ROCKBANK NORTH MTC UDF

STORMWATER MANAGEMENT STRATEGY
13/10/22

PREPARED FOR: MELTON CITY COUNCIL (CITY STRATEGY TEAM)

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1. INTRODUCTION

Spiire has been engaged by Melton City Council to prepare a Stormwater Management Strategy (SWMS) for the future Rockbank North 'Major Town Centre (MTC), and to ultimately inform the Urban Design Framework (UDF)

The SWMS considers overland and piped drainage for the proposed commercial development of the site. The strategy also explores how Town Centre will fit within Melbourne Water's future Kororoit Creek (Upper) Development Services Scheme (DSS).

The following elements form the basis of the SWMS:

- Hydrological analysis of runoff from the site, up to the 1% AEP event;
- Hydraulic analysis demonstrating the capture and conveyance of smaller flows, up to the 10% AEP event via underground drainage; and
- Integrated Water Management opportunities at the site, including the capture and reuse of stormwater/rainwater.

This SWMS also makes reference to the following strategy and planning documents:

- Melbourne Water's Kororoit Creek (Upper) DSS (currently under development within Melbourne Water); and
- Victorian Planning Authority's (VPA) Precinct Structure Plan (PSP) for Rockbank North.

This report will focus on the management of stormwater runoff from the proposed development, with respect to both quantity and quality. This report has been prepared to meet all requirements stipulated under the State Planning Provisions (SPP), Clause 56.07-04 and any specific conditions stipulated by Council, or Melbourne Water (MWC).

2. BACKGROUND

2.1 PROPOSED DEVELOPMENT

In line with the PSP, the site will predominantly be used for a 'major town centre', with a small portion at the north of the site earmarked for high density residential.

There is currently no proposed urban design layout of the site, with no detail on the road alignments or lot footprints. Overtell, a high-level assessment of the site will be undertaken at this stage, to inform the Urban Design Framework (UDF).

The current zoning of the site, per the PSP, is shown in Figure 1 below.

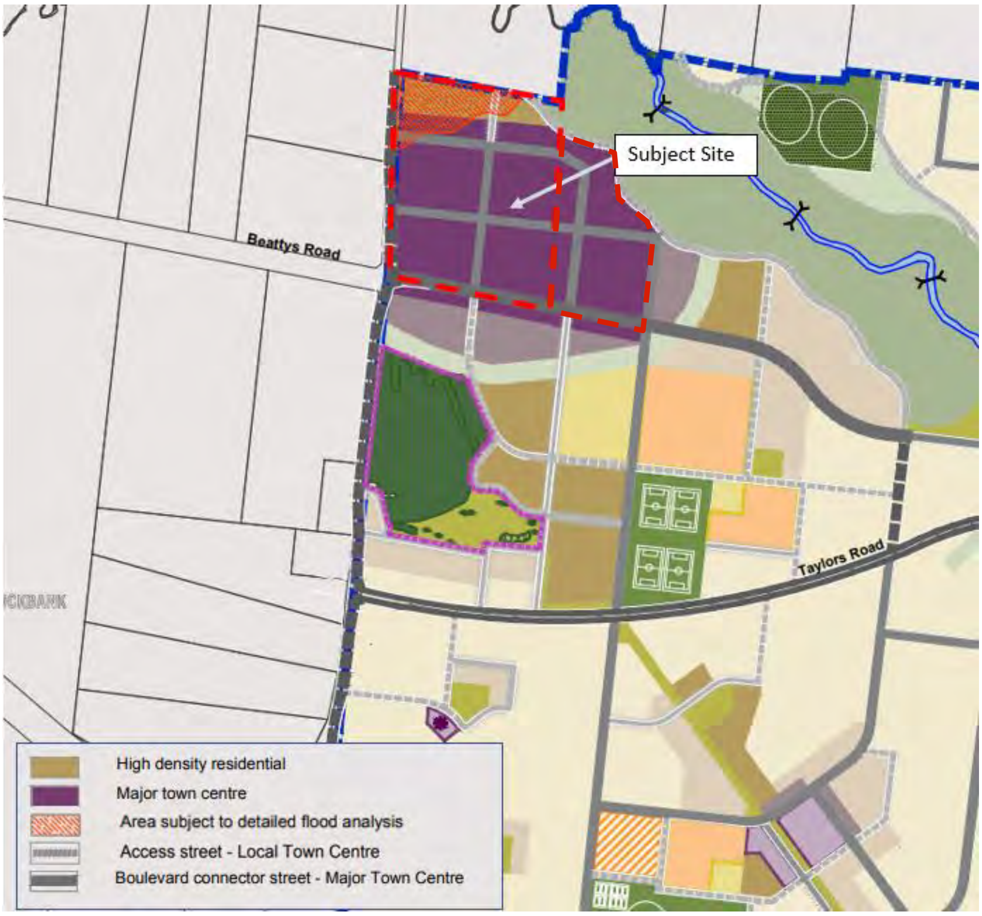

Figure 1: PSP layout for MTC area

2.2 SITE CONDITIONS

The site is bordered by Leakes Road to the west, Beattys Road to the south, and the wider Woodlea Estate to the east. The site is prone to flooding in its north-western corner, with this area being designated as 'Land Subject to Inundation', per Figure 2 below.

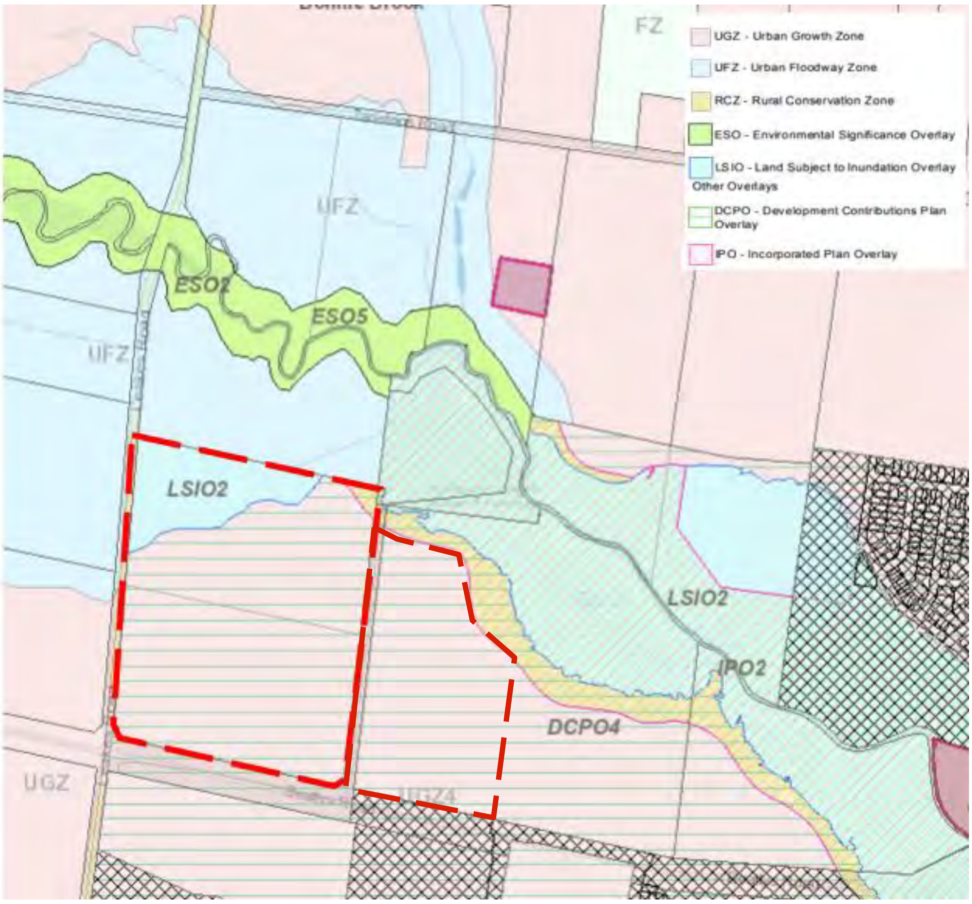

Figure 2: Planning overlays relevant to MTC area

In addition, the site will be mostly bordered to the north by areas of ecological importance, as it will interface with the Kororoit Creek corridor. Figure 3 below outlines some key ecological zones adjacent to the site.

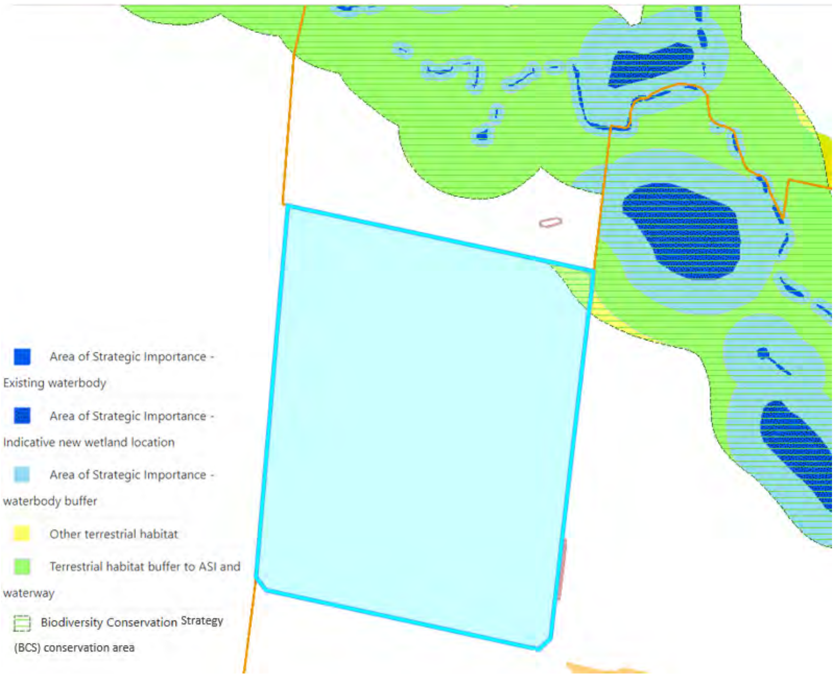

Figure 3: Environmental overlays adjacent to MTC site

Overall, it is noted that the MTC site will be part of the future Kororoit Creek (upper) Melbourne Water Drainage Services Scheme (DSS). This scheme is currently under development internally within Melbourne Water and an updated layout of the scheme was not available at the time of reporting. However, a previous draft of the scheme has been included (per Figure 4), which shows that the majority of the flows from the Kororoit Creek (Upper) DSS being conveyed via a waterway south of the MTC site. This waterway layout will remain consistent, regardless any update to the wider Kororoit Creek (upper) scheme.

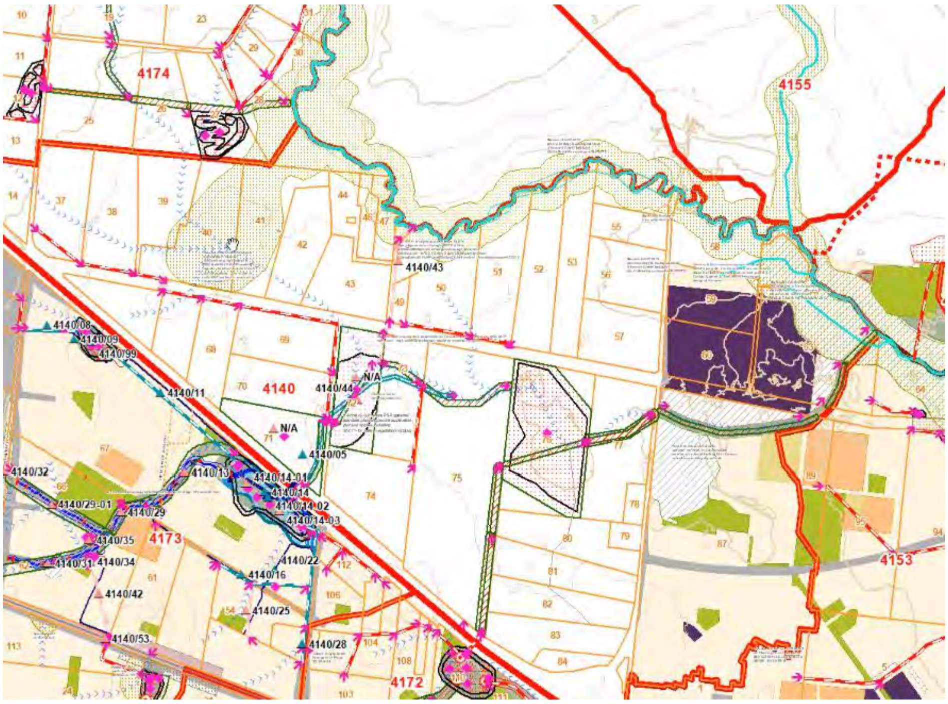

Figure 4: Previous Draft of the Kororoit Creek (Upper) DSS

3. HYDROLOGICAL MODELLING

Hydrological modelling has already been undertaken for the wider Kororoit Creek catchment. No alteration to this modelling has been undertaken as part of the MTC assessment. However, a summary of the hydrological inputs has been provided as part of this section of the report.

3.1 CATCHMENT SUMMARY

The Kororoit Creek Catchment is one of the larger catchments in Melbourne. The catchment extends from Gisborne South at its most upstream end, past Sunbury, through Plumpton and towards Caroline Springs. The catchment moves southeast through developed and developing suburbs to its ultimate discharge point at the Altona Coastal Park in Port Phillip Bay. The entire Kororoit Creek catchment is approximately 32,300 ha in area. The upper half of the catchment is largely characterised by rural land, largely used for farming. Once the Creek reaches Caroline Springs, the catchment is mostly residential, with a strip of mostly industrial use land through the Brooklyn area.

3.2 RORB PARAMETERS

A RORB model was utilised to assess the hydrology at the MTC site. The model was constructed as part of a previous assessment of the wider Kororoit Creek corridor (see Appendix A for a summary report for that project). This modelling utilises Australian Rainfall Runoff (ARR) 2019 modelling methodologies, and supersedes previous Melbourne Water modelling, undertaken by GHD.

The RORB model was constructed specifically to assess the Kororoit Creek catchment and was used as a more accurate basis for the subsequent TUFLOW modelling. The internal sub-areas of the RORB model were updated based on the latest available contour information and LiDAR information, and careful consideration was given to likely hydraulic controls (such as major road crossings) as well as required inflow locations to the TUFLOW model.

Overall, the RORB model extends from the upper catchment north of Gisborne South and terminates just as the model reaches the downstream residential area at the Deer Park flood gauge. Figure 1 shows the final RORB sub-catchment layout and extent (see also Appendix A).

