from the external catchments across Stirling Crs into the Eastern Wetland. As part of detailed design more detailed 2D flood modelling may be required to check this, while noting that the flood risk posed is primarily due to flows generated outside of the subject land.

An analysis of the flood risk for Wetland and Living Stream network showed that the highest risks are generally in the H3 category (*Unsafe for vehicles, children and elderly*) Given this is an industrial area and is not being used for pedestrian or vehicle movement, this risk is considered to be acceptable for the location. Further details can be seen in Table 30. Assuming no blockage of the culverts under the new road, there is no overtopping of this road. As such there is no flood hazard risk at the road point as it crosses the Living Stream.

Table 30 Flood Hazard Analysis for Wetland and Living Stream

Section	Maximum Depth (m)	Maximum Velocity (m/s)	Flood Hazard Rating	Comments
Living Stream 1 Rock lined	0.65	0.63	H3	1:3 rock lined slope with pocket plants
Living Stream 2 - Vegetated	0.74	0.19	H3	1:6 soil slopes with dense planting
Living Stream 3 -Vegetated	0.74	0.15	H3	
Living Stream 4 - Vegetated	0.83	0.14	H3	
Western Wetland	0.83	0.5	H3	Assumed maximum average flow rate near entry and exit points. Depth does not include any potential current excavations, which are assumed to be removed)
Mid Eastern Wetland	0.86	0.5	H3	
Eastern Wetland	0.84	0.5	H3	

8.9 OUTLET SYSTEM STRATEGY AND COMPARISON

To assist with review of future designs for the Wetland and Living Stream outlet the following provides a summary of both the existing system and proposed modifications.

8.9.1 Existing Outlet Situation

At the downstream edge of the subject land, the outflow is controlled by a 375mm pipe set at RL19.02 (also taken as the effective base of wetland water level in winter). Once the capacity of this pipe is exceeded, the water is assumed to fill to the top over point of RL19.4, with an effective overflow width of 5m wide. Both the pipe and weir flow discharge directly into an open drain within the Lewis St road reserve, which contains a wide drain, with an effective base of RL 19.08 (eg level of the discharging pit). Here the flow is captured by the Perth Airport Drainage network with water discharging into twin 750mm drainage pipes (invert RL 18.04). These pipes are set within a grated 4.5m² box chamber (invert RL19.08).

8.9.2 Proposed Outlet System

The final modelled pipe out from the West Wetland is to be kept as a 375mm, laid at the same invert as the current pipe (RL19.02). Once the capacity of this pipe is exceeded, the water is assumed to fill to the top over point of RL19.7, with a 5m wide rock pitch weir to control the outflow. Both the pipe and weir flow discharge directly are to discharge into the existing open drain within the Lewis St road reserve. Here the flow will continue to discharge into the Perth Airport Drainage network via the existing twin 750mm drainage pipes (invert RL 18.04), which are contained within the existing 4.5m² pit(invert RL19.08). The outlet information is summarised in Table 31.

Table 31 Wetland and Living Stream Outlet system comparison

Scenario	Pipe size (mm)	Invert (RLm)	Weir height (RLm)	Weir width (m)
Current	375	19.02	19.4	5
Proposed	375	19.02	19.7	5

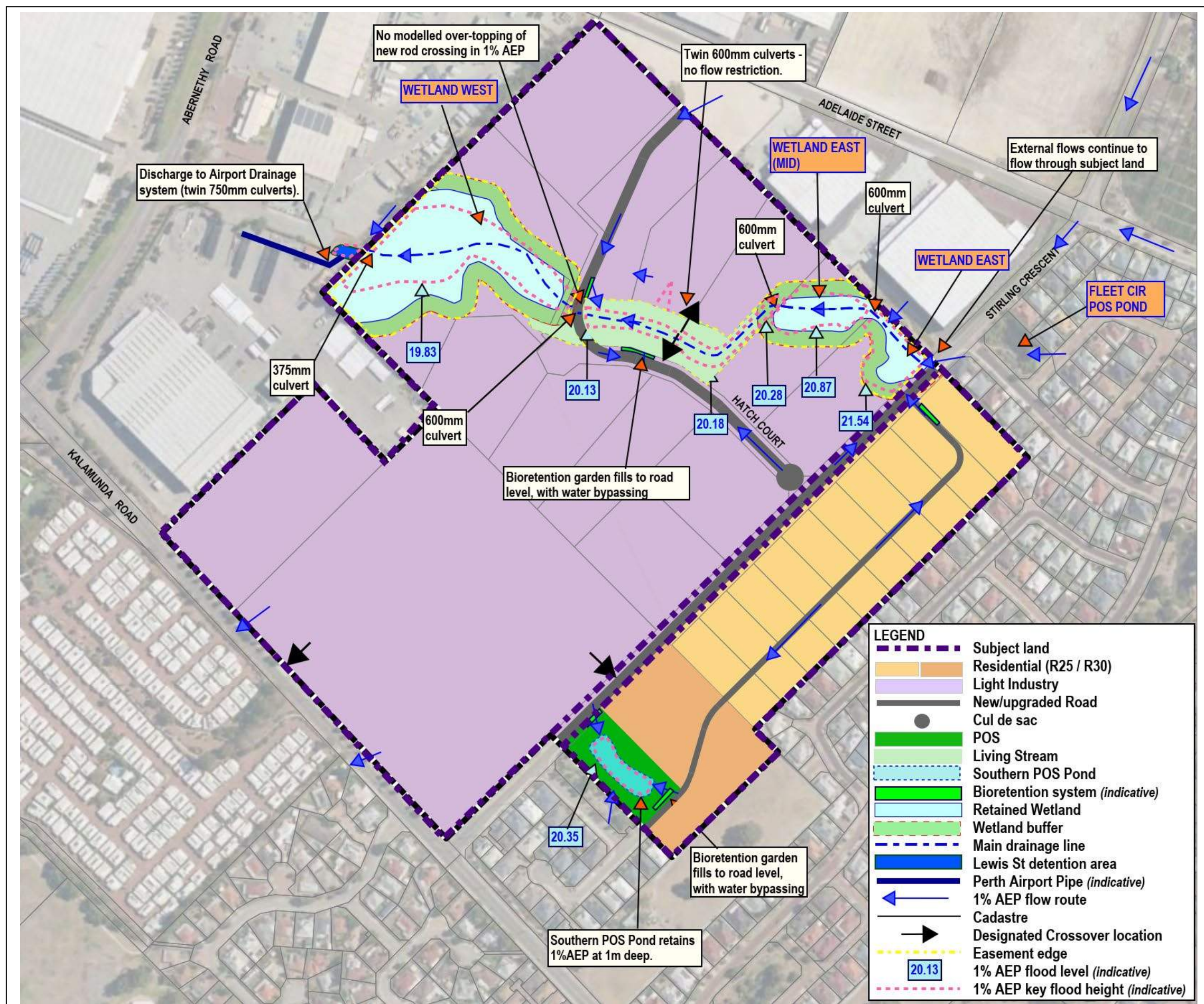


Figure 20 1% AEP flood plan

9 GROUNDWATER MANAGEMENT STRATEGY

The focus of groundwater management for the subject land is to control groundwater to the existing groundwater levels. Groundwater will also be managed to achieve a suitable water quality, via treatment of water entering the groundwater. Furthermore, groundwater discharging into the Wetland and Living Stream network will receive additional treatment prior to flowing out of the subject land. The following provides further details on the management of groundwater.

9.1 INFRASTRUCTURE SEPARATION

A vertical separation between significant infrastructure and the Controlled Groundwater Level (CGL) is to be implemented. In general, a separation of 1.5m from the CGL to the finished lot surface should be achieved. This separation will be achieved through:

- the importation of clean sand fill that allows for infiltrating stormwater to be dispersed into the fill layer
- locating subsoil pipes near infiltration devices to reduce localised mounding from stormwater infiltration
- additional subsoil networks to reduce groundwater mounding along roads and industrial lots within areas of potentially high groundwater\
- providing free draining outlets for the subsoil pipes to the Wetland and Living Stream network
- maintaining a minimum of 0.3m from the base of any infiltration device to groundwater

As part of the detailed design for each area, the groundwater levels should be reviewed so that the final fill levels and subsoil pipes levels are appropriately set. These levels, and the associated design to achieve the above criteria are to be included as part of detailed design submissions.

9.2 QUALITY MANAGEMENT

Industrial lot water will be directed to the lot-based infiltration systems, with bioretention systems preferentially to be used. Bioretention systems within the road network will also filter stormwater runoff. The infiltration of water through the bioretention systems, lot drainage systems and soil profile will remove all coarse sediments and litter as well as minimising nutrients and other contaminants from entering the groundwater.

Street sweeping is also to be used to remove potential pollutants from the paved surfaces before they are washed through to the infiltrating structures.

Groundwater discharged to the Wetland and Living Stream network will receive treatment as it slowly flows through the vegetation and its associated biofilms. This provides additional groundwater treatment prior to it flowing off the subject land as surface flow.

Lot purchasers are to also be provided with information on management of their on-lot groundwater and stormwater system so that the risk of potential contaminants being added to these systems is reduced.

To minimise nutrient migration to the groundwater or stormwater network, the landscaping is to implement nutrient wise practices. This includes:

- soil amelioration with material to hold nutrients within the soil profile,
- use of predominately native plants that are able to grow well with minimal fertiliser and additional watering,
- use of slow-release nutrients suitable to sandy soils, with minimal amounts used to assist with early establishment,
- irrigation control that doesn't result in surface water runoff or excess leaching of water into the groundwater and removal of excess plant material from the site, with its subsequent effect of removing nutrients from the system.

As part of any significant excavations, suitable detailed acid sulphate soil testing and remediation works are also to be undertaken. This is to be in line with geotechnical assessment recommendations for the specific area being developed and will likely include minimisation of disturbance of acidic potential acidic soils as well as liming of trenches and materials as required.

10 WATER DEPENDENT ECOSYSTEMS MANAGEMENT STRATEGY

The focus for water management in relation to water dependent ecosystems (WDE) is threefold:

- to manage the water quality and flow rates so that off site, down gradient (groundwater) and downstream (surface water) ecosystems are protected
- enhance and protect the on-site wetlands
- create new WDE within the subject land

The following is a summary of how each is to be managed.

10.1 OFF-SITE WDE

While there is little in the way of high-quality water dependent ecosystems (WDE) directly adjacent to or within 200m of the subject land, the water quality and flow management strategies outlined in Sections 8 and 9, will assist with protecting downstream/down gradient WDE. These strategies will reduce the potential contaminants entering these WDE and control flows so that the WDE's hydro regime remains similar to its current characteristics.

Furthermore, the enhancement of the WDEs within the subject land will provide additional habitat for fauna that already existing in the surrounding WDE. This is outline further below.

10.2 EXISTING WDE ENHANCEMENT

The onsite existing WDE's are generally degraded. As such there is limited ecological functioning within these systems. To improve this the following works are proposed:

- Retention of the mapped RE wetland
- Inclusion of 15m buffers around the RE wetlands
- Removal of major weeds from the wetland and buffers
- Revegetation with appropriate riparian flora within the wetland and buffers
- Retaining similar hydro regimes to the wetlands
- Treatment of stormwater quality prior to entering the wetlands.

The retained wetlands and buffers can be seen in Figure 19. As part of the detailed design process, a Wetland Management Plan should be produced based on the above items as well as considering the final layout and landuses of the development. Further details can also be found in the Environmental Assessment Report (See Appendix F).

10.3 CREATING NEW WDE

BIORETENTION GARDENS

The bioretention gardens within the roads and industrial lots will provide some limited habitat to generalist wetland and dryland fauna. This is due to the native plant species used within them and their water regime mimicking ephemeral wetlands. They will also assist with fauna movement between higher quality habitats. The locations seen in Figure 16.

LIVING STREAM

The creation of the Living Stream to replace the completely degraded open drain will allow for a significant area of new WDE to be created. It will also link the 2 RE wetlands, which will assist with further enhancing the ecological functioning of these systems. The Living Stream is to utilise a low flow channel and flood plain design, similar to a natural system, where area allows. This can be seen indicatively in Figures 17 - 19. Native riparian plants suited to the different zones created by this configuration are to be planted accordingly. Furthermore, the 15m buffers to the main channel for the widened portion, will also be landscaped and planted, allowing for an effective ecological linkage, as well as protection of the created waterway.

It is recommended that as part of detailed design that the following aspects are considered and incorporated into the Living Stream, to enhance the ecological functioning and provide long-term stability.

- Rock boulders on outer bends for habitat and erosion control
- Minor meanders and pools to increase habitat diversity
- Rock riffles on straights to create aeration and reduce erosion
- Dense sedge and rush planting on the channel toe and sides
- Inclusion of shrubs and trees on sides and within the floodplain
- Careful selection of vegetation alongside industrial lots to manage bushfire risks
- Potential path network for residence recreation and to facilitate maintenance.
- A maintenance access tracks within the easement, along the lot edge

As part of the detailed design process, a Living Stream Design Report should be produced based on the above items that also takes into account the final layout and landuses. The Report may be undertaken by either:

- the developer of the first lot through which the Living Stream will be created
- a joint Report from multiple lot developers through which the Living Stream is to be located
- the City as a representative of the entire precinct
- other entity as determined as part of detailed design

The City will have the ultimate approval of the Living Stream design, to make sure that it is compliant with both the required drainage and ecological functions it is to provide.

SOUTHERN POS POND

The current pond in the proposed Southern POS is effectively a grassed depression with permanent water. As part of the creation of the proposed POS, the pond is to be landscaped to both enhance its ecological functioning and to make it safe for public interaction. The future design should consider the following:

- Battering back of the bank to 1:6 slopes
- Planting the sides and shallow inundated areas with native riparian species
- Keeping grass and other weeds separate from the pond through a path or similar barrier
- Potentially raising the base of the pond so that it is dry by mid spring.
- Minimising fertiliser use near the pond to reduce nutrient entering the waterbody.

10.4 MOSQUITO MANAGEMENT

The design of the proposed stormwater network should not increase the current areas of open water during warmer months. As part of detailed design, a mosquito management plan should be produced to assist with minimising the risk of mosquito breeding and the migration of mosquitos to areas frequented by humans. All on lot and roadside infiltration systems should also be designed to fully drain within 72 hours so that these structures do not provide breeding habitat.

11 WATER SERVICING AND SUSTAINABLE USAGE STRATEGY

11.1 POTABLE WATER

The site is to be connected to the Water Corporations’ potable water supply. The proposed water reticulation network is outlined in the civil engineering report (See Appendix A). It is noted that upgrades will be required to service the area as the current scheme is only suitable for the current rural residential density.

11.2 WASTEWATER MANAGEMENT

The residential areas are to be connected to the Water Corporation’s wastewater system. The proposed internal sewer network and connection points is outlined in the civil engineering report (See Appendix A). It is noted that upgrades will be required to services all of the residential portion

The industrial lots are proposed to be serviced from on-site wastewater treatment systems. The existing surrounding sewer network is too high to allow for connection via gravity. The implementation of the onsite systems is to be in line with the General Site and Soil Evaluation Hatch Court Light Industrial Area and Stirling Crescent Precinct Hatch Court and Stirling Crescent, High Wycombe, WA (Galt 2025). As a general summary, all systems are to be set a minimum of 100m from the Wetland and Living Stream network. Variations to the separation may be made on a case-by-case basis and subject to approval by DWER and the Department of Health. Each system is also to maintain a 1.5m separation from the CGL and the base of the disposal field. A 200mm depth of soil media below the disposal areas is to also have a PRI of at least 20.

The systems are also to be monitored on at least a 3-year period to make sure that they continue to operate as required.

11.3 LANDSCAPING WATER USAGE

The POS areas are generally to only receive irrigation during the first 2 years of establishment. The Southern POS may have some irrigated areas, subject to future detailed design. The irrigation source is to be determined as part of the Landscaping Plan for the POS. It is note that there is currently allocation available within the Superficial Aquifer and that the City already has groundwater licenses for other nearby POS areas.

11.4 FIREFIGHTING WATER SUPPLY

Fire hydrants will be provided throughout, as per the relevant regulations.

12 MONITORING & MAINTENANCE

12.1 PREDEVELOPMENT

12.1.1 Groundwater

The predevelopment groundwater monitoring for levels and quality already undertaken is considered suitable for the subject land. It shows that groundwater rises to the surface and discharged out of the Hatch Court wetland and open drain network. Outside of the areas near this system, the majority of the subject land has a separation in excess of 1m. As such there is limited value in further long-term groundwater level monitoring. There may potentially be value in checking groundwater depths for specific land application areas as part of future detailed design, so that minimum separation levels can be determined.

The groundwater quality is unlikely to have significantly changed since the original quality monitoring was undertaken, given the landuses within the subject land have remained similar, except for some dry industrial land uses. The surrounding landuses have also remained similar over the last 20 years. For this reason, there is likely limited value in additional groundwater quality monitoring, as the results are unlikely to of changed significantly, and there is no proposed use of the superficial groundwater for sensitive uses.

Potentially, base line groundwater quality assessments may be required for particular industrial landuses. This would be for landuses that have the potential to contaminate the groundwater system eg fuel depot. The need for this specific monitoring is to be determined as part of the detailed design for the industrial area.

12.1.2 Surface water

There has been some preliminary surface water system level monitoring as reported in the DWMS. As the subject land that feeds the 2 main proposed stormwater management systems (Hatch Court Wetland and Living Stream / Stirling Crs Basin) has remained the same since this monitoring there is limited value in additional level monitoring.

Event based monitoring may be undertaken if there are particular instances where extreme floods occur, allowing for correlation to modelling data. Should this take place, then this information should be incorporated into the future detailed design of the subject land.

As noted in Section 8,3 the surface water quality is likely highly correlated to the groundwater, for which there is existing pre development monitoring. There is likely to be limited value in undertaking surface water quality testing due to the current quality data and the fact that the ecological systems being retained are already being exposed to the type of surface water quality that is likely to be present post development. Furthermore, main that the effects of development of the subject land on surface water is unlikely to be able to be separated from the impact on already developed areas, unless there is dedicated monitoring of the discharge water from individual lots or pipes across the subject land.

Surface water quality monitoring may be undertaken if there are particular concern from current internal or surrounding landuses, which are yet to be identified. Also monitoring may be required for particular industrial landuses that have the potential to contaminate the surface water system eg truck wash. Should this take place, then this information should be incorporated into the future detailed design of the subject land.

12.2 CONSTRUCTION PHASE

Installation of sediment and stormwater control structures is to be undertaken ahead of the construction phase of the subdivision development where required. This will include the use of water sensitive urban design techniques such as sediment curtains, hydromulching and temporary detention basins to maintain the quality of the water potentially leaving the development area during construction. The full drainage network will be monitored for any damage, including sediment build up and litter accumulation during, and at the completion of, construction to ensure their effectiveness is not diminished post-development. Further details are outlined in Table 31.

12.3 POST-DEVELOPMENT

The post development monitoring and maintenance will be undertaken initially by the developer, with lot owners undertaking the long-term works and responsibilities.

Routine monitoring will focus on the functionality of the relevant elements compared to their specified design requirements. The vegetated WSUD elements are to be monitored by personnel with floristic knowledge and/or qualifications, as they will be capable of identifying evasive species within the natively vegetated WSUD systems. Furthermore, personnel in charge of monitoring will have a good understanding of principles and the functional design of the WSUD elements and the treatment system.

Maintenance inspections are to be scheduled to be conducted after a significant storm event as well as through seasonal periods of higher groundwater. Further details are outlined below and in Table 32.

Stormwater

The stormwater monitoring and maintenance works by the developer initially and ongoing by the lot owner are to ensure that:

- the inlet and outlet structures are kept free of debris;
- sediment build up is not impeding functionality, with any excess sediment removed;
- any erosion is halted and repairs undertaken;
- bioretention systems are not compacted, with remediation works undertaken as required;
- litter is removed;
- the underground infiltration systems are draining as designed
- excessive hydrocarbons, nutrients or other contaminants are not present in the system and that removal is undertaken if found.
- there is no standing water in the network (noting a base groundwater flow in designated areas is required).
- the drainage network vegetation is healthy and providing suitable levels of water quality treatment
- weeds are suitably controlled within all drainage systems
- the Wetland and Living Stream network is free draining, with no clogging or extended ponding

Groundwater

The groundwater monitoring and maintenance works are to ensure that:

- the subsoil outlet structures are free of debris, plants or sediment, with removal undertaken as required;
- the subsoil network is clean and free flowing;
- the groundwater base flow through the perimeter wetland system is not obstructed;
- there is no excessive mounding of groundwater causing issue within infiltrating devices.

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Table 32 Proposed Monitoring and Maintenance Schedule

Function/System	Item to Monitor	Details Monitored	Trigger for Immediate Action	Maintenance Action Required	Proposed Monitoring Frequency	Responsible Authority (Timeline)
CONSTRUCTION PHASE						
Design implementation	Structural Design	Systems are constructed to engineer detailed design specification	Systems constructed differs to design specifications.	Remedial work to rectify systems to meet design specifications.	As part of civil construction inspections	Developer (Until PC achieved))
	Structural Effectiveness (inlets, traps and outlets)	Inspection for debris, litter and sediments surrounding structural components	Debris, litter or sediments causing blockages or impairing functions.	Remove any debris or blockages. Inspect systems for any erosion related issues.	Monthly	Developer (Until PC achieved))
POST-DEVELOPMENT						
Drainage Management Systems (includes traditional and WSUD systems)	Erosion	Inspection for erosion.	Presence of severe erosion or erosion impairing functions.	Investigate, identify and rectify the cause of the erosion. Replace eroded material as required.	Monthly for first 2 years then after high rainfall events	Lot owners (ongoing)
	Sediment Build Up	Inspection for sediment accumulation within pits, on the surface of bioretention systems and within basins.	Accumulation of large volumes of sediments and/or silts in pits or on the surface (according to Local Government standards).	Investigate, identify and stabilise cause of sediment source. Remove accumulated sediments and replace filter media or plants removed.	3 Monthly for first 2 years then after high rainfall events	Lot owners (ongoing)
	Compaction	Inspection of filter media for compaction, could include being driven on.	Water remains ponding longer than designed in bioretention system after a storm event.	Investigate cause of compaction. If localised, remove top 100mm of filter media, break up the filter and then return to system without any compaction. If extensive seek expert advice.	Monthly for first 2 years then after high rainfall events	Lot owners (ongoing)
	Rubbish/Litter	Inspection for the presence of litter.	Litter is blocking structures or detracting from the visual appearance of the system.	Identify source of litter and undertake appropriate responses. Remove litter.	Every 3 months	Lot owners (ongoing)
	Vegetation health	Density of plants, mix of plants and general health.	Area of 5m ² bare, monoculture establishing, many plants appear in poor health	Determine source of issue and rectify via replanting with appropriate species	Every 3 months	Lot owners (ongoing)
	Oil/Hydrocarbons	Inspection for the occurrence of oil on surface.	Oil coverage persists for more than 2 weeks and is thick.	Notify the relevant entities of the spill and clean up requirements.	Every 3 months	Lot owners (ongoing)
	Weeds	Weed encroachment causing obstruction or impacting native plant growth	Weeds cover of more than 5%. Weeds blocking drainage pipes or flow path.	Undertake weed control via herbicide and, where required, physical removal.	Every 3 months	Lot owners (ongoing)
	Road sediment and litter	Determine level of sediment and litter build up on roads.	Visible litter and sediment that is in quantities that could have a detrimental impact on downstream WSUD systems	Sweeping of roads to remove sediment and litter	As required.	Lot owners (ongoing)
	Obstructions	Item/plants blocking flow path	Blockage likely to cause/is causing ponding or flooding	Remove blockage	Every 3 months and as required	Lot owners (ongoing)
	Permeability	Bioretention systems free draining/ no standing water after 72hr	Water present after 72 hrs or draining significantly slower then designed	Determine potential cause including surface contamination with fines or subsoil network not working	Every 3 months and after significant rain events	Lot owners (ongoing)
Groundwater Management	Groundwater levels - infiltration system	Presence of groundwater in bioretention gardens	Groundwater above the floor for more than 1 week.	Install subsoil network to control groundwater rise or lift the floor level and provide additional storage higher up.	Monthly June to October	Lot owners (ongoing)
	Subsoils	Subsoils free draining	Groundwater not outflowing but groundwater is rising within built up portion of development.	Clean out relevant areas of subsoil network	Monthly June to October	Lot owners (ongoing)

13 IMPLEMENTATION PLAN

The developers of the subject land will be responsible for undertaking the majority of the initial water management strategies outlined in this report, with other entities assisting and supporting the works, especially over the longer term. The following details the actions and works to be undertaken by the developer and relevant authorities as part of the development of the subject land.

COMMITMENTS BY DEVELOPER

- Production of Subdivision and Development Water Management Reports (SDWMR) or similar as part of each portion of development
- Production of engineering drawings in line with the LWMR and subsequent SDWMR's. Includes suitable crossing structures and configurations of the Wetland and Living Stream Network.
- Water sensitive urban design techniques such as sediment curtains, hydro-mulching and temporary detention basins will be used to maintain the quality of the water leaving the development area during construction as required.
- Construction of stormwater drainage systems and infrastructure.
- Protection and enhancement of the RE wetlands including initial maintenance
- Creation of suitable easements for the Wetland and Living Stream network.
- Construction and initial maintenance of the Living Stream system
- Construction of groundwater control systems.
- Appropriate earthworks employed across the site.
- Produce and implement Construction Management Plans.
- Implement all servicing and drainage infrastructure in accordance with the LWMR/SDWMR and relevant design reports.
- Utilise nutrient wise and water wise landscaping within the POS areas.
- Undertake post-development monitoring as required.
- Provision of material to lot purchasers on their drainage implementation and ongoing management requirements.

COMMITMENTS BY THE CITY OF KALAMUNDA

- Review and advise on the LWMR
- Review and approval of future SDWMR's and similar guiding documents
- Approval of drainage design and other water management works.
- Management of the drainage network after handover.
- Approval of on-lot stormwater detention systems as part of the individual building licenses.
- Review and approval of on-lot wastewater management systems.
- Suitable management of POS areas after handover
- Suitable management of the Wetland and Living Stream system in conjunction with lot owners

COMMITMENTS BY DEPARTMENT OF WATER AND ENVIRONMENTAL REGULATION

- Review and approval of the LWMR
- Provision of advice to assist with approvals of the SDWMR as requested by the City.

COMMITMENTS BY THE WATER CORPORATION

- Review and approval of residential wastewater servicing designs.
- Manage the residential wastewater servicing for the development post handover.
- Review and approval of water servicing designs.
- Manage the potable water service to the development post handover.

COMMITMENTS BY THE LOT OWNERS

- Implementation of on-lot storage, in line with the LWMR and subsequent building licenses.
- Ongoing management of the on-lot storage.
- Management of relevant portions of Living Stream and Wetland Network in line with approved management plan

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Appendix A ENGINEERING DRAWINGS

Report Name: HATCH COURT AND STIRLING CRESCENT LIGHT
INDUSTRIAL AREA SERVICING REPORT

Project No: PC25100

Project Title: Engineering Services Report



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Revision	Description	Author	Checked	Approved	Date
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EXECUTIVE SUMMARY

Key constraints and recommendations of this report are summarised as follows:

Risk Matrix

Consequence Likelihood	Insignificant	Minor	Moderate	Major	Severe
<u>Remote</u>	Insignificant	Insignificant	Low	Low	Medium
<u>Unlikely</u>	Insignificant	Low	Low	Medium	Medium
<u>Possible</u>	Low	Low	Medium	Medium	High
<u>Likely</u>	Low	Medium	Medium	High	High
<u>Almost Certain</u>	Medium	Medium	High	High	Extreme

Qualitative Measures of Likelihood or Frequency

Scale	Criteria to be used to establish rating
Almost Certain	Will occur. Circumstances or situations are likely to arise often throughout the planning / project period which provide the opportunity for crystallization of risk. Expect frequent, regular occurrences.
Likely	Likely to occur more than once in the planning period but not an 'everyday' occurrence. Preconditions will arise at times throughout the period.
Possible	Likely to occur at least once but not expected to occur much more than this in the planning period.
Unlikely	Not likely to occur in the planning period. A small, but remote chance of occurrence due to circumstances/situations that could arise.
Remote	Would only occur in highly exceptional circumstances that are unlikely to exist in any planning period. Extremely remote chance of occurrence in planning period. 'Once in a lifetime' event.

Qualitative Measures of Impact – Consequence Severity

Impact	Consequence Criteria
Severe	Near impossible to develop subject site and expected development viability is very low. E.g., Significant Habitat, Major floodway within site etc. Requires comprehensive development viability analysis and specialist input.
Major	Very difficult to develop subject site and expected development viability is low, will involve significant investigations, very expensive major service relocations, many significant trees of excellent health etc. Requires development viability analysis and specialist input as required.
Moderate	Challenging to develop subject site, expected development viability is adequate, will involve further investigations, costly service relocations, many registered trees of excellent health etc. Specialist input as required.

Minor	Relatively simple challenges to develop site, expected development viability is good. Minor upgrades to existing services are required to develop site.
Insignificant	No challenges or risk to program in developing site.

Degree of Risk

Risk Rating	Definition of Risk Rating
Insignificant	Certain development prospect, no foreseeable challenges.
Low	Site is developable with only minor works or investigations required. It is advised to progress to continue the development process.
Medium	Site is developable with significant works or investigations required. It is advised to progress to continue the development process.
High	Site is developable with major works or investigations required. No further investigation recommended without cost benefit analysis first being undertaken.
Extreme	Site or component is undevelopable or unviable without significant changes.

Key Site Risks

Below summarises key site risks with associated risk ratings and high-level recommendations to improve clarity for planning and approvals:

VEHICULAR ACCESS

Risk Description: The subject site currently obtains vehicular access from Stirling Crescent, Adelaide Street and Kalamunda Road. Construction of the internal shared road network for the development, together with the site's reliance on the surrounding road network, will require coordination with any broader regional road upgrades planned by MRWA. In particular, future upgrades affecting Stirling Crescent, Kalamunda Road and adjoining intersections may influence the ultimate access arrangements, intersection treatments, staging of works and timing of development within the Hatch Court Light Industrial Area. Failure to appropriately integrate the proposed development with the regional road improvement program may result in additional infrastructure contributions, redesign requirements, increased construction costs and potential delays in obtaining subdivision and development approvals.

Risk: **MEDIUM**

Recommendation: Ongoing consultation should be undertaken with the City of Kalamunda, MRWA and the project traffic engineers to monitor the status and timing of regional road upgrade projects and confirm their implications for the HCLIA. Detailed traffic impact assessments should be updated as the proposal progresses to ensure that the internal road network and access arrangements remain compatible with the ultimate regional road configuration. Where necessary, road infrastructure upgrades and associated contributions should be identified early and incorporated into the development staging strategy to minimise approval risks and facilitate the orderly delivery of the subdivision.

Refer to **Section 5.1** for further information.

BUSHFIRE

Risk Description: The current online bushfire mapping listed on the Department of Fire & Emergency Services (DFES) website demonstrates that the subject site is within a Bushfire Prone Area. Additional planning and building requirements will likely apply to the proposed development.

