Local water management strategy addendum

Date: 05/11/2025
To: Jack-Henry Bresa, Josh Dallimore
From: Kristy Ferguson, Pentium Water

Robinson Grove, (Belle View Estate) Stage 2 – Local water management strategy addendum

Overview

Pentium Water has been engaged by Satterley Property Group Pty Ltd (Satterley) to prepare an addendum to the previously prepared *Local water management strategy, Belle View Estate Stage 2* (Coterra Environment 2020). This previous report was endorsed by the Department of Water and Environmental Regulation (DWER) in 2020. The Structure Plan has since been revised, and a Local Water Management Strategy (LWMS) addendum is required to show that the new Structure Plan adheres to the previously approved stormwater management principles and to support the revised Structure Plan submission. This addendum should be read in conjunction with *Local water management strategy, Belle View Estate Stage 2* (Coterra Environment 2020).

The revised Structure Plan and subdivision concept plan (Appendix A) have a number of changes from the previous plan including:

- No longer a proposed road through the Parks and Recreation reserve crossing the Helena River.
- Change in road and lot layout, with roads or Public Open Space abutting the majority of the Parks and Recreation Reserve rather than lots.
- Inclusion of a Local Centre Lot and increase in the total number of residential lots from 265 to 323.
- Increase in Public Open Space (POS) area from 1.181 ha to 2.073 ha, with POS adjacent to most areas of the Parks and Recreation reserve.

Planning background

The Stage 2 Structure Plan area was rezoned from 'Rural' to Urban' on 14/02/2020 resulting in a subsequent rezoning under the Shire's Local Planning Scheme No. 4 from 'Rural Residential' to 'Development' on 4 December 2020 (TBB 2024).

In September 2020, the Robinson Grove Estate Stage 2 *Structure Plan for Lot 799 (Part) Wilkins Street, Bellevue* was prepared and lodged with the Shire. While the structure plan was recommended for approval by Council, it was never endorsed by the WAPC, but remained with DPLH and assessment on hold. Following that the Structure Plan has now been revised and as outlined in the previous section this LWMS addendum has been prepared to support the revised Structure Plan submission.

Site environmental context

Stage 2 of the Robinson Grove Estate (the site) is located on Lot 9001 (on plan P424349) Katharine Street, Bellevue, within the Shire of Mundaring. The Stage 2 Structure Plan area is approximately 24.36 ha in area and consists of:

- 323 residential lots ranging in size from 350 m² to 650 m²
- Local centre site (9,770 m²)

- Public open space (2.073 ha)

The site has previously been used for agricultural purposes. The surrounding landuses include residential lots to the east and light industrial to the west. Belle View Estate Stage 1 is located to the north of the site. Stage 1 has previously had a DWMS (RPS, 2013), LWMS (Coterra, 2017a) and Urban Water Management Plan (UWMP) (Coterra, 2019) prepared and approved. Construction of stage 1 is currently underway. The site location is shown on Figure A.

Topography

The pre-development topography of the north-eastern portion of the site is relatively flat with 1 m topographic contours at 18 m AHD to 17 m AHD, which then has a steep drop to 7 m AHD to the floodplain area in the southwest of the site. Pre-development topography is shown on Figure B.

Surface geology

Regionally the surface geology of the site has been mapped as (Gozzard 1986):

- MgS1 Pebbly Silt – strong brown silt with common, fine to occasionally coarse-grained, subrounded laterite quartz, heavily weathered granite pebble, some fine to medium-grained coarse sand, of alluvial origin.

The Helena River floodplain has been mapped as:

- Clay – dark, strong brown soil, hard when dry, soft when moist, variable silt content, no sand of alluvial origin.

Regional surface geology mapping is provided on Figure C.

Geotechnical investigations

A geotechnical investigation (Douglas Partners 2015) covering Stages 1 and 2 confirmed the soil type of the foreshore area as:

- *Alluviums of variable nature and consistency in the lower part of the site (floodplain). The alluviums encountered comprise highly variable materials including some very loose and soft materials. These materials are between 7.5 m and 18 m thick and underlain by more competent materials of the Guildford or Osborne Formations.*

While the rest of the area was summarised as:

- Topsoil overlying, a thin layer of sand underlain by gravelly, sandy and clayey materials of the Guildford formation.

An additional geotechnical investigation was completed for Stage 1 and 2 by DTE Geotech (2019), which included in-situ permeability testing at three sites within Stage 2. The results from these tests indicated infiltration rates of 2 x 10^{-7} m/s to 6 x 10^{-7} m/s. Due to the underlying soil type and low infiltration rates, lot soakwells were not recommended for the site.

Acid sulfate soils

DWER broad-scale Acid Sulfate Soil (ASS) risk mapping is based on surface geology mapping and provides a broad-scale indication of the risk of occurrence of ASS. Mapping indicates that the lower portions of the site associated with the Helena River foreshore is in an area of “moderate to low risk” of ASS within the upper 3 m of the soil profile (DWER 2025a), while the higher areas of the site were not mapped as a risk

(Figure D). Douglas Partners prepared an Acid Sulfate Soils Management Plan (2015) as part of the constructed wetland work.

Hydrology

The Helena River is located approximately 250 m to the south of the site which traverses through a 55.52 ha Parks and Recreation reserve as part of the wider landholding. Wangalia Brook intersects the site and along with Kadina Brook confluences with the Helena River immediately to the west of the site within the wider landholding. The Helena River has its headwaters in the Darling Scarp and confluences with the Swan River at Guildford (Coterra 2020). Wangalia Brook is a small ephemeral brook that flows from a residential catchment east of the site through culverts under Katharine Street, and has been modified to now discharge to the chain of constructed wetlands. A living stream, previously Bellevue Drain (which also receives flows from north of the Stage 1 area) dissects Stage 1 and connects with the constructed wetlands located to the south of the Stage 2 area. These wetlands were designed and constructed as part of Stage 1 of the development. The pre-development hydrology is mapped on Figure E.

DWER flood mapping is illustrated on Figure F, which shows the floodplain area to the south of the site for the 10% and 1% Annual Exceedance Probability (AEP) events. The 1% AEP flood event adjacent to the site ranges from 11 m AHD in the east to 10.2 m AHD on the west.

Surface Water monitoring

Post-development monitoring of the constructed wetlands and living stream has been undertaken from March 2022 and is ongoing. Water quality in the constructed wetlands has returned relatively consistent results over the monitoring period. pH has typically been within ANZG (2018) guideline values of 7-8.5. Total phosphorus (TP) has been above the guideline value for a number of monitoring events, during both summer and winter, within each of the wetlands and the living stream, while phosphate-P has been below the guideline value for the majority of events. NO_x-N and NH_4-N results have frequently been above the ANZG guidelines, with fewer exceedances for TN. There have only been two monitoring events (March 2022 and March 2024) where chlorophyll-a was above the ANZG guideline value for the majority of sites. Results from the wetland and living stream monitoring are provided in Appendix B for reference.