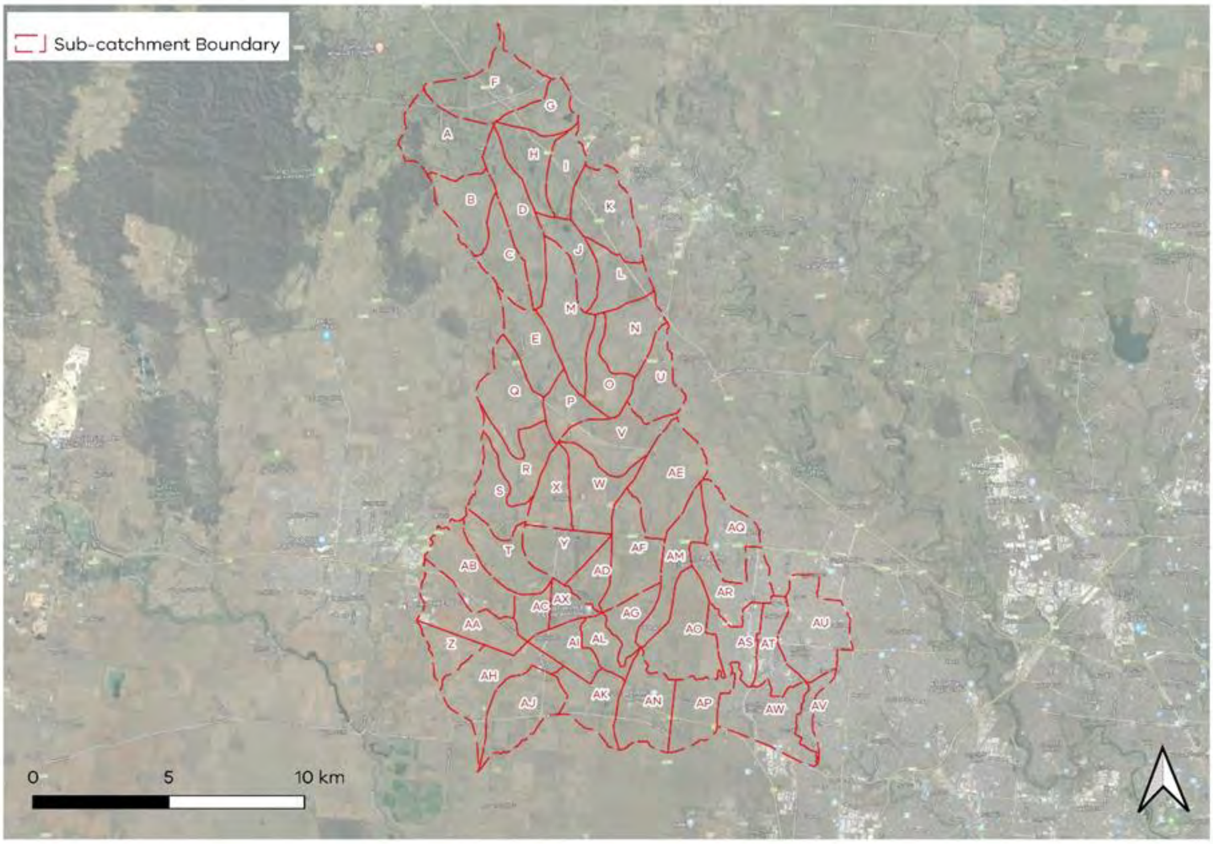

Figure 5: RORB catchment plan

The catchment fraction impervious values (FI) utilised within the RORB model were generated based on a combination of current land use (per the Planning Scheme) and recent aerial photography. Figure 6 shows the FI values adopted across the model.

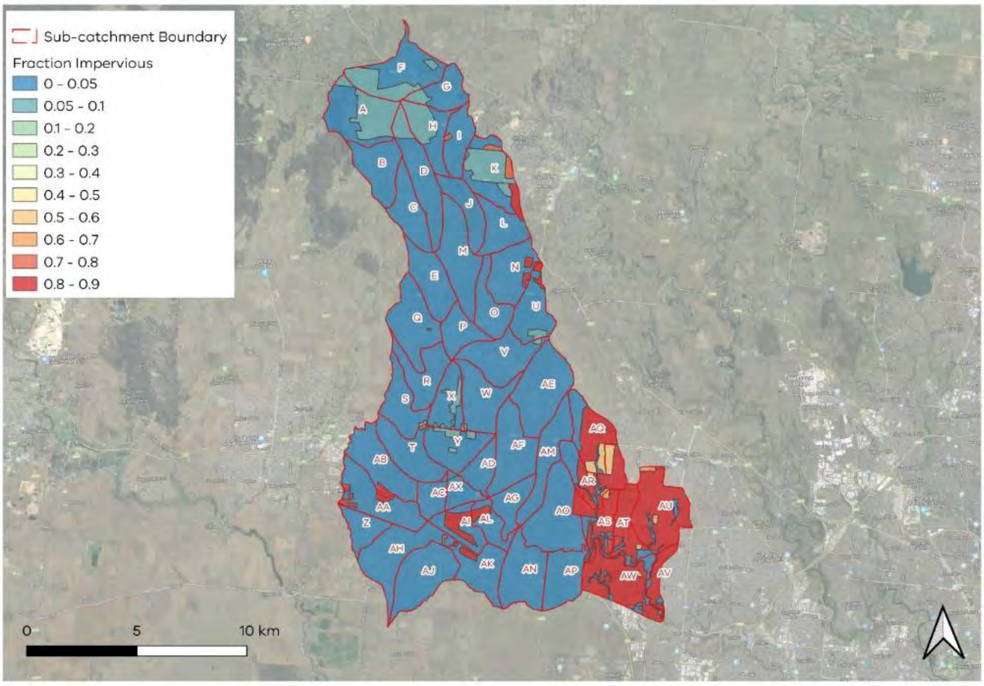

Figure 6: Kororoit Creek RORB Model – Fraction Impervious Values Adopted

It should be noted that fraction impervious values of 0.05 have largely been used for catchments upstream of the MTC site. This value has been selected as it reflects existing condition flows, and because there is an expectation that the developed upstream catchments will retard developed flows to existing condition flow rates. Ultimately, without full understanding of what developed infrastructure will be utilised upstream, utilising a 0.05 fraction impervious value has been deemed appropriate at this stage of modelling.

The RORB reach types were selected based on the best representation of overland flow routing within that subarea, these were predominantly 'Natural', with only a few instances of 'Excavated Unlined' reach type. Again. these reach types have been used to reflect pre-developed conditions, which should be consistent with any retardation targets for the upstream catchments. All reaches were assigned a slope based the available topographic information.

The RORB model was calibrated to the Deer Park gauge. The methodology of this calibration has been summarised as part of Appendix A. The following key parameters were used, following this calibration process:

Table 1: RORB parameter summary

RORB Parameters	Value
Kc	9.4
M	0.8
Storm Initial Losses (mm)	16 mm
Storm Continuing Loss (mm/hr)	3 mm/h
Temporal Patterns	Per ARR Data Hub

RORB Parameters	Value
Areal Pattern	Per ARR Data Hub
Areal Reduction Factor Details	Per ARR Data Hub
Loss Factor	Continuing Losses

Note that the RORB model was developed to generate the various inflows to the TUFLOW model. These inflows are summarised in Section 4.3 of this report.

4. HYDRAULIC MODELLING

4.1 BACKGROUND

A hydraulic model has already been undertaken as part of Kororoit Creek Flood Study. As such, the modelling for the MTC site has utilised this wider flood model, while integrating a number of elements of the proposed MTC development.

A report summarising the wider Kororoit Creek flood model has been provided in Appendix A.

4.2 PROPOSED DEVELOPMENT

The following hydraulic elements have been integrated into the modelling of the proposed development, to ensure that incoming 1% AEP flows can be sufficiently conveyed through the site.

- Collection channel/depression on the western side of Leakes Rd.
- Lifting the road to provide 2% AEP (50 year) flood immunity
- 20no 900mm (h) x 1500mm (w) culverts to convey an expected 2% AEP flow entering the site (i.e. the flow corresponding to the 2% AEP event)
  - An inlet depression will be required on the upstream side of the Leakes Rd culverts (i.e. on western side of Leakes Rd)
  - It is expected that flows in excess of the 2% AEP event, will overtop Leakes Rd
  - During detailed design of Leakes Rd, close assessment of safety criteria will need to be undertaken for the 1% AEP flows overtopping the road.
- Shaping a waterway corridor downstream of Leakes Rd, to sufficiently convey the 1% AEP event.
- Raising the proposed developable land adjacent to the major flow path, to allow for 600mm freeboard to the 1% AEP flood levels.

Melbourne Water will undertake future modelling, encompassing the full extents of Leakes Rd floodplain. There is a possibility that Leakes Road will need to be above the 1% AEP plus climate change flood level. In this instance, the culverts would need to be upsized to cater for these additional flows.

Figure 7 below shows the general arrangement of the proposed development.

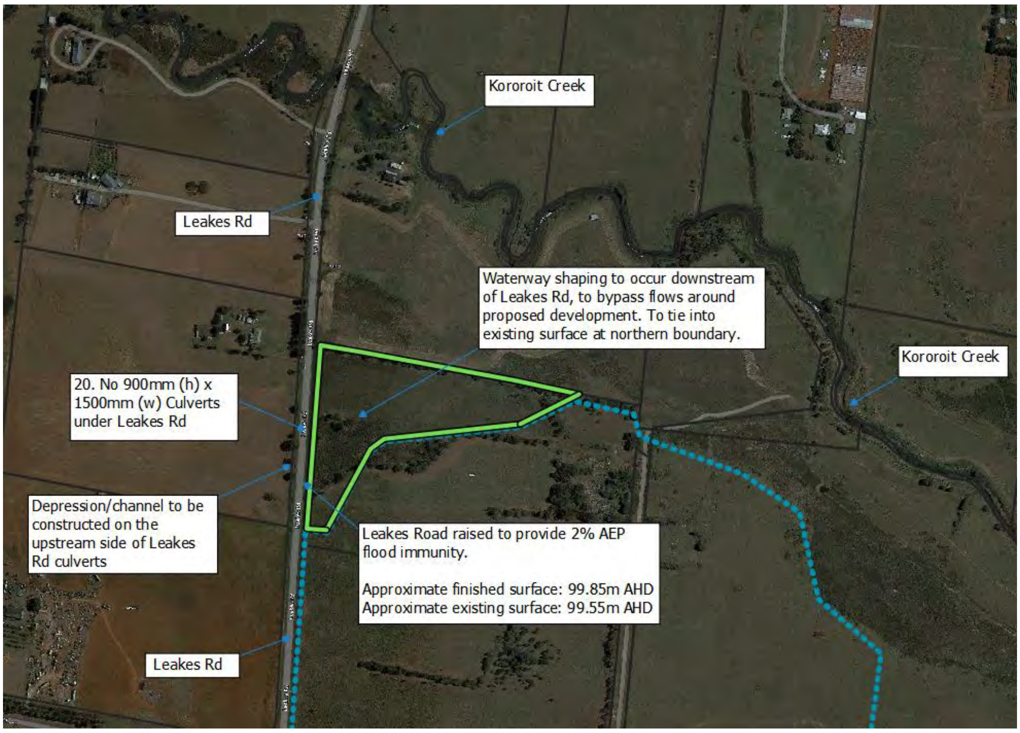

Figure 7: Proposed conditions layout

4.3 INFLOWS INTO TUFLOW

The outflows from the RORB model were selected at strategic locations as inflows to the TUFLOW model. To do so, the peak flows generated from the median+1 results from the RORB analysis for each scenario were selected as inflows to the model. Selected flows, critical durations and temporal patterns that were entered into the model are shown below in Table 4. The RORB catchment plan showing the associated RORB sub-catchments has been provided as part of Appendix A.

Table 2: RORB Ensemble modelling - resultant Inflows

Peak RORB ID	RORB Name	TUFLOW Inflow ID	Ensemble Median+1 flow	Critical Duration	Temporal Pattern #
Existing, 10% AEP					
Peak 01	Calculated hydrograph: US point	S	123.87	6 hours	13
Peak 03	Sub-area T - Rain ex.	T	30.32	1.5 hrs	15
Peak 06	Calculated hydrograph: Subcatchment AC	AC	31.85	3 hrs	15
Peak 10	Calculated hydrograph: Subcatchment Y	Y	38.42	6 hrs	17
Peak 13	Sub-area AD - Rain ex.	AD	15.35	1.5 hrs	15

Peak RORB ID	RORB Name	TUFLOW Inflow ID	Ensemble Median+1 flow	Critical Duration	Temporal Pattern #
Peak 17	Calculated hydrograph: Sub catchment AF	AF	23.12	6 hrs	15
Peak 20	Sub-area AG - Rain ex.	AG	17.60	1.5 hrs	15
Peak 24	Sub-area AL - Rain ex.	AL	16.96	1.5 hrs	14
Peak 27	Calculated hydrograph: Subcatchment AI and AK	AIAK	33.03	6 hrs	15
Peak 29	Sub-area AM - Rain ex.	AM	24.97	1.5 hrs	14
Existing, 1% AEP					
Peak 01	Calculated hydrograph: US point	S	281.62	9 hrs	28
Peak 03	Sub-area T - Rain ex.	T	65.72	45 mins	24
Peak 06	Calculated hydrograph: Subcatchment AC	AC	70.59	2 hrs	28
Peak 10	Calculated hydrograph: Subcatchment Y	Y	90.13	6 hrs	22
Peak 13	Sub-area AD - Rain ex.	AD	33.28	45 mins	24
Peak 17	Calculated hydrograph: Subcatchment AF	AF	54.96	6 hrs	23
Peak 20	Sub-area AG - Rain ex.	AG	38.15	45 mins	24
Peak 24	Sub-area AL - Rain ex.	AL	33.18	45 mins	24
Peak 27	Calculated hydrograph: Subcatchment AI and AK	AIAK	79.28	6 hrs	23
Peak 29	Sub-area AM - Rain ex.	AM	58.27	1 hr	23

4.4 MODEL CONFIGURATION

The digital elevation data for the TUFLOW model was created using the following:

- LiDAR as of mid – 2019;
- Existing conditions surface produced from survey data; and
- Design surfaces of civil stages (Woodlea Estate)

Other model configuration parameters include:

- TUFLOW build:
  - Grid cell size: 2 metres;
  - 2D time-step: 1 second
- The Manning's n values applied for the creek and surrounds land throughout the model are shown in Table 3 below.

Table 3: Land Uses and Associated Manning's n Values

Land Use	Manning's n Value
Residential Urban (High Density)	0.2
Residential Rural (Lower Density)	0.3
Open Pervious Areas, Minimal Vegetation (Grassed)	0.04
Open Pervious Areas, Thick Vegetation (Trees)	0.07
Waterways / Channels – Vegetated	0.05 – 0.07
Gravel Roads	0.035

4.5 FLOOD MODELLING RESULTS

Water surface models have been generated from the TUFLOW model. TUFLOW results for both the 2% AEP and 1% AEP flood events have been produced. Overall, it was shown that by incorporating the design elements (outlined in Section 3.2), the following could be achieved:

- Leakes Road remained flood immune in the 2% AEP event.
- No afflux, or worsening flood conditions were caused upstream or downstream of the MTC site.
- Some additional developable land could be gained (albeit somewhat minor gains), by integrating and shaping the waterway in the north-western corner of the site.