Risk: MEDIUM

Recommendation: Additional planning and building requirements may apply to the proposed subdivisional development in accordance with Schedule 2 Part 10A of the Planning and Development (Local Planning Schemes) Regulations 2015, State Planning Policy 3.7, WA Guidelines for planning in Bushfire Prone Areas, and the Building Code of Australia.

Refer to **Section 2.6** for further information.

SITE GRADING AND EARTHWORKS

Risk Description: Site grading will generally be determined by the proposed building pads, servicing requirements and environmental and geotechnical constraints of the site to ensure a sustainable as well as economic development. Bulk Earthworks will be dictated by building pads and vehicle access point. The stormwater strategy will need to be confirmed; however, it is likely that stormwater for major storm events will be directed naturally towards the closest watercourse. To accurately assess stormwater requirements further information is required in regard to the site's geotechnical properties. These requirements may incur additional costs and result in potential delays in timeframe for the proposed development.

Risk: MEDIUM

Recommendation: The subject site earthworks will mainly be determined by the drainage requirements and the building pads as per the proposed LSP development plan. The general topography of the subject sites is mild sloping from east to west at approximately 1 in 50 to 1 in 100 slopes across the site. The highest point is at the intersection of Hatch Court and Stirling Crescent at approximately 24m AHD and the lowest point is over the subject site at approximately 20m AHD at the western boundary of the site. Shallow groundwater was encountered across the southern half of the site at depths of approximately 0.6 m to 0.8 m below existing ground level and may potentially have an adverse effect on stormwater infrastructure or proposed development, however it is recommended that a geotechnical assessment be undertaken to accurately assess the site.

Refer to **Section 3** for further information.

SEWER

Risk Description: Development to date within the Hatch Court Light Industrial Area has proceeded with onsite effluent disposal, as the site is not currently connected to a reticulated sewer network, with the nearest existing sewer infrastructure within the planned catchment for the landholdings, located a significant distance from the subject land. Each development site will be required to assess its needs with regards to wastewater disposal and make due applications to the regulatory health authorities for on-site treatment and disposal.

Advice from the Water Corporation is that the subject site is dependent on the sewers to the north heading across the bypass, where the current sewer catchment planning shows sewerage from the area is required to discharge. There are existing sewers located to the south west at the intersection of Stirling Crescent and Acton Link and Wem Mews and to the north east at the intersection of Benson Way /Stirling Crescent, however, connection to these existing sewers can only be achieved provided a suitable depth to the sewer is established as part of the extension works.

Risk: HIGH

Recommendation: Confirm proposed layout of the development and assess the impact on the existing sewer. Provide Water Corporation with additional information detailing the residential subdivision levels to confirm whether Water Corporation will entertain connecting either all or a portion of the proposed residential area within the LSP area. Current advice is that the area will require servicing

to the north/northwest through landholdings outside of the LSP area.

Water Corporation will also be required to confirm serviceability of the site based on the ultimate design of the development.

Refer to **Section 6** for further information.

POTABLE WATER

Risk Description: The subject site is currently serviced by existing potable water mains located along Stirling Crescent and the Hatch Court cul-de-sac, which primarily provide residential connections. These existing assets offer potential connection points for the proposed water reticulation network; however, the suitability of these connections will depend on the ultimate water demand generated by the development.

A detailed assessment of potable water requirements will be necessary to determine whether upgrades or additional water reticulation infrastructure will be required to adequately service the development. This assessment should consider peak demand, fire flow requirements, staging, and the capacity of surrounding network assets.

All internal potable water reticulation infrastructure is to be designed and constructed in accordance with the relevant Australian Standards and the Water Corporation of Western Australia's design, construction, and servicing requirements to ensure compliance, service reliability, and long-term operational performance.

Risk: MEDIUM

Recommendation: Confirm the existing potable water infrastructure's connection, alignment, and size. Correspondence with Water Corporation has confirmed that the current existing water infrastructure will require upgrades. All internal potable water reticulation pipework is to be designed and constructed to the standards and requirements of the Water Corporation of Western Australia. Standard Water Corporation water headwork charges will apply. Verification with the Water Corporation will also be required to confirm serviceability of the site based on the ultimate design of the development.

Refer to **Section 6** for further information.

STORMWATER DRAINAGE

Risk Description: An existing double-side entry stormwater pit is located on Hatch Court with a 300mm pipe connection through to the existing drainage easement on the subject site. The majority of the stormwater on hatch court flows to the side entry pit, however stormwater from the cul-de-sac head flows back onto adjoining private property. Construction of on-site stormwater drainage infrastructure will be required for the proposed development which may incur additional costs and potential delays in timeframe. There are also potential risks involved with clashes between the drainage corridors and other services that will traverse the local road network, as well as safety issues surrounding the drainage corridor depths.

Risk: HIGH

Recommendation: Drainage should be constructed in accordance with the Hatch Court Local Water Management Strategy (LWMS) and subsequent Urban Water Management Plans. MRWA safety guidelines should be adhered to for depth and swale slope steepness, the slope must not be greater 1 in 4 and the height must not exceed 0.9m.

Refer to **Section 6** for further information.

SUBSOIL DRAINAGE

Risk Description: The subject site will require subsoil drainage after development due to the close proximity of the finished ground levels to the groundwater table.

Risk: **HIGH**

Recommendation: Subsoil drains are to be installed within the verge to manage groundwater levels, as recommended by the hydrological consultant. The subsoil drainage pipes should be designed to convey groundwater to the nearby waterway.

Refer to **Section 6** for further information.

GAS

Risk Description: DBYD information and review of the Atco gas network coverage map shows that there is reticulated gas services available in the immediate surrounding area. A 63 PE 1.5 PEHP 70kPa polyethylene high pressure gas main runs along Hatch Court. A Critical Asset Warning applies to this area. No works within 15 metres of the critical assets are permitted without prior written approval from ATCO Gas Australia. Hand exposure via pothole method is mandatory prior to any excavation in the vicinity of these assets. The project team must contact ATCO Gas Australia directly before commencing any works.

Risk: **HIGH**

Recommendation: Confirm the existing gas service infrastructure's connection, alignment and size.

Refer to **Section 6** for further information.

PEDESTRIAN ACCESS

Risk Description: There is currently no existing Pedestrian Path located in the general vicinity of the subject site. The provision of pedestrian infrastructure upgrades or modifications if required may incur additional costs for the development, however, is likely to be shared over the total development.

Risk: **LOW**

Recommendation: Peritas recommend undertaking a condition report of the existing bus stops surrounding the site prior to award of the contract to the builder. Any damage during the construction to be rectified by the builder.

ENVIRONMENTAL CONTAMINATION

Risk Description: A contaminated land search on the DWER website indicates the site is not within known contaminated sites. No further actions from an environmental contamination perspective are required for the proposed development site. There is high to moderate risk and moderate to low risk (<3m from the surface) Acid Sulfate Soils (ASS) in the subject site, however additional testing may be required to be undertaken.

Risk: **LOW**

Recommendation: Further actions from an environmental contamination perspective may be required for the proposed development site. Future development plans, including the depth of excavation and any dewatering for sewer installation, would determine whether further investigation and ASS management is required.

Refer to **Section 2.4 and 2.7** for further information.

ELECTRICAL AND STREETLIGHTING

Risk Description: The proposed development currently has overhead HV and LV infrastructure in the subject site vicinity. Existing overhead High Voltage distribution lines (1 kV – 33 kV) and a Transmission line (33 kV – 330 kV) are present within and adjacent to the precinct, along with Low Voltage overhead lines (< 1 kV) serving existing lots. Underground HV/LV cables, street light circuits, pillars and terminations are also present within the local road network including along Stirling Crescent. All works in proximity to these assets must comply with Western Power clearance requirements.

Risk: **HIGH**

Recommendation: Confirm the existing electrical service infrastructure's connection, alignment, and size. An EPR/LFI assessment is required when a transformer/switchgear is installed as part of the subdivision. An application to the Western Power Transmission team is required for an assessment to determine the easement width. Western power assessment is required before carrying out any work in the vicinity

Refer to Section 6.5 for further information.

FLOOD.

Risk Description: DWER confirms they have no information on flooding or flood levels at this location.

Risk: **Low**

Recommendation: A minimum habitable floor level of 0.5 metre above the adjacent 1% AEP flood level is recommended to ensure adequate flood protection.

Refer to **Section 2.8** for further information.

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1. INTRODUCTION

Peritas Group was commissioned by Dynamic Planning and Developments on behalf of the City of Kalamunda to review the engineering constraints and servicing requirements associated with the Development of the subject site.

The subject site comprises of a light industry area and several residential lots to a total of approximately 33.6 hectares as shown in **Figure 1** below. The subject site is located approximately 14kms northeast of the Perth CBD and 6km from the Perth International airport. The High Wycombe Train station is located approximately 4km from the subject site. The site is located in close proximity to major road links, including Roe Highway, Kalamunda Road and Abernethy Road.



Figure 1 Aerial View

The majority of the site is clear of significant vegetation with minimum existing structures, which will need to be considered in the relevant development stages.

In summary, this report highlights:

- The subject land is capable of sustaining development in keeping with the proposed light industrial and residential development.
- The land is capable of being connected to and provided with all essential services to sustain residential development (based on current and future service authority planning).
- The proponent's strategy for the subject land will complement the natural landform by careful design of the bulk excavation, site grading and landscaping.

This report has been compiled based on the following terms of reference:

- Briefing discussions and meetings with the client.
- Site inspection and site walkover.
- Numerous discussions with Local Government Agencies.
- Site data and documents included on this report.
- Servicing concepts and Regional Strategic Infrastructure planning by the regulatory authorities.

The majority of the subject site is zoned as Light Industrial and partially residential as shown in MNG Maps in **Figure 2** below:



Figure 2 Town Planning Map (MNG)

1.1 Proposed Development

The proposed development is yet to be confirmed in more detail, however, at the time of this report the subject site comprises of the following approximate land usages:

Table 1 Summary of land use areas

Total Structure Plan Area	31.882ha
Area of each land use zones: • Residential	4.9126ha
Light Industry	21.57ha
Area of reserves: • New Road Reserves • Public Open Space/Drainage • Wetlands & Buffer	1.4088ha 0.29ha 3.0591ha
Living Stream	0.6415ha
Estimated lot yield (Residential)	140 lots
Estimated dwellings	140 dwellings
Estimated density per site hectare	28.5 dwellings
Estimated population	350 residents @ 2.5 people per household.
Primary Schools	None
High Schools	None
Total Structure Plan Area	31.882ha
Estimated population	350 residents @ 2.5 people per household.

The proposed structure plan layout for the subject site can be found in Figure 3 below.

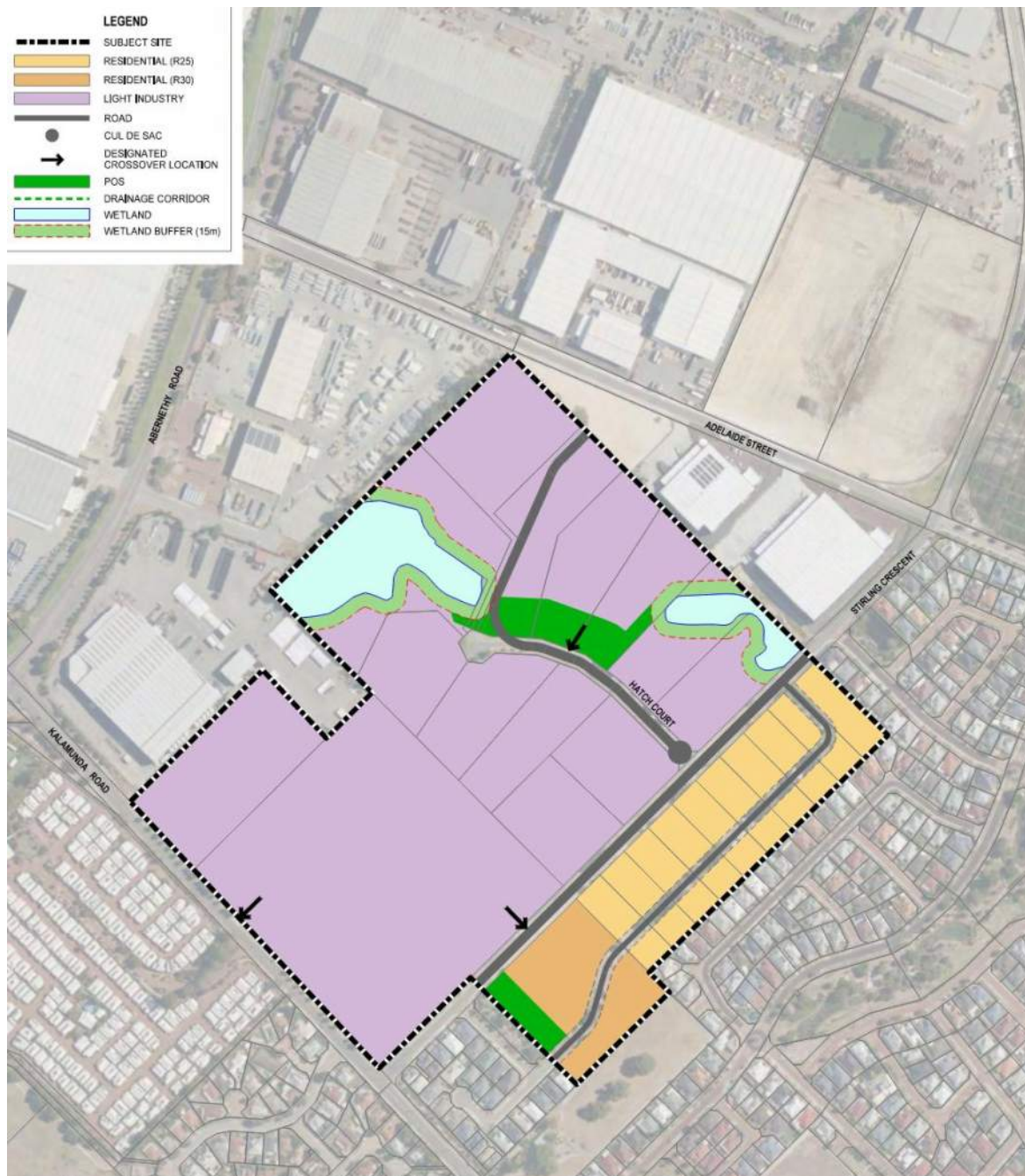


Figure 3 Draft Structure Plan Layout

2. SITE EVALUATION

2.1 General

Within this section, a detailed summary of the existing services and constraints information has been compiled and summarized for the subject site. The detailed analysis includes a review of Dial Before You Dig (DBYD) information, aerial photography, review of DWER and DPLH Databases, Water Corporation records, and correspondence obtained from service authorities.

The general topography of the subject sites is mild sloping from east to west at approximately 1 in 50 slopes across the site. The highest point is at the intersection of Hatch Court and Stirling Crescent at approximately 24m AHD and the lowest point is over the subject site at approximately 20m AHD at the western boundary of the subject site as seen in **Figure 4** below.

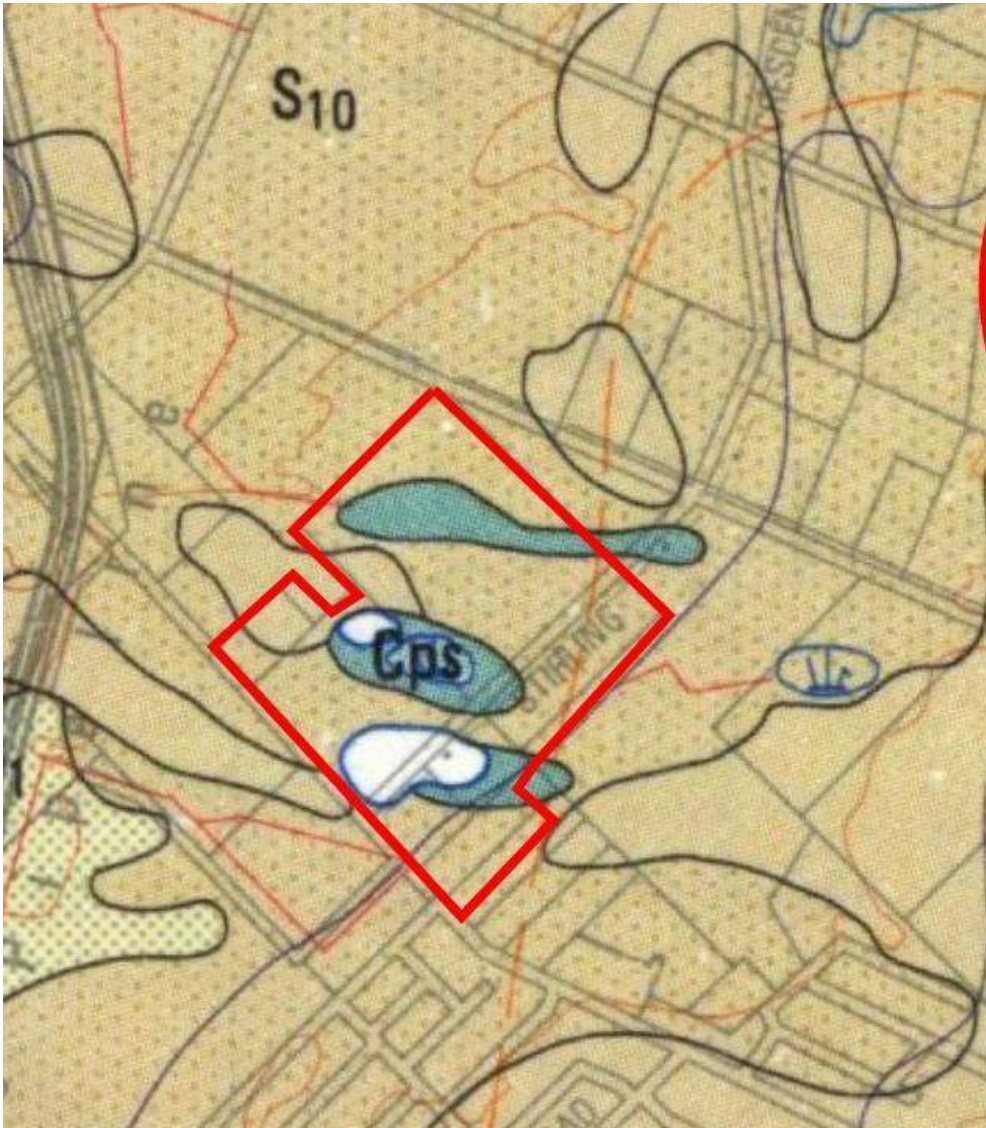


Figure 4 Natural Surface Level Contours (Water Corporation ESnet 22)

Subject to final development layout, the land might require bulk earthworks to be completed to regrade the site to suit the building footprint.

2.2 Site Geology

The subject site geology can be seen in **Figure 5** below, which shows that the majority of the site is underlain by sandy soils. Within the vicinity of the existing creek corridor, a layer of organic silty sand approximately 0.8 m thick overlies the underlying sand profile. In the northern portion of the site, iron-indurated sand (commonly referred to as *coffee rock*) has been encountered at an approximate depth of 2.0 m below existing ground.



Map Unit		Description
Unconsolidated Material ¹	Rock ²	
Cps		PEATY CLAY – dark grey and black ³ with variable sand content of lacustrine origin
M ₂		SILT – grey mottled yellowish brown, blocky, firm, variable clay content
P		PEAT – black, clayey in part, saturated fibrous organic soil
Sp		PEATY SAND – greyish brown, medium-grained quartz, moderately well sorted, variable organic content, of lacustrine origin

Figure 5 Site Soil Classification (Geological Survey of Western Australia)

Table 2 Summary of Geological Mapping

Map Sheet	Map Scale	Mapped soils	Site findings
Perth	1:50000	Northern portion of site underlain by a thin layer of Bassendean Sand overlying Guildford Formation Southern portion of site underlain by Swamp Deposits (Peaty Clay)	SAND (SP) overlying Coffee Rock in the northern half of site; and Organic Silty SAND (OL) overlying SAND (SP) in the southern half of site

The subject site will require further investigation during specific development phases with due regard to the proposed building pads and drainage requirements.

2.3 Previous Geotechnical Investigations

A geotechnical investigation was also undertaken by Galt Geotechnics in 2025. The key findings from the investigation reinforce the ASS study and the geotechnical study and show they are generally consistent with the geological mapping. The summary of the geotechnical assessment is specified in the table below.

Table 3 Summary of Geotechnical Assessment

Type	Clause	Parameter	Comment
Site Suitability	-	-	We consider both sites to be geotechnically suitable for the proposed development with appropriate site preparation measures. Standard site preparation measures will apply for most of the site.
Site Classification (AS2870)	GDR5	A / P	Class A for most of each site. Class P in drainage lines, wetland areas and lakes. The site classification in these areas could be improved if organics soils are removed and replaced
Site Preparation	GDR6	Ce	For most of the site: preparation will comprise GDR6.2.1 Common Measures followed by GDR6.2.2 Sand Sites. Surficial uncontrolled fill in the northern part of the site must be remediated. We anticipate raising of the site above shallow groundwater levels by importation and compaction of sand fill

			(Permeable Sand) however this is subject to civil design. In drainage lines, wetland areas and lakes. If these areas are to be developed, organic soils present in these areas will need to be removed and replaced with approved fill. Dewatering and treatment of water / soil for acid sulfates will also be required.
Footing Preparation and Testing	GDR6.4	-	We expect the base of footings at this site to be entirely within sand. We refer you to GDR6.4.1. A PSP may be used to verify compaction in footing excavations as discussed below.
Topsoil Strip	GDR6.2.1	Thickness = 100 mm	Expected thickness of topsoil strip (average).
Compaction Control	GDR7	-	Requirements for "Sand" as per GDR7 Compaction control at this site may be done using a Perth sand penetrometer (PSP). The target blow counts for "Bassendean Sand" are applicable as per GDR7.4 Perth Sand Penetrometer.
Approved Fill	GDR8	Permeable Sand or General Sand	Approved fill at this site is to comprise Permeable Sand (where stormwater disposal is required) or General Sand (where stormwater disposal is not required) as per GDR8 Approved Fill and Conformance Testing. The insitu sand is suitable for reuse as General Sand and is likely to have an unsaturated hydraulic conductivity of approximately 3 m/day when compacted. Further permeability testing of recompacted insitu sand is required to derive a design hydraulic conductivity value.
Excavations, batters and slopes	GDR12	1V:2H (temporary) 1V:3H (permanent)	Excavations in sand should be readily achievable to 2 m with 15 ton excavator or similar. The batter angles given are for slopes up to 2 m high and above groundwater. Refer to GDR12 Excavations, Batters and Slopes for more information. Dewatering will be required for excavations in lower lying areas of shallow groundwater.
Unsaturated Hydraulic Conductivity	GDR13	k _{unsat} = 3 m/day for isolated soakwells, and k _{unsat} = 5	k _{unsat} values apply where disposing into natural grey sand, minimum 0.5 m above the groundwater table, coffee rock layers (or overlying perched water) or black / brown sand layers near the groundwater table as per GDR13.4.

		m/day for interconnected soakwells.	
Pavement Subgrades	GDR16	CBR = 10%	For subgrades of granular pavements comprising compacted approved fill / insitu sand.
Acid Sulphate Soils	-		Management of acid sulphate soils is likely to be required during construction.

The soil field testing results are summarized in table 3 below.

Table 4 Summary of Field-testing results

Field pHf range	Field pHfox range	pH change	Laboratory pH range	Maximum Acidity	Net
4.7 – 8.5	2.6 – 6.5	1.0 – 5.8	4.0 – 9.5	<0.02 – 0.14	

2.4 Ground Water

As outlined in the Local Water Management Strategy prepared by Oversby Consulting, the following groundwater management measures are recommended for the Hatch Court Light Industrial Area:

- Surface water inflows to groundwater are to be treated via bioretention gardens and the proposed living stream / wetland network.
- Where required, development areas are to be raised using clean engineered fill to maintain adequate vertical separation from groundwater levels.
- Subsoil drainage systems are to be installed in areas where groundwater is less than 1.5 m below finished surface levels to manage seasonal groundwater rise.
- Connection to reticulated sewerage will remove potential wastewater pollutants from developed lots for off-site treatment.
- The removal of existing stock access and extensive garden areas is expected to reduce nutrient loading to the groundwater system.

Review of the Perth Groundwater Atlas (DWER) indicates that regional groundwater flow is generally in a north-westerly direction, with interpreted maximum groundwater levels reducing across the site from approximately RL 19.9 mAHD to RL 17.2 mAHD.

In addition, a 12-month groundwater monitoring program undertaken as part of the broader District Water Management Strategy investigations (ENV, 2009) included bores MW1 to MW4 located within the subject land, together with DoW Bore 4849 to the east. Based on the monitoring results, the Average Annual Maximum Groundwater Level (AAMGL) was established, with results summarised in Table 4. The broader groundwater assessment identified a general northerly groundwater flow direction.

Table 5 DWMS groundwater level results

Bore	Maximum Recorded Groundwater Level (mAHD)	Depth to maximum Recorded Groundwater Level (m)	AAMGL (mAHD)	Depth to AAMGL (m)
MW1	22.273	1.02	22.136	1.157
MW2	21.484	0.248	21.32	0.412
MW3	21.451	1.555	21.314	1.692
MW4	21.173	0.695	21.016	0.852
DoW 4849	14.937	-	14.72	-

Given the above-average rainfall experienced during 2025, groundwater levels recorded during the recent investigation period are considered likely to be representative of near-maximum seasonal conditions. Groundwater discharge was also observed into the drainage line traversing the site, which assists in limiting further groundwater rise during peak periods.

Groundwater depths are generally shallowest in proximity to the existing wetlands and drainage corridor, while depths increase to greater than 2.0 m within the elevated sand dune areas. Localised zones were also identified where groundwater was within 1.0 m of the natural surface during August / September 2025. Groundwater was additionally encountered within excavated areas on the subject land and within the adjoining POS basin. Discussions with nearby landowners indicate that groundwater levels within the southern open waterbody may fluctuate by approximately 1.0 to 1.5 m annually.

Based on observed pond water levels and available geotechnical investigation data, a refined groundwater contour assessment has been developed. This indicates groundwater levels generally fall in a north to north-westerly direction, from approximately RL 23 mAHD to RL 19 mAHD across the locality. Some minor localised groundwater mounding is also evident in areas where less permeable subsurface soils restrict vertical infiltration. These local influences are expected to diminish as seasonal groundwater levels recede below the invert level of the drainage line, allowing perched or mounded groundwater to dissipate into surrounding more permeable areas.

Groundwater quality

Groundwater sampling was undertaken as part of the geotechnical investigation program to assess baseline groundwater quality conditions across the site.

Laboratory results indicated groundwater pH values ranging from 6.18 to 7.16, which is considered slightly acidic to neutral. Mildly elevated inherent acidity was identified, together with high to very high alkalinity concentrations, suggesting the groundwater possesses adequate natural buffering capacity to maintain an acceptable pH balance in the event of Acid Sulfate Soil (ASS) disturbance or oxidation.

Elevated concentrations of aluminium and iron were also recorded, which may indicate that some degree of historical ASS oxidation has previously occurred within the site or surrounding locality. Notwithstanding this, the detected metal concentrations are generally consistent with groundwater conditions commonly observed throughout the eastern Swan Coastal Plain.

Chloride concentrations were found to exceed the applicable non-potable groundwater use guideline within monitoring bore MW01, where a concentration of 330 mg/L was recorded. This elevated chloride level may reflect local hydrogeological influences, historical land use activities, or natural saline trends within the regional groundwater system.

Overall, the groundwater quality results indicate conditions typical of the surrounding area, with no unusual anomalies identified beyond those commonly associated with seasonal groundwater fluctuations and local soil chemistry.

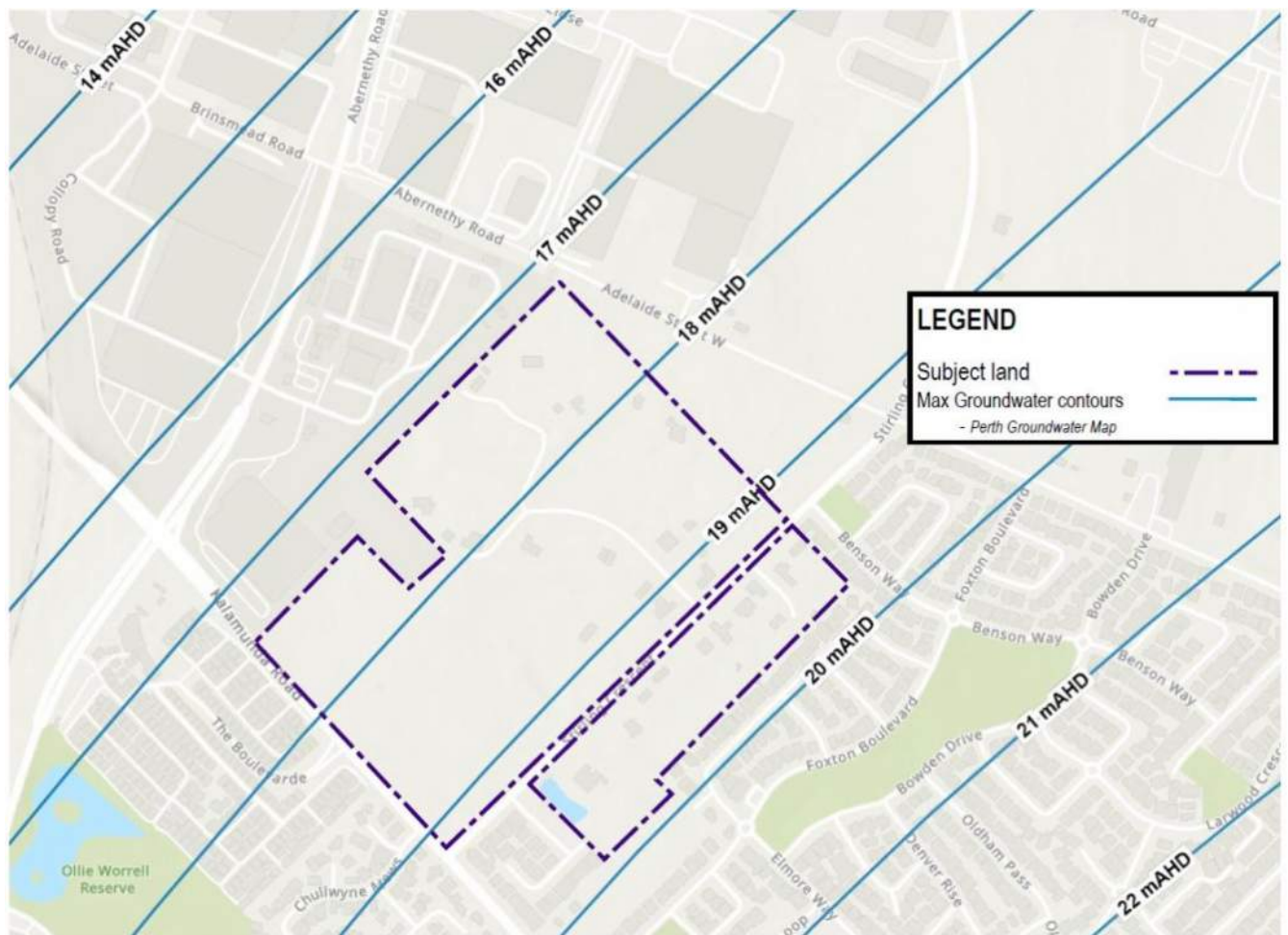


Figure 8 Predevelopment Groundwater Conditions (Perth Groundwater Map -2019)

2.5 Acid Sulphate Soils



Figure 9 DWER Acid Sulfate Soils

Based on the information from DWER groundwater database shown in below there is High to moderate and moderate to low risk Acid Sulfate Soils (ASS) in the subject site, therefore additional testing is recommended to be undertaken.