Geomorphic wetland mapping

The DBCA geomorphic wetland mapping shows the Helena River and floodplain within the wider landholding to be classified as a Resource Enhancement Wetland (14230 Floodplain Resource Enhancement) (DBCA, 2025). Resource Enhancement wetlands (REW) are wetlands that have been identified for maintenance and enhancement of their existing ecological functions. Downstream of the site the Helena River is classified as a Conservation Category Wetland (CCW) (15440), the highest level of wetland protection. The portion of the Helena River and floodplain located on the wider landholding was previously classified as a CCW but was reclassified in 2006 due to the degraded nature of the site. Rehabilitation of the Helena River foreshore and the creation of the wetland chain within the REW was previously approved and constructed (Coterra, 2017). Wetland mapping is illustrated on Figure G.

Groundwater

Site groundwater monitoring between 2012 and 2014 recorded maximum measured groundwater levels from 10.71 m AHD to 10.84 m AHD (5.78 to 6.15 metres below ground level (mbgl)). Site specific groundwater contours were not completed for the site as part of the previous LWMS (Coterra, 2020), however DWER produced minimum

groundwater contours for May 2003, which ranged from 10 m AHD on the eastern side of the site to 7 m AHD in the southwest of the site.

Three years of post-development groundwater monitoring was undertaken for Stage 1 of the Belle View estate from 2022-2024. This monitoring program included five bores (CO-08, CO-09 (destroyed in 2022), CO-10, CO11 and CO-02). While this monitoring program is for Stage 1, two of the bores (CO-02 and CO-08) are located within the Stage 2 boundary. Groundwater levels measured during this time period followed seasonal trends with groundwater levels ranging from 9.19 m AHD (CO-11) to 15.527 m AHD (CO-08). The post-development monitoring program has been continued in 2025 as there were still large sections of Stage 1 undeveloped during the three-year post-development monitoring period.

Groundwater quality measurements found elevated nutrients, in particular Total Phosphorus (TP), Total Nitrogen (TN) and NO_x-N frequently exceeded guideline values from groundwater sampled. The monitoring results have been included in Appendix B.

Irrigation supply

Taliska Securities Pty Ltd has a groundwater licence for 42,000 kL from the Perth Superficial Aquifer, covering the whole landholding including the Helena River Parks and Reserves area. Plan E have created an irrigation schedule for permanent irrigation areas, which is provided as a part of Appendix C.

An additional licence application will be lodged with DWER for temporary water uses including dust suppression during construction and establishment irrigation for 10,000 kL. An assessment was recently completed of the bore network across the landholding, which identified that a new irrigation bore will be required to be installed, and a 26D licence to install a bore will also be submitted to DWER for this.

Landscape concept plan

Plan E prepared a landscape master plan for the Parks and Recreation area/ Regional Open Space and the POS areas within the development and those POS areas that interface to the Regional Open Space. The landscape masterplan has been included in Appendix C.

The Regional Open Space incorporates:

- Helena River and associated foreshore and vegetation to be retained
- other existing vegetation to be retained
- previously constructed wetland system
- biofiltration areas
- path network
- low-growing native shrub planting, and rehabilitation planting areas
- paddock/grassland to be retained,

The interface POS areas include turfed area, garden beds, shade structures with picnic seating.

Water servicing

Potable water supply

The proposed development will be supplied with potable water through connection to the existing Water Corporation Integrated Water Supply System and can be serviced from existing infrastructure around the site, though headworks could be required (Cossill & Webley 2025).

Wastewater servicing

Wastewater servicing will be via connection to the existing Water Corporation sewer network. Stage 2 will connect into an existing gravity sewer network in Stage 1 of the development, which reticulates sewage to the Education Road pump station (Cossill & Webley 2025).

LWMS stormwater design objectives

The LWMS (2020) outlined how the development would achieve stormwater management through the implementation of water sensitive urban design (WSUD) principles and best management practices (BMPs). The aim of the design is to control water quality and quantity from both minor and major storm events. Stormwater management for the revised Structure Plan will adhere to the previous design objectives which are outlined in Table 1.

Consistent with the LWMS (Coterra 2020), the guiding principles for the drainage strategy are outlined below and further detailed in Table 1:

- Maintain the existing flow paths from upstream catchments
- Maintain or improve the hydrological regime and environmental flows within the Helena River
- Treat first flush runoff from road reserves prior to discharge
- Protect people and the built environment from flooding and inundation
- No adverse impacts of flood risk upstream or downstream of the development.

Table 1: Stormwater management design objectives

Element	Principle	Objective
Surface water management	Manage catchments to maintain or improve water resources	Maintain or where possible improve the water quality in the Helena River.
		Contribute to the restoration of flows in the Helena River
		Treat stormwater as close to source as possible.
	Ensure that economic, social and cultural values are recognised and maintained.	Protect Aboriginal and European Heritage sites within the site.
	Manage environmental assets	Maintain and where possible improve the quality of the waterways and wetlands within the site.
Flood Risk Management	Manage risks to human life and property.	Protect people and the built environment from flooding and inundation on site.
		No adverse impact in terms of flood risk to communities upstream and downstream of the development.
Groundwater management	Manage catchments to maintain or improve water resources.	Maintain or improve groundwater quality.
	Manage risks to human life and property.	Provide adequate separation distance to groundwater for built infrastructure.
Nutrient management	Manage catchments to maintain or improve water resources.	Reduce nitrogen load generated on the site.
		Reduce phosphorous load generated on the site.

Water conservation strategy (potable and alternative water source)	Ensure the efficient use of water resources	Achieve water targets of household water consumption.
		Minimise the external use of potable water.

The overall drainage strategy for the site includes:

- Due to the impermeable soil, lots will have direct connections to the road reserve piped network.
- Treatment of the 'first flush' (15 mm) in water quality treatment biofiltration areas prior to discharge to the Helena River foreshore wetlands (with this approach previously agreed with DWER in the previous LWMS).
- Events larger than the 20% Annual Exceedance Probability (AEP) event to be conveyed in the road reserve directly to the Helena River foreshore wetlands.
- The constructed wetlands will overtop in larger events and flow to the Helena River.
- Catchment B on the western side of the site will have biofiltration areas that overtop to the foreshore and will not discharge to the constructed wetlands.

Changes to the drainage as a result of changes to the Structure Plan

The overall drainage strategy for the site will be consistent with that proposed in the previous LWMS for stage 2:

Figure 1 shows the previous post-development catchments versus the current proposed post-development catchments which are shown in Figure 2. One of the main changes is that catchment 12 has now been split into Catchments B and C, to avoid having a biofiltration basin at the south-western end of the development. While there have been some modifications to catchment areas, overall, the strategy remains the same and the changes to the biofiltration areas from including runoff from lots can be accommodated within the POS and Regional Open Space.