It should be noted that some investigations were undertaken into reducing the waterway footprint in the north-eastern corner of the site. However, when reducing the corridor width by only several meters, a detrimental afflux in the neighbouring properties was observed. Nevertheless, there will likely be opportunity during more detailed design phases to more efficiently shape the waterway corridor, and gain slightly more developable area within the MTC site.

Overall, flood mapping results have been supplied as part of Appendix B. These flood mapping results include:

- Existing conditions mapping for both the 1% and 2% AEP storm events
- Developed MTC conditions mapping for both the 1% and 2% AEP storm events
- Afflux mapping for both the 1% and 2% AEP storm events.

5. LOCAL SITE DRAINAGE

In addition to the broader flood modelling undertaken for the site, consideration has been given to the local drainage within the MTC site itself. Overall, as the site will be commercial in nature, and as such it is expected that the piped drainage will allow for conveyance of 10% AEP flows. The road reserves will, in addition, provide adequate conveyance of 1% AEP gap flows.

Based on the current existing contours, and the expectation that there will be fill at the northern interface of the site (i.e. along the interface with the LSIO to the north), the flows within the MTC area will approximately be as per Figure 8 below.

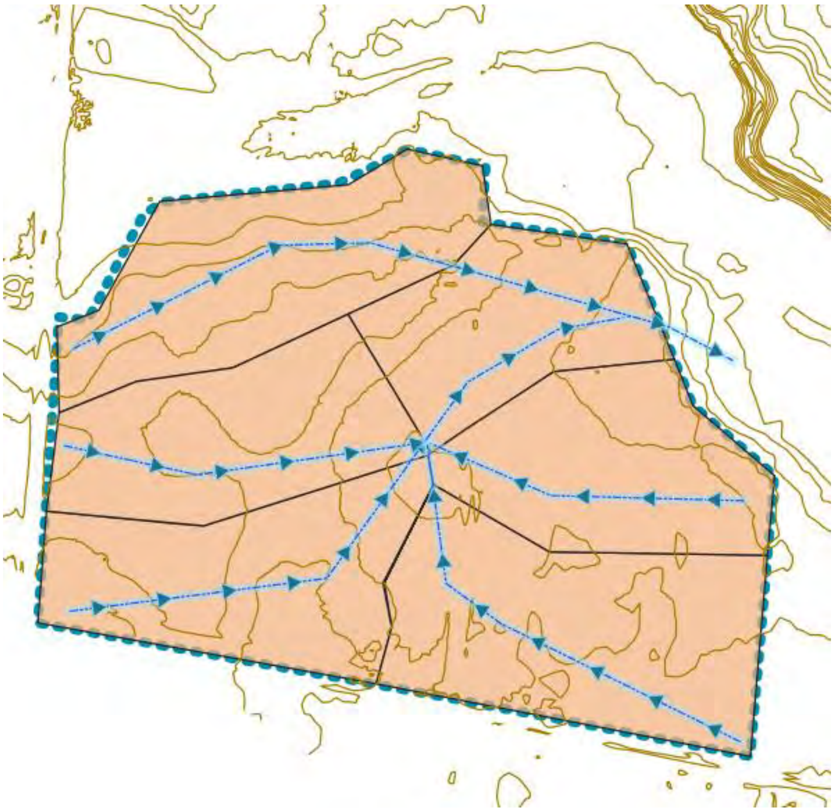

Figure 8: MTC site existing contours and general overland flow directions

As shown in the above image, the site generally grades to a central low point, and subsequently discharges towards the north-east. However, some filling across the site may be undertaken as part of the detailed design of the site, to alter this natural flow path.

Ultimately, the drainage within the site is expected to drain towards the north-eastern corner, and ultimately drain towards a future wetland and sediment basin located externally, within the Kororoit Creek corridor. An indicative layout of the MTC area, showing developed overland flow paths has been provided in Figure 9. and Table 4 provides a rough estimate of the flows within the developed site.

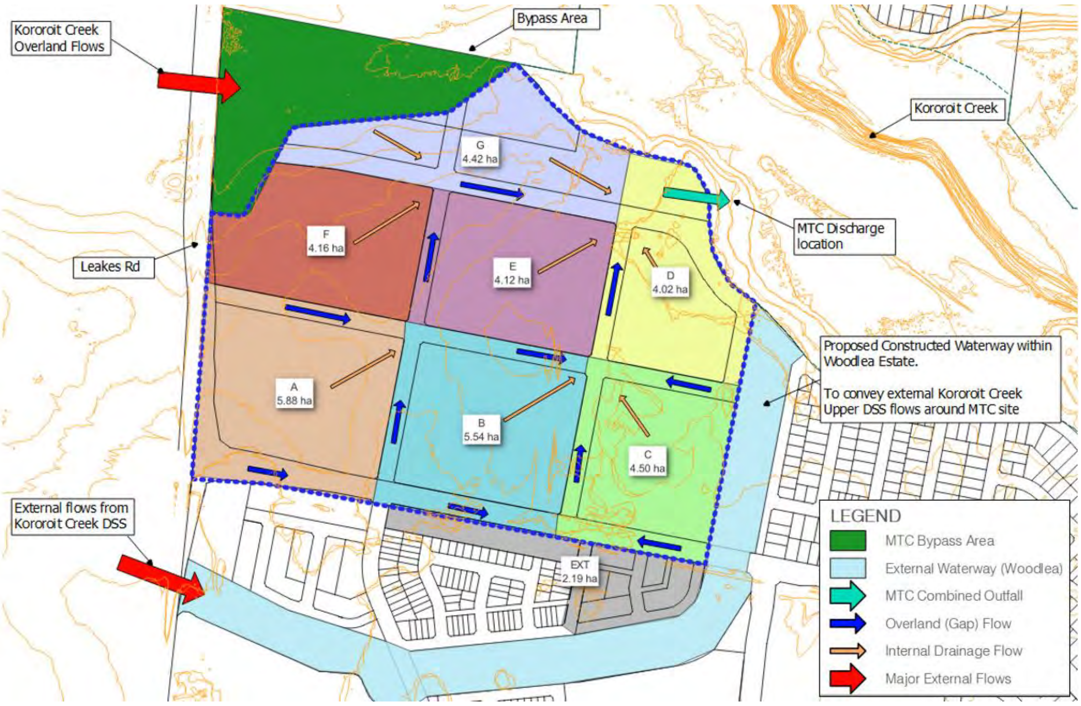

Figure 9: MTC Developed Conditions Flow Layout

Table 4: Summary of flows

Catchment Name	10% AEP Flow (Pipe Flow) (m³/s)	1% AEP Gap Flow (m³/s)
A	1.05	0.74
B	0.80	0.86
C	0.66	0.71
D	0.56	0.59
E	0.60	0.65
G	0.61	0.66
G	0.62	0.64
Ext	0.34	0.40
Total (at catchment outlet)	3.86	3.36

Additionally, it is expected that there will be no retardation requirements for the 1% AEP storm event (i.e. the downstream wetland will not have a retardation function), with these flows able to discharge directly into Kororoit Creek. In addition, it is also assumed, at this stage, that no temporary retardation will be required for the development.

6. WATER QUALITY

6.1 WATER QUALITY OBJECTIVES

It is expected that the water quality objectives will be achieved via a sediment pond and a wetland/macrophyte zone system, located downstream of the MTC site.

It is expected that the downstream stormwater treatment assets, will be designed in accordance with State Policy criteria, referencing Best Practice (BPEMG), as follows:

Table 5: Objectives for Environmental Management of Stormwater

Pollutant	Current Best Practice Performance Objectives
Total Suspended Solids (SS)	80% retention of the typical urban load
Total Phosphorus (TP)	45% retention of the typical urban load
Total Nitrogen (TN)	45% retention of the typical urban load
Gross Pollutants/Litter	70% retention of the typical urban load

Future design and assessment of these assets will likely be undertaken using MUSIC parameters have been set in line with MWC's MUSIC guidelines and MWC's Constructed Wetlands Guidelines Part A2 – Deemed to comply criteria (DtC). These assets and subsequent modelling will need to account for treatment of the entire MTC site.

6.2 PROPOSED DEVELOPMENT

As noted, the flows from the MTC site will be treated downstream of the site. A sediment basin and wetland will be situated downstream of the site (to the north) within the Kororoit creek corridor. A layout of the proposed water quality assets has been provided in Figure 10 below.

The wetland footprint shown in Figure 10 has been preliminarily sized using MUSIC software, and has been sized to meet best practice treatment requirements outlined in Table 5. Overall, current modelling is still high-level, and additional modelling will need to be undertaken as part of a more detailed assessment of the site.

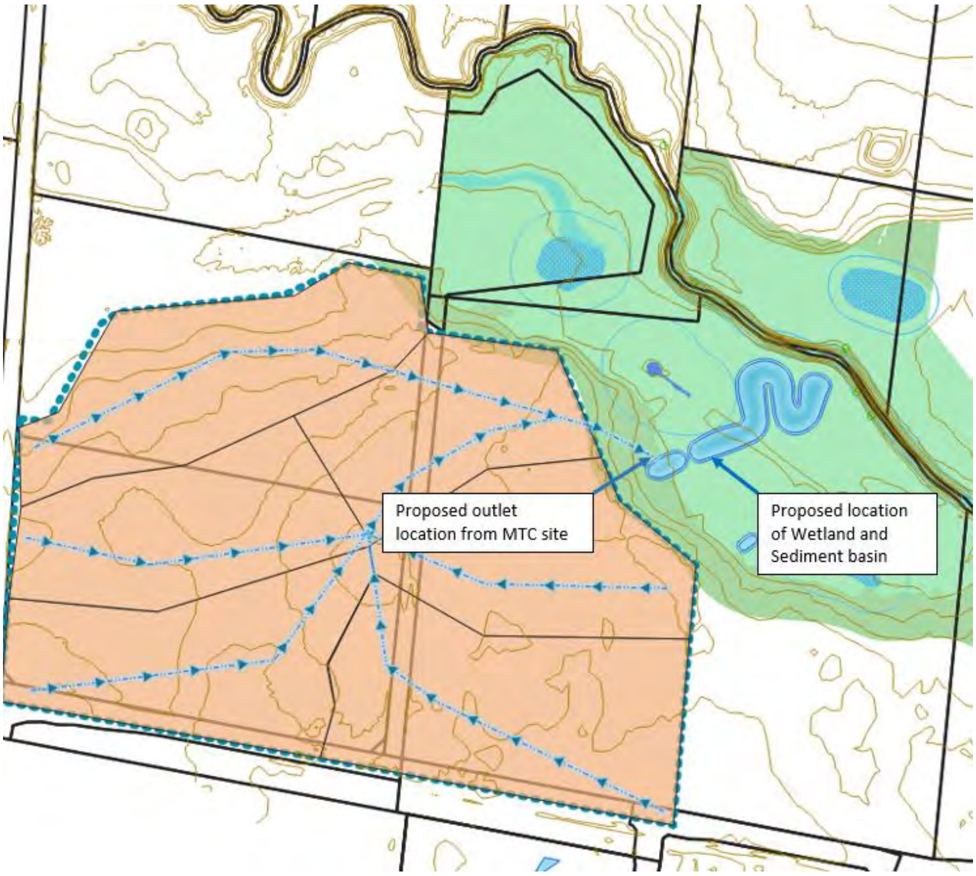

Figure 10: Proposed development flows and approximate location of future water quality assets

6.3 WETLAND AND SEDIMENT BASIN

The downstream constructed wetland and sediment basin will have a number of key design elements incorporated. These are summarised below:

- The bathymetry of the macrophyte zones are designed to Melbourne Water standards.
- A 350mm extended detention depth will be targeted for both the wetland and sediment basin.
- A twin chamber outfall pit with side-winding penstock will be incorporated into the wetland, for outlet control. This will allow for the 72hour drawdown of water within the wetland (in a 4EY event), to ensure water treatment objectives are met.
- The wetland will be sized to have an appropriately sized minimum width, to accommodate the incoming 4EY (i.e. 3month) flow rate. Overall. the corresponding velocity through the wetland will be approximately 0.05 m/s for the 4EY flow. This is in line with the Melbourne Water deemed to comply requirements.
- Velocity of flows entering the sediment pond will be kept low to ensure the incoming flows do not re-suspend sediment within the basin.
- A diversion will likely need to be in place, to send the 4EY flows into the wetland, while the remainder of the flows from the MTC site will bypass the macrophyte zone via channel or pipe.

The bathymetry of the macrophyte zone will be designed in accordance with MWC's Wetlands Design Manual.

7. INTEGRATED WATER MANAGEMENT OPTIONS

As this report is only considering a high-level assessment of the site to inform the UDF, and as the specific land use and water demands remail unclear, the integrated water management strategies are difficult to accurately assess. As such, only some high-level IWM options have been provided as part of this report.

Overall, the objectives for IWM will remain aligned with the objectives outlined in the City of Melton Integrated Water Management Plan as shown in Table 6.

Table 6: City of Melton IWM Plan Objectives (May 2018)

Objective	Outcome	Opportunities
Reduced reliance on potable water	Effective and efficient use of all water sources across Council assets	Stormwater harvesting Recycled water Rainwater tanks
	Increase use of non-potable water sources	
Healthy waterways and wetlands	Ecological and habitat values within the City of Melton's waterways improve over time	Ecological and aesthetic enhancement
	Stormwater drainage and WSUD assets are resilient and effective	Effective WSUD to meet best practice
Valued landscapes that are connected and accessible	Maximise connections between the community, waterways and open space.	Shared paths to and along waterways and open spaces
	Reduced urban heat island effect across the City of Melton	Passive irrigation
	An informed and water-wise community	Education and interpretation

7.1 WASTEWATER

The development is proposed to be serviced through trunk sewer infrastructure connecting to a regional sewage treatment plant, the Melton Recycled Water Plant, operated by Greater Western Water. A sewer pump station is also proposed within the MTC site footprint (per Figure 6).

It should be noted that all sewage treated at the Melton Recycled Water Plant is recycled for use through the Melton Class A Dual reticulation scheme, or for irrigation demands in the Melton and Bacchus Marsh areas. Other resources in the sewage are also recycled, with biogas being generated to produce electricity and biosolids recycled, again for agriculture.

An excerpt of the sewer servicing plan is shown in Figure 11**Error! Reference source not found.**, with the site highlighted in red.