To avoid construction delays or compliance issues, early-stage acid sulfate soil testing is recommended prior to any dewatering, excavation, or detailed design finalization.

2.6 Bushfire

The current online bushfire mapping listed on the Department of Fire & Emergency Services (DFES) website demonstrates that the subject site is within a Bushfire Prone Area, as shown in **Figure 10** below. Additional planning and building requirements may apply to the proposed subdivisional development in accordance with Schedule 2 Part 10A of the Planning and Development (Local Planning Schemes) Regulations 2015, State Planning Policy 3.7, WA Guidelines for planning in Bushfire Prone Areas, and the Building Code of Australia.



Figure 10 DFES Bushfire Prone Map 2024

2.7 Environmental and Contamination

A contaminated land search on the DWER website indicates the site is not within known contaminated sites. No further actions from an environmental contamination perspective are required for the proposed development site.

2.8 Flood

Based on advice provided by the Department of Water and Environmental Regulation (DWER), the subject site at Hatch Court is not located within a mapped floodplain and is not subject to riverine or regional flood risk. DWER has confirmed that the area is not affected by major flooding associated with surrounding catchments and waterways.

Accordingly, no floodplain management measures or development restrictions associated with 1% Annual Exceedance Probability (AEP) flooding are applicable to the site. The proposed development can therefore proceed without the need for floodplain-specific mitigation measures, subject to compliance with standard stormwater management requirements and detailed drainage design to address local runoff and minor storm events.

This assessment relates to major flooding only and does not preclude the need for appropriate stormwater drainage infrastructure to manage local rainfall events in accordance with relevant authority standards.

The following advice was provided by DWER:

[“We have no information on flooding or flood levels at this location. The Lots are located more than 2.6 km away from our nearest mapped watercourse, the Helena River. The proposed development is outside of the Helena River floodplain.](#)

[Please read the Better Urban Water Management guidelines with regards to stormwater design.](#)

[Better urban water management](#)

[You can also contact our Swan Avon Region for other planning advice on water and environmental matters.](#)

Swanavon.landuse@dwer.wa.gov.au

[It should be noted that this advice is related to major flooding only and other planning issues such as environmental and ecological considerations may also need to be addressed.”](#)

3. SITE GRADING & BULK EARTHWORK

Site grading and remodelling will be kept to minimum limits wherever possible but will be required to form roadworks, building pads for future development, and associated works within the following parameters:

- Creation of the building pads for the proposed development.
- Contouring of land to suit servicing requirements for development, sewerage and stormwater drainage requirements.
- Clearing of trees and vegetation.
- Possible 1% AEP flood protection requirements based on final proposed development layout.

Site grading will generally be determined by the proposed building pads, servicing requirements and environmental and geotechnical constraints of the site to ensure a sustainable as well as economic development.

Peritas anticipate that the bulk earthwork operations will be partly completed using material available from the area. If importation of sand is required, it will be sourced from existing sand mining operations within the locality.

Preparatory works prior to earth working should be limited to the following:

- Removal of existing trees and vegetation
- Demolition and disposal of existing building
- Removal of fencing and other improvements as necessary.
- Stripping and grubbing of areas to be earth worked to the depth 700mm below existing ground level.
- Strip and disposal of topsoil.
- Cut to fill operations and imported fill to selected areas to suit design layout.
- Stabilisation of any areas to be landscaped or where topsoil has not been respread on verges and embankments.
- Site levels shall be set in accordance with the following parameters:
- Geotechnical and soil parameters to ensure that the site is capable of development.
- Fill levels to provide clearance to groundwater (AAMGL and as prescribed by authority approvals). Not likely to be an issue for this site however further investigations are required.
- Finished building pad levels are to be 0.5m above 1% AEP flood levels.
- If required, finished transformer site pad levels are to be set at least 1.0m above 100-year flood event.

Upon completion of bulk earthworks, any disturbed areas shall be stabilised either by resspreading the stockpiled topsoil from the bulk earthwork operations or via hydro mulching stabilisation as appropriate or in accordance with the requirements of the local authority.

Estimated cut-and-fill quantities should be calculated during detailed design to optimize earthworks balance and minimize import/export costs. Additionally, site grading must be designed to ensure all finished building pads meet or exceed the minimum 0.5 m clearance above the 1% AEP flood level.

4. LAND STABILISATION AND DUST SUPPRESSION

Prior to construction taking place, a construction water supply will be established to provide water for dust suppression, temporary sand stabilisation and irrigation during the construction phases. Water trucks and spray equipment will be on site throughout the construction programme to damp down exposed sand surfaces until the surface is physically stabilised. In the event that adjacent occupied homes or trafficked roads are affected by sand drift, a sand-trapping fence will be constructed fronting the affected section of the development.

All dust suppression activities should comply with the City of Kalamunda's dust control regulations. Daily monitoring of dust emissions should be implemented during earthworks to ensure adherence to local environmental health requirements.

In the event of strong winds blowing towards adjacent properties that cause blown sand to reach those properties, earthworks, including the stripping or respreading of topsoil, will be temporarily suspended and dust suppression measures immediately implemented.

Stabilisation of the soil surface will be carried out, as required, immediately following topsoil re-spreading and minor regrading. Soil stabilisation will be maintained until such time as the building construction commences.

5. ROAD NETWORK & TRAFFIC CONSIDERATIONS

5.1 Vehicular and Pedestrian Access

The subject site is accessed via Hatch Court, which connects to the wider local and regional road network through Stirling Crescent. The existing Hatch Court road is a 6.0 m sealed carriageway constructed within an 18 m road reserve.

The site is located in close proximity to key regional transport corridors, including the Great Eastern Highway Bypass, Roe Highway, Kalamunda Road and Abernethy Road, which together provide strategic connectivity to the broader metropolitan and industrial road network.

The construction of a proposed 20 m road reserve linking Hatch Court to Adelaide Street will provide a direct connection between the Hatch Court Light Industrial Area (HCLIA) and the regional road network. This new link will enable industrial Restricted Access Vehicle (RAV) movements from Hatch Court to Abernethy Road via Adelaide Street. To support this function, the existing bitumen seal along Hatch Court will require widening to approximately 9.0 m and may require pavement upgrades to accommodate increased traffic volumes and heavier industrial vehicle loading.

The State Government, through Main Roads Western Australia, is proposing major road infrastructure upgrades that will significantly enhance industrial vehicle access to the HCLIA. These works include the Great Eastern Highway Bypass Interchange Project, which will upgrade the interchanges at Roe Highway and Abernethy Road, as well as the extension of Adelaide Street through to Abernethy Road.

In addition, the City of Swan proposes to construct a new roundabout at the intersection of Stirling Crescent and Adelaide Street, with the intent of directing industrial vehicle movements from the

Hazelmere Industrial Area to Abernethy Road via Adelaide Street. This will reduce reliance on Kalamunda Road for industrial traffic accessed via Stirling Crescent.

Collectively, the proposed transport infrastructure upgrades are expected to significantly improve industrial access, efficiency and safety for the subject site and the broader HCLIA.

The existing road network is shown in **Figure 11** below.

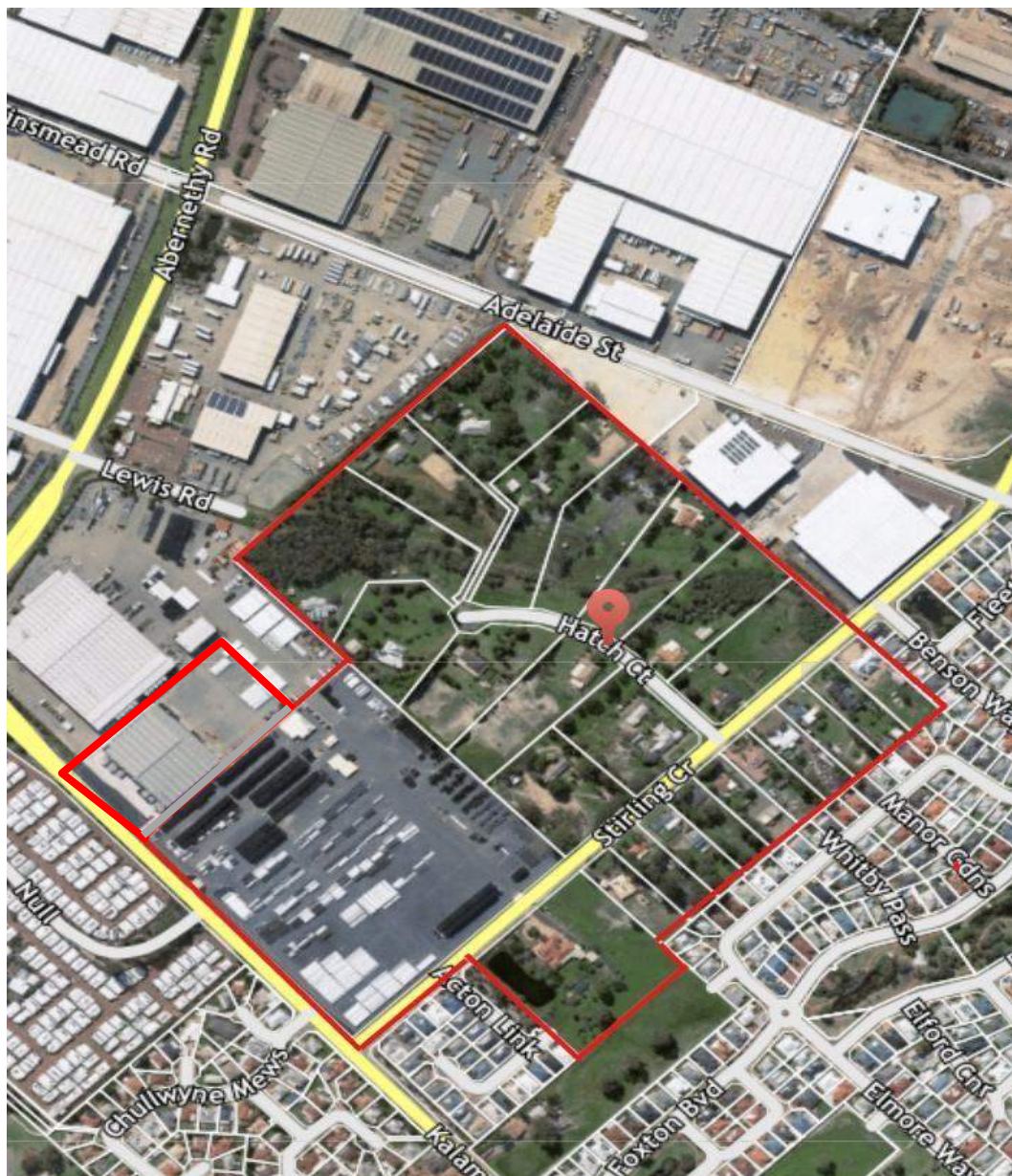


Figure 11 Existing Local Road Network

A formal Traffic Impact Assessment (TIA) has been prepared to support the Local Structure Plan which details the relevant road network upgrade needs and confirm access arrangements.

5.2 STORMWATER DRAINAGE

An existing double side-entry stormwater pit is located along Hatch Court and is connected via a 300 mm diameter pipe to the existing drainage easement within the subject site. The majority of stormwater runoff from Hatch Court is conveyed to this side-entry pit. However, runoff generated from the cul-de-sac head currently flows back onto adjoining private property.

No additional stormwater drainage infrastructure has been identified within Hatch Court.

Stormwater Management Approach

Preliminary hydrologic and hydraulic modelling was undertaken by Brendan Oversby to inform the LSP planning and ensure post-development compliance with drainage and floodplain requirements set by DWER.

Key elements include:

- Surface water is managed through vegetated swales, park avenues, and living streams.
- Detention storage will be utilized throughout the site to ensure post-development peak discharges are reduced or maintained relative to pre-development.
- All modelling and strategy development to align with:
 - Stormwater Management Manual for Western Australia (DWER)
 - Decision Process for Stormwater Management in WA (DWER, 2017)
 - Peak discharge and storage targets based on DWER floodplain benchmarks.

Design of drainage swales and open channels within or adjacent to road reserves must comply with DWER & Council guidelines to ensure both hydraulic performance and vehicle safety. The key safety considerations relate to swale depth, batter slopes, and the risk of vehicle rollover or occupant drowning in the event of an accident.

Considerations include:

- Water depth not to exceed 0.6 m, or
- Side slopes are steeper than 1:4, or
- Both criteria are combined and present rollover or submersion risk

5.3 SUBSOIL DRAINAGE

Based on predevelopment groundwater levels, Peritas recommends the installation of subsoil drainage to manage potential groundwater rise associated with post-development lot fill.

Subsoil drains are proposed beneath the road reserves, designed with a minimum longitudinal grade of 1:500 to ensure gravity flow and effective groundwater control. To maintain system performance and constructability, road levels must be designed with at least 1.2 meters of clearance above the invert level of the subsoil drainage pipes.

Subsoil discharge will connect into the main drainage conduits within the adjacent swales, which ultimately outfall to the nearest waterway.

Final pipe sizing and configuration for the slotted subsoil drains will be confirmed during detailed design, in consultation with the hydraulic consultant, and will be based on site-specific groundwater conditions and expected seasonal flows.

5.4 WASTEWATER DISPOSAL

Development to date within the Hatch Court Local Infrastructure Area has proceeded with onsite effluent disposal, as the site is not currently connected to a reticulated sewer network, with the nearest existing sewer infrastructure located a significant distance from the site. Existing Water Corporation sewer reticulation in the subject site vicinity can be found in **Figure 12**.

Existing Infrastructure and Proposed Extensions

The nearest sewer infrastructure is a DN150/225 reticulation sewers near the intersection of Acton Link & Stirling Crescent, Wim Mews and is also available at Benson Way / Stirling Crescent, however this infrastructure is too high to serve the subject site by gravity.

Ultimately the subject land is part of a sewer catchment that gravitates to the regional wastewater pump station located near the corner of Abernethy Road and Worrell Avenue.

A DN225 gravity main is planned along Abernethy Road heading north to Lewis Road and then eastwards into the subject site.

The internal gravity network within the LSP/Subject area is expected to include reticulation mains of DN225, depending on location and topography. These mains will be sized to accommodate flows from future development areas including the residential zone south of Stirling Crescent.

The delivery of the external sewer extension to the site will be expensive and may only be developed based on development demand downstream or by owners within the LSP catchment contributing to the sewer extensions to the area (Unlikely that this cooperation will occur).

A pump station and rising main were also considered as an alternative to the gravity extension, however, this option was found to be cost prohibitive when compared to the gravity sewer extension, factoring in both capital costs and the ongoing operational and maintenance costs associated with pump station infrastructure. As such, extension of the gravity network remains the preferred approach, subject to development demand and/or catchment owner contribution as noted above.

Interim Infrastructure Considerations

There may be an opportunity to service a portion of the residential portion of the site but Water Corporation has previously advised that this is outside of the approved catchment to the south and would not be considered at this time. More formal approaches to Water Corporation will be required in the future to secure the appropriate approvals which we believe are technically possible.

In order to service the residential portion of the LSP area a significant portion of the proposed residential area will require fill to provide the necessary cover to an extend sewerage network discharging to the north east (Benson Way) and south west (Stirling Crescent / Acton Link). A more detailed assessment together with relevant planning layout changes to accommodate lot orientation to suit the sewers routes will be required. Lots will not be able to front onto Stirling Crescent as they would need to be elevated above the road by up to 1-1.5m.

This could be accommodated with a conforming fencing arrangement as provided in other major residential estates. Appropriate design of the wall and potentially landscaping would reduce the impact of the structure required along the Stirling Crescent interface that would have the rear of the lots along that boundary.

The industrial/commercial portion of the site will most likely be developed as a dry industry and wastewater treated on site utilizing proprietary ATU technology and associated soakage field disposal.

Delivery Strategy and Developer Requirements

Subject to development staging and regional demand will be dependent on:

- Negotiation with adjacent landowners
- Creation of sewer easements where required
- Development approvals over third-party land

Ongoing engagement with Water Corporation will be essential to confirm:

- Preferred alignment
- Servicing timeframes
- Staging of infrastructure delivery

Early liaison is strongly encouraged at the structure planning or preliminary subdivision design stage to ensure servicing requirements and land access arrangements are well understood.

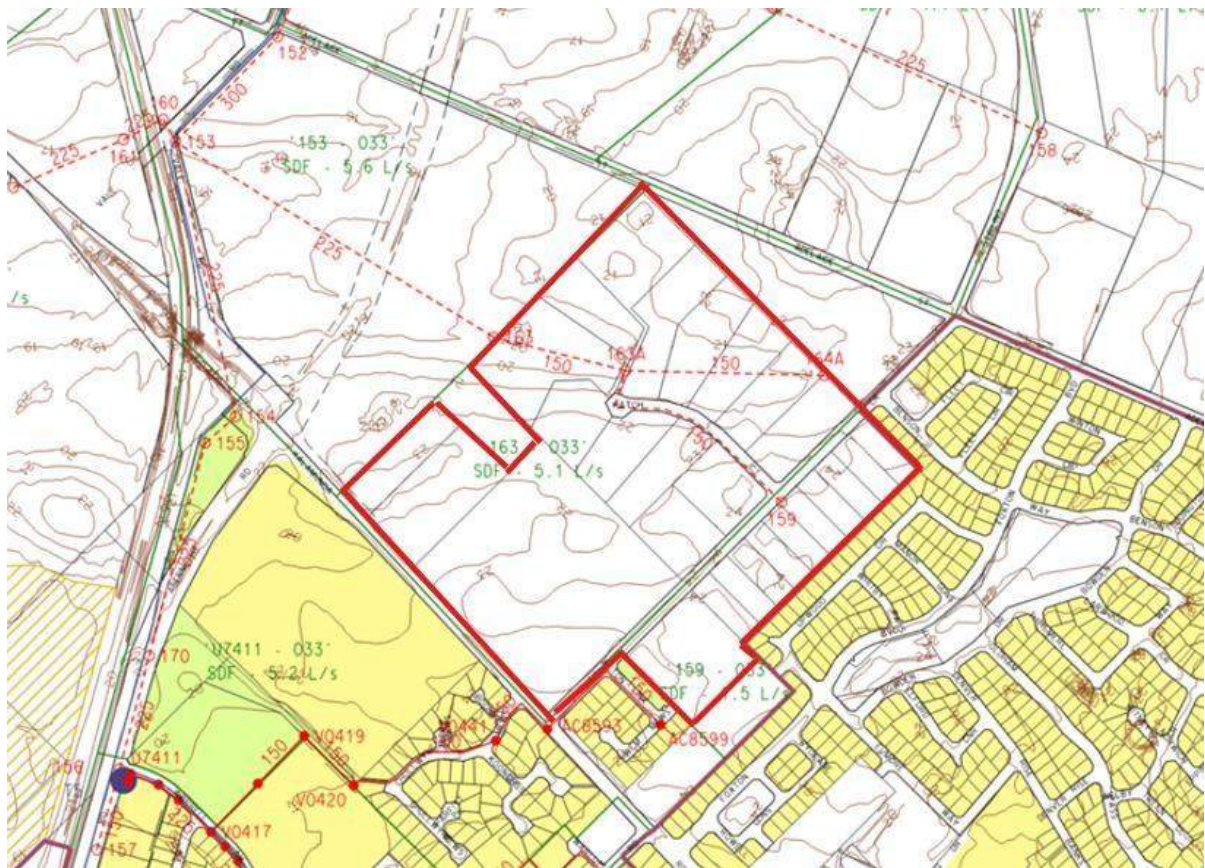


Figure 12 – Existing Water Corporation Wastewater Planning

5.5 POTABLE WATER SUPPLY

The following advice was provided at a meeting with Water Corporation in regard to potable water reticulation:

Whilst the current area is serviced by reticulated water supply, the mains are sized for the current zoning which is predominately rural and therefore would require upgrading.

When the area is developed, upgrading of water mains will be required to provide the required capacity to the developed lots (both residential and industrial).

Please note the extract below from the current ESINET planning (Refer **Figure 13** below). The mains will be required to be constructed as part of the subdivision process of this or other proposed developments in the surrounding area.

The plans confirm the presence of existing Water Corporation reticulation and distribution mains throughout the Hatch Court light industrial precinct and surrounding road network.

The existing water supply infrastructure servicing the Hatch Court and Stirling Crescent area is not expected to present any significant constraints to the proposed upgrade works within Hatch Court. A 100 mm cast iron (100CI) water main currently runs along the Hatch Court alignment, providing reticulation to the existing lots, with individual property service connections evident from aerial imagery. The presence of this asset will need to be considered during detailed design and construction planning to avoid service disruptions; however, its location is known and can be managed through standard construction practices and utility protection measures.

While the existing network configuration suggests that there is capacity available to accommodate further industrial development, the extent of any spare capacity cannot be quantified based solely on asset size and location. Confirmation of the available capacity, and the ultimate servicing requirements of the proposed industrial development, would require consultation with Water Corporation and/or a hydraulic network assessment to verify that the existing system can support the anticipated development demand.

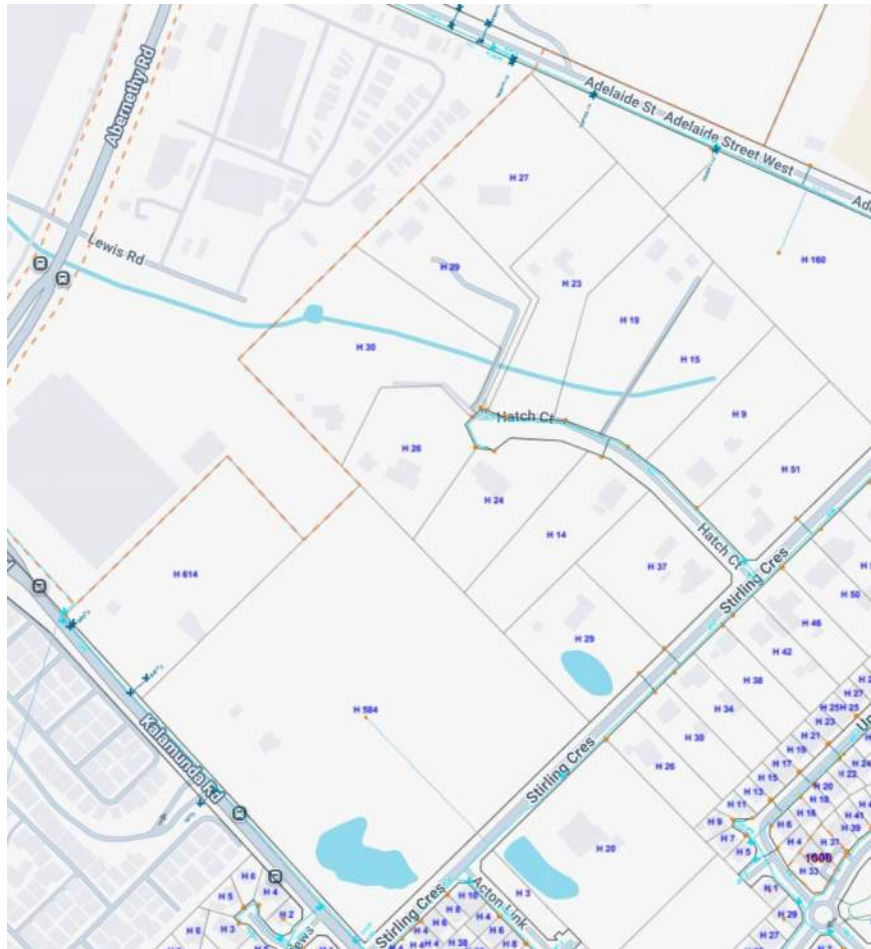
Along the Stirling Crescent corridor, a 100mm cast iron (100CI) reticulation main is present, consistent with the distribution network serving the established residential and light industrial lots fronting this road. Larger transmission and distribution mains in the vicinity include a 250mm P-12 main and a 100mm P-12 main running generally northwest-southeast along the Stirling Crescent and Fleet Crescent alignments, serving the broader precinct.

In the broader area around Kalamunda Road, significant Water Corporation infrastructure is present including a 225mm cast iron (255CI) main, a 150mm P-12 main, and a 100mm steel (100S) main running within or adjacent to the road reserve. These represent part of the trunk distribution network for the area.

Also notable within the wider study area is a 250mm P-12 main along the Adelaide Street / Hatch Court interface, and an 180mm MDPE main in the northern portion of the precinct.

All main water extensions for the subject area must be laid within the existing and proposed road reserves, on the correct alignment and in accordance with the Utility Providers' Code of Practice.

Existing water mains are located within the subject area. (Please note plan of existing assets attached) water mains should not be located in private land and should be in and protected by reserves (i.e. road reserves).



5.6 POWER, TELECOMMUNICATION & GAS

5.6.1 Western Power

A Western Power overhead and underground asset search was undertaken for the subject area. The plans identify existing overhead powerlines within and adjacent to the Hatch Court precinct, including High Voltage distribution lines (1 kV – 33 kV) running along Stirling Crescent, and a Transmission line (33 kV – 330 kV) traversing the broader area in a northwest-southeast alignment. Low Voltage overhead lines (< 1 kV) are also present servicing existing lots.

The underground HV/LV plan confirms the presence of underground High Voltage cables (1 kV – 33 kV), Low Voltage cables (< 1 kV), street light circuits, and associated pillars and terminations within the local road network, including along Stirling Crescent and adjacent streets.

A proposed Design Area is indicated near the Adelaide Street / Stirling Crescent intersection, suggesting active or planned Western Power works in this vicinity. Prior to any excavation or construction works, hand exposure via pothole method is mandatory in the vicinity of underground assets.

It is anticipated that all lots within the proposed development will be served with underground power. The cost of this work will need to be met in full by the developer. Western Power requirements will apply.

It is likely that a number of pad mount sites will be required throughout the development, however, due to the range of sizes of lots proposed within the development, it is not envisaged that there will be a problem in providing the sites strategically located to meet both Western Power design requirements and the requirements of the developer.

The street lighting throughout the development shall provide effective illumination for both pedestrian and vehicles.

5.6.2 Telecommunication Services

At Hatch Court, the plans confirm in-service/constructed NBN™ conduit running along the Hatch Court Road reserve, with multiple pit structures present at lot frontages providing individual property connections. The conduit appears to service the existing lots within the court, with pits distributed at regular intervals along the alignment.

Along Stirling Crescent, NBN™ conduit infrastructure is present with pits and direct-buried cables distributed along the road reserve. Multiple conduit runs are visible, consistent with both the existing Telstra-owned (PO) PVC conduit and NBN-owned (P40) 40mm PVC conduit running in the same corridor. Pit spacings are generally 20–25 m apart. A pillar (orange symbol) is also shown near the Stirling Crescent / Winton Crescent intersection, indicating a network aggregation point for the surrounding residential area.

Along the Kalamunda Road corridor, the plans show NBN™ conduit and pit infrastructure running generally parallel to the road reserve, with conduit connections branching to service the surrounding lots. This is consistent with the established network serving the residential and light industrial subdivision in the area.

Information from Telstra indicates there is a service network within the area. It is anticipated that all lots within the proposed development will be served with Telstra Telecommunication services.

Telstra will design (developer to pay) and provide details for the installation of a pit and pipe network at the cost of the developer the new telecommunication network facilities to the proposed lots. Alternatively, where cable routes match power underground supply routes, Telstra will wherever possible use the Western Power trenches in lieu of the developer providing additional trenching.

Telstra or other communications providers will cable the development once development has commenced in the area and applications are made by the land owners for communications services to their development. Headwork charges for Telstra services extensions are anticipated.

5.6.3 Gas Supply

At Hatch Court, a 50mm PVC distribution main (MAOP 70 kPa, natural gas) is present, with individual service connections to existing lots.

Along Stirling Crescent, multiple gas assets are present in close proximity, including a 155mm PVC distribution main (MAOP 70 kPa, NG) and a CRITICAL high-pressure 150mm steel transmission pipeline (MAOP 1,900 kPa, NG). The critical asset is noted to be approximately 0.9 m deep at a deviation point, and 1.5 m deep either side of the deviation. A 155mm PVC main (MAOP 70 kPa) is also present. Individual service connections serve adjoining lots along this alignment.

Along Kalamunda Road, a 160mm PE distribution main (MAOP 70 kPa, NG) is present, along with a CRITICAL 160mm PE pipeline (MAOP 700 kPa, NG) and a CRITICAL 150mm steel pipeline (MAOP 1,900 kPa, NG).

A Critical Asset Warning applies to this area. No works within 15 metres of the critical assets are permitted without prior written approval from ATCO Gas Australia. Hand exposure via pothole method is mandatory prior to any excavation in the vicinity of these assets. The project team must contact ATCO Gas Australia directly before commencing any works.

ATCO Gas has advised that reticulated gas services are available in the surrounding area.

ATCO Gas may provide road crossing conduits for future use; however, this is subject to cost allocations and budgets being approved by the gas authorities.

Please refer to the attached plans in **Appendix C** for further information regarding gas assets.

6. CONCLUSIONS & RECOMMENDATIONS

All essential infrastructure services—water, drainage, power, and gas—can feasibly be extended to service the site. However, given the site's position at the edge of the current servicing envelope, careful coordination and early planning will be required, particularly where upgrades or infrastructure extensions are necessary.

Peritas does not identify any immediate critical barriers to development. However, we recommend ongoing liaison with the relevant authorities to address infrastructure delivery, land access, and network capacity issues early in the planning process. This is especially important for a stand-alone development, where cost apportionment and timing of broader infrastructure upgrades may pose constraints if not addressed proactively.

Further Investigations and Key Next Steps

The recommendations listed below are intended to identify the additional work streams that may be required to facilitate the orderly progression of the Local Structure Plan (LSP) through the statutory planning process and subsequent subdivision and development stages. They are not necessarily all prerequisites to Council's consideration of whether the LSP should be advertised.

At this stage, the servicing report has been prepared to provide a high-level assessment of the site's servicing opportunities and constraints to inform the LSP. The recommendations identify matters that may require further investigation or confirmation as the planning and development process advances.

1. Liaise further with Water Corporation regarding water and sewer connection strategies, including potential temporary solutions based on staging and coordination with neighbouring developments.
2. Consult Western Power to identify suitable connection points and determine the need for Earth Potential Rise (EPR) or Low Frequency Induction (LFI) assessments.
3. Coordinate with the Western Power transmission team to confirm easement requirements under high-voltage lines.

Since preparation of the servicing report, preliminary consultation has been undertaken with relevant servicing authorities to identify the presence of existing infrastructure and any obvious constraints affecting the site. The outcomes of these investigations have informed the conclusions of the report, namely that the site is capable of being serviced; however, further detailed assessment and confirmation by the respective authorities will be required as the proposal progresses through later planning and development stages.