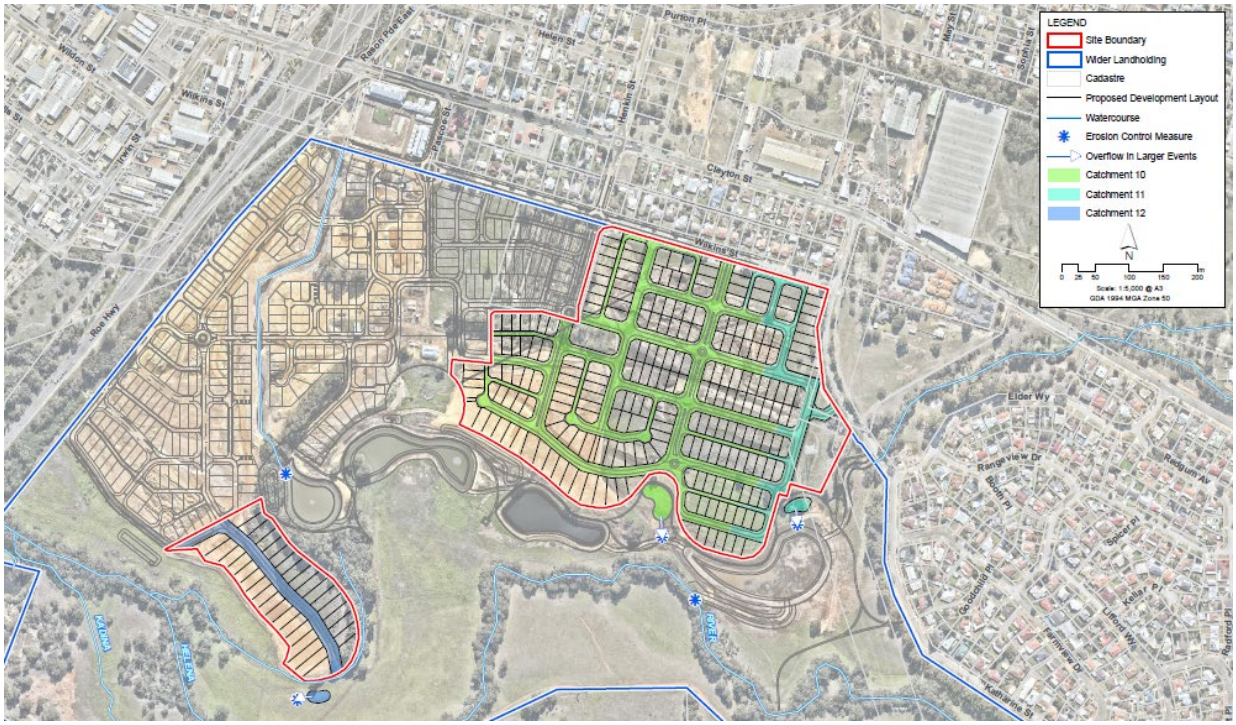

Figure 1: Previous post-development catchments for Stage 2

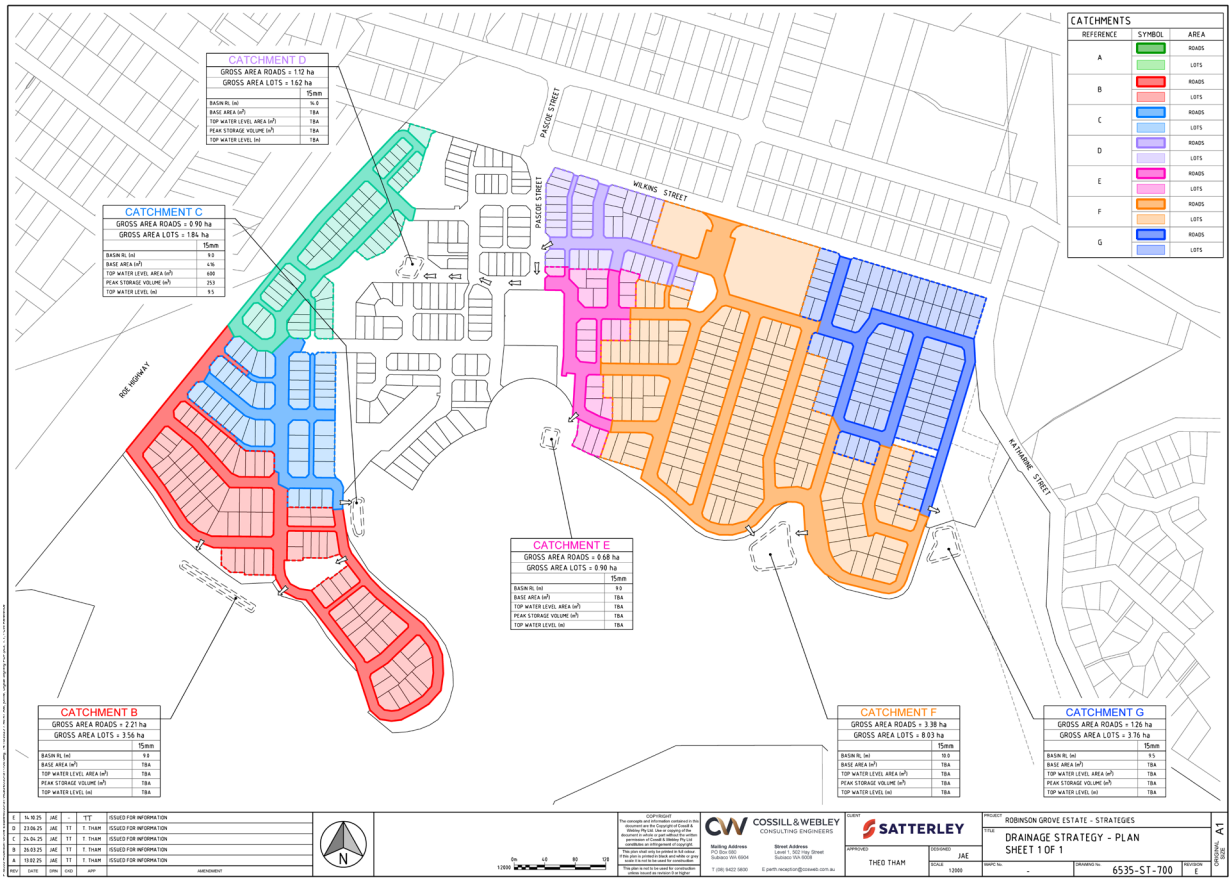

Figure 2: Current post-development catchments for Stage 2 and sections of Stage 1

Drainage strategy

Stormwater management for Stage 2 of the development is dictated by the previous Stage 1, which included the modelling, design and construction of four lined linked wetlands (OW1, OW2, OW3 and OW4), with OW1 overflowing into the Helena River during larger events. The wetlands were constructed in 2018 (Coterra, 2020) and were designed to detain flows greater than the 15 mm event from sub-catchments of stages 1 and 2 of the development and ultimately overflow to the Helena River in major events. Sub-catchment B on the western side of the development will have bio-filtration basins that directly overflow to the Helena River foreshore zone. The bio-filtration basin locations relative to the existing hydrological features are shown on Figure H.