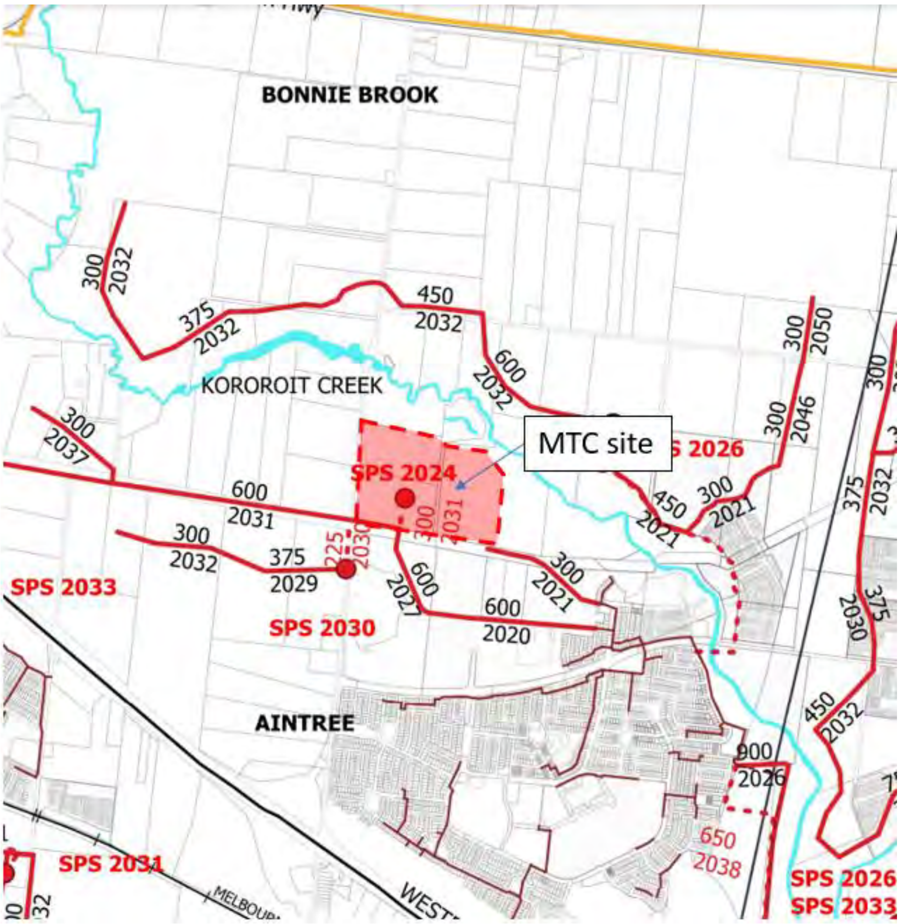

Figure 11: Sewer servicing plan for surrounding MTC area

7.2 DRINKING WATER SUPPLY

Drinking water is provided to the site via adjacent water mains, which runs adjacent to the site. Supply is provided from the Melbourne water supply system, comprised of water from the Yarra-Thomson and the Victorian Desalination Plant. The drinking water supply is operated by Greater Western Water.

There is potential for a portion of the water demand at the site to be offset through the use of alternative water supplies, such as rainwater harvesting.

An extract of the water supply servicing plan is shown in Figure 12**Error! Reference source not found.** with the site highlighted in red.

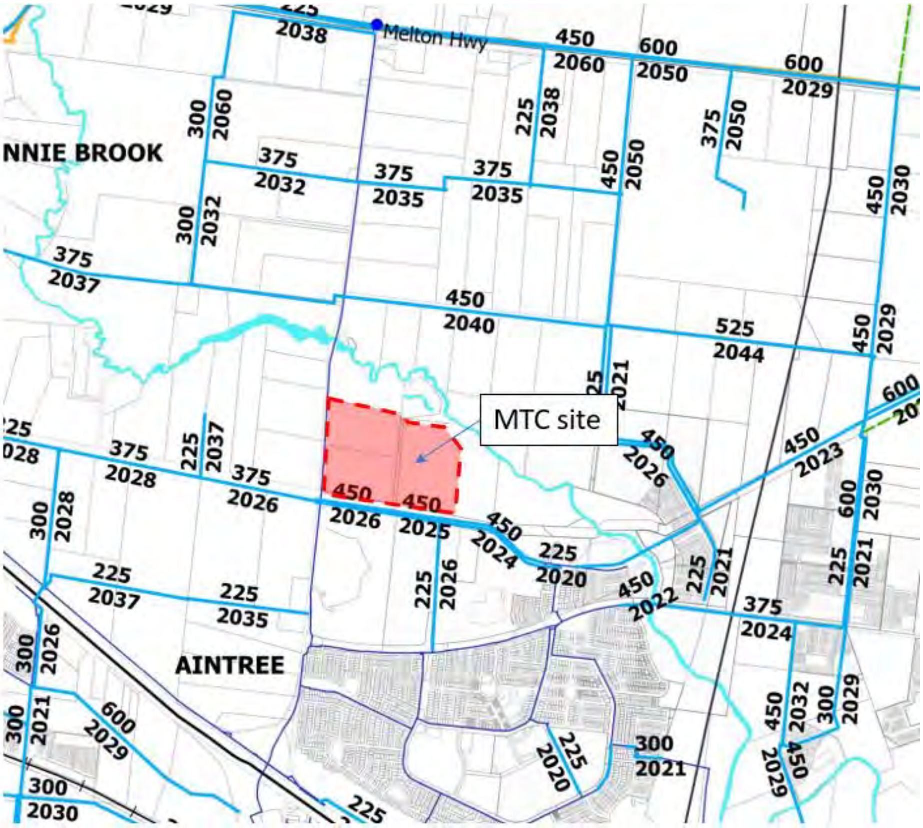

Figure 12: Water supply servicing strategy for surrounding MTC area

7.3 NON-DRINKING WATER SUPPLY

It is assumed that no recycled water supply is proposed by Greater Western Water for the site. However, with the expected large roof spaces available within each lot within the proposed site, there is an opportunity to provide non-drinking water to the development through rainwater harvesting and other sources. These have been further explored through this document.

7.4 LOT SCALE IWM MEASURES

Lot scale IWM opportunities are typically low cost, simple to implement and can deliver significant outcomes when multiplied across an entire development.

There are a number of lot scale IWM opportunities that have been investigated as options to improve water cycle management across the development. These options include:

- Rainwater harvesting
- Water efficiency through water saving appliances
- Passively irrigated street trees

The below provides a summary of the options investigated, to enable an assessment of the most viable options.

7.4.1 RAINWATER TANKS

Rainwater tanks can be implemented as above ground or underground tanks on each lot. The aim is to connect a large enough roof catchment to a rainwater tank to provide sufficient reliability of harvested rainwater to the intended use. Rainwater harvested by a typical residential rainwater tank system is only suitable for limited use, and therefore potable water will continue to form an essential part of the residential water supply.

The greatest potential user of harvested rainwater to flush toilets and to irrigate green spaces and grassed areas. Some developments have extended this to hot water systems; however this is not yet considered typical. Additional plumbing and pumps would be required to connect rainwater tanks to toilets which increases the capital and maintenance costs of the household system, however this installation contributes to meeting 6-star energy rating building requirements.

While rainwater tanks provide means for a significant reduction in the demand for potable water and assist in the protection of downstream waterways, the reliability of harvested during prolonged dry periods reduces the benefits delivered. The efficiency of rainwater harvested is also impacted by the operation and maintenance of rainwater tanks that rely on individual landowners or tenants.

Water balance should be undertaken as part of a more detailed IWM review of the site, during future design phases for the site. Modelling would need to be undertaken to determine the appropriate rainwater tank sizing within the town centre area, and once there is a better understanding of the water demands and re-use opportunities within the site.

7.4.2 NATURE STRIP IRRIGATION

Tree-scaped streets contribute significantly to the vegetation cover within the development, as there are no designated open space areas. Passive irrigation of these tress further improves this canopy cover. Spiire recommends the adoption of Melton City Council's Passive Street Irrigation detail or approved equivalent. Note, the exact number and location of kerb inlets is to be determined during the detailed design of each lot**.** During prolonged dry periods and the plant establishment phase, it may be necessary for street vegetation to be irrigated with tanked recycled water or potable water. The resilience of vegetation can be improved by careful plant selection and by supporting root growth, which should be discussed with the site landscape architects.

Where implementation of passive irrigation is deemed feasible, some fundamental changes are required at typical road cross-section to enable passive irrigation, including:

- Landscaped areas subject to passive irrigation must lay lower than the adjacent road level to allow the natural flow of water on vegetated areas. Alternatively, specific 'tree pits' could be used to direct runoff to the root zone of trees underground.
- Kerb cuts or flush kerbs (edge strip kerb type) are required to allow water to flow on vegetated areas. Provision may be made for bollards to prevent vehicle access where flush kerb is installed.
- Vegetated areas need to be easy to maintain.
- Passive irrigation may reduce the interval of typical side-entry pits (while still satisfying drainage requirements). Passive irrigation will also require grated pits to be installed within

the nature strips to capture excess flows, and sub-surface drainage ensure appropriate soil moisture conditions.

Ultimately, any proposed kerb cuts can be incorporated into the road and drainage detailed design for the site. Any kerb cuts would be designed around the proposed street trees to provide a source of additional water for trees during rainfall events. It should be noted that this will not increase the regularity of wetting from rainfall events but would increase the potential quantity of rainwater runoff to the trees during rainfall events.

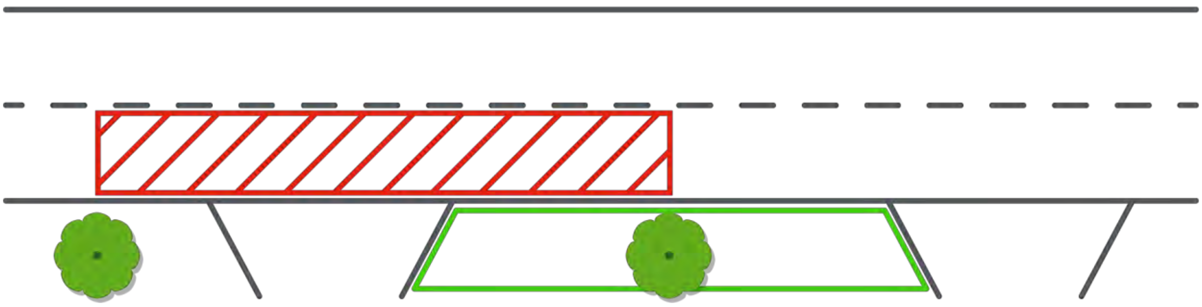

Figure 13: General arrangement for kerb cuts

Spiire recommends the adoption of Melton City Council's Passive Street Irrigation detail or approved equivalent. Note, that these locations do not consider the alignment and depths of services and therefore the exact number and location of kerb inlets is to be determined during the detail design of each stage.

7.5 PRECINCT SCALE IWM OPTIONS

Adopting IWM opportunities at a precinct scale can result in significant IWM outcomes due to typically larger catchments and associated water volumes, combined with improved liveability opportunities associated with centralised assets within the community, such as constructed wetlands feeding a stormwater harvesting system for a sports precinct.

7.5.1 RECYCLED WATER

Class A recycled water could be considered for use for the proposed lots and for any nearby public open spaces, as 'third pipe' system if the pipe infrastructure is built into the development. By using recycled water, occupants could reduce their potable water demand by up to 50% by connecting recycled water to things such as toilets, laundry and irrigation. By utilising recycled water, Council could fully offset their irrigation demands.

In 2021/22 Greater Western Water charges recycled water at a flat rate of $1.8882 per kL and an annual service charge of $116.91, providing cost savings to the residents, particularly if they are using over 440 litres per day. Furthermore, as permanent water saving rules do not apply to recycled water, irrigation of gardens can continue under water restrictions, resulting in heathier and greener environments.

Class B recycled water could also be an option for the site, and could be supplied for public open space irrigation, or to suitable industries. Class B recycled water supply is significantly cheaper than potable or Class A recycled water, however there are management practices that must be employed for its safe use, typically outlined through an Environmental Improvement Plan developed between the user and Greater Western Water.

7.5.2 STORMWATER HARVESTING

Stormwater harvesting can deliver water supply and waterway health outcomes, and is most feasible on large scale residential and commercial catchments (i.e. precinct/estate wide). This strategy is most effective when stormwater can be captured in a wetland or diverted off a major drainage pipeline and stored in an end-of-line tank or pond, and where demand is nearby, i.e. a public open space.

To protect waterway health, a significant volume of stormwater may need to be harvested and infiltrated. In areas deemed high priority for conservation, this volume will likely be such that the stormwater needs to be harvested and exported from the development. In such instances a precinct scale solution will be inadequate and a regional solution will likely be required.

7.5.3 AMENITY AND LIVEABILITY

While wetlands provide an important function for treating stormwater, they can also provide significant amenity and recreation for the local community. Within the precinct the wetland and surrounding Kororoit Creek corridor can include elements such as: sporting courts/fields, pedestrian bridges, viewing platforms, seating, playgrounds, outdoor gyms, BBQ areas and water features. All these elements contribute to creating a hub that the community can enjoy that is centred around water.

7.5.4 EDUCATIVE SIGNAGE

Educative signage around stormwater assets provides the public with opportunities to learn about the water cycle, water assets and the water story within the precinct. The purpose of this signage is to increase awareness of the water cycle, natural environment and the holistic management of water. Signage could also include water saving and water quality tips as well as education on draught tolerant practices further increasing sustainability throughout the development.

8. SUMMARY AND RECOMMENDATIONS

This SWMS has investigated the management of catchment runoff and water quality to ensure the subject site is in accordance with best practice and Melbourne Water guidelines. This involved investigating:

- Flood protection treatments to protect surrounding environments;
- Implementation of stormwater quality elements to treat post-developed pollutant laden run-off to back practice guidelines; and

Overall, both RORB and TUFLOW modelling has been undertaken to assess the proposed conditions. Results have shown that the following elements will need to be incorporated into the MTC development, to ensure sufficient flood mitigation is achieved and no negative afflux to surrounding areas occurs:

- Implementing an inlet collection channel/depression on the western side of Leakes Rd.
- Lifting the road to provide 2% AEP (50 year) flood immunity
  - Noting that Melbourne Water may require the road to be lifted to above the 1% AEP plus climate change level
- 20no 900mm (h) x 1500mm (w) culverts to convey an expected 2% AEP flow entering the site
  - Where it is expected that flows in excess of the 2% AEP event, will overtop Leakes Rd
  - If Melbourne Water require 1%AEP plus climate change immunity, culverts will have to be upsized accordingly.
- Shaping of a waterway corridor downstream of Leakes Rd and through the north-west corner of the MTC site, to sufficiently convey the 1% AEP event.
- Raising the proposed developable land adjacent to the major flow path, to allow for 600mm freeboard to the 1% AEP flood levels.

In addition, IWM opportunities have been considered. These may include:

Rainwater Tanks

- Rainwater tanks are proposed to capture roof water, with the roof catchment area maximised through a siphonic roof drainage system. The rainwater tank size depends on the roof area.
- Water from the rainwater tanks is proposed to be used for non-potable purposes, such as toilet flushing, irrigation and wash down areas.
- Due to the size of the roof catchments, the rainwater tanks capture a significant amount of water that could be used for other demands across the site. Current modelling shows that supplying water for toilet flushing uses only a portion of the rainwater captured with a large portion spilling from the rainwater tanks as overflow. This additional water could be made available for other end uses within the development, or beyond through a regional stormwater harvesting scheme.