Accordingly, the recommendations should be viewed as a roadmap for the next phase of investigations rather than as outstanding matters that prevent Council from considering the LSP for advertising. Any requirements identified through agency referrals during the advertising process can be addressed prior to final adoption of the LSP or as conditions of subsequent subdivision approvals, as appropriate.

Priority Recommendations:

Post-LSP Progression

Finalize servicing alignments.

Acid sulfate soil (ASS) testing & Management Plan as part of subdivision development.

Asset relocation and protection coordination.

Early and proactive engagement with major service authorities is recommended to confirm detailed requirements for:

- Confirm servicing capacities and connection strategies
- Clarify potential infrastructure upgrades

- Enable coordinated forward works planning and budgeting

In summary, the subject site presents a viable and serviceable urban development opportunity. With further detailed investigation and ongoing stakeholder collaboration, the site can be delivered as a high-quality, fully serviced development precinct.

APPENDIX A- LOCAL STRUCTURE PLAN & LAYOUT



APPENDIX B – GEOTECHNICAL REPORT

Report on:

**GEOTECHNICAL STUDY
PROPOSED ROAD FROM HATCH COURT TO
ADELAIDE STREET
LOT 13 HATCH COURT, HIGH WYCOMBE**

WAG240007-01 003 R Rev2

Submitted to:

McDowall Affleck
69 Great Northern Highway
Midland WA 6056

19 March 2024

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Figure 1: Site and Location Plan

Appendix A:	Supplied Drawing
Appendix B:	Site Photographs
Appendix C:	Borehole and Pavement Dipping Reports
Appendix D:	Geotechnical Laboratory Test Results
Appendix E:	Chemical Laboratory Test Results

Standard Geotechnical Definitions, Recommendations, Requirements and Limitations

1. INTRODUCTION

This report presents the outcomes of Galt Geotechnics' (Galt's) geotechnical study for the proposed road between Hatch Court and Adelaide Street, High Wycombe ("the site").

This report is to be read in conjunction with the appended "Geotechnical Definitions, Recommendations, Requirements and Limitations", 'Clause GDR1', etc. at the back of this report.

2. KEY FINDINGS

The site is geotechnically suitable for the proposed road.

The majority of the site is underlain by sand. In the area of the existing creek, there is a 0.8 m thick layer of organic silty sand over the sand.

In the northern part, there is a layer of iron indurated sand (coffee rock) at a depth of about 2 m.

The southern half of the site lies within a registered "sumpland" area. Seasonal shallow groundwater and surface water is expected during winter. Shallow groundwater was encountered in the southern half of site at depths of between 0.6 to 0.8 m (we expect the groundwater will rise over winter).

The proposed drainage basin in the southeast corner of site will not be very effective for on-site disposal of stormwater due to the shallow groundwater in this area.

The northern part of site may be more suitable for the proposed drainage, provided that the base of the basin is at least 0.5 m above the groundwater.

Soakwells may be used if the surface is raised with permeable sand such that is at least 0.5 m above the design groundwater elevation (to be confirmed by a hydrologist).

3. SITE DESCRIPTION

A description of the site currently and historically is presented below in Table 1.

Table 1: Summary of Site

Item	Comment
Site Extent	Refer Figure 1
Site Area	Total site area is about 1.3 ha, with approximately 5,000 m ² for the road reserve.
Current Site Surface Levels ¹	Around RL 20 m AHD to RL 22 m AHD
Vegetation	Mature trees present along proposed road reserve
Current Land Use	Semi-rural residential
Existing Infrastructure	Existing dwellings
Site History ²	1953 to 1985: Bushland/pasture. 1985 to 1989: Construction of houses, sheds and driveways within and adjacent to site 1995- to present: Largely unchanged.

- NOTES:**
1. Site levels based on publicly available data (Landgate)
 2. Site history based on aerial imagery (Landgate)

4. PROPOSED DEVELOPMENT

Table 2: Summary of Proposed Development

Item	Comment
Proposed Development	Proposed road connecting Adelaide Street to Hatch Court.
Proposed Finished Level	Unknown
Cut/Fill	Minimal or as required to facilitate road and drain levels. Fill may be required to tie in proposed road with existing Hatch Court road.
Assumed Retaining Walls	Minimal or as required to facilitate road and drain levels.
Assumed Stormwater Disposal	Via drainage basin in southeastern corner of site (note shallow groundwater in this area)

NOTES: 1. Proposed development details based on supplied information presented in Appendix A.

5. PROJECT OBJECTIVES

The objectives of the study were to:

- assess subsurface soil and groundwater conditions along the proposed road across Lot 13;
- recommend site preparation procedures including compaction criteria;
- assess the permeability of the soils at the proposed drainage basin;
- provide a subgrade California bearing ratio (CBR) value for pavement design of the new road; and
- assess the existing pavement along Hatch Court for the proposed widening.

6. FIELDWORK

Fieldwork was carried out by a representative from Galt on 22 February 2024. The work is summarised below.

Table 3: Summary of Field Data

Type	Results Appendix	Summary	GDR Clause	Equipment Used	No. Tests	Depth Range (m)
Site Plan	Figure 1	-	-	Hand held GPS ¹	-	-
Photographs	B	-	-	-	-	-
Machine Auger Boreholes (BH)	C	Section 9	GDR3.3	EVH Scout on utility	8	1.0 – 3.0
Dynamic Cone Penetrometer (DCP)	C	N/A	GDR3.4	Hand operated DCP	8	0.7 – 1.0
Infiltration Tests (I) ³	-	-	GDR3.7	Inverse auger hole	-	-

NOTES:

1. Hand held GPS is accurate to ± 5 m.
2. DCP tests carried out adjacent to boreholes.
3. Infiltration testing was not carried out within the proposed drainage basin due to the presence of shallow groundwater and low permeability soils (organic silty SAND)

7. LABORATORY TESTING

Table 4: Summary of Laboratory Testing Undertaken

Type	No. Tests	Results Summary	Results Appendix
Particle Size Distribution	6	Attached Table 1	D
Atterberg limits and linear shrinkage	2		
Organic Content ¹	1		
Emerson Class	1		
Calcium Carbonate Content	1		
Modified Maximum Dry Density	2		
California bearing ratio (CBR)	2		
Phosphorus Retention Index	2	Attached Table 2	E
pH	2		

8. SITE CONDITIONS

8.1. Geology

Table 5: Summary of Geology Mapping

Map Sheet	Map Scale	Mapped Soils	Site Findings
Perth	1:50,000	Northern portion of site underlain by a thin layer of Bassendean Sand overlying Guildford Formation Southern portion of site underlain by Swamp Deposits (Peaty Clay)	SAND (SP) overlying Coffee Rock in the northern half of site; and Organic Silty SAND (OL) overlying SAND (SP) in the southern half of site

8.2. Groundwater

Table 6: Summary of Groundwater Levels

Item	Date	Depth Range (m)	Elevation Range (m AHD)	Comment
Perth Groundwater Atlas ¹	2004	6 - 9	13 - 14	
Site observations ²	2024	0.6 – 1.8	20 - 22	Groundwater was not encountered within the northern portion of site (BH01 and BH02) to a depth of about 2.0 m.

- NOTES:**
1. Perth Groundwater Atlas (2004) shows typical seasonal minimum groundwater elevations
 2. Investigation carried out in summer 2024. We expect groundwater to rise over winter

The southern half of the site lies within a registered “sumpland” area. Seasonal shallow groundwater and surface water is expected during winter.

8.3. Defect Survey

The pavement condition and defects noted in the vicinity of boreholes carried out along Hatch Court may be summarised as follows:

- Significant delamination of the spray seal, particularly near the cul-de-sac. Degree of delamination reduces towards the east along Hatch Court.
- Moderate crocodile cracking observed in the vicinity of the cul-de-sac.
- No significant pavement deformation noted along the road alignment.

8.4. Pavement and Subgrade Profile

The exposed pavement and subgrade profiles are summarised in Table 7.

Table 7: Summary of Pavement and Subgrade Profile

Location	BH06	BH07
Pavement Layer	Description/Thickness (mm)	
Wearing Surface	Spray Seal 20 mm	Spray Seal 10 mm
Basecourse	FILL: Sandy GRAVEL (GP-GM) Crushed Granite 100 mm	FILL: Sandy GRAVEL (GP-GM) Crushed Granite 70 mm
Subbase	FILL SAND (SP-SM) Crushed Limestone 150 mm	FILL SAND (SP-SM) Crushed Limestone 150 mm
Subgrade	FILL SAND (SP) to a depth of up to 1 m	

- Notes:**
1. The terms wearing surface, basecourse and subbase are used to describe the pavement stratigraphy and do not imply a certain material quality, strength and/or specification compliant fill material.
 2. Detailed descriptions according to AS1726 (2017) are presented on the pavement dipping reports in Appendix C.

Preliminary calculations indicate that the existing road (Hatch Court) would be suitable for a lifetime traffic load of 2.5×10^5 ESA. This is based on a minimum pavement thickness of 220 mm and design CBR subgrade of 10%.

We can provide advice on suitable options and pavement recommendations if required. We would require design traffic loads for this.

9. GROUND MODEL

The subsurface conditions are generalised in the inline image and table below. The generalised subsurface units are described in Table 8 with geotechnical design parameters.

Inline Image 1 – Idealised cross section of soil conditions.

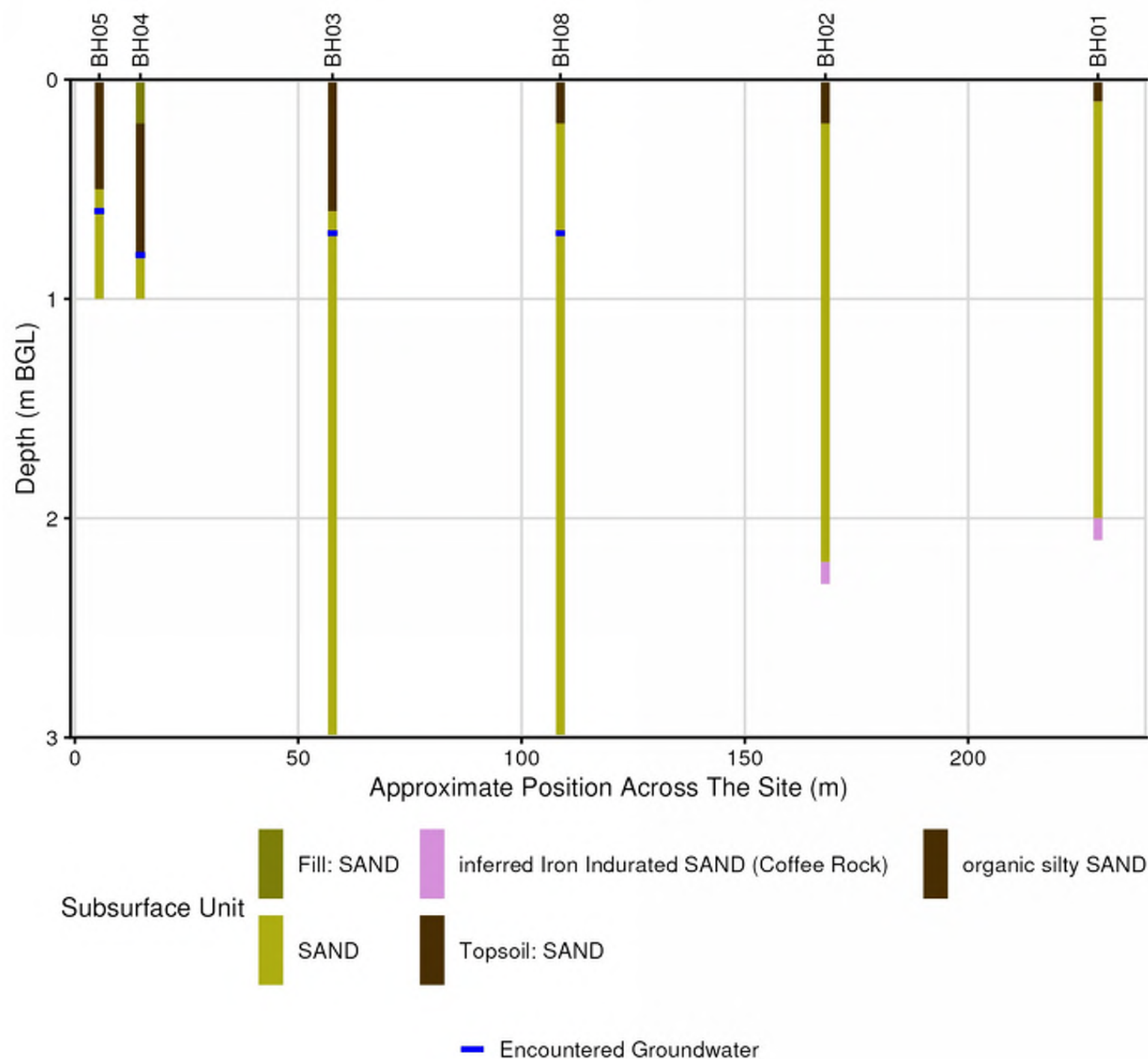


Table 8: Geotechnical Model Units and Design Parameters

Unit Name	Material Type	Where Found	Description	Comment	γ_{bulk} (kN/m ³)	ϕ' (°)	c' (kPa)	S_u (kPa)	E_v (MPa)	ν	k_0	Wall Friction=0		Wall Friction=0.5 ϕ	
												k_a	k_p	k_a	k_p
A	SAND	Near surface to maximum investigated depth of 3 m (most of the site)	Fine to medium grained, sub-angular to sub-rounded, grey/white, brown, trace fines	Typically medium dense	17	34	-	-	25	0.3	0.39	0.28	3.54	0.25	6.47
B	Organic silty SAND	Southern part of site from surface to about 0.8 m	Organic silty sand, black, 10-25% non-plastic fines	Loose becoming medium dense	16	30	-	-	10	0.4	0.42	0.33	3.00	0.29	4.40

- NOTES:**
- These units are a generalization of results from individual tests, which should be referred to for more information.
 - Topsoil is not included as a discrete unit.
 - For all earth pressure coefficients (retaining wall design) refer to clause GDR11.2 for more detail and interpretation. Unit weights for retaining structure design should be as per GDR11.2 or 1 kN/m³ greater than the values in the table above.
- γ_{bulk} – bulk unit weight
 ϕ' – effective friction angle
 S_u – undrained shear strength
 c' – effective cohesion
 E_v – vertical elastic modulus
 ν – Poisson's Ratio
 k_a – coefficient of active earth pressure (Coulomb – AS4678-2002, Appendix E)
 k_p – coefficient of passive earth pressure (Coulomb – AS4678-2002, Appendix E)
 k_0 – coefficient of at-rest earth pressure (Jaky)

10. GEOTECHNICAL ASSESSMENT

10.1. Summary

Table 9: Summary of Geotechnical Assessment

Type	Clause	Parameter	Comment
Site Suitability	-	-	We consider the site to be geotechnically suitable for the proposed road. Layer of organic silty sand to be removed and replaced with engineered fill.
Site Preparation	GDR6	-	GDR6.2.1 Common Measures followed by GDR6.2.2 Sand Sites . We note the presence of shallow groundwater and organic silty soils (locally present in the southern part of site) Refer to Section 10.2 for additional site preparation measures recommended as part of remediation.
Approved Fill	GDR8		Approved Fill for this site is to comprise General Sand . All <u>natural</u> and <u>existing fill</u> sands may be assumed to be General Sand except the organic silty soils (black) noted within the top 0.8 m in the southern portion of site. If additional fill is required, imported General Sand will be needed.
Compaction Control	GDR7	-	A PSP may be used for compaction control on site-derived General Sand . Deemed to comply values for 'Bassendean Sand' in GDR7.4 are applicable.
Unsaturated Hydraulic Conductivity	GDR13	N/A	Infiltration tests were not carried out within the proposed drainage basin due to presence of shallow groundwater and low permeability, organic soils. If a drainage basin is required, we recommend it is positioned in the northern portion of site (if possible). Additional testing is recommended to confirm the suitability of any new proposed locations.
Pavement Subgrade CBR	GDR16	CBR = 10%	Design CBR value is applicable where natural sand is exposed or at least 1 m of sand fill is present above organic soils.

10.2. Additional Site Preparation Measures

The site preparation measures outlined below are to be completed in the southern part of the alignment (area underlain by organic silty sand).

- Strip vegetation within the proposed road footprint area.
- Remove all organic silty soils (as encountered) to expose underlying sand (typically around 0.6 m to 0.8 m below ground surface).
- Proof roll in-situ sand.
- Backfill with approved fill as per **GDR6.2.1 Common Measures** followed by **GDR6.2.2 Sand Sites**

We note that groundwater was encountered at depths ranging from 0.6 m to 0.8 m in the southern half of site. When groundwater is present within 1 m of a compacted surface it is often difficult to achieve the required density. This can be remedied by:

- dewatering to lower the groundwater to at least 1 m below the compacted surface; or
- a coarse pioneer layer (say 0.3 m thick of 19 mm crushed igneous rock) and compacting using a heavy smooth drum roller in static mode.

11. CLOSURE

GALT GEOTECHNICS



Timothy Dunton
Engineering Geologist



Rick Piovesan CPEng
Geotechnical Engineer

[https://galtgeo.sharepoint.com/sites/wag240007/shared documents/01 porter si hatch ct/03 correspondence/wag240007-01 003 r rev0.docx](https://galtgeo.sharepoint.com/sites/wag240007/shared%20documents/01%20porter%20si%20hatch%20ct/03%20correspondence/wag240007-01%20003%20r%20rev0.docx)

Attached Table 1: Summary of Geotechnical Index Test Results

Test Name	Sample Depth (m)	Soil Class (AS1726 2017)	Gravel (%)	Sand (%)	Fines (%)	Emerson Class	LL (%)	PI (%)	LS (%)	Org %	MMDD (t/m ³)	OMC (%)	CBR (%)	CBR Swell (%)	CaCO ₃
BH01	0.1 – 0.5	SAND (SP)	0	97	3	-	-	-	-	-	1.78	12.5	25	0	-
BH02	0.2 – 0.4	SAND (SP)	1	97	2	-	-	-	-	-	1.76	12.5	19	0	-
BH03	0 – 0.5	Organic Silty SAND (SM / OL)	0	68	32	-	40	12	3.0	7.4	-	-	-	-	-
BH03	0.7 – 1.1	Silty SAND (SM)	0	85	15	5	-	-	-	-	-	-	-	-	-
BH06	0.01 – 0.1	GRAVEL (GP-GM)	66	27	7	-	NO	NP	1.5	-	-	-	-	-	-
BH06	0.1 – 0.25	SAND (SP-SM)	22	65	13	-	-	-	-	-	-	-	-	-	58.2

Notes	1.	Particle size distribution (by mass)													
		Gravel: 2.36 mm – 63 mm													
	2.	Atterberg Limits													
		LL: Liquid limit													
	3.	Org: Organic content (by mass)													
	4.	Modified compaction													
		MMDD: Modified maximum dry density													
	5.	CBR: California bearing ratio													
		Remoulding dry density ratio: 95% MMDD													
	6.	CaCO ₃ : Calcium carbonate													

Sand: 0.075 mm – 2.36 mm

Fines: <0.075 mm

PI: Plasticity index

LS: Linear shrinkage

OMC: Optimum moisture content

Surcharge: 4.5 kg

Soaking: 4-day soaked

Attached Table 2: Summary of Chemical Test Results

Location	Sample Depth (m)	Soil Description	Soil Condition	pH	PRI
BH01	0.1 – 0.5	SAND (SP)	B	7.1	0.74
BH03	0.7 – 1.1	SAND / Silty SAND (SP/SM)	A	5.4	7.60

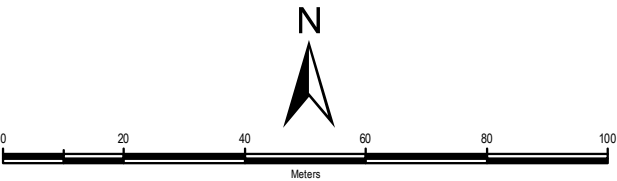
- NOTES:**
- Soil condition
A – high permeability soils (sands and gravels) which are below water table.
B – Low permeability soils (silts and clays) and all soils above water table
 - PRI – Phosphorous Retention Index

Figures

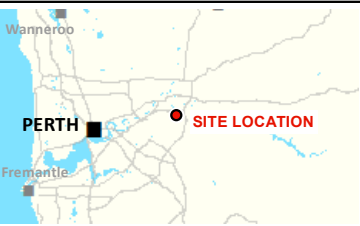


Legend

- Site Boundary
- Borehole
- Pavement Dipping



NOTES
Aerial Imagery and Cadastre sourced from Landgate/SLIP



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DATE DRAWN	14/3/2024	
CHECKED	RP	
DATE CHECKED	17/3/2024	
PROJECTION	GDA 1994 MGA Zone 50	



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Osborne Park WA 6017

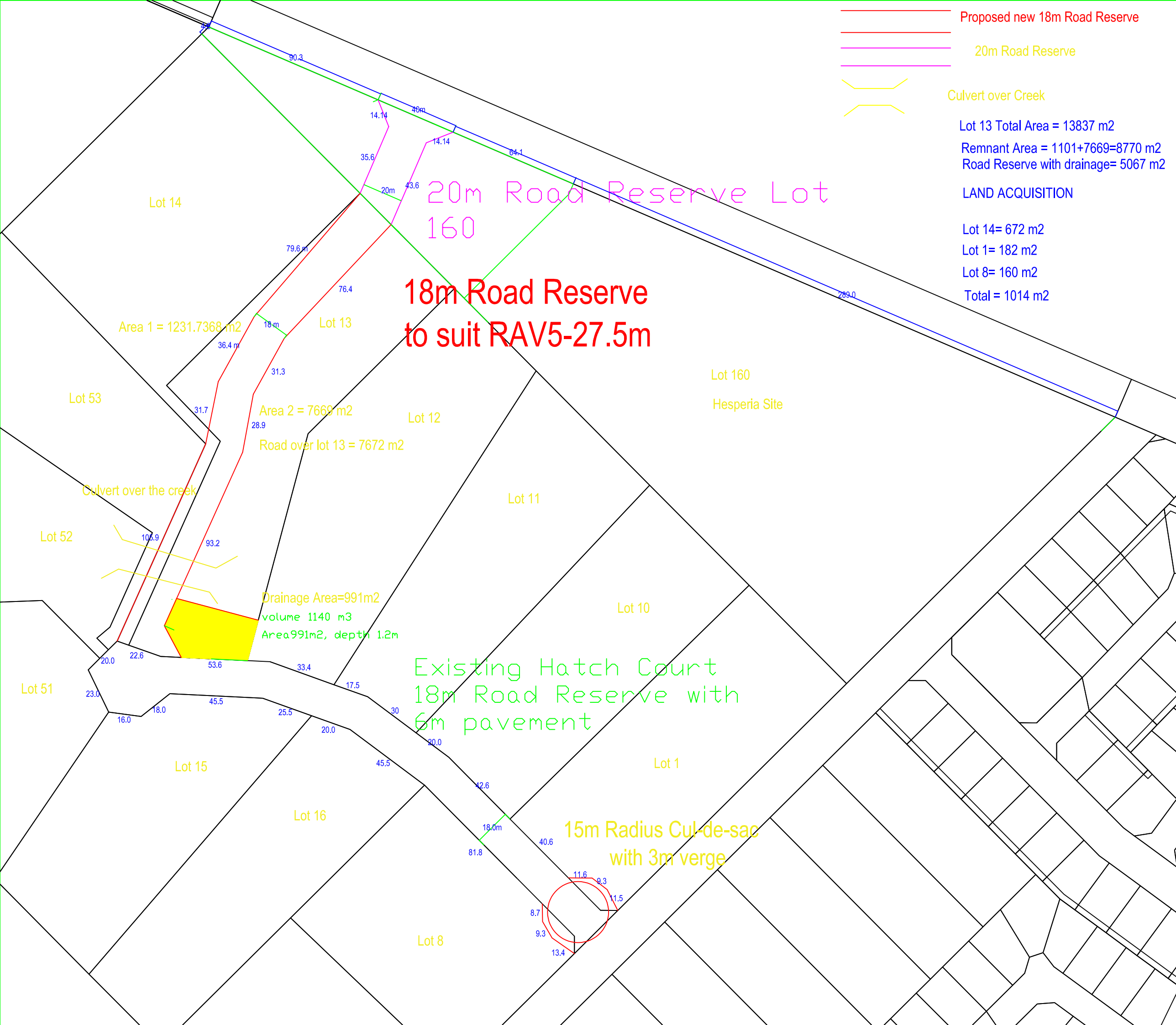
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CLIENT	MAPL		
PROJECT	PROPOSED ROAD		
LOCATION	23 HATCH COURT HIGH WYCOMBE		
TITLE	SITE & LOCATION PLAN		
Job No	WAG240007 -01	Fig No	FIGURE 1
		Rev	A

Appendices

Appendix A: Supplied Drawing





Appendix B: Site Photographs

Photograph 1: Looking south at creek from near BH03



Photograph 2: View of creek



Photograph 3: Looking south from near BH01



Photograph 4: Looking east from near BH01



Photograph 5: Looking west from near BH04



Photograph 6: Delamination noted near cul-de-sac along Hatch Court



Photograph 7: Crocodile cracking noted near cul-de-sac along Hatch Court



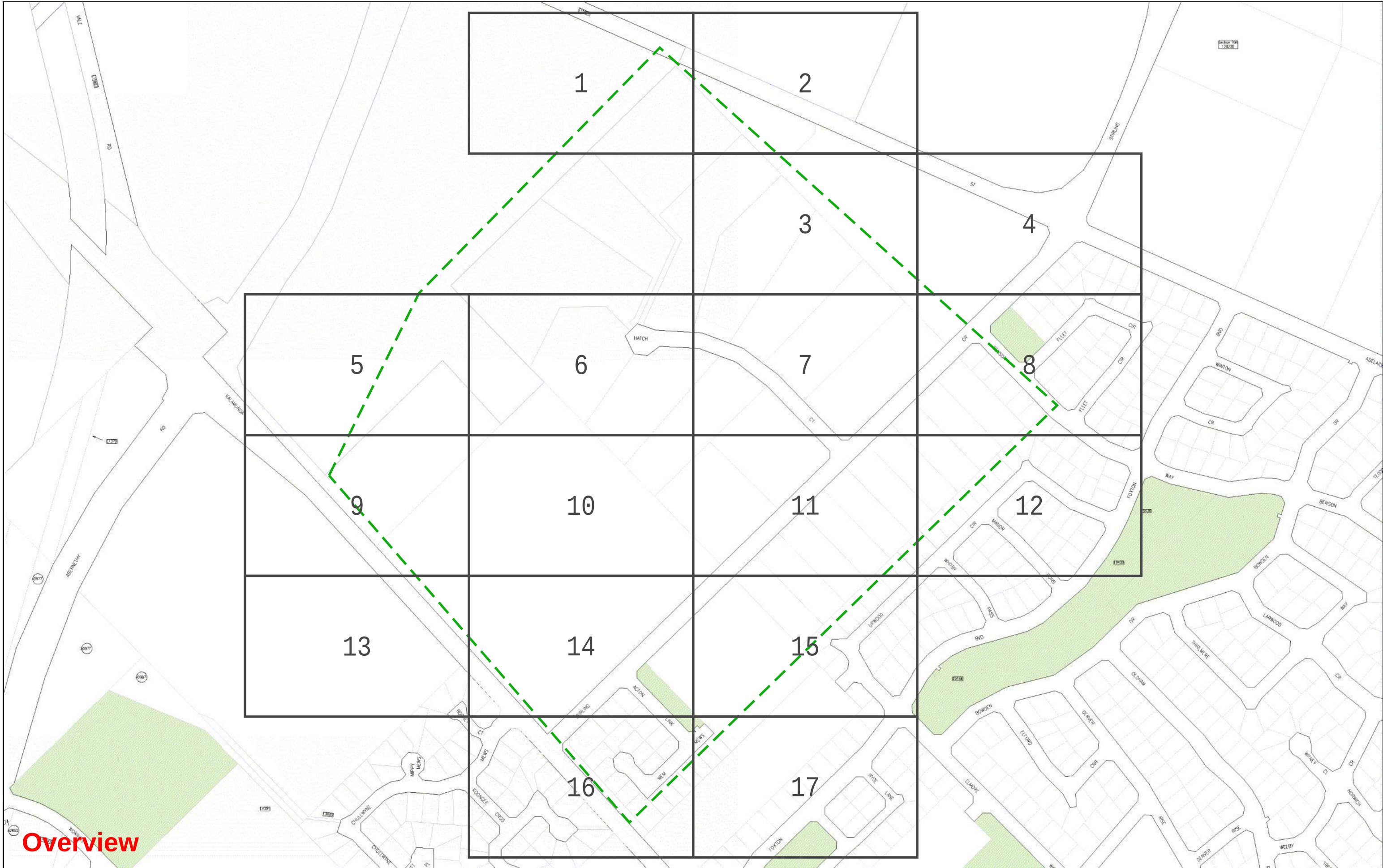
Photograph 8: Looking east from BH07 – minor delamination patches noted