The design utilises outflow from the Bellevue living stream (Stage 1), which will be conveyed through four linked open water wetlands (OW3, OW4, OW2 & OW1) prior to entering the Helena River (Coterra 2020). In normal operation, the system is designed to follow a reverse flow path to the Helena River to maximise residence time and therefore water quality treatment. Runoff from catchments C and D will discharge to the living stream, while catchments E, F and G will discharge to the wetlands after first flush (15 mm) water quality treatment areas. The Wangalia Brook has been realigned from its original flow path and will discharge into the final wetland, OW1 which will overspill into the Helena River during larger events. The wetlands will not be embanked so the whole Helena River floodplain will remain operational during periods of high flow.

Post-development stormwater modelling included flood modelling was previously undertaken using xpswmm as part of the LWMS (Coterra, 2020). The changes that have been made to the Structure Plan are not anticipated to materially affect flow rates or volumes to the living stream or constructed wetlands and subsequently further downstream receiving environments. Based on this further XPSWMM modelling for the LWMS addendum was not considered warranted.

The previous design also included runoff from the minor 15 mm event from the connected impervious road reserve discharging to water quality treatment areas which will overspill at designated points to the constructed wetlands. These have been resized for this addendum due to the changes in catchments. It was previously identified that the site was not suitable for the use of lot soakwells. Based on this the biofiltration areas have been sized to receive water from all lots within each of the respective catchments.

Water management for each of the sub-catchments

There are six post-development catchments relevant to Stage 2, which also include sections from Stage 1. The post-development catchment plan and earthworks plan are provided in Appendix D and also shown on Figure 2.

The following sub-sections outline how stormwater runoff will be managed in each of these catchments post-development.

Catchment B

Stormwater from the directly connected lots and piped road network will be directed to a biofiltration basin located to the southwest. Events larger than the 15 mm will overtop to the Helena River foreshore zone. Catchment B primarily consists of Stage 1, and this is consistent with the plan presented in the UWMP for Stage 1 (Coterra 2019). In the Stage 1 UWMP, this catchment was labelled zone 4. Previously the impervious catchment area was 2.47 ha, and is now 4.39 ha due to the removal of catchment A, and directing this stormwater to Catchment B to avoid a biofiltration basin to the south of the development area. As the biofiltration basin has not been constructed yet and

there is space within the reserve for the increase in size in the biofiltration area, this variation from the previous reports does not pose a detrimental impact to the drainage strategy. As per previous plans, when the capacity of the biofiltration basin has been exceeded, runoff will discharge to the floodplain via overland flow, with rock pitching to manage erosion.

Catchment C

As with catchment B, catchment C is primarily part of Stage 1 and the biofiltration basin has already been sized. While the landscaping for this biofiltration basin has not been completed, the pipework and earthworking has been done. This catchment was previously zone 3 in the Stage 1 UWMP, which had an impervious area of 2.1 ha, and in the currently catchment calculations the effective impervious catchment area is now 1.98 ha. Events greater than the 15 mm event will discharge to the constructed wetland chain in the Helena River foreshore.

Catchment D

Catchment D will be piped to a biofiltration basin which will then discharge to the already constructed living stream in Stage 1. Previously zone 5 (Stage 1 UWMP, Coterra 2019), this drainage strategy is overall consistent with the previous plan, although the 15 mm event was previously proposed to be treated in raingardens, with larger events to be piped directly to the living stream. The previous impervious area was 1.36 ha, which has increased to 2.08 ha, however the biofiltration basin in the POS and living stream has the capacity to detain runoff from this slightly larger area.

Catchment E

Runoff from the 15 mm event from catchment E is proposed to be piped to a biofiltration basin located in the amphitheatre POS. The direct connected impervious catchment is 1.19 ha. Events greater than the 15 mm will discharge to the constructed wetland chain.

Catchment F

Runoff from the 15 mm event will discharge to a biofiltration basin located within the Parks and Recreation reserve. Events greater than the 15 mm will overtop the biofiltration basin and discharge to the constructed wetland chain between OW1 and OW2. This is consistent with what was presented in the previous LWMS (2020). The connected impervious catchment for this basin is 7.68 ha. The shaping of this biofiltration will avoid existing vegetation identified to be retained.

Catchment G

Catchment G will be piped to a biofiltration basin located within the POS, southwest of the powerline easement. The connected impervious catchment area is 3.85 ha. This basin will also be required to be shaped to avoid existing vegetation identified to be retained as part of the landscape plan. Events greater than the 15 mm will discharge to the constructed wetland OW1.

Basin design

Table 2 below presents the design and storage requirements of the basins. The basins were designed using an infiltration rate of 3 m/day. There will be a freeboard of between 0.3 m to 0.5 m for the various basins. The basin locations are shown in Figure H.

Table 2: Stormwater basin design and storage requirement for the 15 mm event

Parameter	Connected equivalent impervious catchment (ha)	Basin RL (m AHD)	Storage depth (m)	Basin TWL (m AHD)	Base area (m^2)	Infiltration area (m^2)	Storage volume (m^3)
Basin B	4.39	9.0	0.5	9.5	888	1,068	533
Basin C	1.98	9.0	0.5	9.5	420	510	253
Basin D	2.08	14.0	0.5	14.5	440	532	265
Basin E	1.19	9.0	0.5	9.5	184	292	145
Basin F	7.68	10.0	0.5	10.5	1,925	2,137	1,067
Basin G	3.85	9.5	0.5	10.0	812	934	466

All basins have 1:4 batter and an infiltration rate of 3 m/day has been used

Water quality treatment

The development will utilise structural and non-structural controls for water quality treatment including:

- Vegetated biofiltration basins
- Soil amendment in the biofiltration basins
- Constructed wetlands will provide an additional filter for sediment and litter, as well as nutrient stripping.
- Stormwater drainage infrastructure maintenance
- Street sweeping
- Erosion and dust control during construction
- Post-development monitoring to ensure that water quality targets are being met.

Groundwater management

As no subsoil drainage was previously proposed for the development, there are no changes to groundwater management with the LWMS addendum.

Post-development monitoring

The post-development monitoring will continue as per the current post-development monitoring plan which covers Stage 1 and 2 of the development.

Conclusion

This LWMS addendum has been prepared to support the revised Structure Plan submission for Stage 2 of the Robinson Grove estate, Bellevue. Overall, there has been no significant changes to the drainage strategy from the previous LWMS (Coterra 2020) due to the changes that have occurred with the Structure Plan and subsequent division of catchments post-development.

The drainage strategy is largely determined by the work that was completed for Stage 1, which included the modelling, design and construction of four lined linked wetlands (OW1, OW2, OW3 and OW4), as well as the modelling and construction of the living stream intersection Stage 1 and Stage 2 of the development.

This LWMS addendum demonstrated that the previously approved LWMS outcomes can be maintained including:

- Stormwater modelling demonstrates that the biofiltration basins can retain runoff from the 15 mm event.
- Events greater than the 15 mm event will be either directed to the foreshore or the previous constructed chain of wetlands and ultimately the Helena River.