Passive Irrigation

APPENDIX A

PREVIOUS HYDROLOGICAL MODELLING REPORT

KOROROIT CREEK MODELLING REPORT

OCTOBER 2020

PREPARED FOR 3L ALLIANCE & LEAKES ROAD ROCKBANK

This report has been prepared by the office of Spiire
Level 6, 414 La Trobe Street PO Box 16084 **Melbourne** Victoria 8007

Issue Date	Rev No	Authors	Checked	Approved
2020.10.13	A	Luke Cunningham & Zubin Irani	Ross Carnegie	

Spiire Job Number: 307254

Citation: Spiire 2020, KOROROIT CREEK MODELLING REPORT Click here to enter text..
Authors: Luke Cunningham & Z.Irani Spiire Australia Pty Ltd. Project Number 307254

File Name: G:\30\307254\Integrated Water\Documents & Calculations\Reports\307254-REP-Kororoit Creek Hydrology Report.docx

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1. INTRODUCTION

Spiire has been engaged in a jointly funded project by 3L Alliance and Leakes Road Rockbank, to undertake hydrological and hydraulic modelling of Kororoit Creek in the Melbourne West Growth Corridor.

The modelling produces a robust understanding of flows in the creek, according to Australian Rainfall & Runoff (ARR) 2019 hydrology methodology, and is calibrated to real instream data captured at a downstream gauge in Deer Park. The model predicts flows for 3 events:

- 10% Annual Exceedance Probability (AEP) event, formerly known as a 10 year event;
- 1% AEP event, formerly known as a 100 year event, and;
- 1% AEP event, with climate change factors to account for expected future increases in peak rainfall intensity, also calculated as per ARR 2019 parameters.

Hydrology results from RORB software have be used in TUFLOW software to model the movement of flows over a digital terrain model, over 9km in length. The output of this model is flood mapping for each of the events, which is provided as appendices to this report, and electronically for use in GIS software.

2. CATCHMENT DESCRIPTION

The Kororoit Creek Catchment is one of the larger catchments in Melbourne. The catchment extends from Gisborne South at its most upstream end, past Sunbury, through Plumpton and towards Caroline Springs. The catchment moves south east through more developed suburbs through to its ultimate discharge point at the Altona Coastal Park in Port Phillip Bay. The entire Kororoit Creek catchment is approximately 32,300 ha in area. The upper half of the catchment is largely characterised by rural land, largely used for farming. Once the Creek reaches Caroline Springs, the catchment is mostly residential, with a strip of mostly industrial use land through the Brooklyn area.

3. HYDROLOGY ASSESSMENT

3.1 EXISTING RORB MODELLING

Previous 1% AEP flows were made available to Spiire from Melbourne Water. These flows were sourced from an older study completed by GHD. Melbourne Water had developed a RORB model for Kororoit Creek in 1986 and calibrated it to three historical events at the Deer Park gauge. GHD then adopted the Melbourne Water RORB model and modified catchment details in 2001.

Details of the delineation of the previous RORB model were not available, but it was generally agreed with Melbourne Water that while the GHD modelling had provided a good estimate of flows, it would be worthwhile updating the RORB modelling to today's standards. For this reason, the GHD RORB modelling supplied to Spiire was not adopted for the study but was used as a comparison point later in the project.

3.2 NEW RORB MODELLING

A new RORB model was constructed specifically for this project. The overall outer catchment boundary of Kororoit Creek matched well with previous modelling, with the internal sub-areas of the RORB model updated based on the latest available contour information and LiDAR information. Careful consideration was given to likely hydraulic controls (such as major road crossings) as well as required inflow locations to the TUFLOW model.

The model extends from the upper catchment north of Gisborne South and terminates just as the model reaches the downstream residential area at the Deer Park flood gauge. Figure 1 shows the final RORB sub-catchment layout and extent.

It must be noted that the RORB model was developed in order to generate inflows to the TUFLOW model.

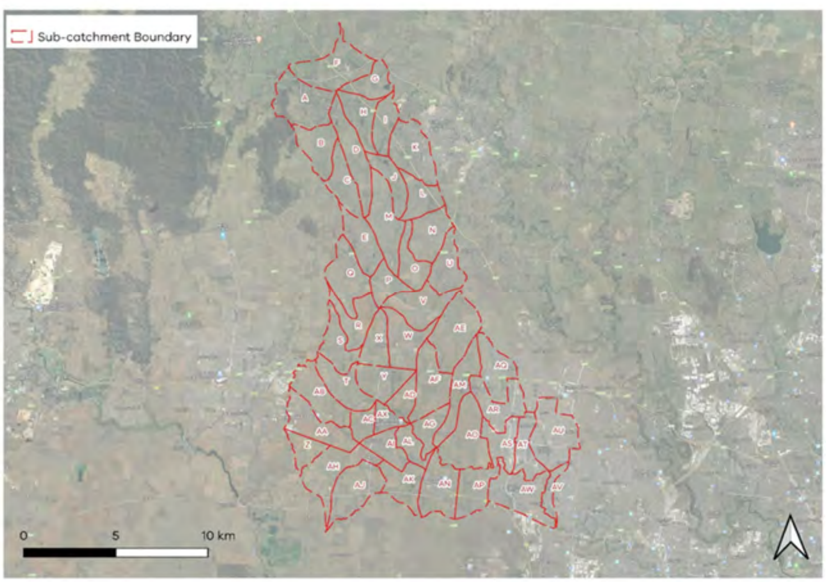


Figure 1: RORB sub-catchment delineation

Catchment fraction impervious values (FI) were generated based on a combination of current land use (per the Planning Scheme) and recent aerial photography. Figure 2 shows the FI values adopted across the model.

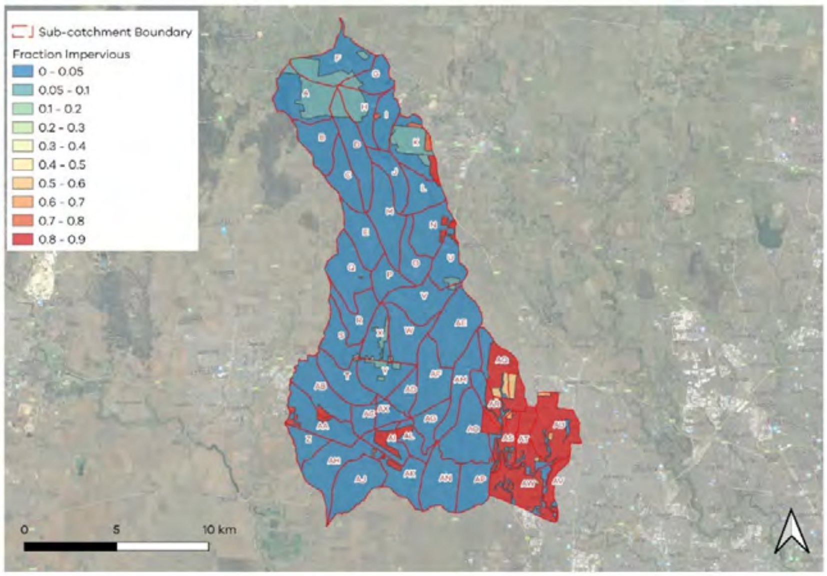


Figure 2: Kororoit Creek RORB Model – Fraction Impervious Values Adopted

RORB reach types were selected based on the best representation of overland flow routing within that subarea. Generally, this resulted in reaches being either 'Natural' or 'Excavated Unlined' types. All reaches were assigned a slope based the available topographic information, but were only utilised in the 'Excavated Unlined' reaches. The distribution of reach types is shown in Figure 3.

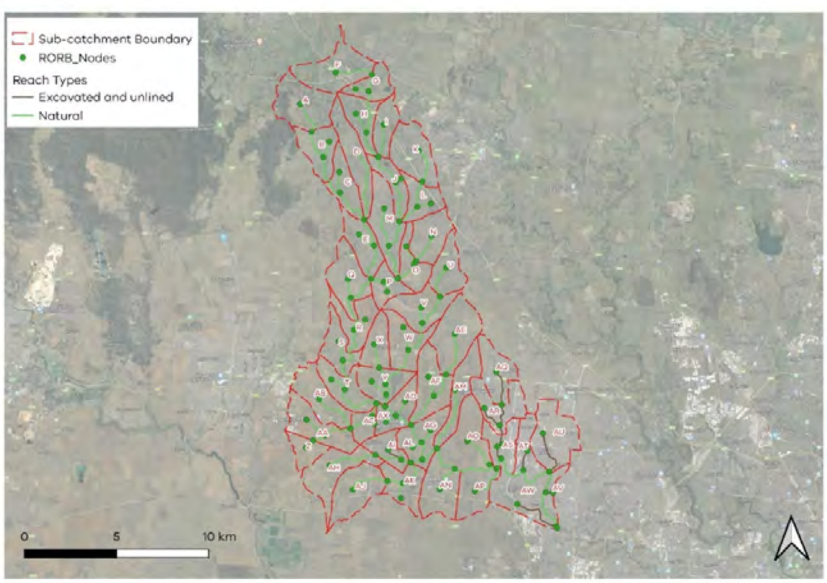


Figure 3: Reach Types

3.2.1 RORB PARAMETERS

The model was run per ARR19 guidance. The ARR Data Hub was used to extract the required rainfall parameters for the model. The Leakes Road gauge (144.657, -37.7) was used as the point of interest. The Data Hub then provides the temporal patterns and rainfall IFDs for the area, applicable for the full range of AEP and durations to be modelled. The ARR Data Hub also suggests loss values to use in lieu of better information. The following values were suggested:

Storm Initial Losses (mm) = 11.0*

Storm Continuing Losses (mm/hr) = 0.3*

*As discussed below, the RORB model has been calibrated to gauge data, and hence the above losses were only used as a comparison to the final selected losses.

3.2.2 CALIBRATION

Two gauges exist within the area of interest, one immediately downstream of the Leakes Road crossing of the creek (Station Number 231105B), and one at Deer Park (Station Number 231104A).

The Leakes Road Gauge has a reliable estimate up to around the 11-year return period with the Deer Park Gauge providing a more reliable range of data, exceeding the 40-year return period, as shown in Figure 4. For this reason, the Deer Park Gauge was selected as providing a more reliable calibration point. This correlates well with the previous study by GHD.

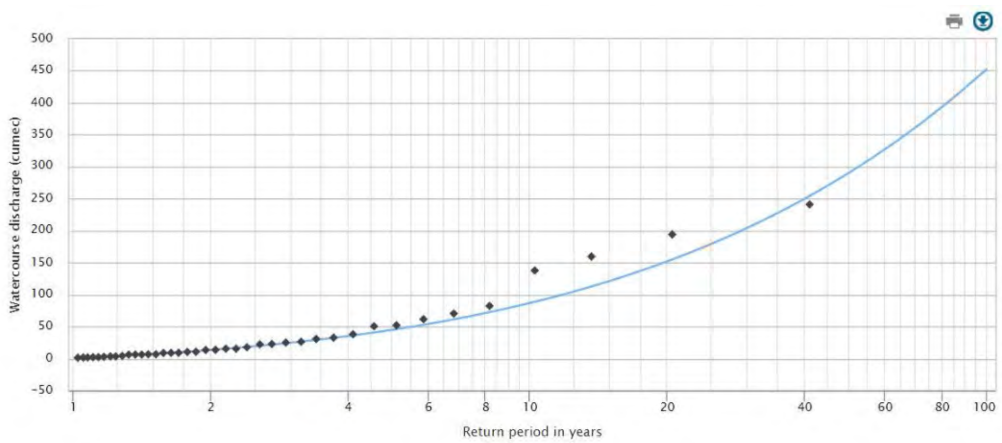


Figure 4: Kororoit Creek at Millbank Drive Deer Park – Flood Frequency Analysis

Gauge data for Kororoit Creek at Deer Park was extracted and a series of ‘FIT’ runs were completed to find the loss parameters which provided the best match to the historical data set. ARR19 run parameters were used along with a full ensemble estimate. Table 1 below shows the 1% AEP peak flows from various points within the RORB model, highlighting the flow of 450.13 m3/s at the Deer Park gauge.

Table 1: RORB model outflow results

RORB Output Location	Name	Calibration to FFA @ Deer Park (2020) – Ensemble m3/s (1% AEP)
E11	Leakes Road	257.20
E12	Confluence DS Leakes Road	285.80
E13	N/A	328.00
E14	Beattys Road	352.84
E16	Plumpton gauge station	405.54
E22	**Deer Park**	**450.13**

To achieve the above fit to the FFA, the following RORB parameters were selected:

Storm Initial Losses (mm) = 16.0

Storm Continuing Losses (mm/hr) = 3.0

RORB Kc Value = 9.4

RORB m Value = 0.8

As a comparison, the calibrated 1% AEP flow of 450.13 m^3/s at the Deer Park Gauge was compared to other available estimates as shown below:

Previous GHD modelling = 361 m^3/s

Regional Flood Frequency Estimate (BoM) = 231 m^3/s

Flood Frequency Analysis extrapolated to 1% AEP (BoM) = 452 m^3/s

3.2.3 CLIMATE CHANGE

There are two main likely impacts of climate change on flood hydrology – sea level rise and increased rainfall intensities. The area of interest is not subject to risk from sea level rise, and hence increase rainfall intensities were singled out to be assessed.

Current best practice for hydrological modelling of the increases in rainfall intensity suggest using a percentage increase in rainfall at the year 2100 for the Representative Concentration Pathway (RCP) of 8.5. The ARR data hub supplies estimates up to the year 2090. A temperature increase of 3.48C was hence forecasted by Spiire from the available data for the year 2100. This was then calculated to translate to an 18.5% increase in rainfall intensity, following the following formula:

100 x (1.05^3.48-1)

An 18.5% increase in rainfall intensity was hence applied within the RORB model to simulate potential climate change conditions. This was applied directly to the IFD data for all AEP events up to the 0.5% AEP. No other run parameters were varied. Table 2 shows the temperature increase forecasting completed by Spiire.

Table 3 below shows a comparison of the 1% AEP peak flows at key locations throughout the model between existing climate and 2100 climate conditions. The 18.5% increase in rainfall intensity has resulted in increases in flows of between 27-48% throughout the catchment.

Table 2: Temperature Increase Forecast (RCP 8.5)

Year	Temp increase - C
2030	0.811
2040	1.084
2050	1.446
2060	1.862
2070	2.298
2080	2.719
2090	3.090
2100 (forecast)	3.480

Table 3: Climate change scenario flow rates

RORB Output Location	Name	Calibration to FFA @ Deer Park (2020) - Ensemble m3/s	Climate Change (18.5% increase in rainfall intensity) – Ensemble m3/s	Flow Increase
E11	Leakes Road	257.2	369.64	44%
E12	Confluence DS Leakes Road	285.8	422.32	48%
E13	N/A	328	423.09	29%
E14	Beattys Road	352.84	447.89	27%
E16	Plumpton gauge station	405.54	505.84	25%
E22	**Deer Park**	**450.13**	**581.05**	**29%**

3.2.4 INFLOWS TO TUFLOW

The outflows from the RORB model at strategic locations were selected as inflows to the TUFLOW model. To do so, the peak flows generated from the median+1 results from the RORB analysis for each scenario were selected as inflows to the model. Selected flows, critical durations and temporal patterns that were entered into the model are shown below in Table 4.