Photograph 9: Looking west from near BH07



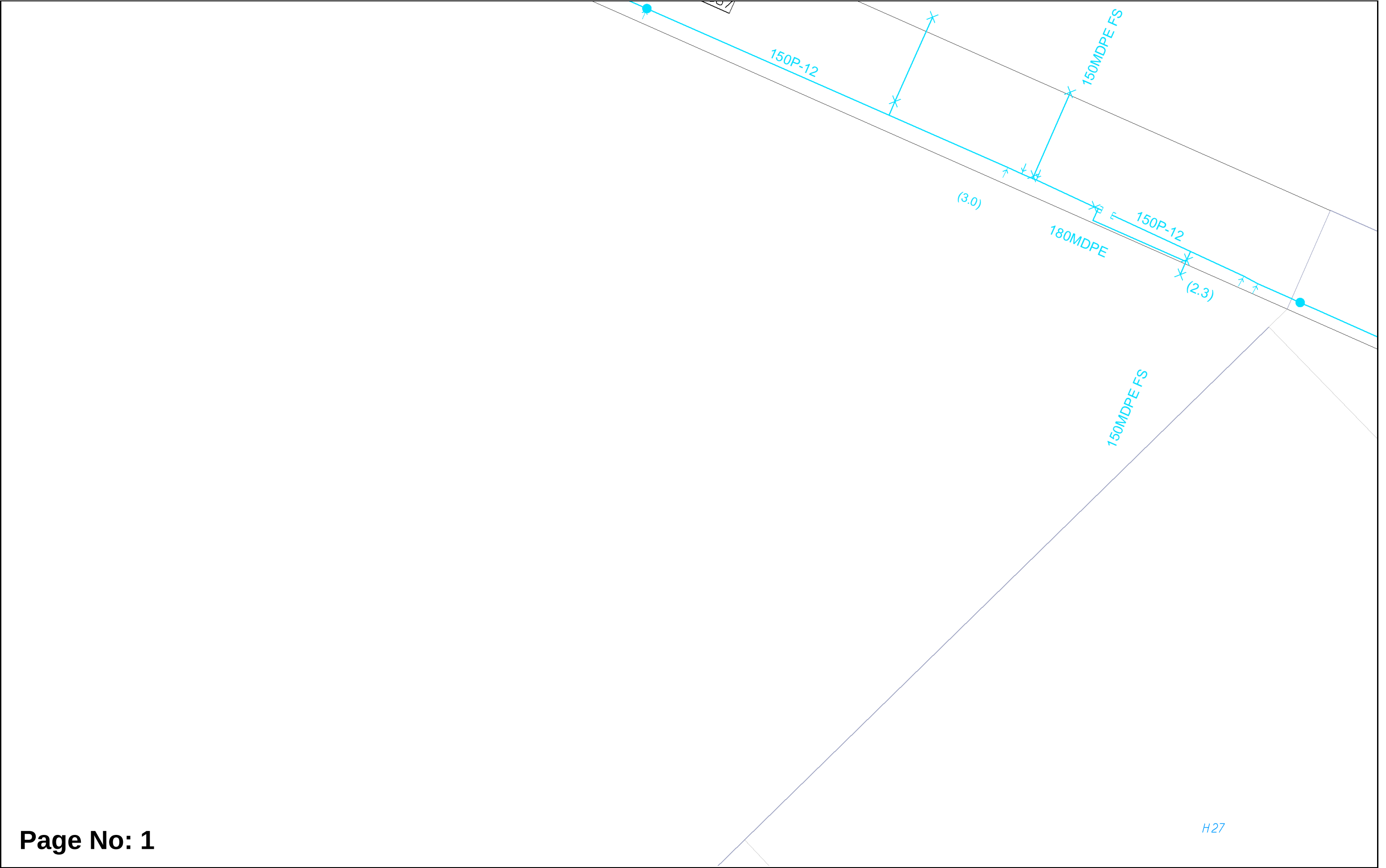
APPENDIX C – DBYD SERVICES



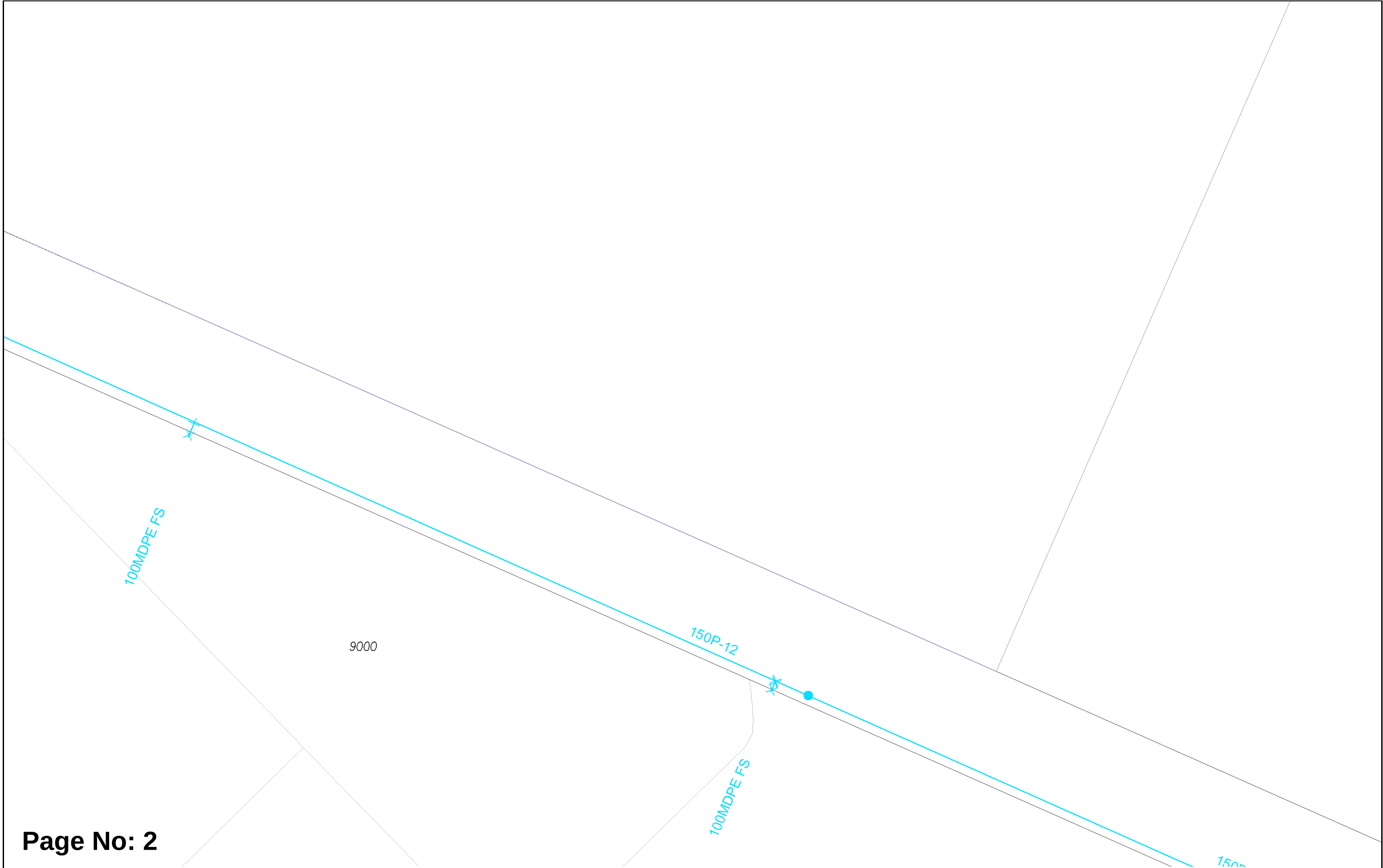
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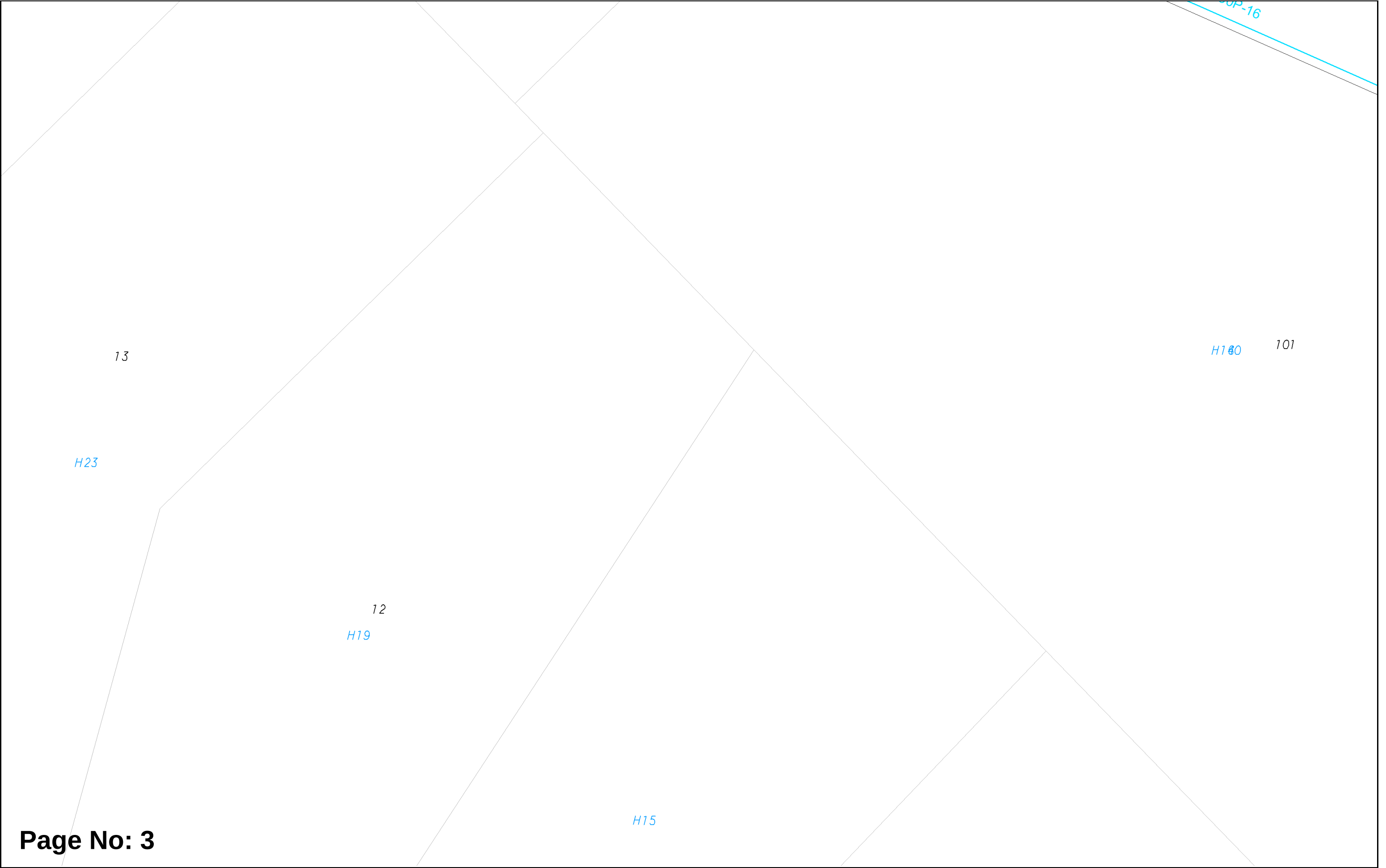
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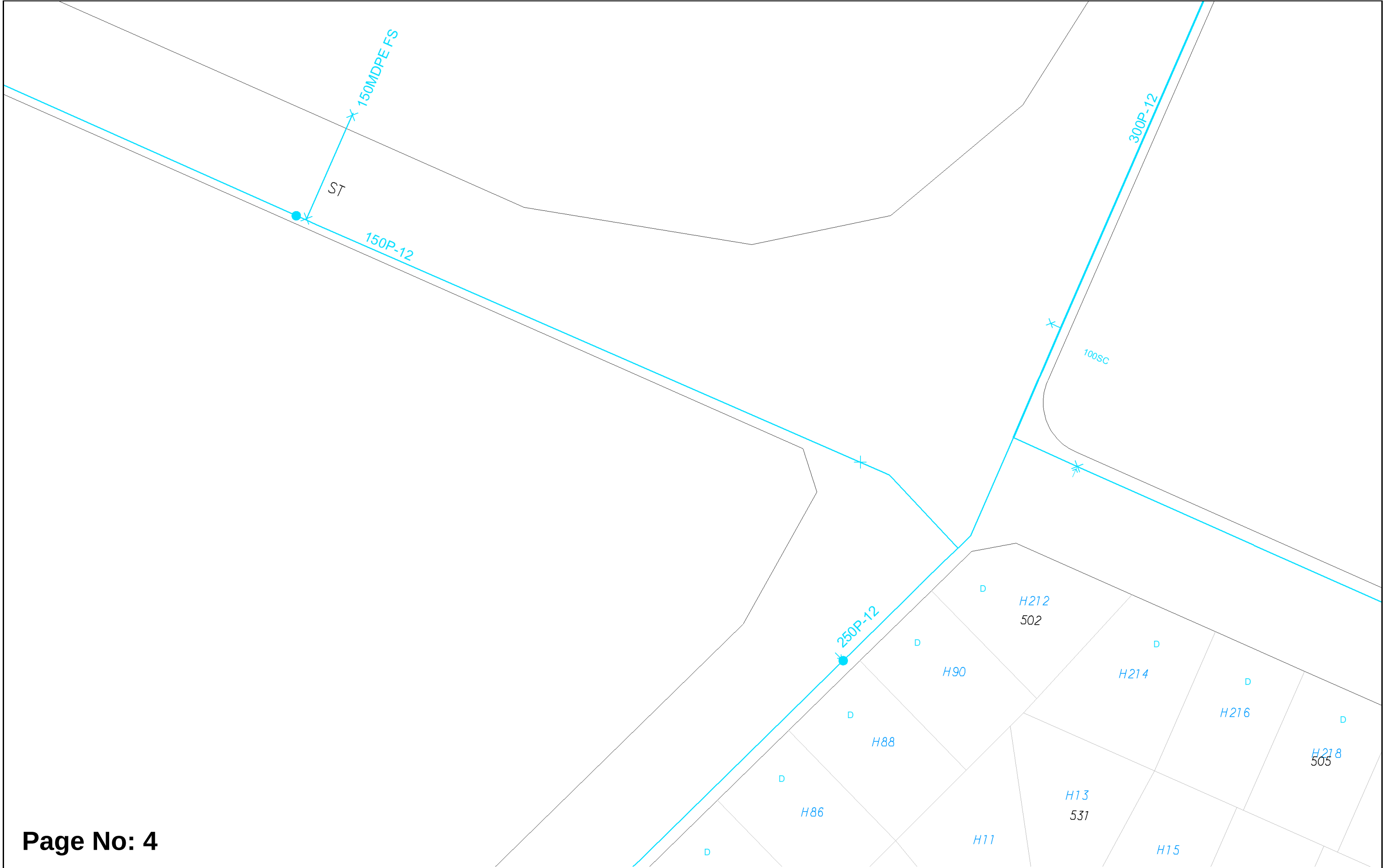
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Water

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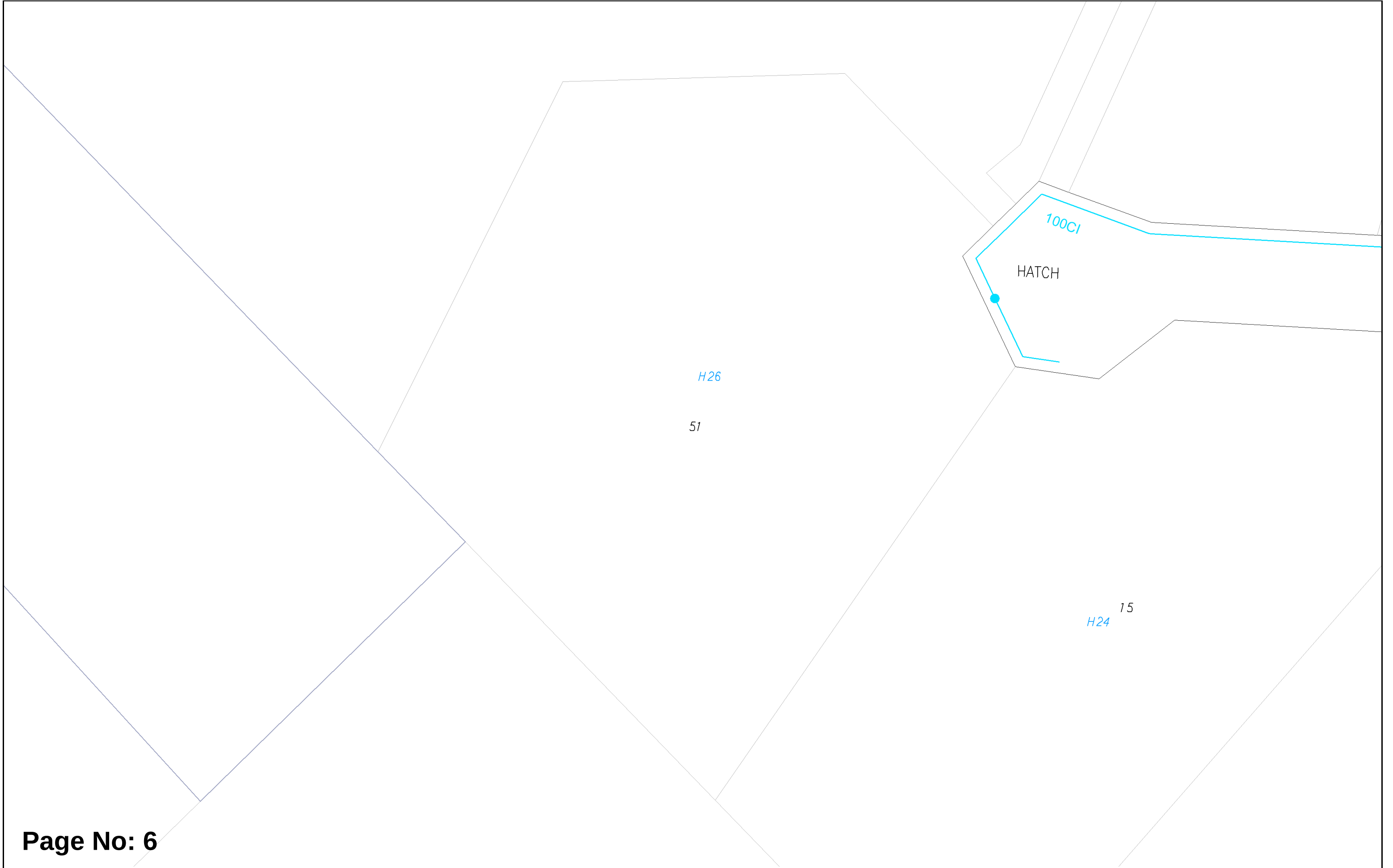


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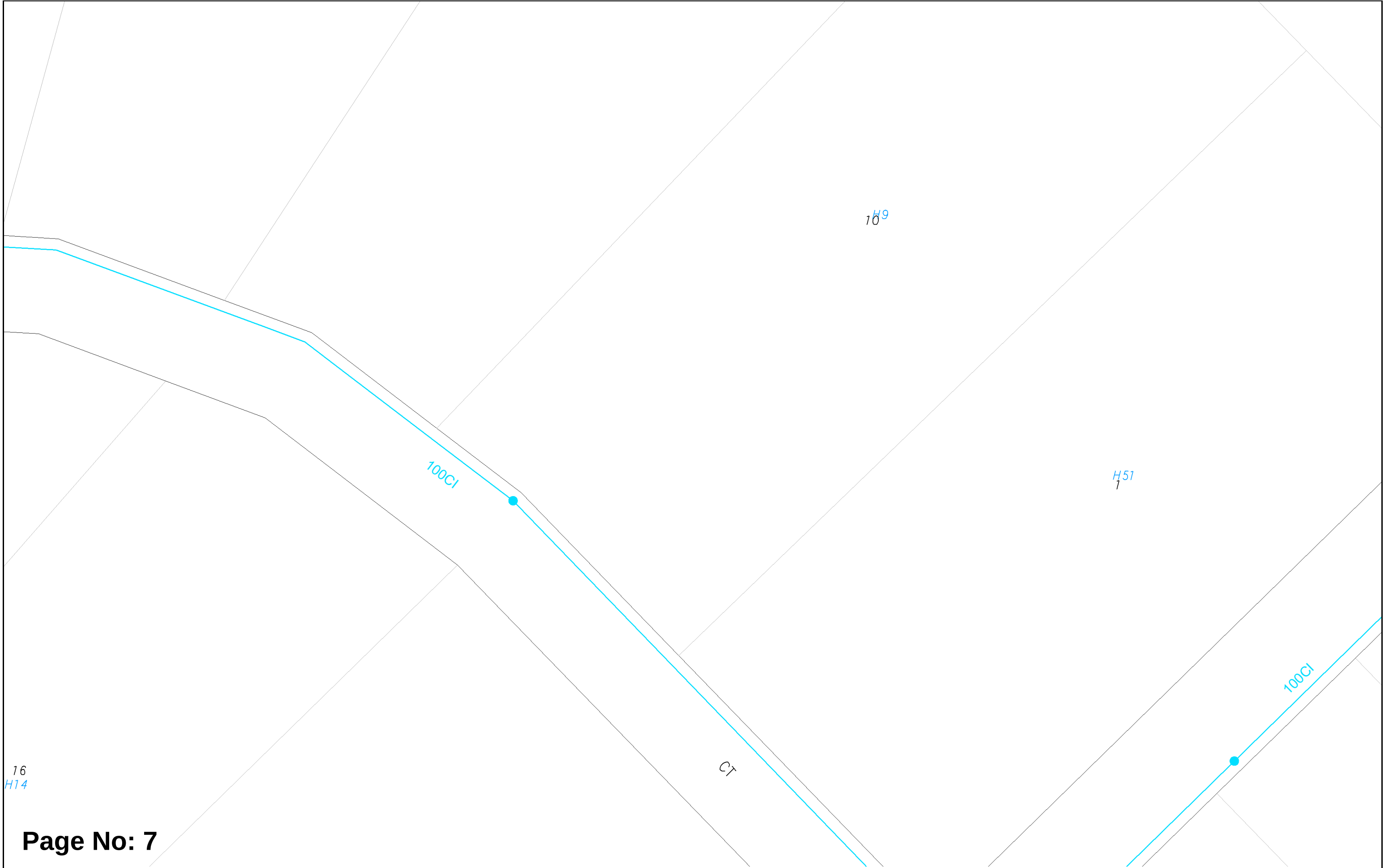


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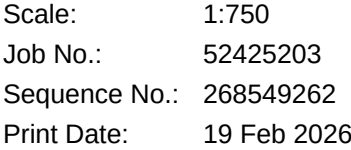
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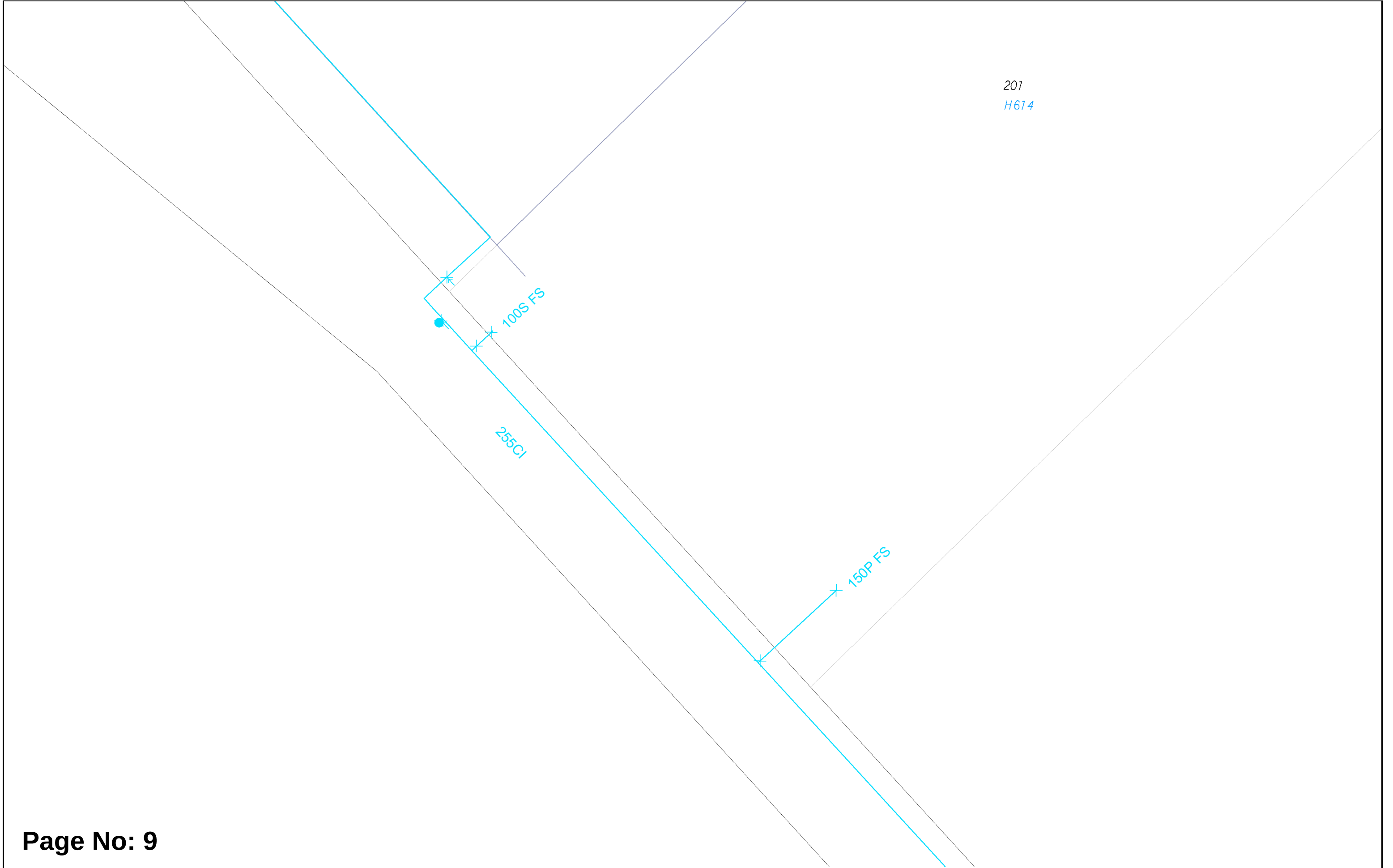
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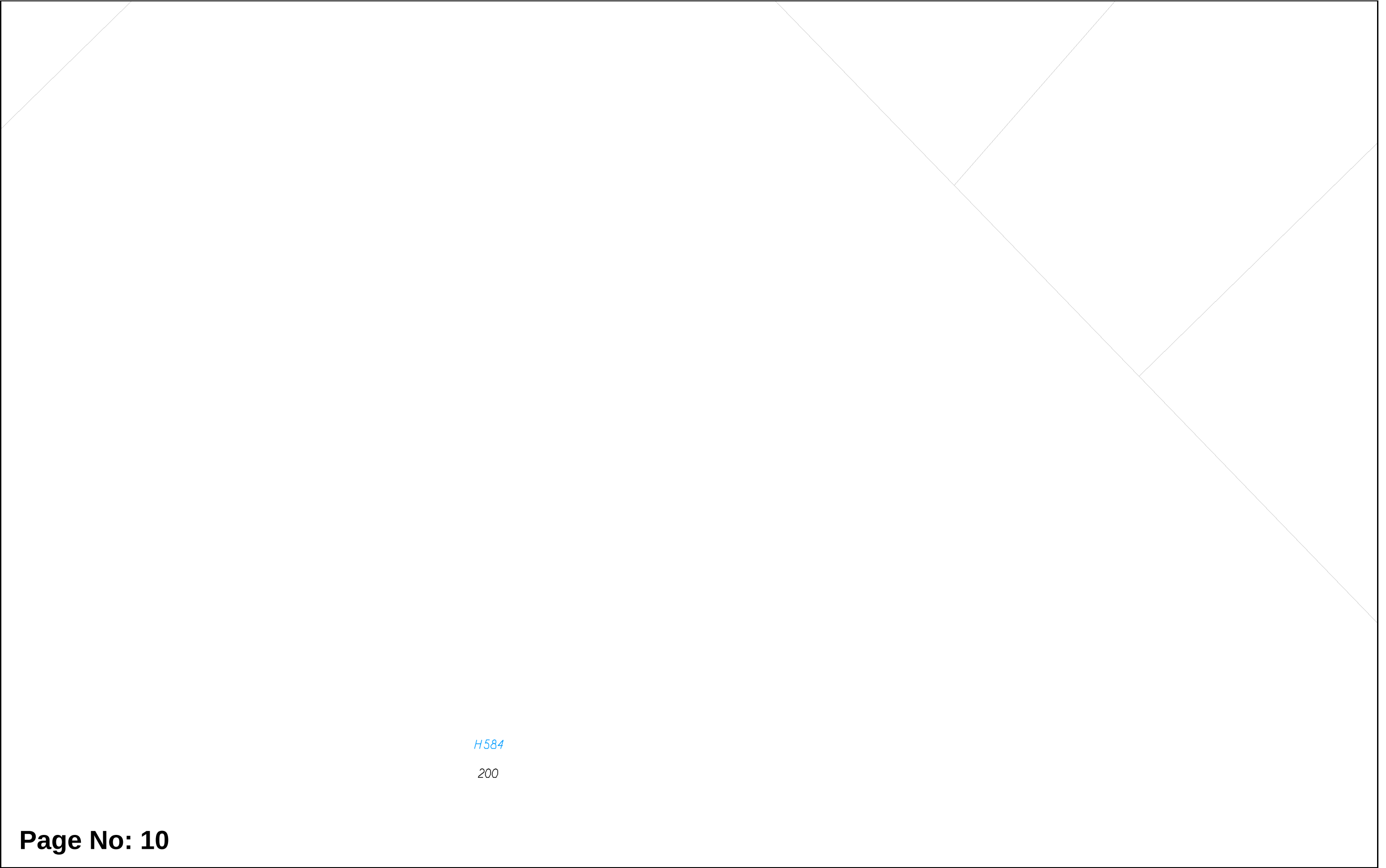
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H6