In consideration of the above, the water management is consistent with the previous LWMS (2020). Further details of the stormwater drainage infrastructure and basins will be completed during the detailed design phase of the development and reported in subsequent UWMP/s.

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Figures

PENTIUM WATER

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Drawn by: K Ferguson
Date: 01/09/2025
Scale: 1:5400
Page size: A4
Sources: data.gov.au, landgate

0 100 200 m

GDA94 / MGA zone 50

Figure A

Site location

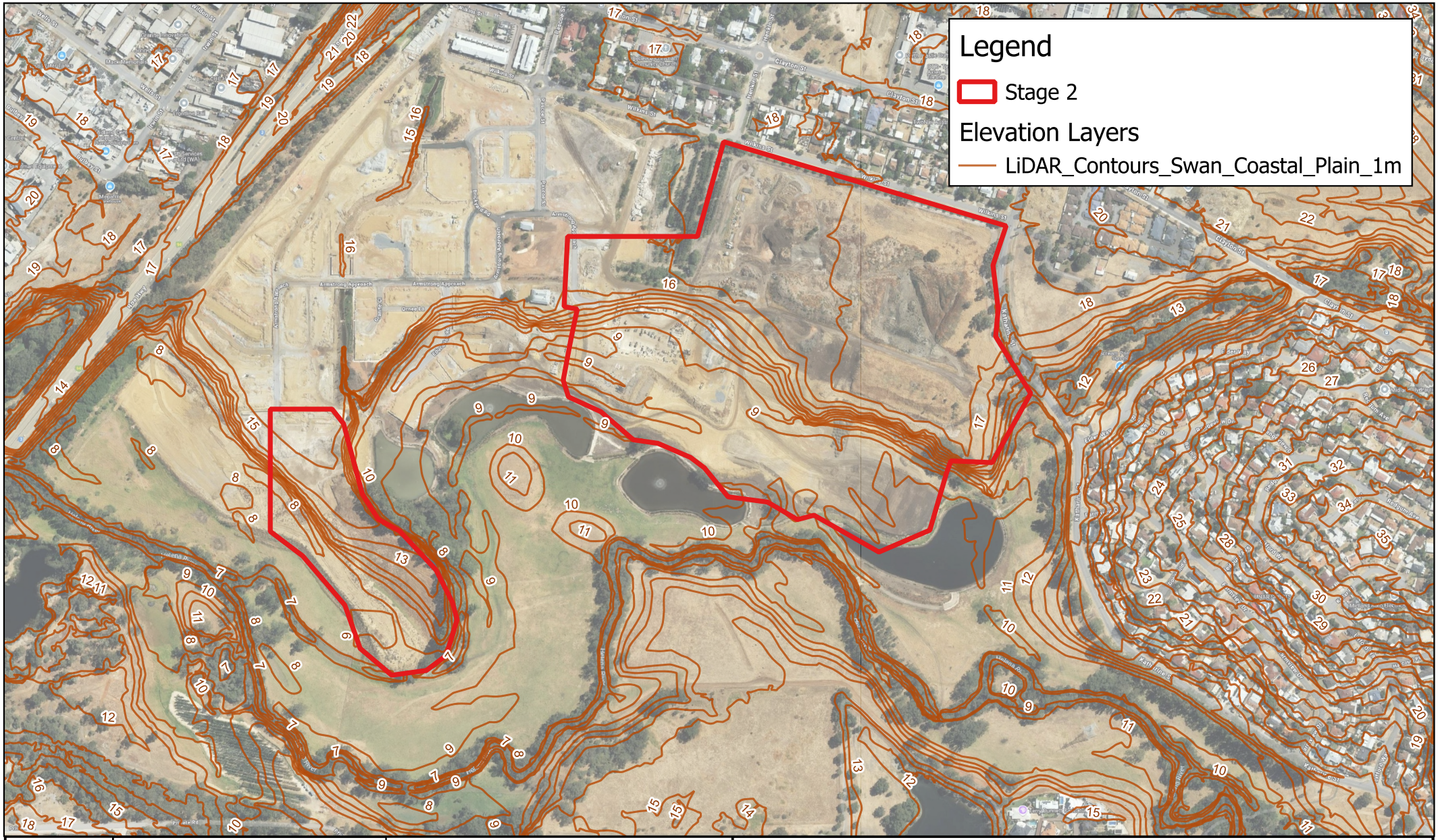

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Figure B

1 m topographic contours

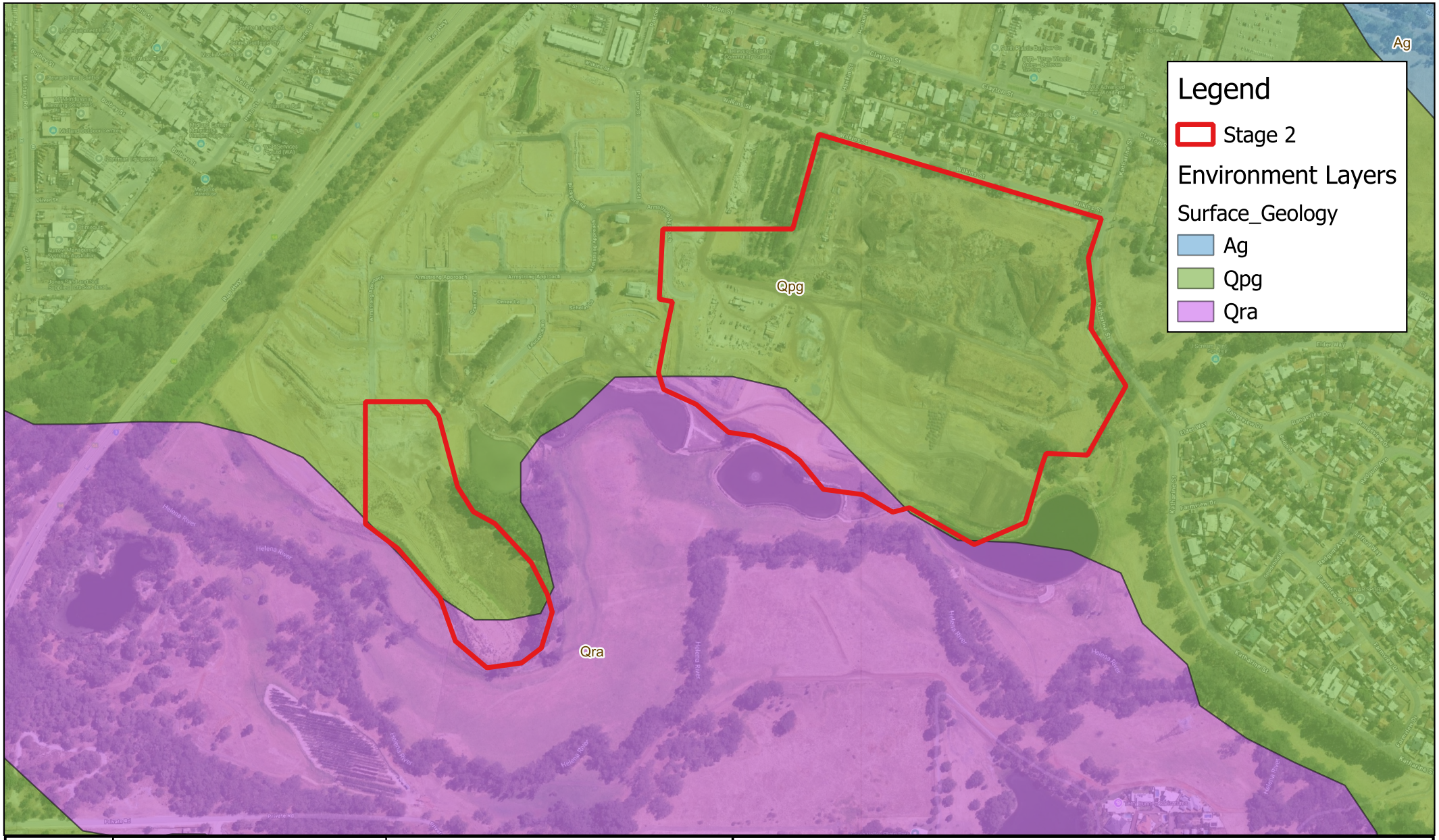