Table 4: Ensemble Result Inflows

Peak RORB ID	RORB Name	TUFLOW Inflow ID	Ensemble Median+1 flow	Critical Duration	Temporal Pattern #
Existing, 10% AEP					
Peak 01	Calculated hydrograph: US point	S	123.87	6 hours	13
Peak 03	Sub-area T - Rain ex.	T	30.32	1.5 hrs	15
Peak 06	Calculated hydrograph: Subcatchment AC	AC	31.85	3 hrs	15
Peak 10	Calculated hydrograph: Subcatchment Y	Y	38.42	6 hrs	17
Peak 13	Sub-area AD - Rain ex.	AD	15.35	1.5 hrs	15
Peak 17	Calculated hydrograph: Subcatchment AF	AF	23.12	6 hrs	15
Peak 20	Sub-area AG - Rain ex.	AG	17.60	1.5 hrs	15
Peak 24	Sub-area AL - Rain ex.	AL	16.96	1.5 hrs	14
Peak 27	Calculated hydrograph: Subcatchment AI and AK	AIAK	33.03	6 hrs	15
Peak 29	Sub-area AM - Rain ex.	AM	24.97	1.5 hrs	14
Existing, 1% AEP					
Peak 01	Calculated hydrograph: US point	S	281.62	9 hrs	28
Peak 03	Sub-area T - Rain ex.	T	65.72	45 mins	24
Peak 06	Calculated hydrograph: Subcatchment AC	AC	70.59	2 hrs	28
Peak 10	Calculated hydrograph: Subcatchment Y	Y	90.13	6 hrs	22
Peak 13	Sub-area AD - Rain ex.	AD	33.28	45 mins	24
Peak 17	Calculated hydrograph: Subcatchment AF	AF	54.96	6 hrs	23
Peak 20	Sub-area AG - Rain ex.	AG	38.15	45 mins	24
Peak 24	Sub-area AL - Rain ex.	AL	33.18	45 mins	24
Peak 27	Calculated hydrograph: Subcatchment AI and AK	AIAK	79.28	6 hrs	23
Peak 29	Sub-area AM - Rain ex.	AM	58.27	1 hr	23
Climate Change, 1% AEP					
Peak 01	Calculated hydrograph: US point	S	351.57	9 hrs	24
Peak 03	Sub-area T - Rain ex.	T	78.56	45 mins	24
Peak 06	Calculated hydrograph: Subcatchment AC	AC	93.05	2 hrs	22
Peak 10	Calculated hydrograph: Subcatchment Y	Y	108.78	6 hrs	26
Peak 13	Sub-area AD - Rain ex.	AD	39.78	45 mins	24
Peak 17	Calculated hydrograph: Subcatchment AF	AF	68.91	1.5 hrs	28
Peak 20	Sub-area AG - Rain ex.	AG	45.61	45 mins	24

Peak 24	Sub-area AL - Rain ex.	AL	39.61	45 mins	24
Peak 27	Calculated hydrograph: Subcatchment AI and AK	AIAK	100.83	1.5 hrs	26
Peak 29	Sub-area AM - Rain ex.	AM	71.76	45 mins	24

4. HYDRAULIC MODELLING

Hydraulic modelling has been conducted in TUFLOW, with hydrographs from the hydrological modelling providing key input.

4.1 MODEL CONFIGURATION

The digital elevation data for the TUFLOW model was created using the following:

- LiDAR as of mid – 2019;
- Existing conditions surface produced from survey data; and
- Design surfaces of civil stages; and

Other model configuration parameters include:

- TUFLOW build:
  - Grid cell size: 2 metres;
  - 2D time-step: 1 second; and

The Manning's n values applied for the creek and surrounds land throughout the model are shown in Table 5 below.

Table 5: Land Uses and Associated Manning's n Values

Land Use	Manning's n Value
Residential Urban (High Density)	0.2
Residential Rural (Lower Density)	0.3
Open Pervious Areas, Minimal Vegetation (Grassed)	0.04
Open Pervious Areas, Thick Vegetation (Trees)	0.07
Waterways / Channels – Vegetated	0.05 – 0.07
Gravel Roads	0.035

4.1.1 BOUNDARY CONDITIONS

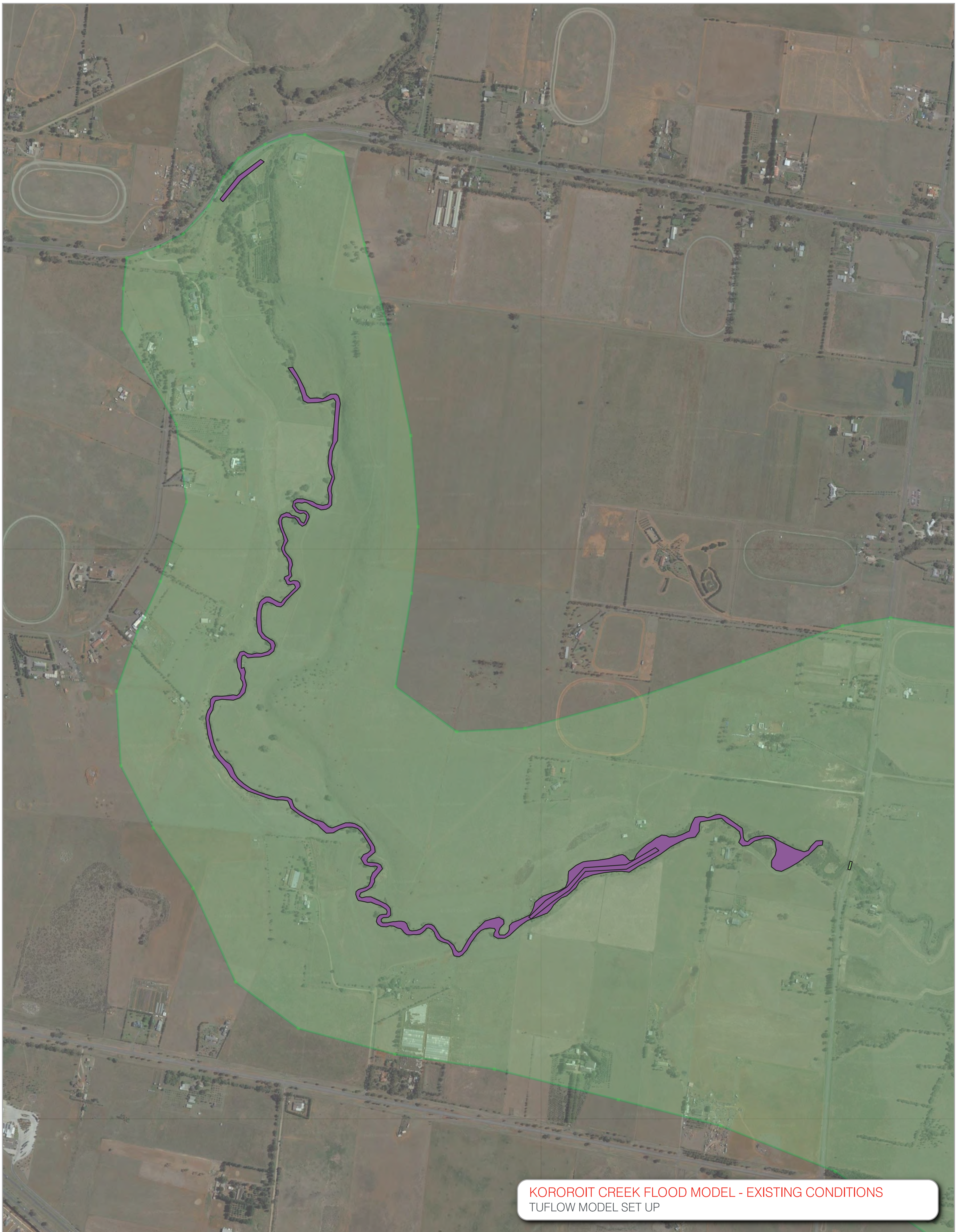
The inlet boundary condition to the hydraulic model is set by applying an inflow hydrograph directly as discussed in Section 3.2.4.

4.2 RESULTS

Water surface models have been created from the TUFLOW model results for the 10% AEP, 1% AEP and 1% AEP with climate change factor events. They show expected high water level event extents for the existing surface conditions and flows. These have been supplied as mapping files in the report appendices.

Electronic versions of these models will be supplied with this report, enabling future use in GIS software. Note that these models are subject to change.

APPENDIX A – TUFLOW MODEL SETUP



KOROROIT CREEK FLOOD MODEL - EXISTING CONDITIONS
TUFLOW MODEL SET UP

NOTATIONS

File Ref: 307254
Plan: W GIS 002 1% AEP Flood Map
Rev: A
Date: 08.10.2020

Designed: B.N.
Checked: R.C.
Authorised: L.H.

Flood Results:
Data:

LEGEND

- Bridge Shape
- Model Extents
- Hydrograph Inflows

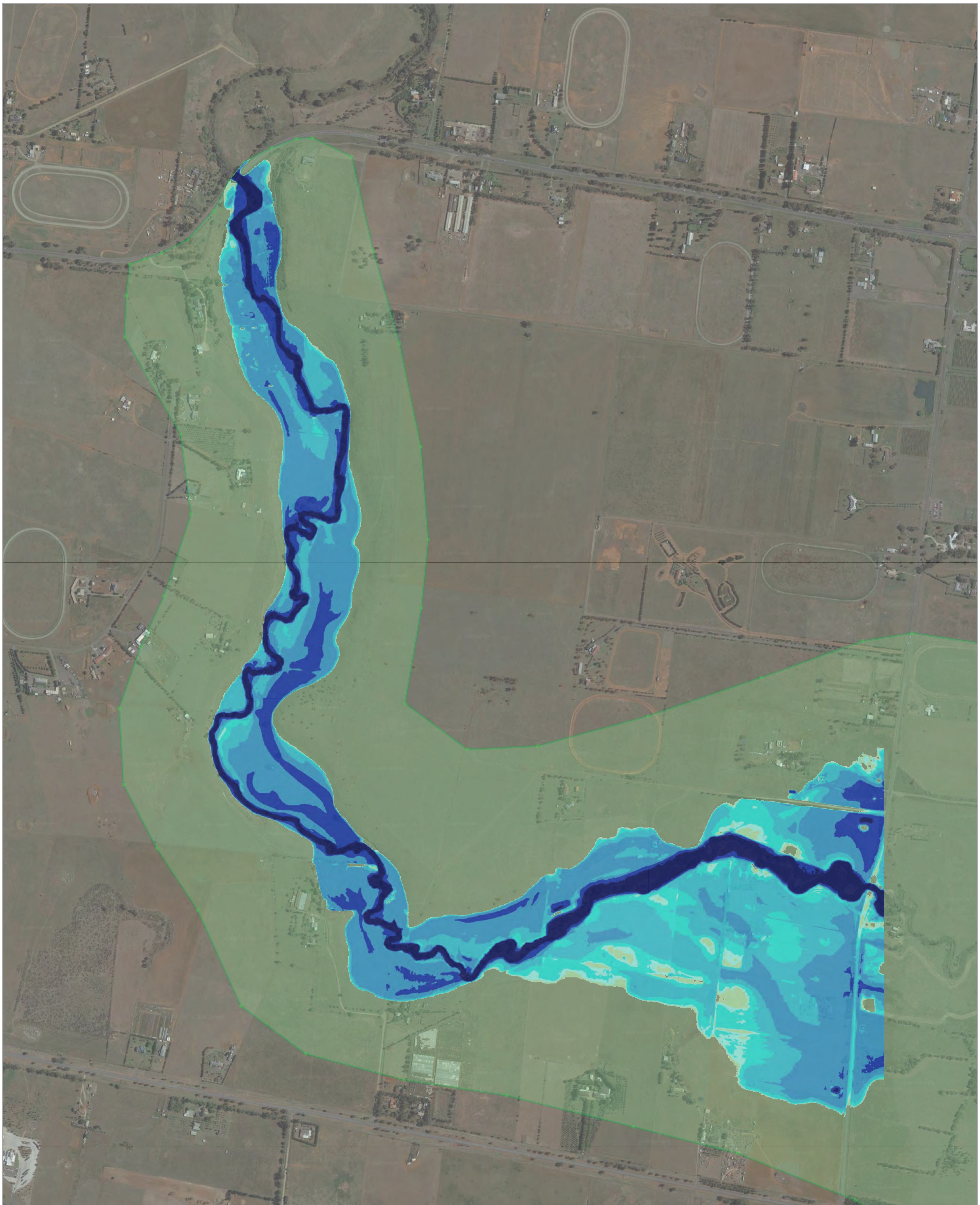
1:10000

100 0 100 200 300 m

Coordinate System: GDA 1994 MGA Zone 55
Paper size A3 Landscape

spiire
414 La Trobe Street
PO Box 16084
Melbourne Vic 8007
T 61 3 9993 7888
spiire.com.au
ABN 55 050 029 635

APPENDIX B – 1% AEP FLOOD MAP



KOROROIT CREEK FLOOD MODEL - EXISTING CONDITIONS

1% AEP FLOOD DEPTHS

NOTATIONS

File Ref: 307254
Plan: W GIS 002 1% AEP Flood Map
Rev: A
Date: 13.10.2020

Designed: B.N.
Checked: R.C.
Authorised: L.H.