267H5

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L

BODNEY

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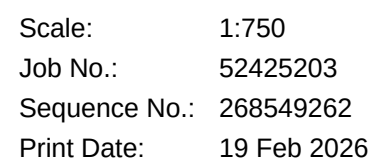
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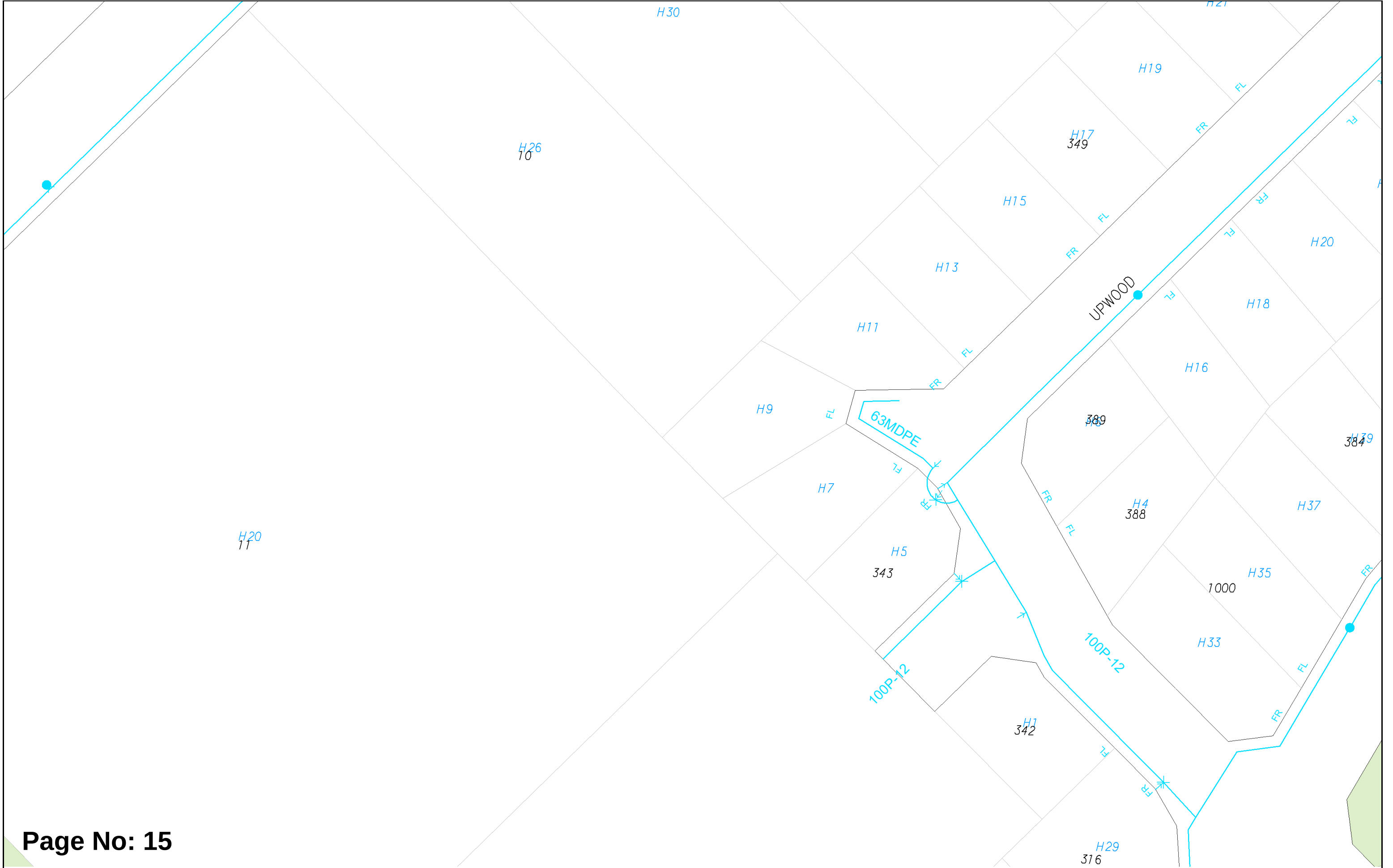
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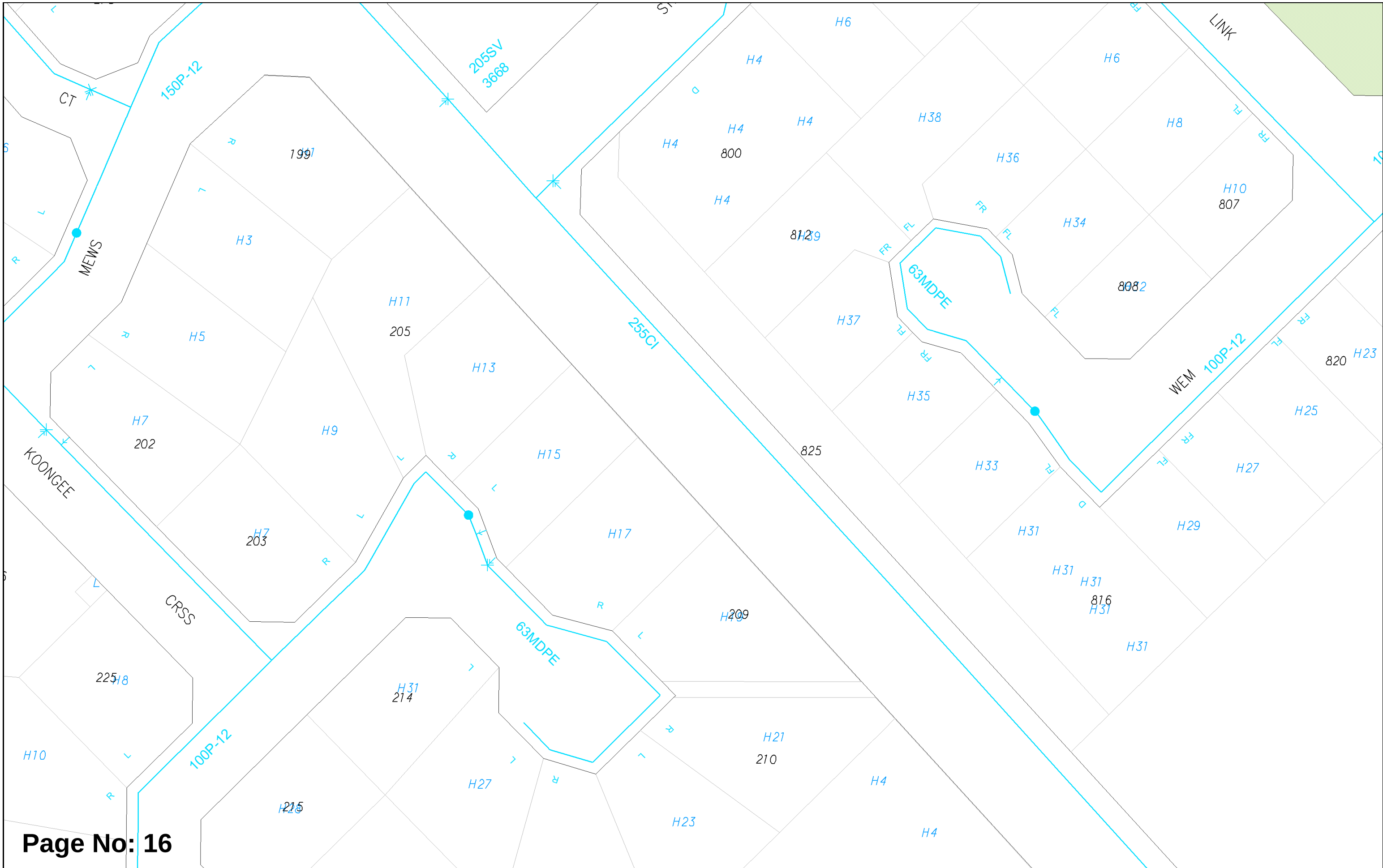
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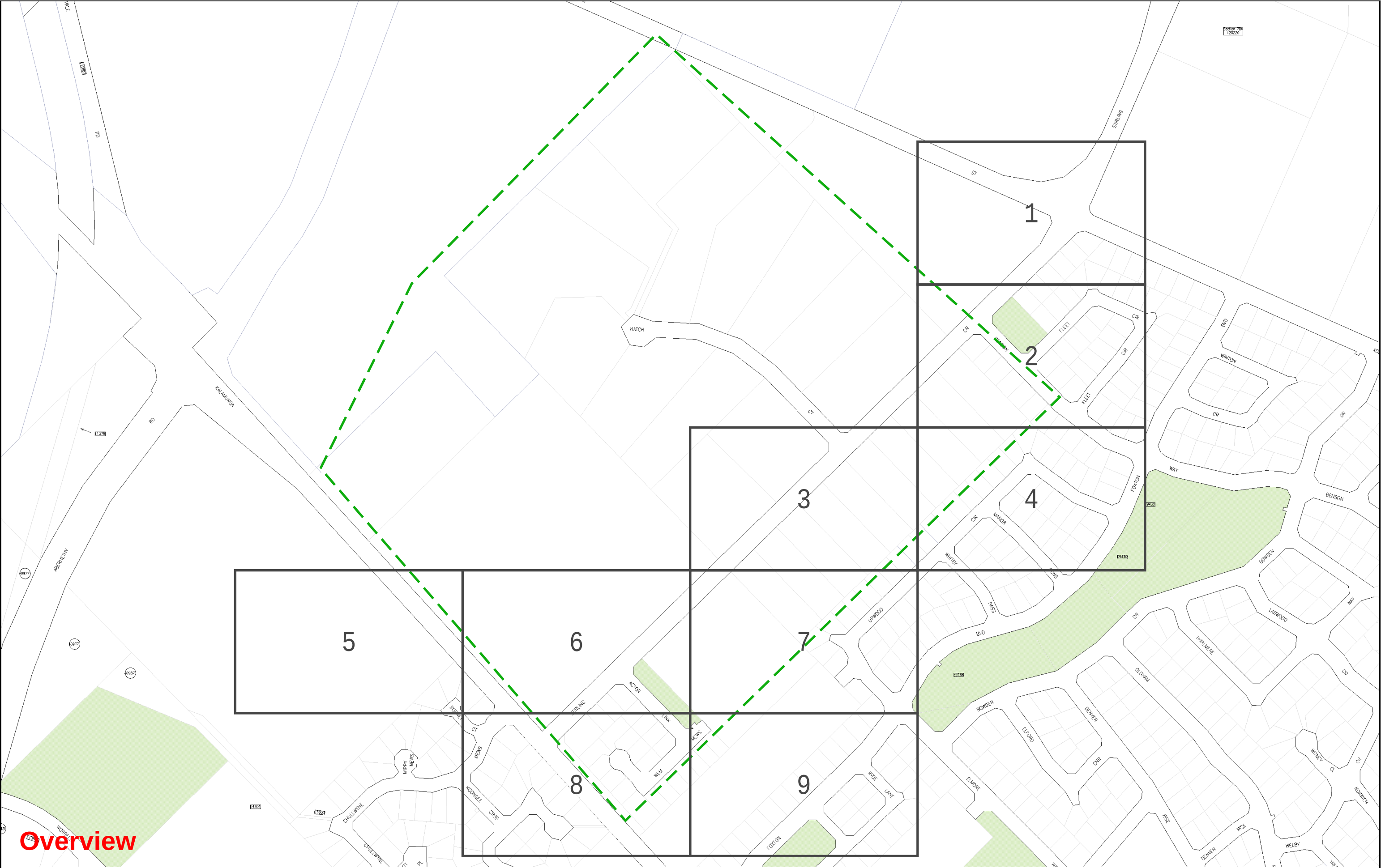
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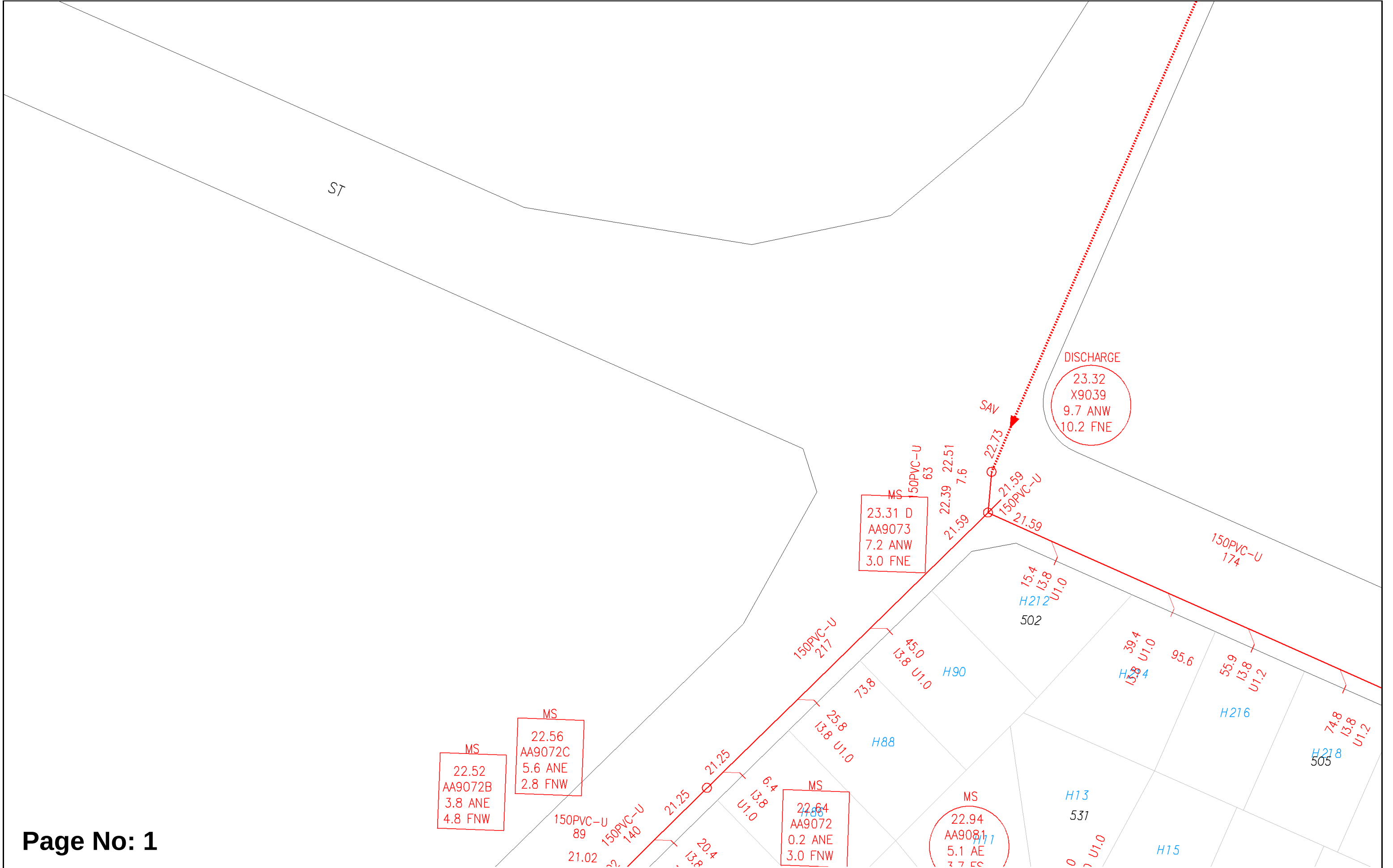


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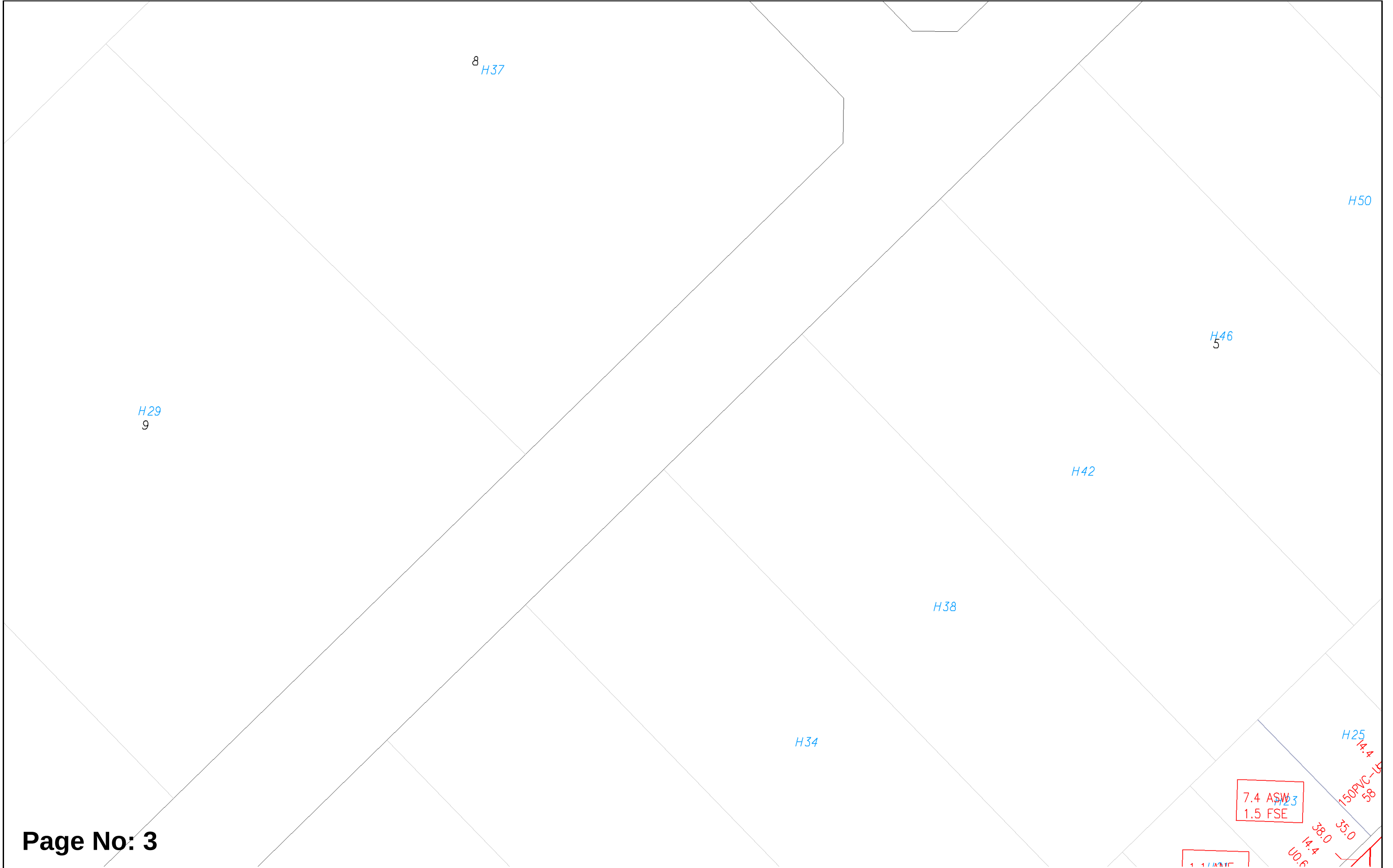






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H597

100

H6

267H5

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0.3 FSE

23.66
V0444

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U1.5
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BODNEY
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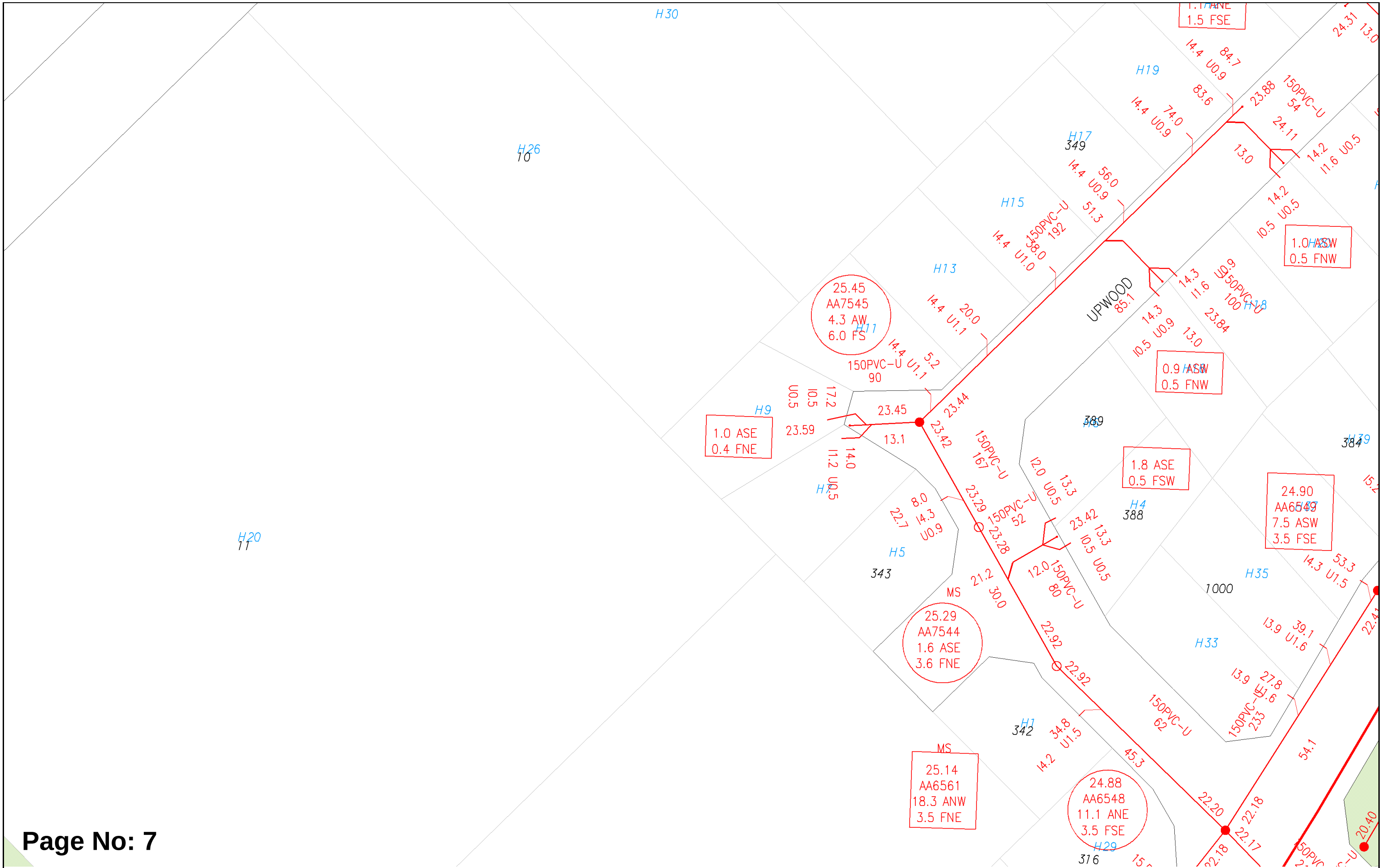


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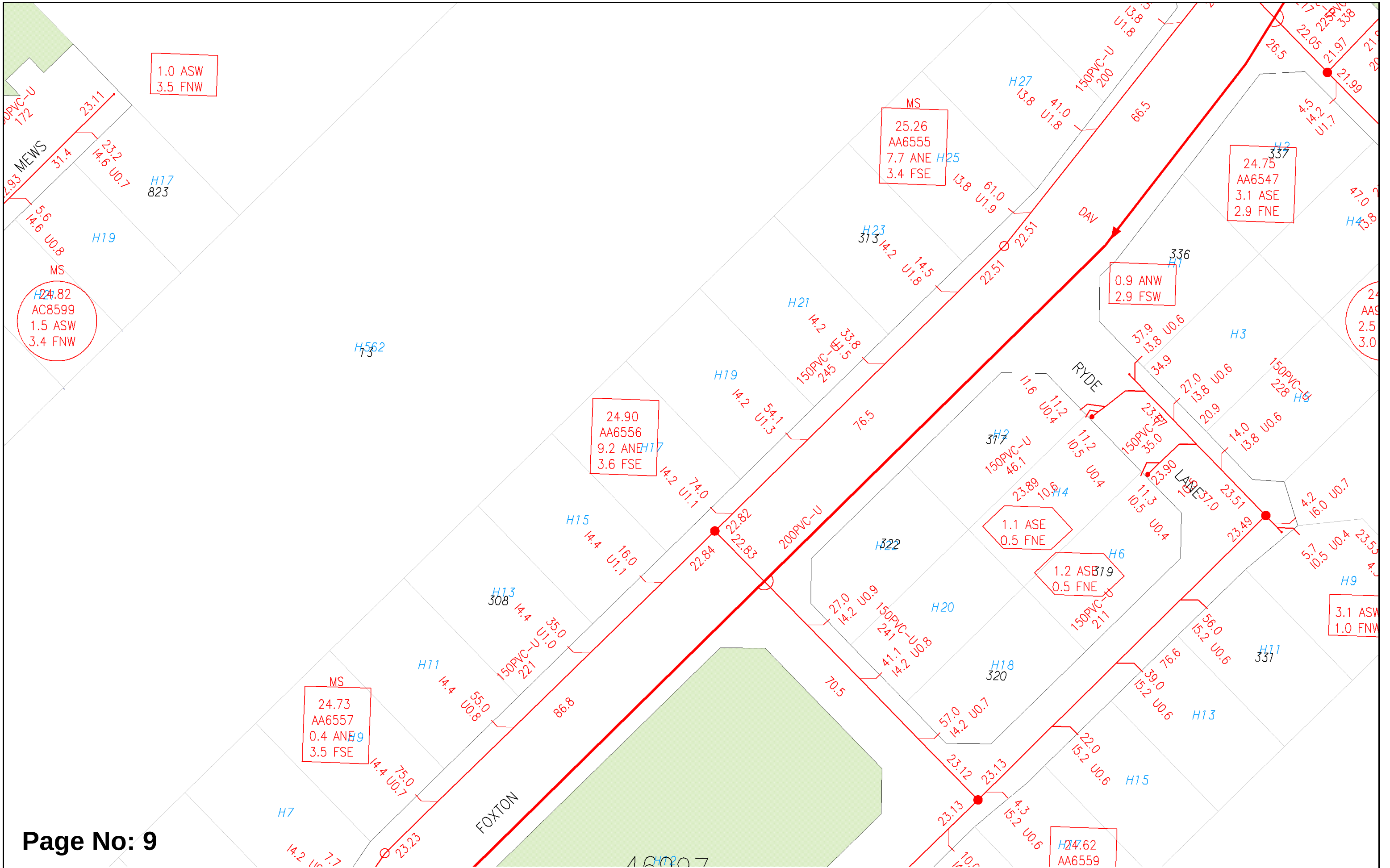


Sewer

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Sewer

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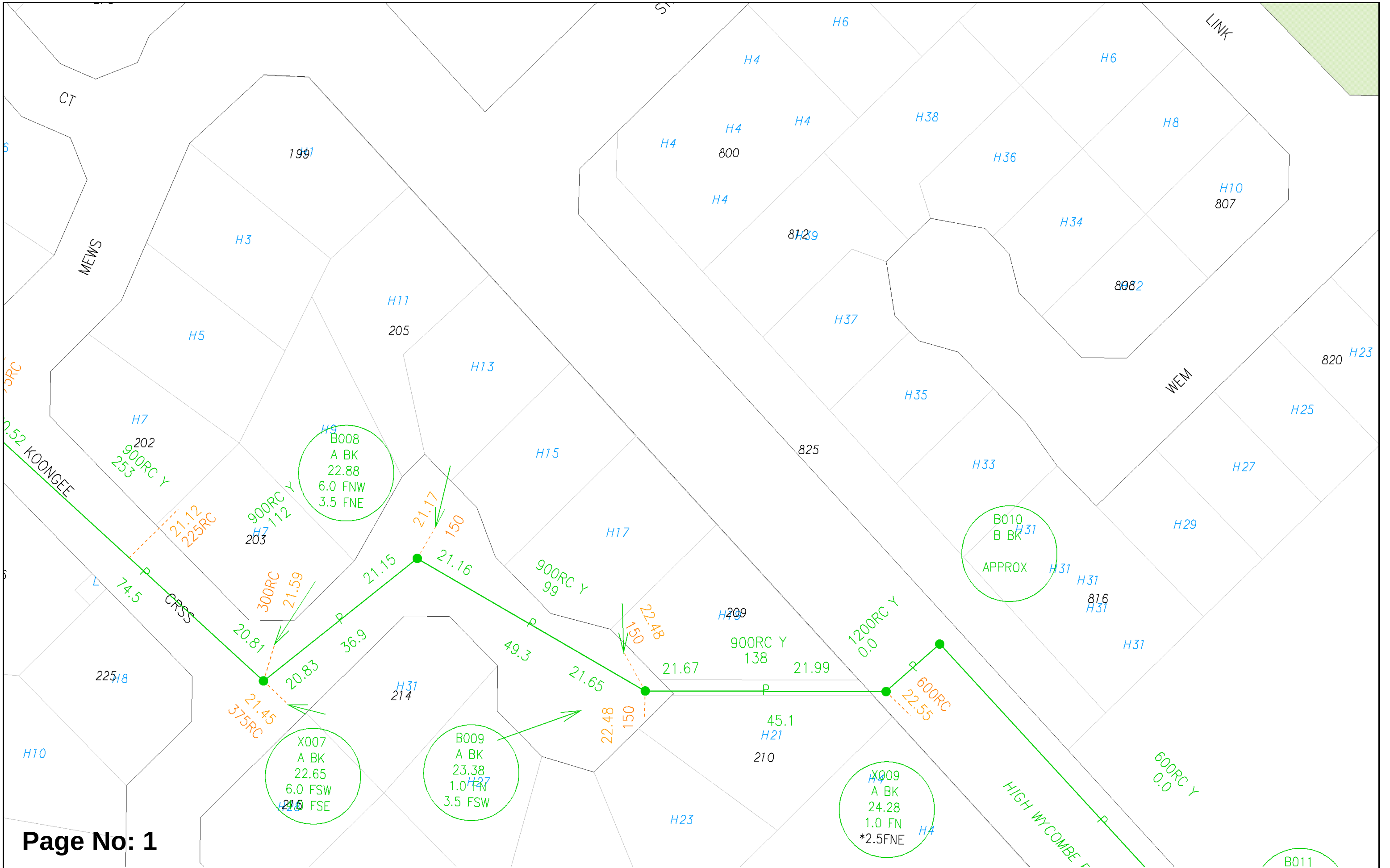


Scale:	1:4542
Job No.:	52425203
Sequence No.:	268549262
Print Date:	19 Feb 2026



Drainage

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Page No: 1



Scale: 1:750
Job No.: 52425203
Sequence No.: 268549262
Print Date: 19 Feb 2026



Drainage

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UNDERGROUND LEGEND

Structures

- | | |
|--|---|
|  Pillar |  UG Crossing * |
|  Metal Pole |  Ring Main Unit |
|  Transformer Site |  LV Distribution Frame |

Distribution Cables

-  High Voltage Cable (1kV - 33kV)
-  Low Voltage Cable (< 1kV)
-  Street Light Circuit (< 1kV)
-  Street Light Pilot (< 1kV)
-  Earth Wire

Cable Pole Terminations

-  HV Termination
-  LV Termination

Proposed Construction Assets

-  Design Area *
-  High Voltage Underground Cable
-  Low Voltage Underground Cable
-  Metal Pole
-  Pillar
-  Transformer site
-  HV Termination
-  LV Termination

State Underground Power Project

-  CURRENT Work Area *
-  COMPLETED Area *

Feature

-  Area of Interest

* Please refer to coversheet

Privately owned cables NOT SHOWN
(including house services)