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Figure C

Surface geology

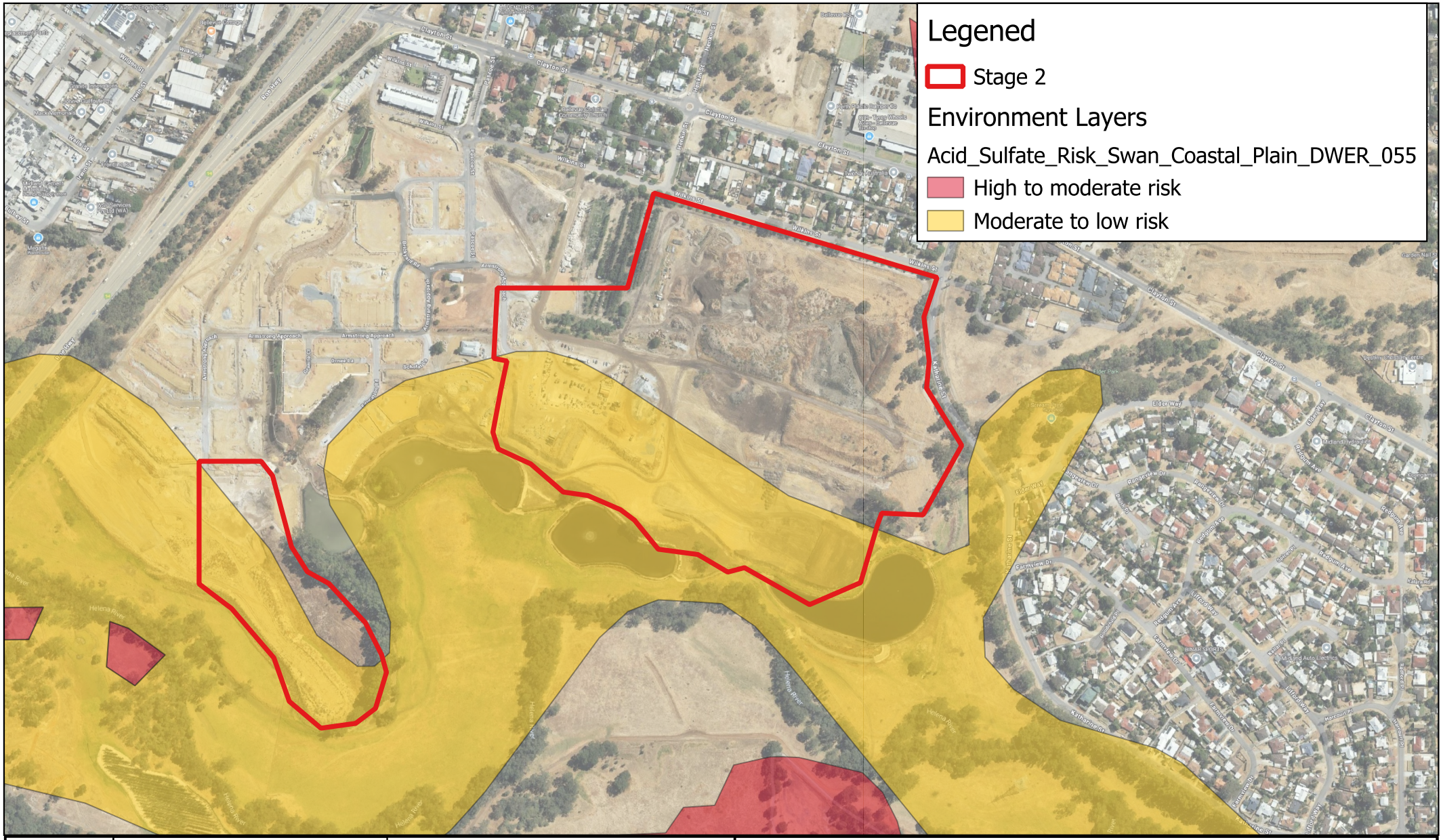

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Figure D

Regional Acid sulfate soil mapping

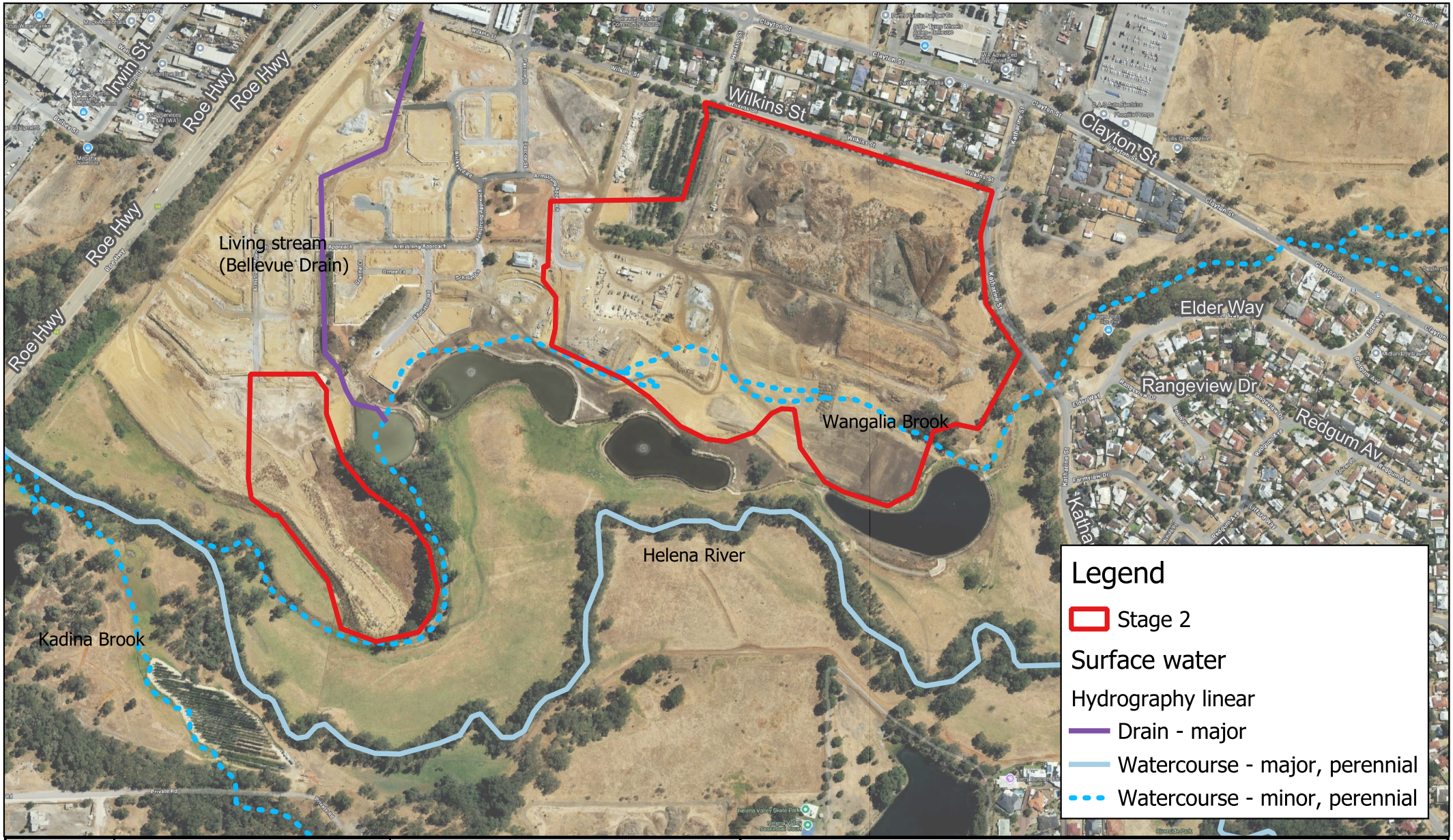

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Figure E

Hydrology

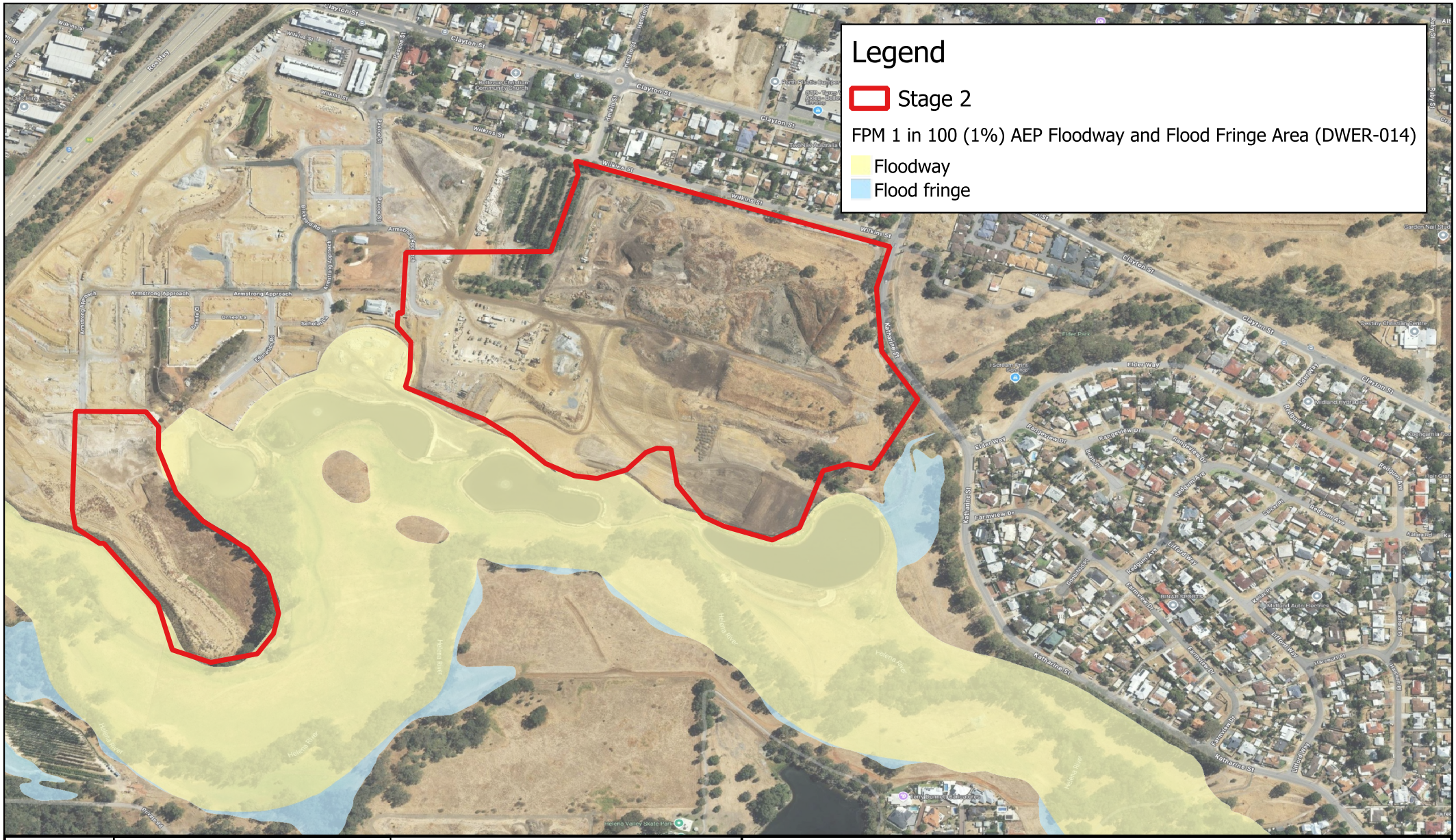