Flood Results:
Data:

LEGEND

Model Extents

Flood Depth (m)
- 0 - 0.05
- 0.05 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- >2.0

1:10000

100 0 100 200 300 m

Coordinate System: GDA 1994 MGA Zone 55
Paper size A3 Landscape

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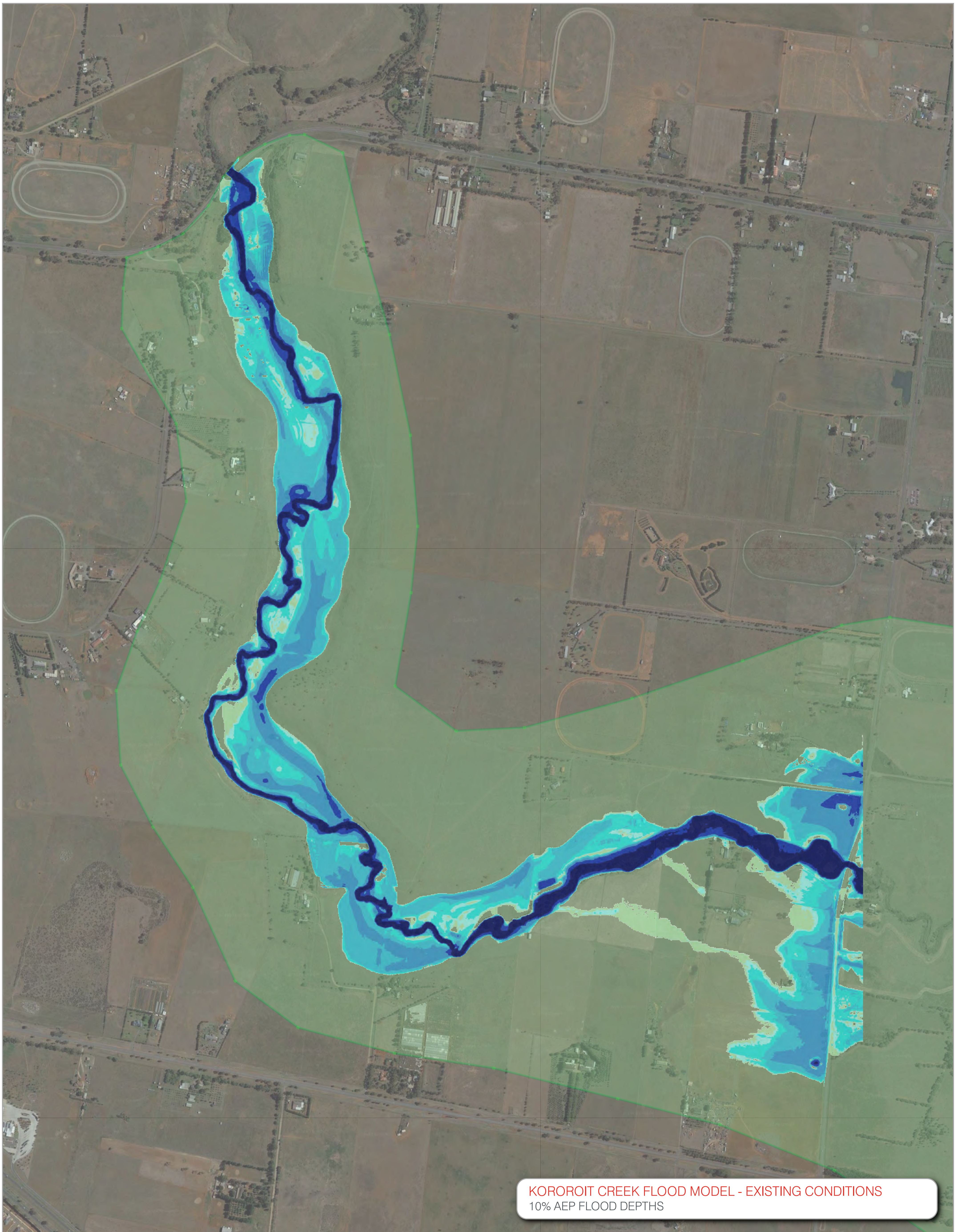
ABN 55 050 029 635

APPENDIX C – 10% AEP FLOOD MAP



KOROROIT CREEK FLOOD MODEL - EXISTING CONDITIONS
10% AEP FLOOD DEPTHS

NOTATIONS

File Ref: 307254
Plan: W GIS 003 10% AEP Flood Map
Rev: A
Date: 13.10.2020

Designed: B.N.
Checked: R.C.
Authorised: L.H.

Flood Results:
Data:

LEGEND

Model Extents

Flood Depth (m)
- 0 - 0.05
- 0.05 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- >2.0

100 0 100 200 300 m

1:10000

Coordinate System: GDA 1994 MGA Zone 55
Paper size A3 Landscape

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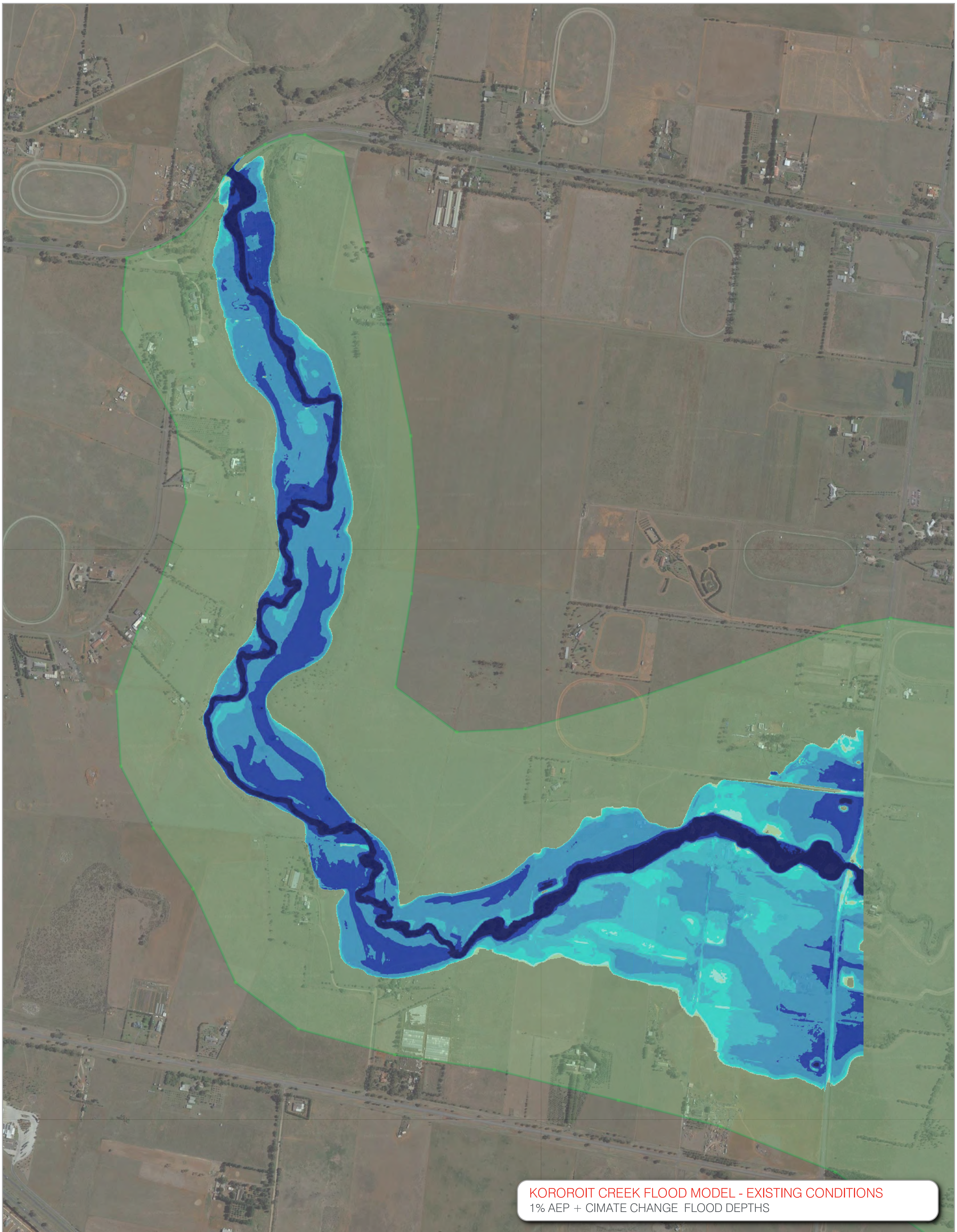
ABN 55 050 029 635

APPENDIX D – 1% AEP WITH CLIMATE CHANGE FACTOR FLOOD MAP



KOROROIT CREEK FLOOD MODEL - EXISTING CONDITIONS

1% AEP + CIMATE CHANGE FLOOD DEPTHS

NOTATIONS

File Ref: 307254
Plan: W 004 1% AEP + CC Flood Map
Rev: A
Date: 13.10.2020

Designed: B.N.
Checked: R.C.
Authorised: L.H.

Flood Results:
Data:

LEGEND

Model Extents

Flood Depth (m)

- 0 - 0.05
- 0.05 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- >2.0

1:10000

100 0 100 200 300 m

Coordinate System: GDA 1994 MGA Zone 55
Paper size A3 Landscape

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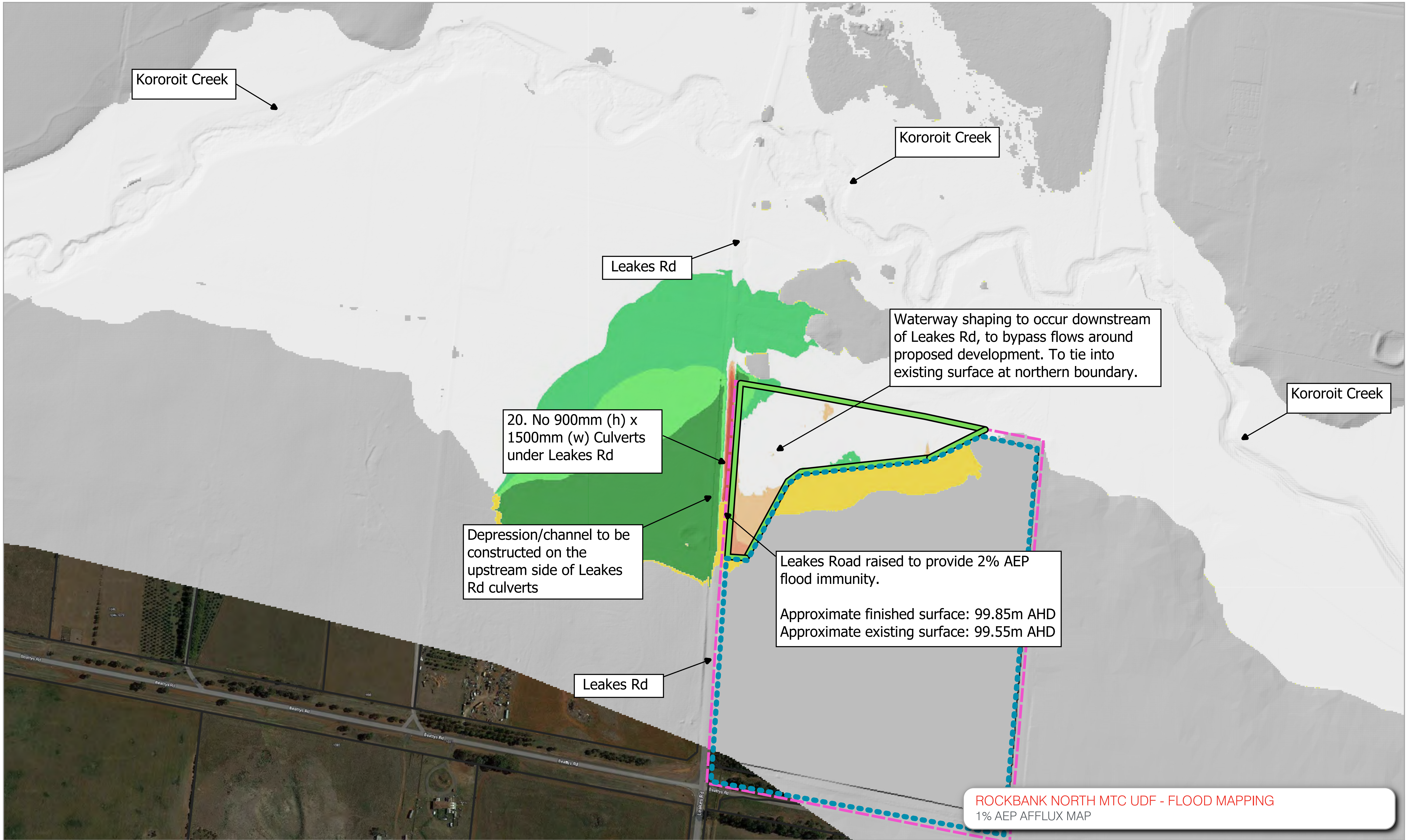
APPENDIX B

FLOOD MAPPING RESULTS



ROCKBANK NORTH MTC UDF - FLOOD MAPPING
1% AEP AFFLUX MAP

NOTATIONS

File Ref: xxxxxx
Plan: W GIS xxx
Rev:
Date: 07.10.2022

Designed:
Checked:
Authorised:

Flood Results:
Data:

LEGEND

- Property Boundaries
- Subject Site
- WaterWay Extents
- Approx. Developable Area

Afflux (m)

- <= -0.2
- -0.2 - -0.1
- -0.1 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- Was wet - now dry
- Was dry - now wet

1:5,000

51 0 51 102 153 m

Coordinate System: GDA 1994 MGA Zone 55
Paper size A3 Landscape

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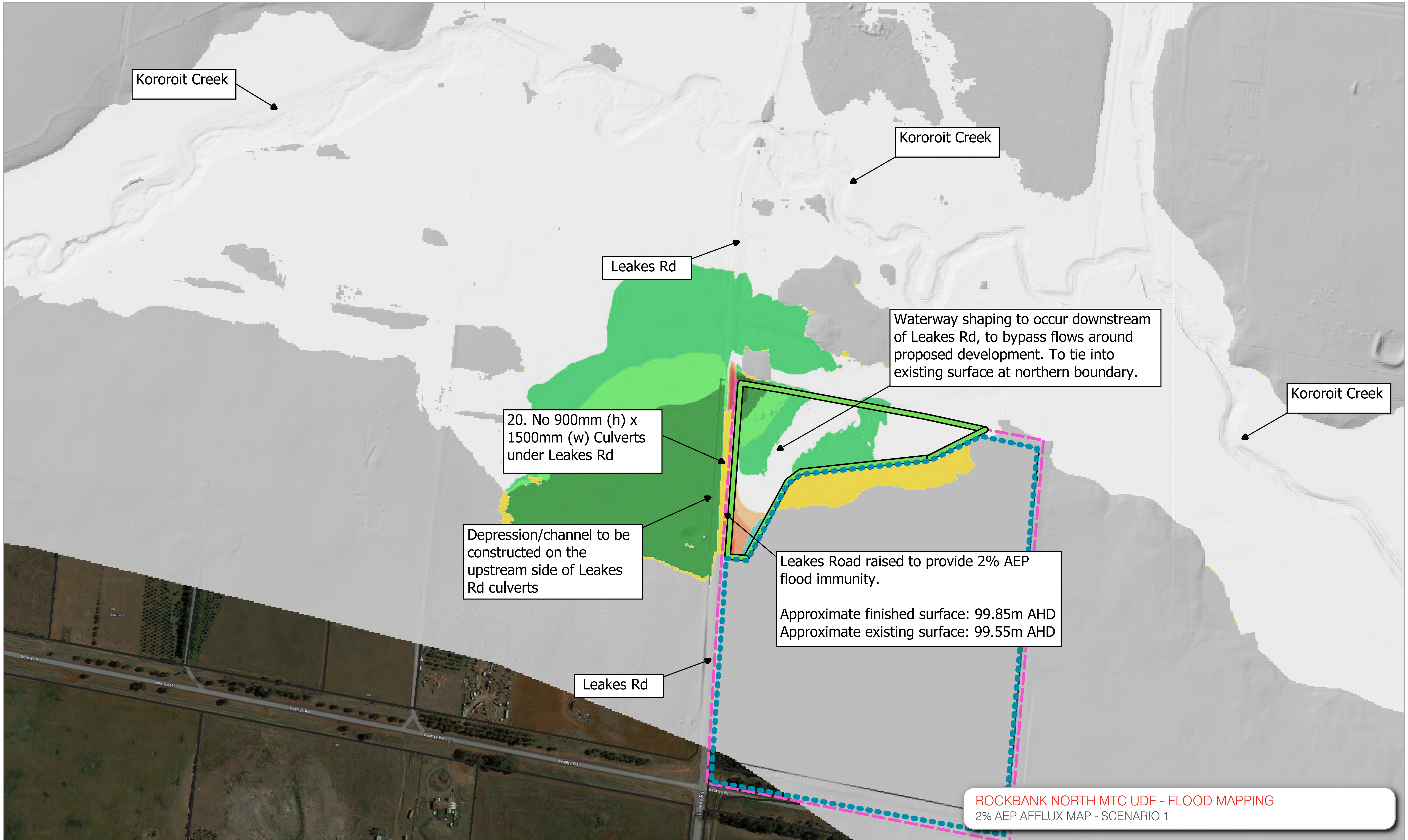
ABN 55 050 029 635