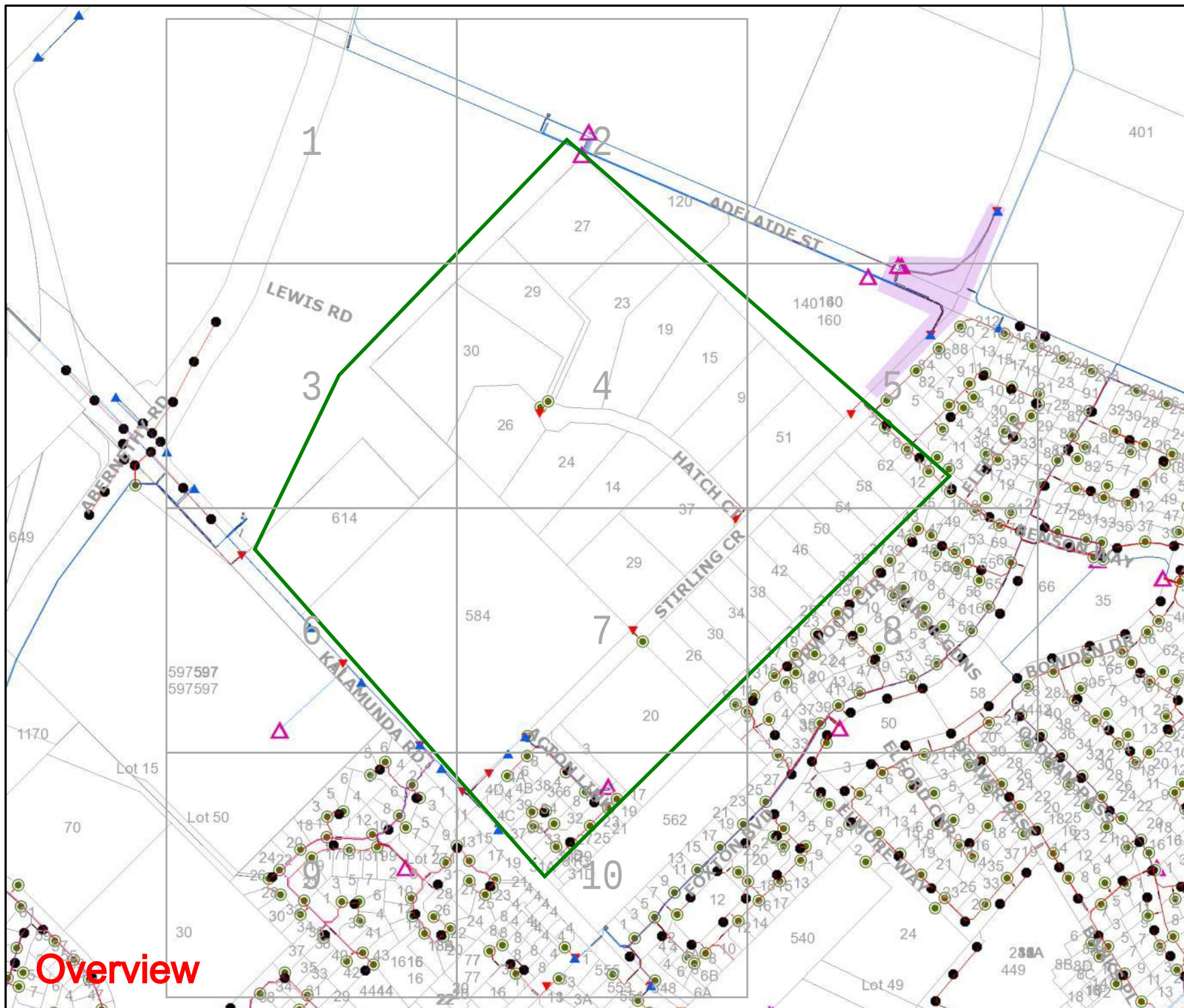
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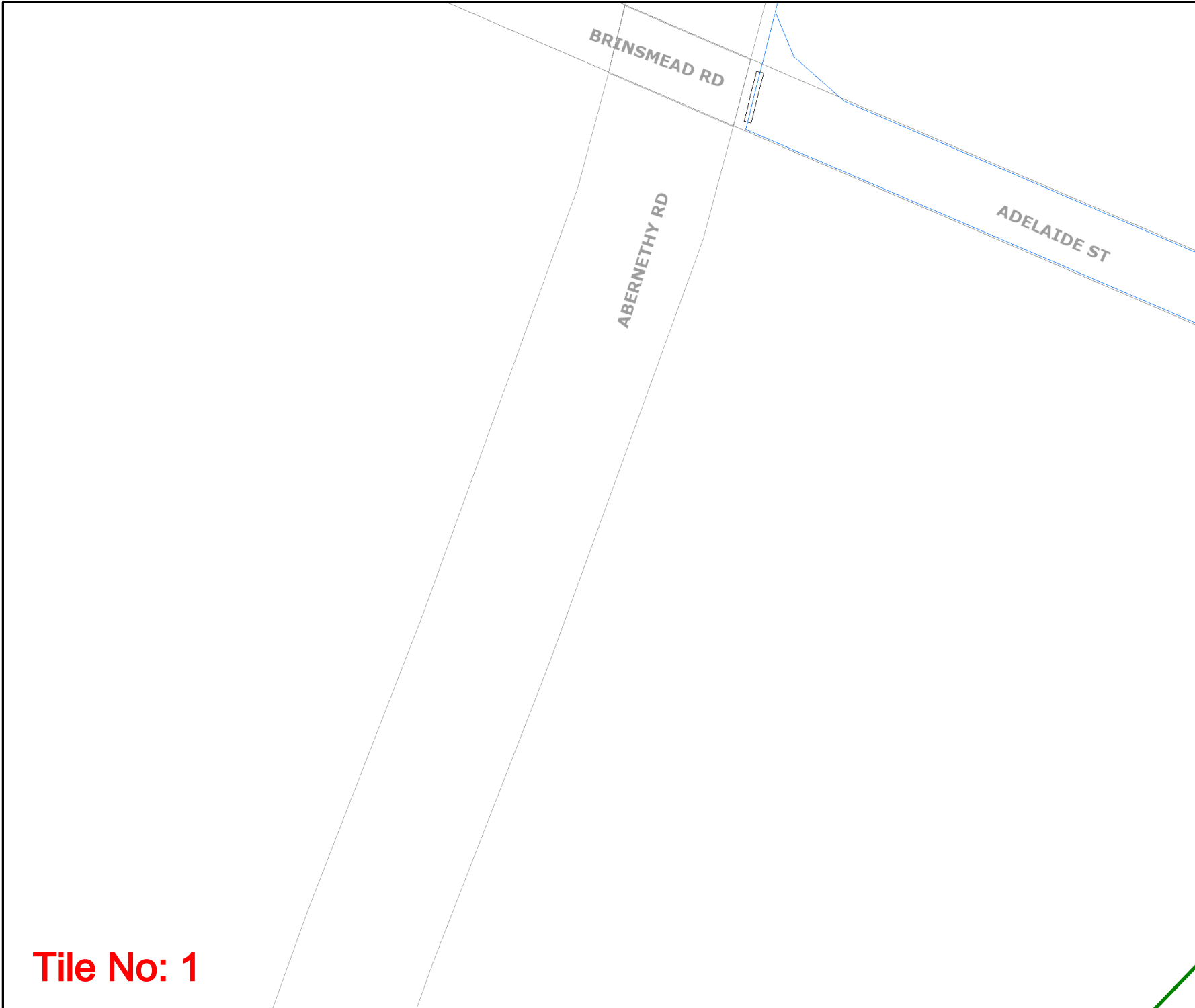
Information valid for 30 days
from date of issue

A4 Scale : 1:6150

**WARNING! Look out for
overhead power lines**



Overview





UNDERGROUND LEGEND

Structures

 Pillar

 Metal Pole

 Transformer Site

 UG Crossing *

 Ring Main Unit

 LV Distribution Frame

Distribution Cables

 High Voltage Cable (1kV - 33kV)

 Low Voltage Cable (< 1kV)

 Street Light Circuit (< 1kV)

 Street Light Pilot (< 1kV)

 Earth Wire

Cable Pole Terminations

 HV Termination

 LV Termination

Proposed Construction Assets

 Design Area *

 High Voltage Underground Cable

 Low Voltage Underground Cable

 Metal Pole

 Pillar

 Transformer site

 HV Termination

 LV Termination

State Underground Power Project

 CURRENT Work Area *

 COMPLETED Area *

Feature

 Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

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A4

Scale : 1:1500

WARNING! Look out for overhead power lines

Tile No: 1

UNDERGROUND LEGEND

Structures

- | | |
|--|---|
|  Pillar |  UG Crossing * |
|  Metal Pole |  Ring Main Unit |
|  Transformer Site |  LV Distribution Frame |

Distribution Cables

-  High Voltage Cable (1kV - 33kV)
-  Low Voltage Cable (< 1kV)
-  Street Light Circuit (< 1kV)
-  Street Light Pilot (< 1kV)
-  Earth Wire

Cable Pole Terminations

-  HV Termination  LV Termination

Proposed Construction Assets

-  Design Area *
-  High Voltage Underground Cable
-  Low Voltage Underground Cable
-  Metal Pole
-  HV Termination
-  Pillar
-  LV Termination
-  Transformer site

State Underground Power Project

-  CURRENT Work Area *
-  COMPLETED Area *

Feature

-  Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN
(including house services)

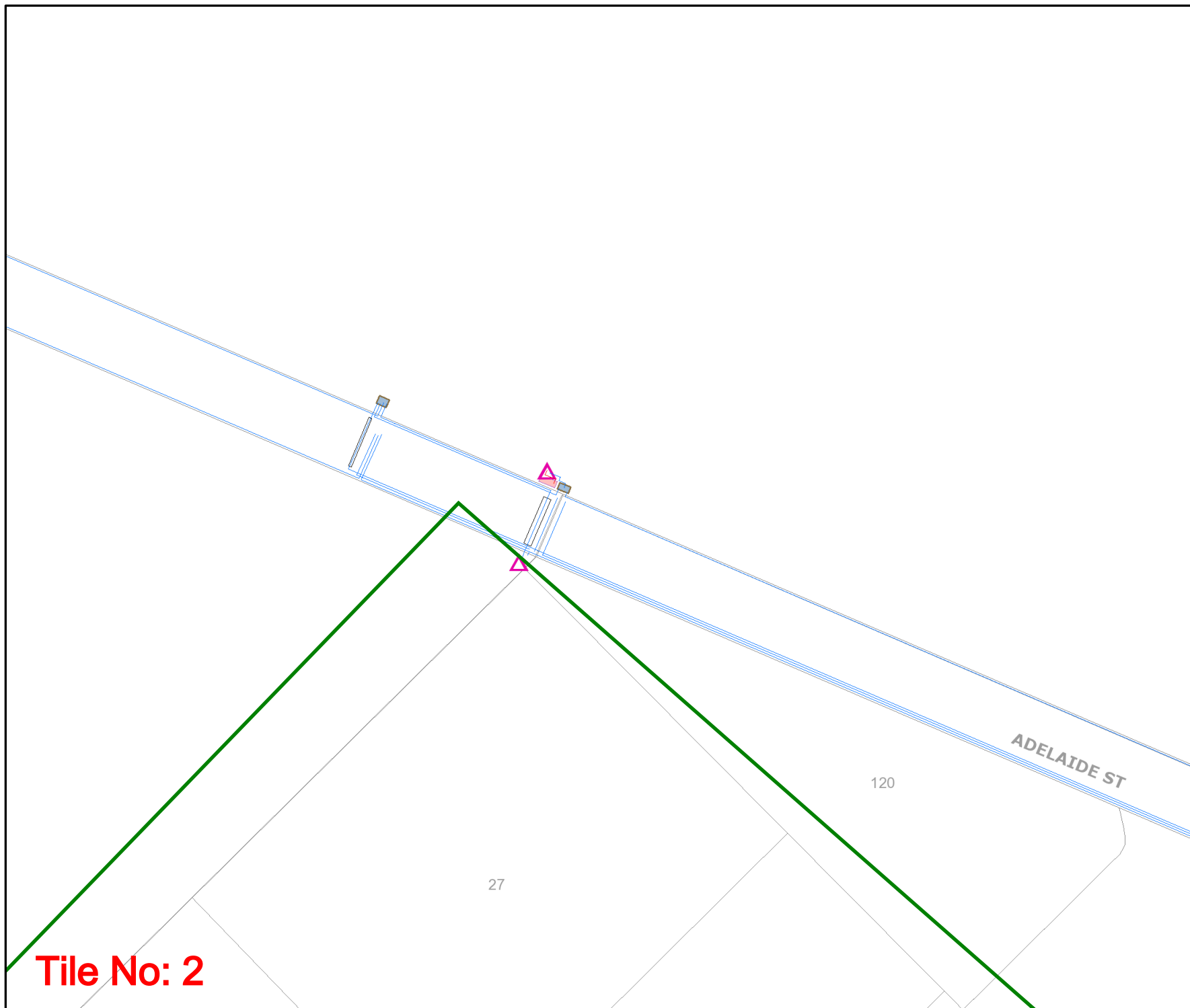
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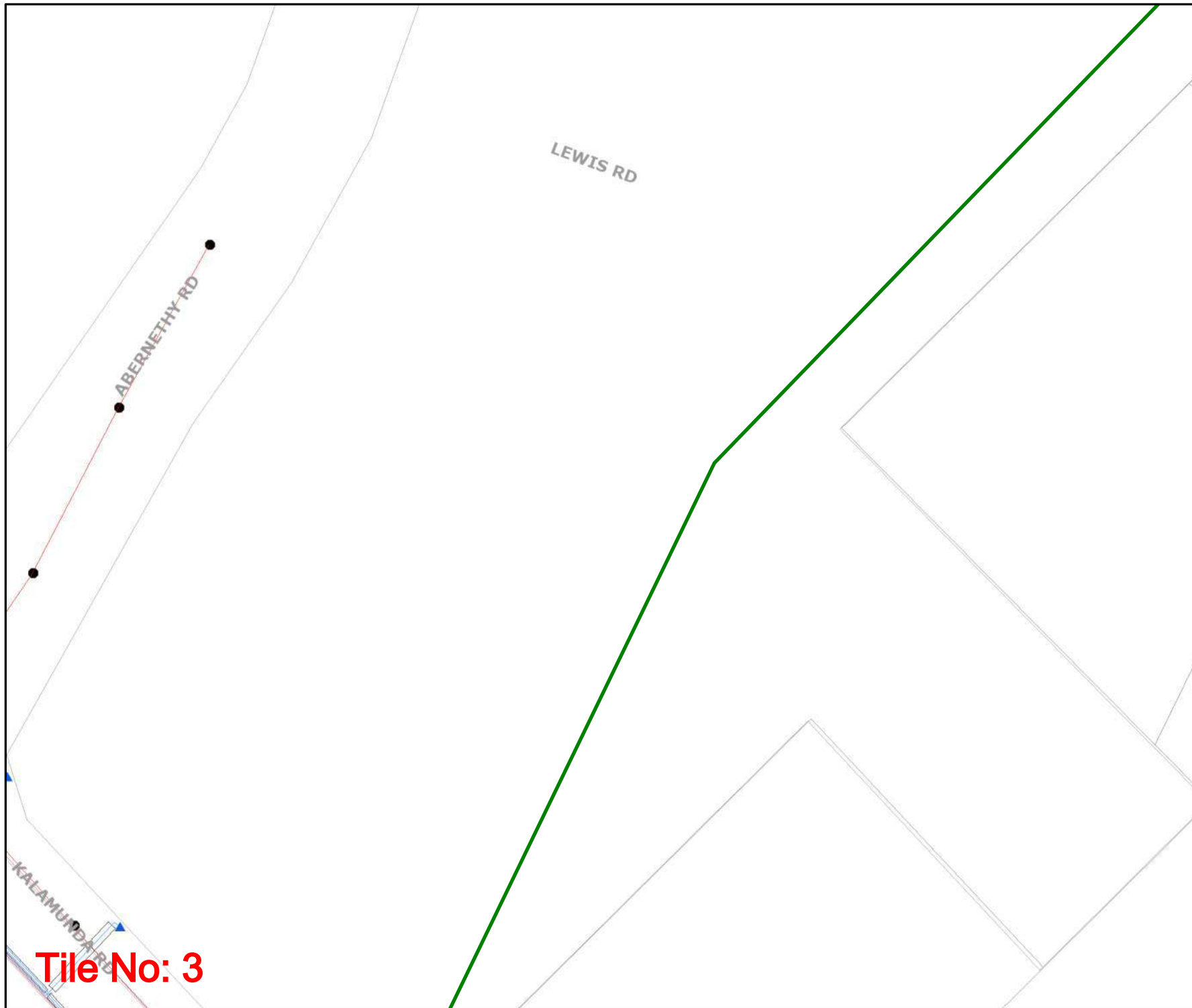
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A4 Scale : 1:1500

**WARNING! Look out for
overhead power lines**



Tile No: 2





UNDERGROUND LEGEND

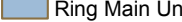
Structures

 Pillar

 Metal Pole

 Transformer Site

 UG Crossing *

 Ring Main Unit

 LV Distribution Frame

Distribution Cables

 High Voltage Cable (1kV - 33kV)

 Low Voltage Cable (< 1kV)

 Street Light Circuit (< 1kV)

 Street Light Pilot (< 1kV)

 Earth Wire

Cable Pole Terminations

 HV Termination

 LV Termination

Proposed Construction Assets

 Design Area *

 High Voltage Underground Cable

 Low Voltage Underground Cable

 Metal Pole

 Pillar

 Transformer site

 HV Termination

 LV Termination

State Underground Power Project

 CURRENT Work Area *

 COMPLETED Area *

Feature

 Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

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A4

Scale : 1:1500

WARNING! Look out for overhead power lines

Tile No: 3

Sequence Number: 268549260

Date of Issue: 19 Feb 2026

UNDERGROUND LEGEND

Structures

- | | |
|--|---|
|  Pillar |  UG Crossing * |
|  Metal Pole |  Ring Main Unit |
|  Transformer Site |  LV Distribution Frame |

Distribution Cables

-  High Voltage Cable (1kV - 33kV)
-  Low Voltage Cable (< 1kV)
-  Street Light Circuit (< 1kV)
-  Street Light Pilot (< 1kV)
-  Earth Wire

Cable Pole Terminations

-  HV Termination  LV Termination

Proposed Construction Assets

-  Design Area *
-  High Voltage Underground Cable
-  Low Voltage Underground Cable
-  Metal Pole  HV Termination
-  Pillar  LV Termination
-  Transformer site

State Underground Power Project

-  CURRENT Work Area *
-  COMPLETED Area *

Feature

-  Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN
(including house services)

This map is INDICATIVE ONLY.
Hand exposure via pothole
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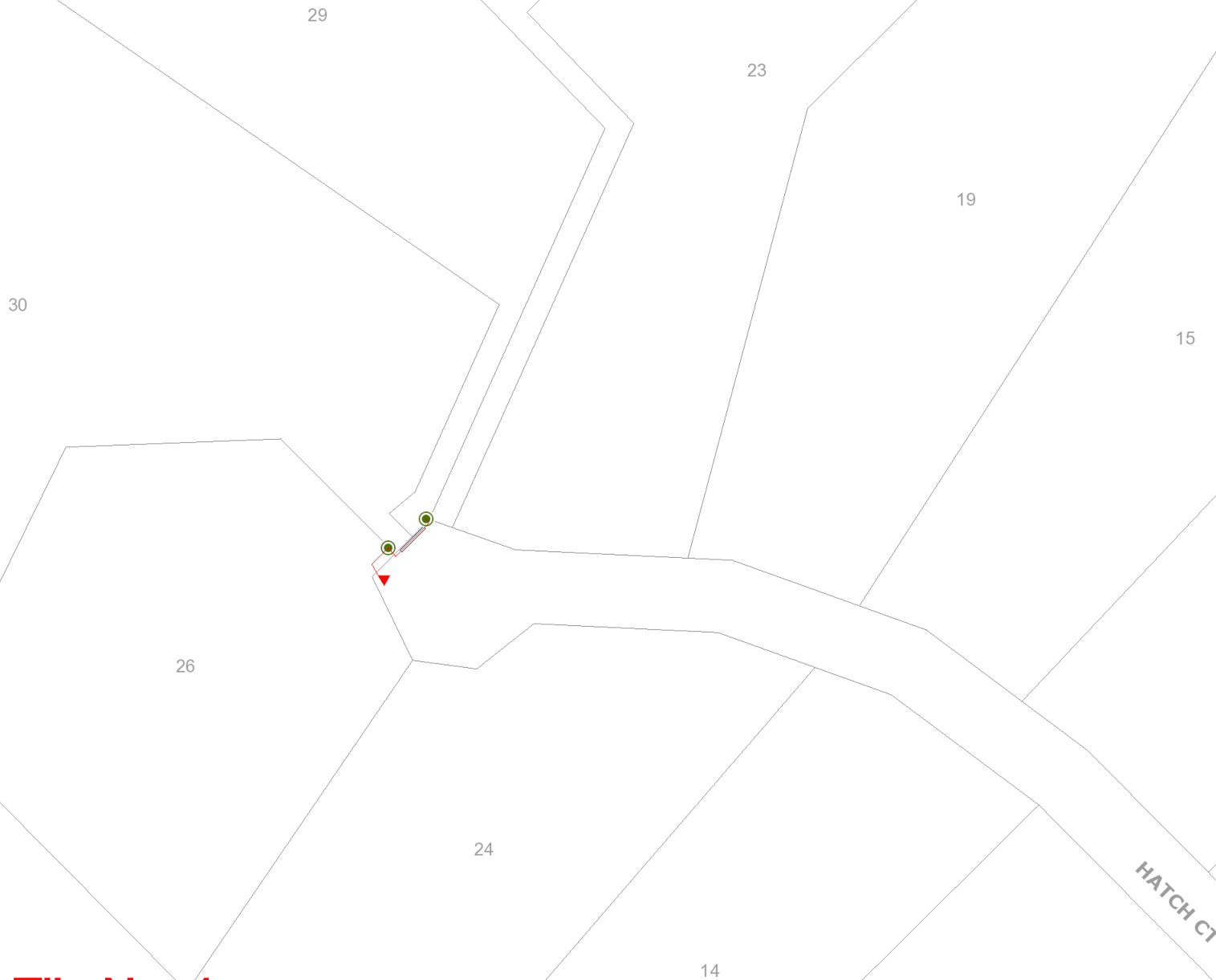
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Information valid for 30 days
from date of issue

A4

Scale : 1:1500

**WARNING! Look out for
overhead power lines**



Tile No: 4

UNDERGROUND LEGEND

Structures

- | | |
|--|---|
|  Pillar |  UG Crossing * |
|  Metal Pole |  Ring Main Unit |
|  Transformer Site |  LV Distribution Frame |

Distribution Cables

-  High Voltage Cable (1kV - 33kV)
-  Low Voltage Cable (< 1kV)
-  Street Light Circuit (< 1kV)
-  Street Light Pilot (< 1kV)
-  Earth Wire

Cable Pole Terminations

-  HV Termination
-  LV Termination

Proposed Construction Assets

-  Design Area *
-  High Voltage Underground Cable
-  Low Voltage Underground Cable
-  Metal Pole
-  Pillar
-  Transformer site
-  HV Termination
-  LV Termination

State Underground Power Project

-  CURRENT Work Area *
-  COMPLETED Area *

Feature

-  Area of Interest

* Please refer to coversheet

Privately owned cables NOT SHOWN
(including house services)

This map is **INDICATIVE ONLY**.
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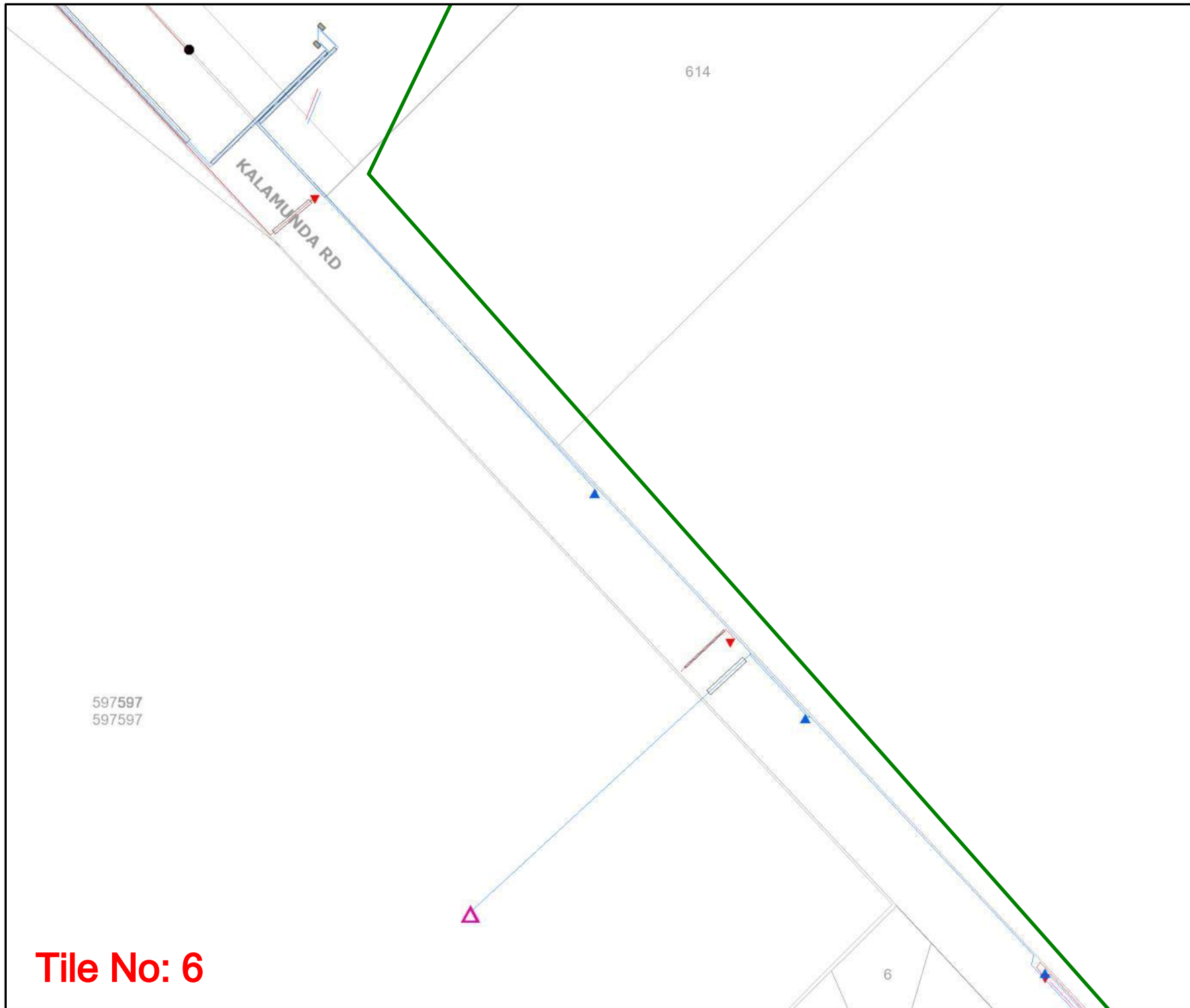
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from date of issue

A4 Scale : 1:1500

**WARNING! Look out for
overhead power lines**

Tile No: 5



UNDERGROUND LEGEND

Structures

- | | |
|------------------|-----------------------|
| Pillar | UG Crossing * |
| Metal Pole | Ring Main Unit |
| Transformer Site | LV Distribution Frame |

Distribution Cables

- | |
|---------------------------------|
| High Voltage Cable (1kV - 33kV) |
| Low Voltage Cable (< 1kV) |
| Street Light Circuit (< 1kV) |
| Street Light Pilot (< 1kV) |
| Earth Wire |

Cable Pole Terminations

- | | |
|----------------|----------------|
| HV Termination | LV Termination |
|----------------|----------------|

Proposed Construction Assets

- | | |
|-------------------------------|--------------------------------|
| Design Area * | High Voltage Underground Cable |
| Low Voltage Underground Cable | HV Termination |
| Metal Pole | LV Termination |
| Pillar | Transformer site |

State Underground Power Project

- | |
|---------------------|
| CURRENT Work Area * |
| COMPLETED Area * |

Feature

- | |
|------------------|
| Area of Interest |
|------------------|

*** Please refer to coversheet**

**Privately owned cables NOT SHOWN
(including house services)**

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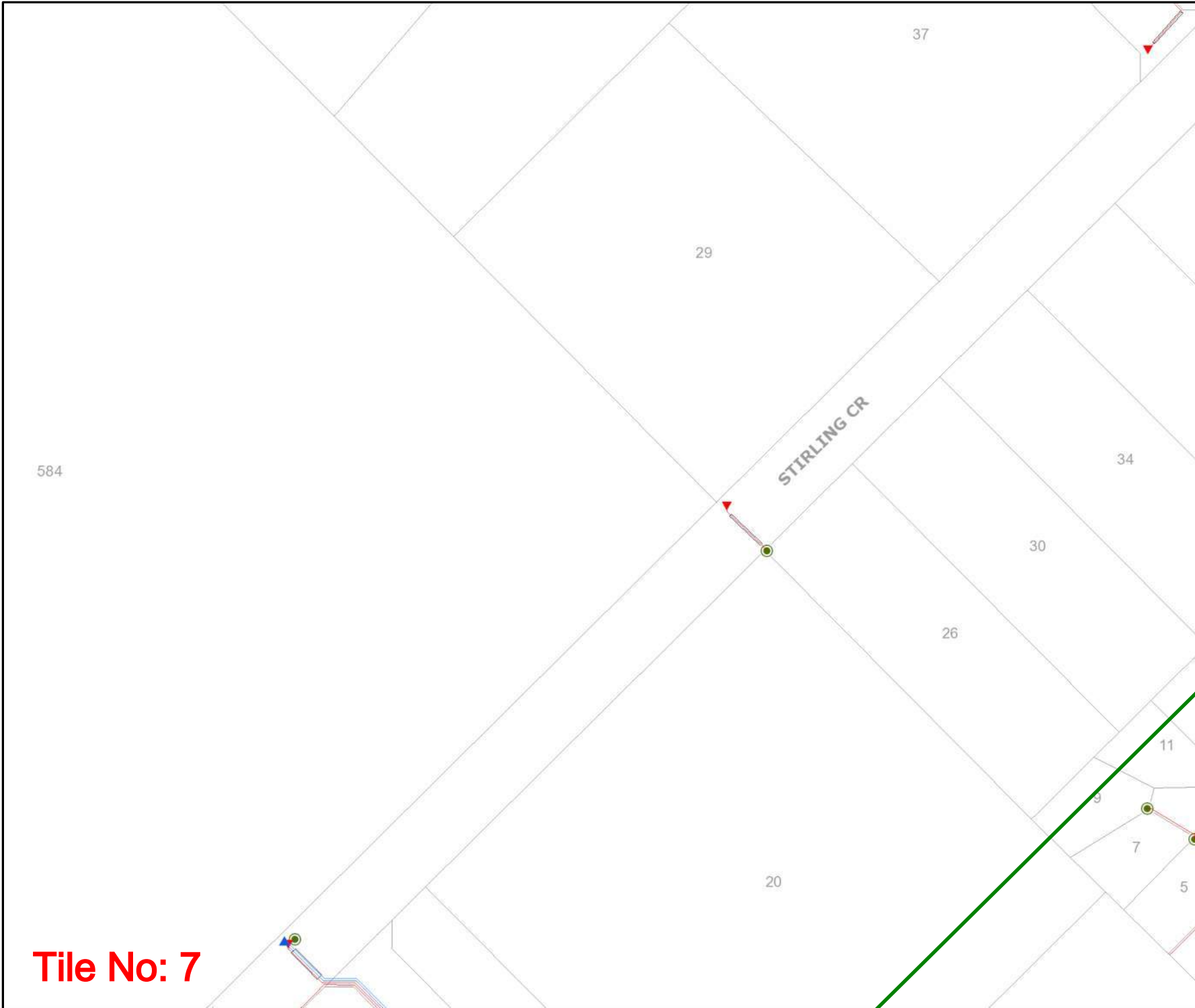
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**Information valid for 30 days
from date of issue**

A4	Scale : 1:1500
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**WARNING! Look out for
overhead power lines**

Tile No: 6





UNDERGROUND LEGEND

Structures

 Pillar

 Metal Pole

 Transformer Site

 UG Crossing *

 Ring Main Unit

 LV Distribution Frame

Distribution Cables

 High Voltage Cable (1kV - 33kV)

 Low Voltage Cable (< 1kV)

 Street Light Circuit (< 1kV)

 Street Light Pilot (< 1kV)

 Earth Wire

Cable Pole Terminations

 HV Termination

 LV Termination

Proposed Construction Assets

 Design Area *

 High Voltage Underground Cable

 Low Voltage Underground Cable

 Metal Pole

 Pillar

 Transformer site

 HV Termination

 LV Termination

State Underground Power Project

 CURRENT Work Area *

 COMPLETED Area *

Feature

 Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

This map is INDICATIVE ONLY.
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A4

Scale : 1:1500

WARNING! Look out for overhead power lines

Tile No: 7

Sequence Number: 268549260

Date of Issue: 19 Feb 2026

UNDERGROUND LEGEND

Structures

-  Pillar
-  Metal Pole
-  Transformer Site
-  UG Crossing *
-  Ring Main Unit
-  LV Distribution Frame