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Figure F

DWER 1% AEP flood mapping

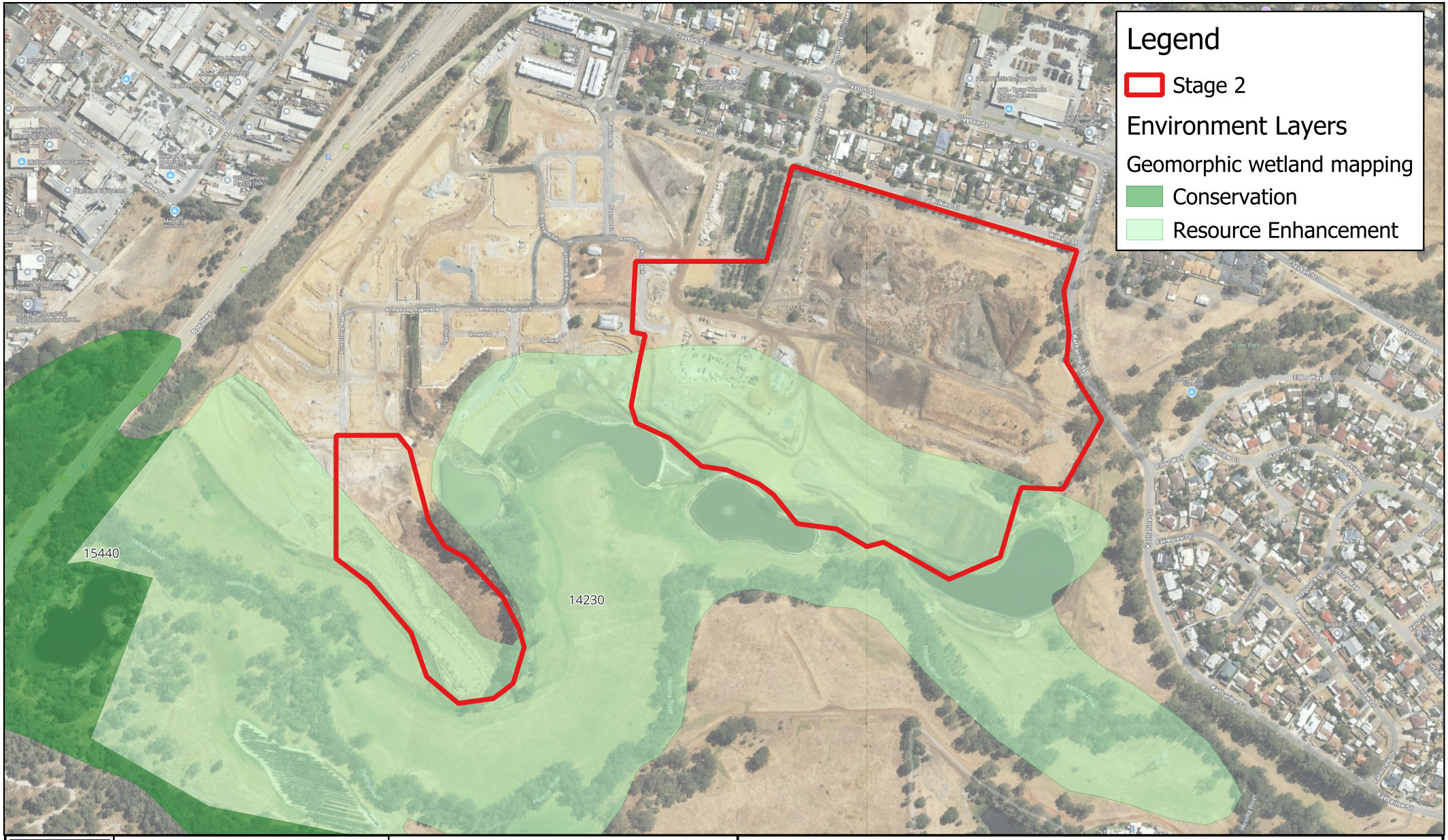

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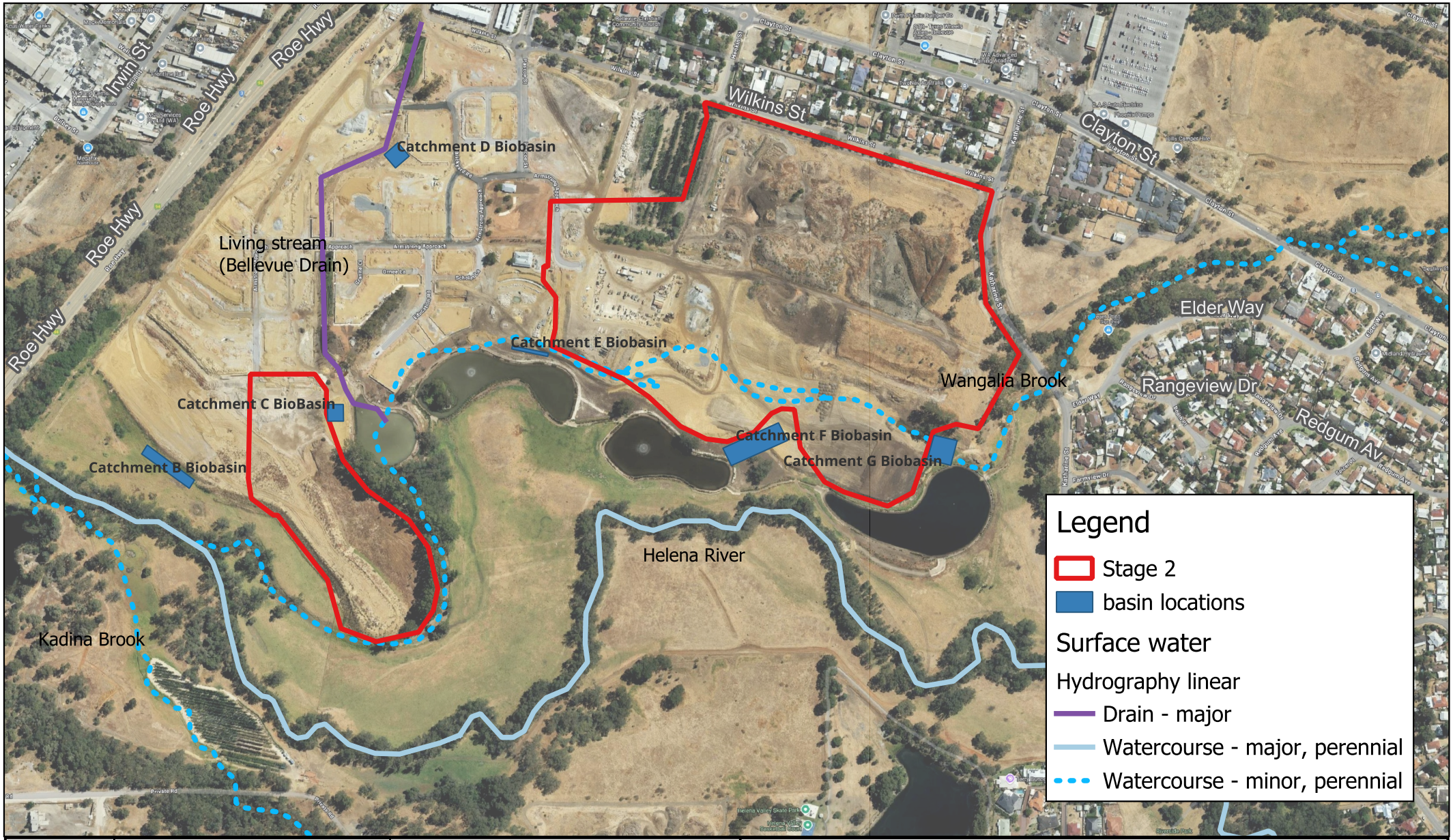
Figure G

Geomorphic wetland mapping



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GDA94 / MGA zone 50

Figure H

Biofiltration basin locations