Distribution Cables

-  High Voltage Cable (1kV - 33kV)
-  Low Voltage Cable (< 1kV)
-  Street Light Circuit (< 1kV)
-  Street Light Pilot (< 1kV)
-  Earth Wire

Cable Pole Terminations

-  HV Termination
-  LV Termination

Proposed Construction Assets

-  Design Area *
-  High Voltage Underground Cable
-  Low Voltage Underground Cable
-  Metal Pole
-  Pillar
-  Transformer site
-  HV Termination
-  LV Termination

State Underground Power Project

-  CURRENT Work Area *
-  COMPLETED Area *

Feature

-  Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN
(including house services)

This map is **INDICATIVE ONLY**.
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from date of issue

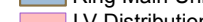
A4 Scale : 1:1500

**WARNING! Look out for
overhead power lines**

Tile No: 8

UNDERGROUND LEGEND

Structures

- | | |
|--|---|
|  Pillar |  UG Crossing * |
|  Metal Pole |  Ring Main Unit |
|  Transformer Site |  LV Distribution Frame |

Distribution Cables

- | |
|---|
|  High Voltage Cable (1kV - 33kV) |
|  Low Voltage Cable (< 1kV) |
|  Street Light Circuit (< 1kV) |
|  Street Light Pilot (< 1kV) |
|  Earth Wire |

Cable Pole Terminations

- | | |
|--|--|
|  HV Termination |  LV Termination |
|--|--|

Proposed Construction Assets

- | | |
|---|--|
|  Design Area * |  High Voltage Underground Cable |
|  Low Voltage Underground Cable |  Metal Pole |
|  Pillar |  HV Termination |
|  Transformer site |  LV Termination |

State Underground Power Project

- | |
|---|
|  CURRENT Work Area * |
|  COMPLETED Area * |

Feature

- | |
|--|
|  Area of Interest |
|--|

* Please refer to coversheet

Privately owned cables NOT SHOWN
(including house services)

This map is **INDICATIVE ONLY**.
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from date of issue

A4 Scale : 1:1500

**WARNING! Look out for
overhead power lines**

Tile No: 9

UNDERGROUND LEGEND

Structures

-  Pillar
-  Metal Pole
-  Transformer Site
-  UG Crossing *
-  Ring Main Unit
-  LV Distribution Frame

Distribution Cables

-  High Voltage Cable (1kV - 33kV)
-  Low Voltage Cable (< 1kV)
-  Street Light Circuit (< 1kV)
-  Street Light Pilot (< 1kV)
-  Earth Wire

Cable Pole Terminations

-  HV Termination
-  LV Termination

Proposed Construction Assets

-  Design Area *
-  High Voltage Underground Cable
-  Low Voltage Underground Cable
-  Metal Pole
-  Pillar
-  Transformer site
-  HV Termination
-  LV Termination

State Underground Power Project

-  CURRENT Work Area *
-  COMPLETED Area *

Feature

-  Area of Interest

* Please refer to coversheet

Privately owned cables NOT SHOWN
(including house services)

This map is **INDICATIVE ONLY**.
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A4 Scale : 1:1500

**WARNING! Look out for
overhead power lines**

Tile No: 10

OVERHEAD LEGEND

Structures

- Power Pole
- Transmission Poles

Transmission Overhead Powerline

- Transmission (33kV - 330kV)

Distribution Overhead Powerline

- High Voltage (1kV - 33kV)
- Low Voltage (< 1kV)

Proposed Construction Assets

- Design Area *
- High Voltage Overhead Powerline
- Low Voltage Overhead Powerline
- Power Pole

Communications Assets

- Overhead Pilot Cable

Feature

- Area of Interest

* Please refer to coversheet

**Privately owned cables NOT SHOWN
(including house services)**

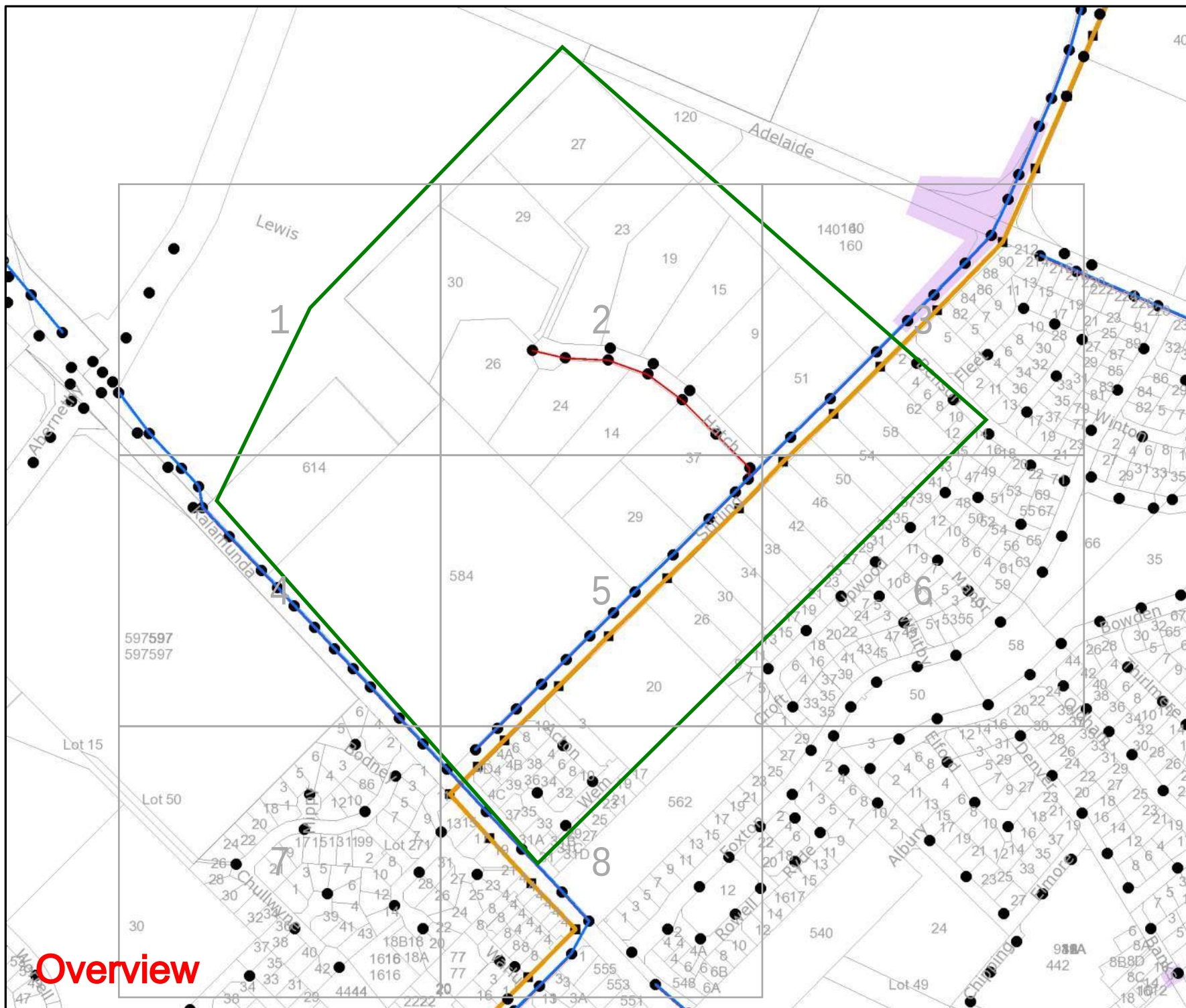
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Check that you have enough
clearance from the **DANGER ZONES**
near overhead powerlines.

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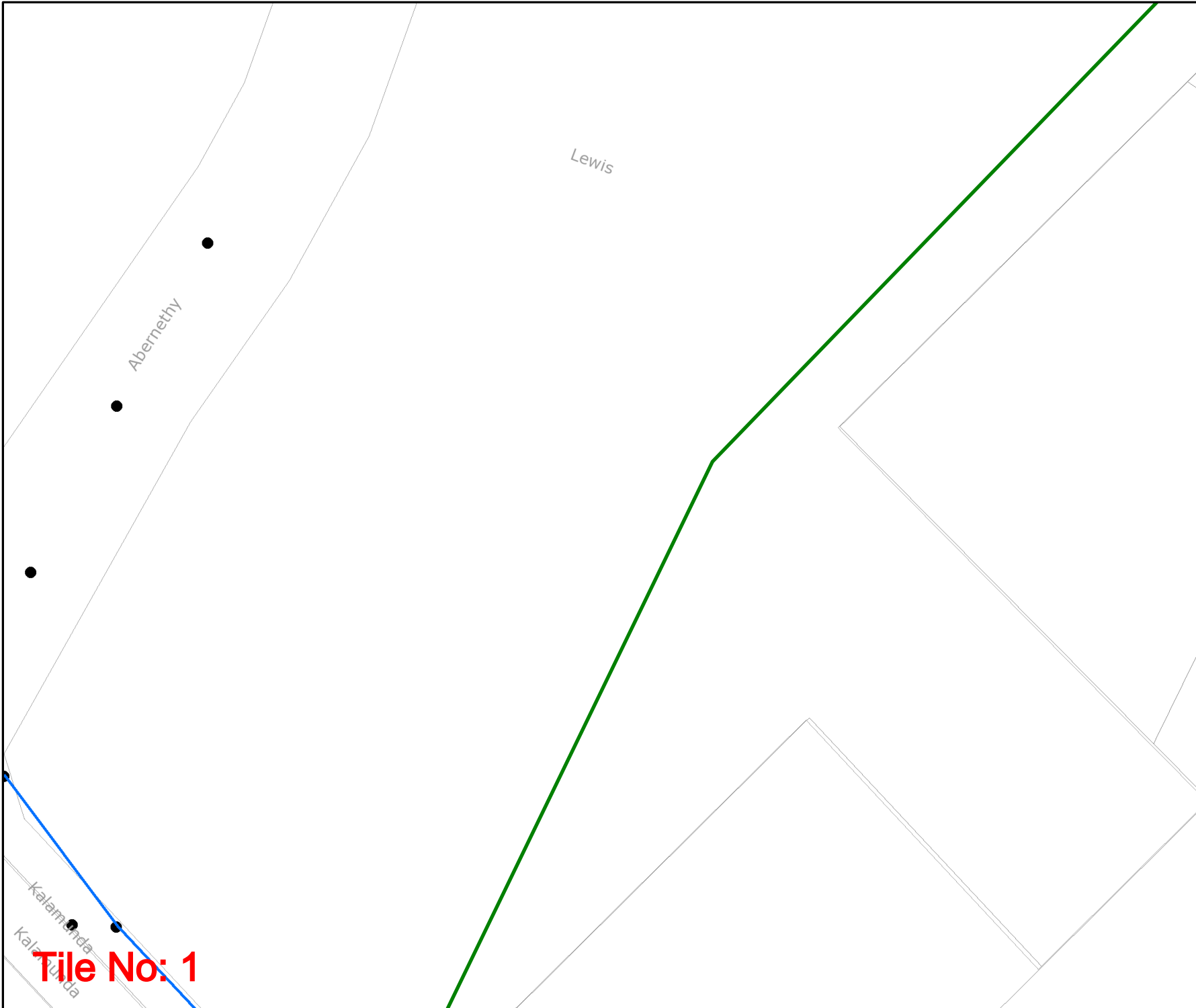
Information valid for 30 days
from date of issue

A4 Scale : 1:5546

**WARNING! Look out for
overhead power lines**



Overview





OVERHEAD LEGEND

Structures

 Power Pole

 Transmission Poles

Transmission Overhead Powerline

 Transmission (33kV - 330kV)

Distribution Overhead Powerline

 High Voltage (1kV - 33kV)

 Low Voltage (< 1kV)

Proposed Construction Assets

 Design Area *

 High Voltage Overhead Powerline

 Low Voltage Overhead Powerline

 Power Pole

Communications Assets

 Overhead Pilot Cable

Feature

 Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

This map is INDICATIVE ONLY.
Check that you have enough clearance from the DANGER ZONES near overhead powerlines.

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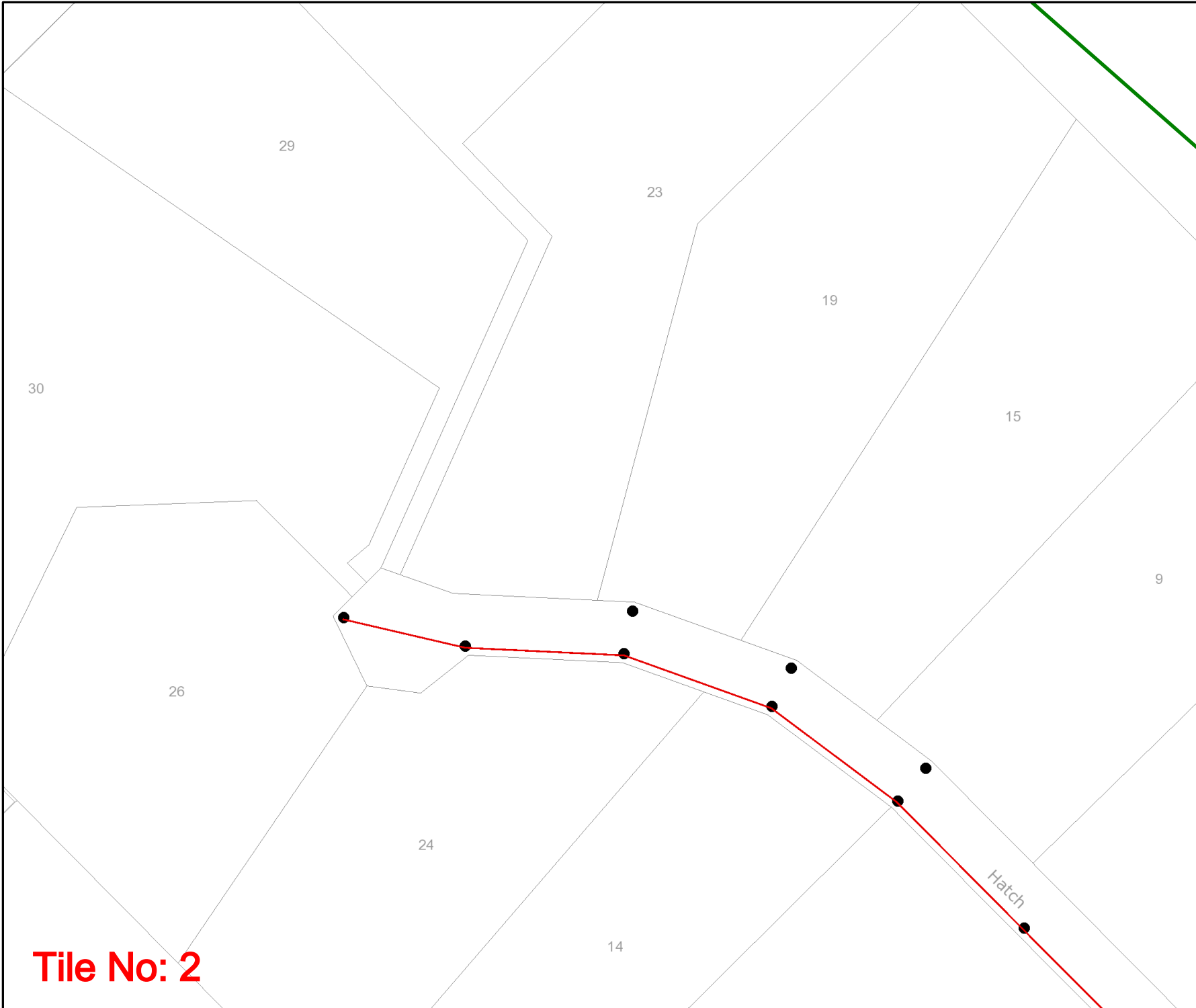
Information valid for 30 days from date of issue

A4

Scale : 1:1500

WARNING! Look out for overhead power lines

Tile No: 1



OVERHEAD LEGEND

Structures	
● Power Pole	■ Transmission Poles
Transmission Overhead Powerline	
Transmission (33kV - 330kV)	
Distribution Overhead Powerline	
High Voltage (1kV - 33kV)	
Low Voltage (< 1kV)	
Proposed Construction Assets	
Design Area *	
High Voltage Overhead Powerline	
Low Voltage Overhead Powerline	
Power Pole	
Communications Assets	
Overhead Pilot Cable	
Feature	
Area of Interest	

* Please refer to coversheet

Privately owned cables NOT SHOWN
(including house services)

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Check that you have enough
clearance from the DANGER ZONES
near overhead powerlines.

Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30

Information valid for 30 days
from date of issue

A4 | Scale : 1:1500

WARNING! Look out for
overhead power lines

Tile No: 2

OVERHEAD LEGEND

Structures

- Power Pole
- Transmission Poles

Transmission Overhead Powerline

- Transmission (33kV - 330kV)

Distribution Overhead Powerline

- High Voltage (1kV - 33kV)
- Low Voltage (< 1kV)

Proposed Construction Assets

- Design Area *
- High Voltage Overhead Powerline
- Low Voltage Overhead Powerline
- Power Pole

Communications Assets

- Overhead Pilot Cable

Feature

- Area of Interest

*** Please refer to coversheet**

**Privately owned cables NOT SHOWN
(including house services)**

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Check that you have enough
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near overhead powerlines.

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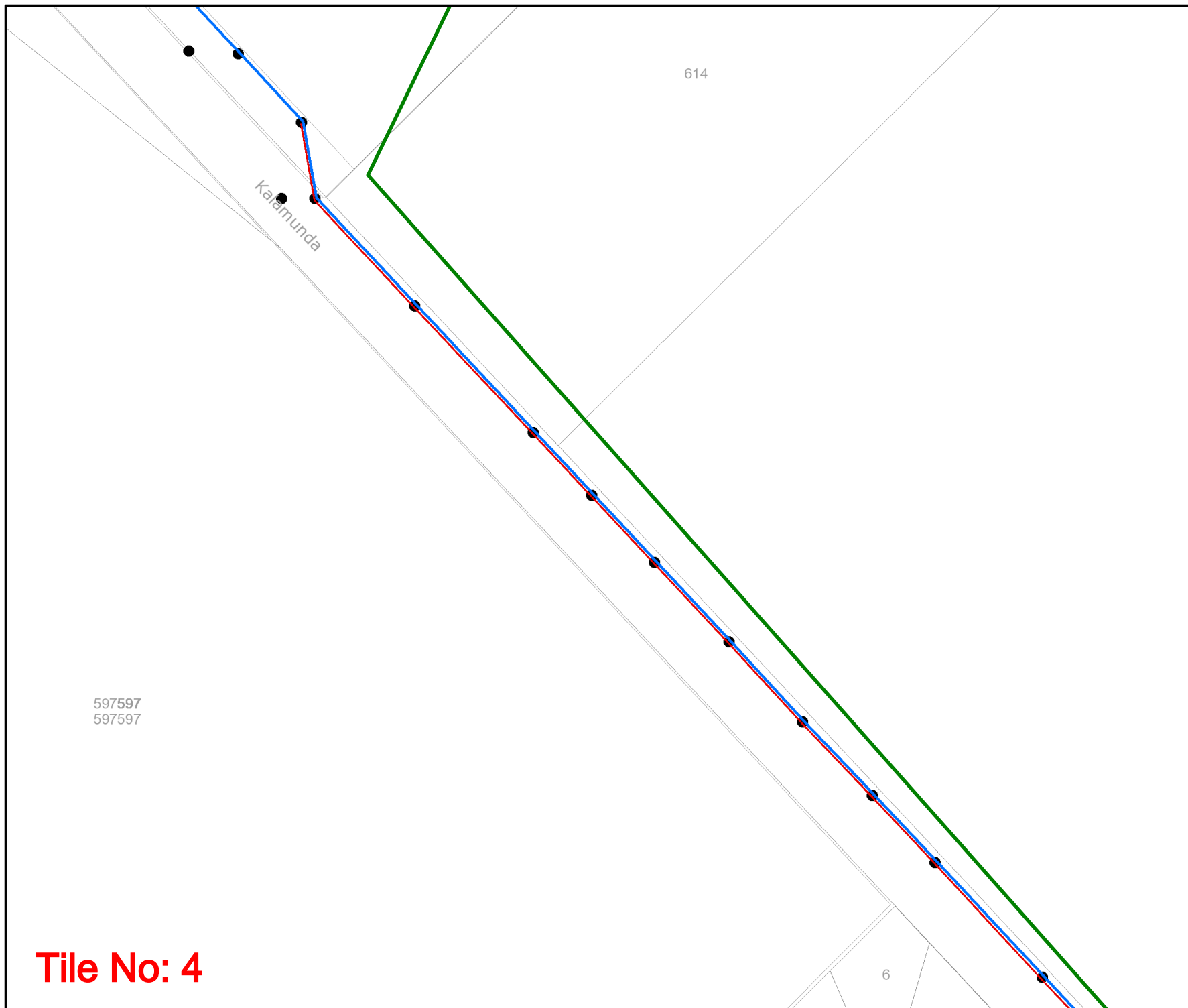
Information valid for 30 days
from date of issue

A4

Scale : 1:1500

**WARNING! Look out for
overhead power lines**

Tile No: 3



OVERHEAD LEGEND

Structures

- Power Pole
- Transmission Poles

Transmission Overhead Powerline

- Transmission (33kV - 330kV)

Distribution Overhead Powerline

- High Voltage (1kV - 33kV)
- Low Voltage (< 1kV)

Proposed Construction Assets

- Design Area *
- High Voltage Overhead Powerline
- Low Voltage Overhead Powerline
- Power Pole

Communications Assets

- Overhead Pilot Cable

Feature

- Area of Interest

* Please refer to coversheet

Privately owned cables NOT SHOWN
(including house services)

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Check that you have enough
clearance from the DANGER ZONES
near overhead powerlines.

Telephone Support: 1300 769 345
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Information valid for 30 days
from date of issue

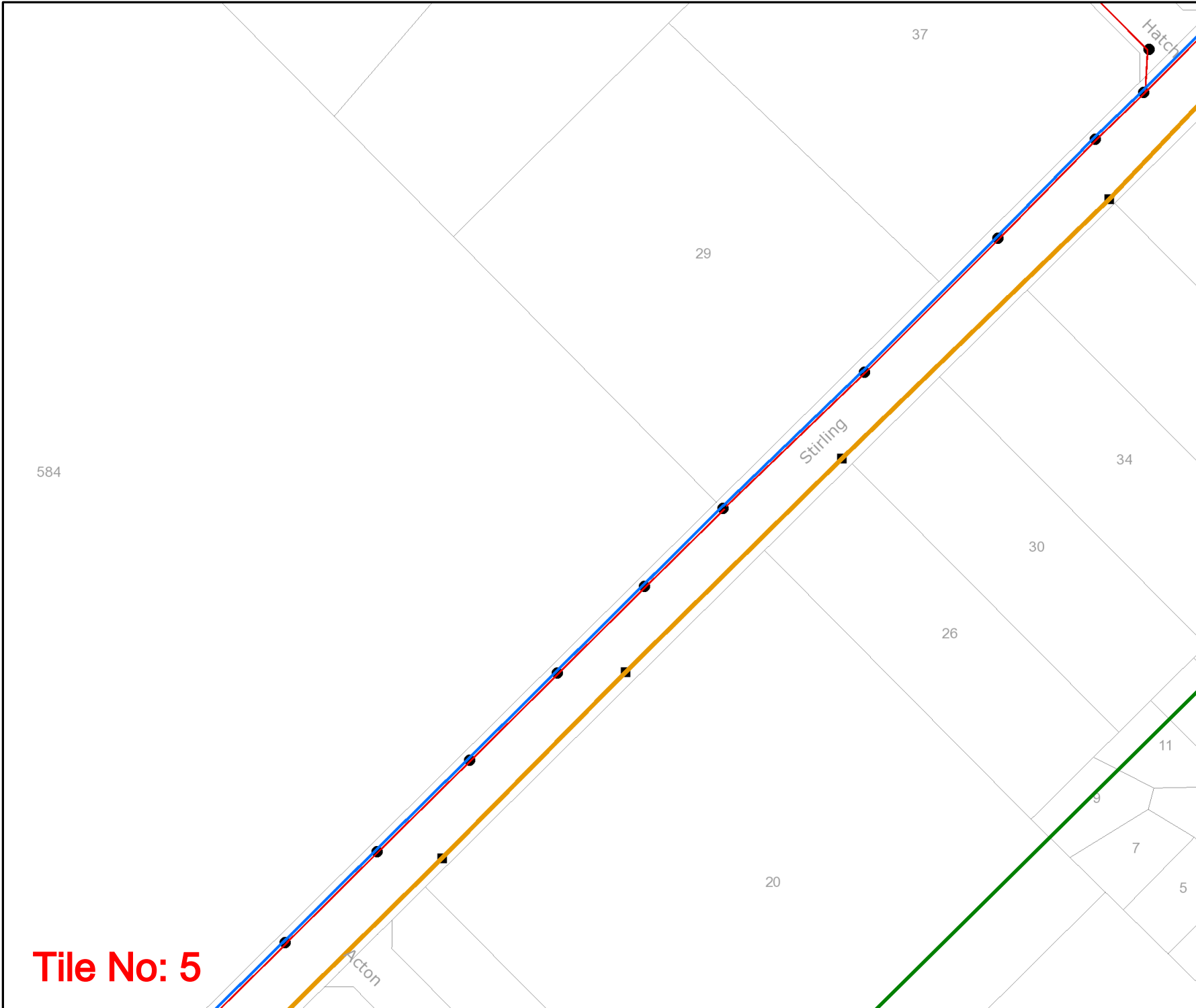
A4 Scale : 1:1500

**WARNING! Look out for
overhead power lines**

Tile No: 4

Sequence Number: 268549260

Date of Issue: 19 Feb 2026





OVERHEAD LEGEND

Structures	
● Power Pole	■ Transmission Poles

Transmission Overhead Powerline

Transmission (33kV - 330kV)

Distribution Overhead Powerline

High Voltage (1kV - 33kV)

Low Voltage (< 1kV)

Proposed Construction Assets

Design Area *

High Voltage Overhead Powerline

Low Voltage Overhead Powerline

● Power Pole

Communications Assets

Overhead Pilot Cable

Feature

Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

This map is **INDICATIVE ONLY**.
Check that you have enough clearance from the **DANGER ZONES** near overhead powerlines.

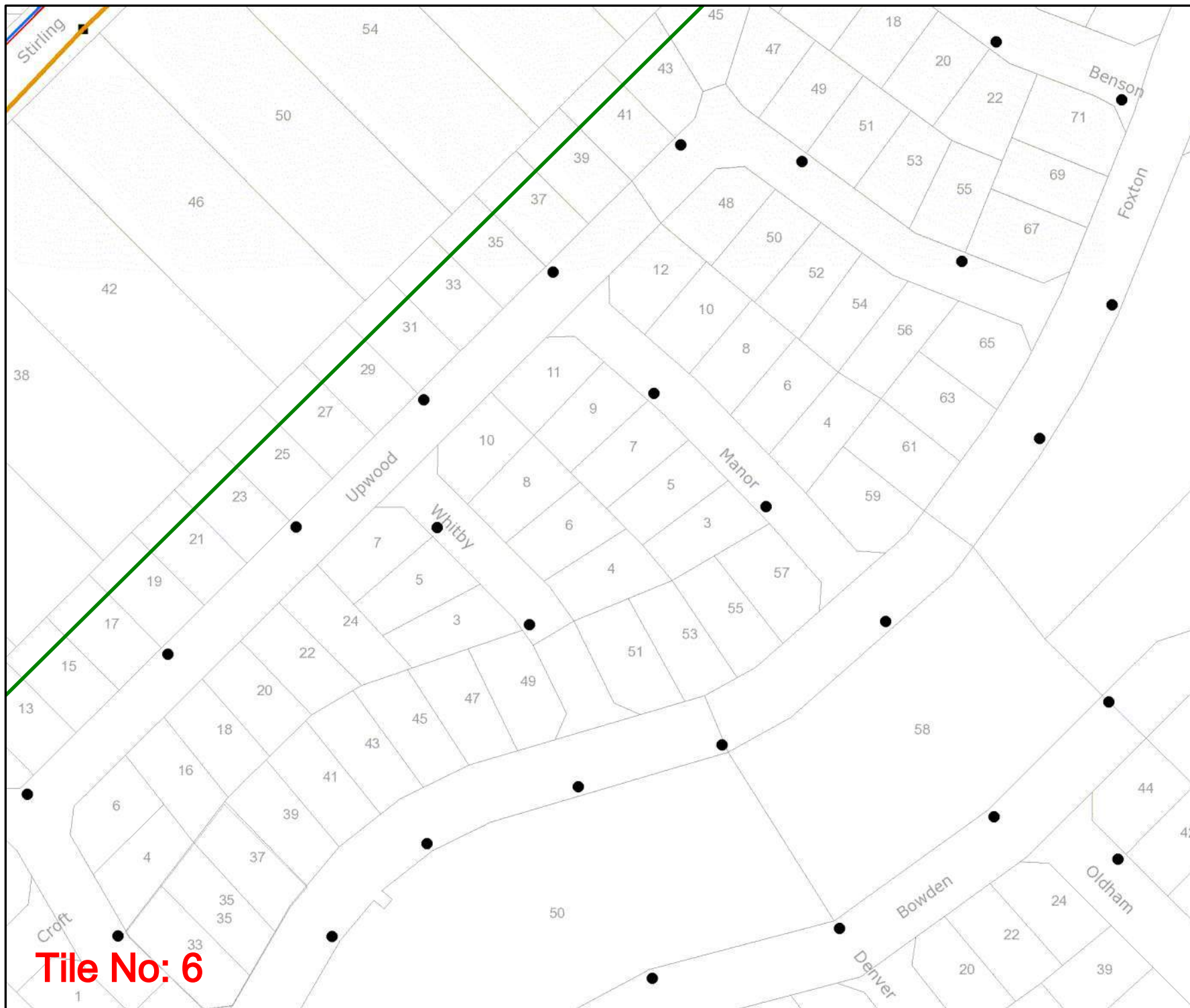
Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30

Information valid for 30 days from date of issue

A4 | Scale : 1:1500

WARNING! Look out for overhead power lines

Tile No: 5



OVERHEAD LEGEND

Structures

- Power Pole
- Transmission Poles

Transmission Overhead Powerline

- Transmission (33kV - 330kV)

Distribution Overhead Powerline

- High Voltage (1kV - 33kV)
- Low Voltage (< 1kV)

Proposed Construction Assets

- Design Area *
- High Voltage Overhead Powerline
- Low Voltage Overhead Powerline
- Power Pole

Communications Assets

- Overhead Pilot Cable

Feature

- Area of Interest

*** Please refer to coversheet**

**Privately owned cables NOT SHOWN
(including house services)**

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Check that you have enough
clearance from the DANGER ZONES
near overhead powerlines.**

**Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30**

**Information valid for 30 days
from date of issue**

A4 | Scale : 1:1500

**WARNING! Look out for
overhead power lines**

Tile No: 6

Sequence Number: 268549260

Date of Issue: 19 Feb 2026