ROCKBANK NORTH MTC UDF - FLOOD MAPPING

2% AEP AFFLUX MAP - SCENARIO 1

NOTATIONS

File Ref: xxxxxx
Plan: W GIS xxx
Rev:
Date: 07.10.2022

Designed:
Checked:
Authorised:

Flood Results:
Data:

LEGEND

- Property Boundaries
- Subject Site
- WaterWay Extents
- Approx. Developable Area

Afflux (m)

- <= -0.2
- -0.2 - -0.1
- -0.1 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02
- 0.02 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- Was wet - now dry
- Was dry - now wet

51 0 51 102 153 m

1:5,000

Coordinate System: GDA 1994 MGA Zone 55
Paper size A3 Landscape

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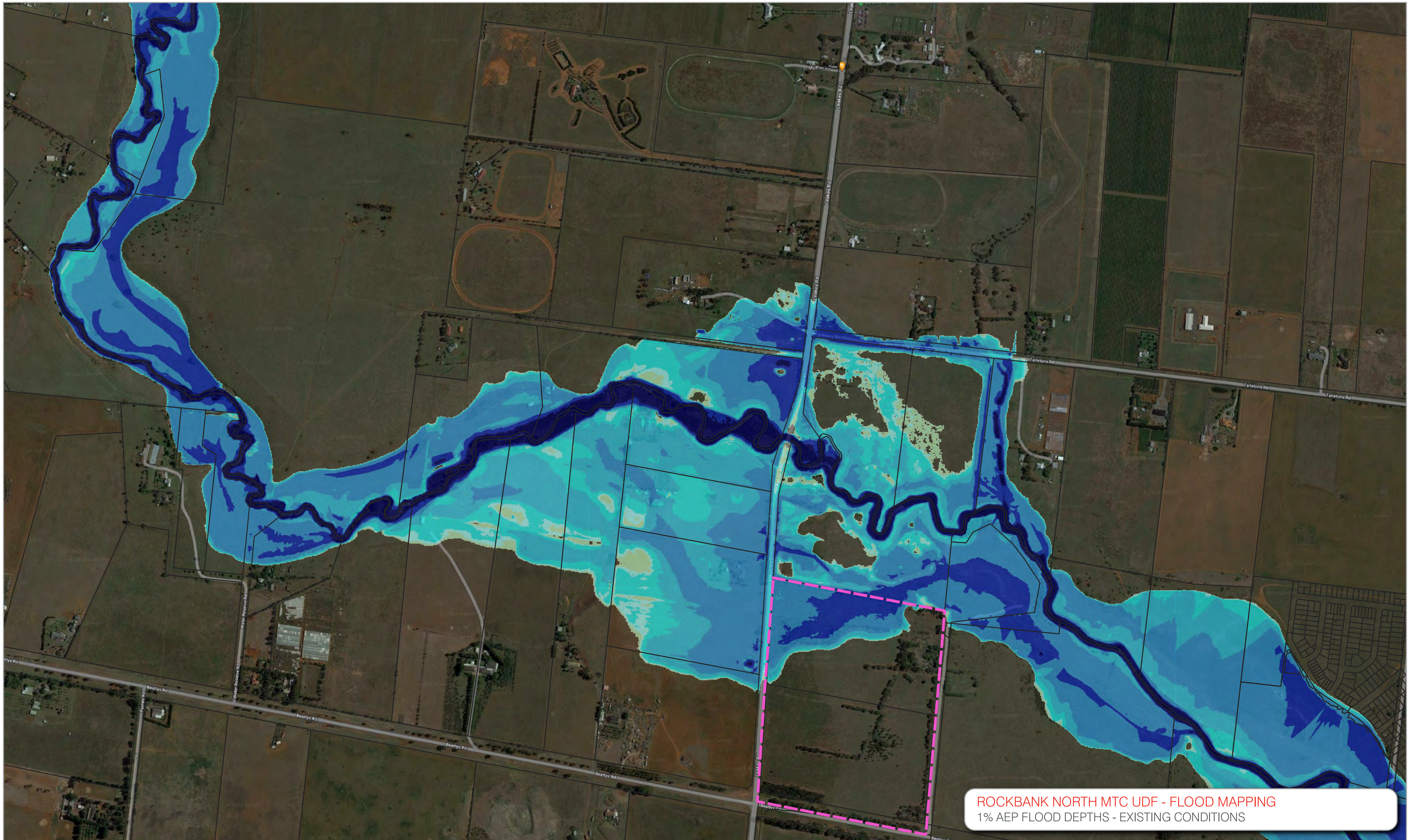

ROCKBANK NORTH MTC UDF - FLOOD MAPPING
1% AEP FLOOD DEPTHS - EXISTING CONDITIONS

NOTATIONS

File Ref: xxxxxx
Plan: W GIS xxx
Rev:
Date: 03.06.2022

Designed:
Checked:
Authorised:

Flood Results:
Data:

LEGEND

- Property Boundaries
- Subject Site

Flood Depth (m)
0 - 0.05
0.05 - 0.1
0.1 - 0.25
0.25 - 0.5
0.5 - 1.0
1.0 - 2.0
>2.0

1:9,000

92 0 92 184 276 m

Coordinate System: GDA 1994 MGA Zone 55
Paper size A3 Landscape

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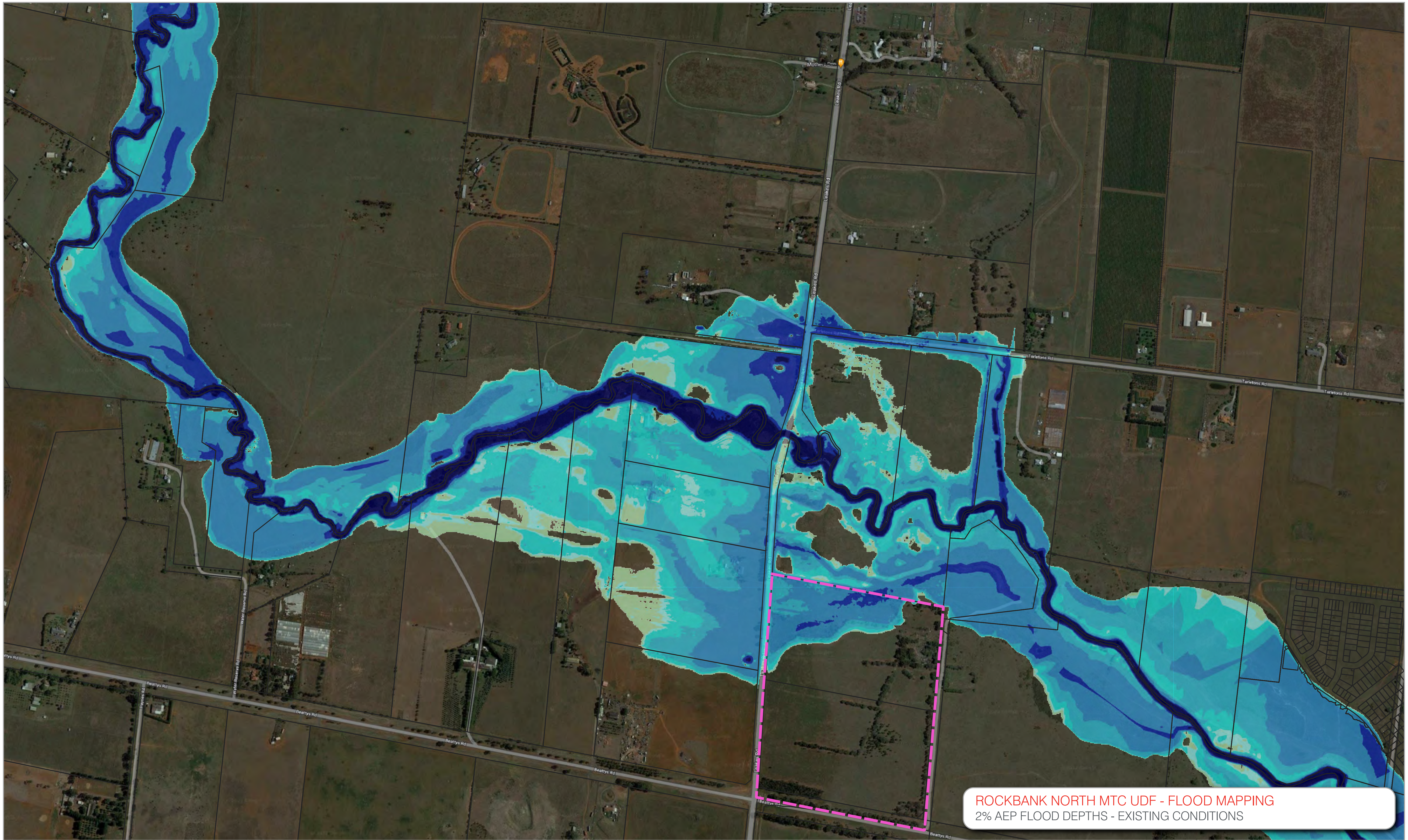

ROCKBANK NORTH MTC UDF - FLOOD MAPPING
2% AEP FLOOD DEPTHS - EXISTING CONDITIONS

NOTATIONS

File Ref: xxxxxx
Plan: W GIS xxx
Rev:
Date: 03.06.2022

Designed:
Checked:
Authorised:

Flood Results:
Data:

LEGEND

- Property Boundaries
- Subject Site

Flood Depth (m)
- 0 - 0.05
- 0.05 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- >2.0

92 0 92 184 276 m

1:9,000

Coordinate System: GDA 1994 MGA Zone 55
Paper size A3 Landscape

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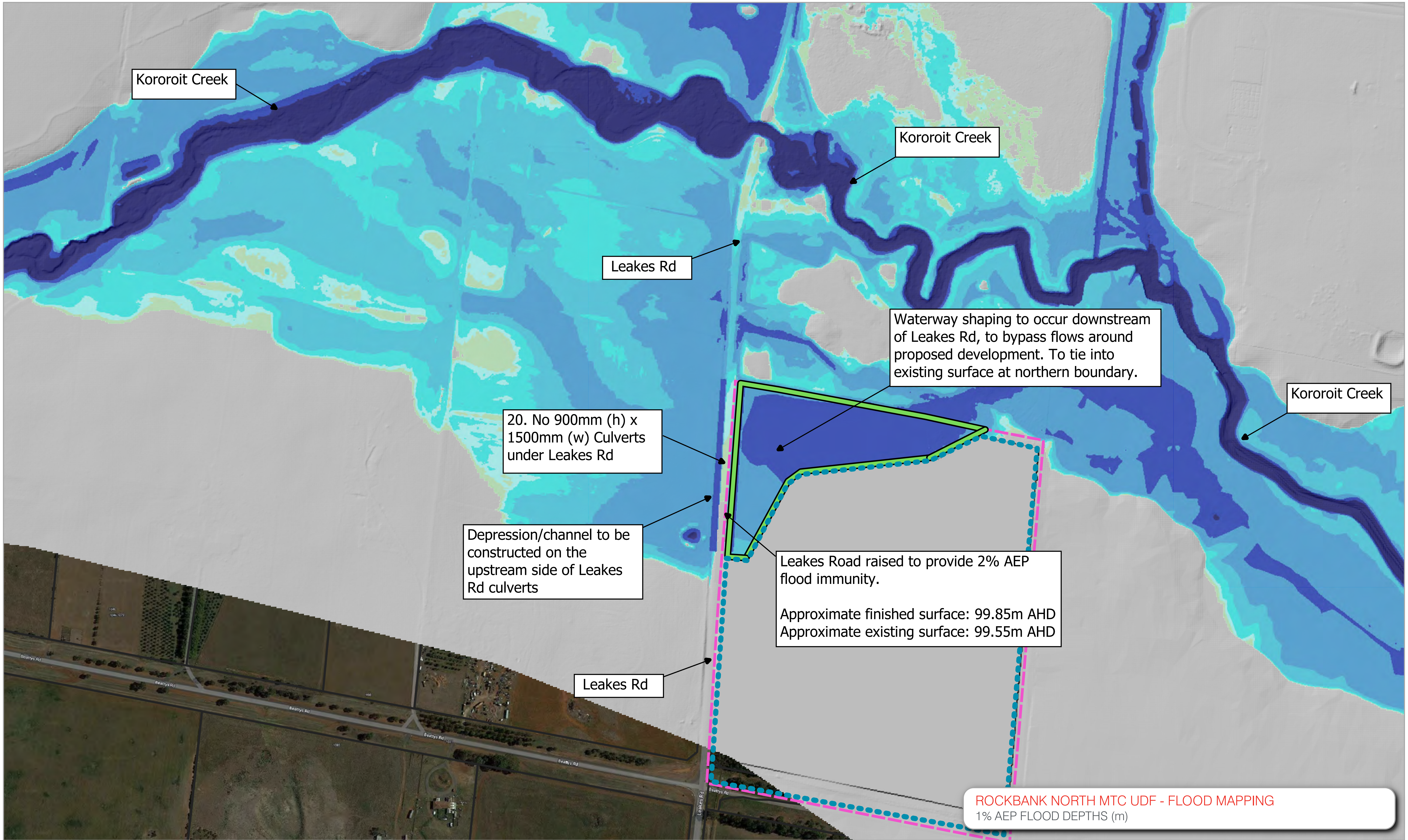

ROCKBANK NORTH MTC UDF - FLOOD MAPPING

1% AEP FLOOD DEPTHS (m)

NOTATIONS

File Ref: xxxxxx
Plan: W GIS xxx
Rev:
Date: 07.10.2022

Designed:
Checked:
Authorised:

Flood Results:
Data:

LEGEND

- Property Boundaries
- Subject Site
- WaterWay Extents
- Approx. Developable Area

Flood Depths (m)

- 0 - 0.05
- 0.05 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- >2.0

51 0 51 102 153 m

1:5,000

Coordinate System: GDA 1994 MGA Zone 55
Paper size A3 Landscape

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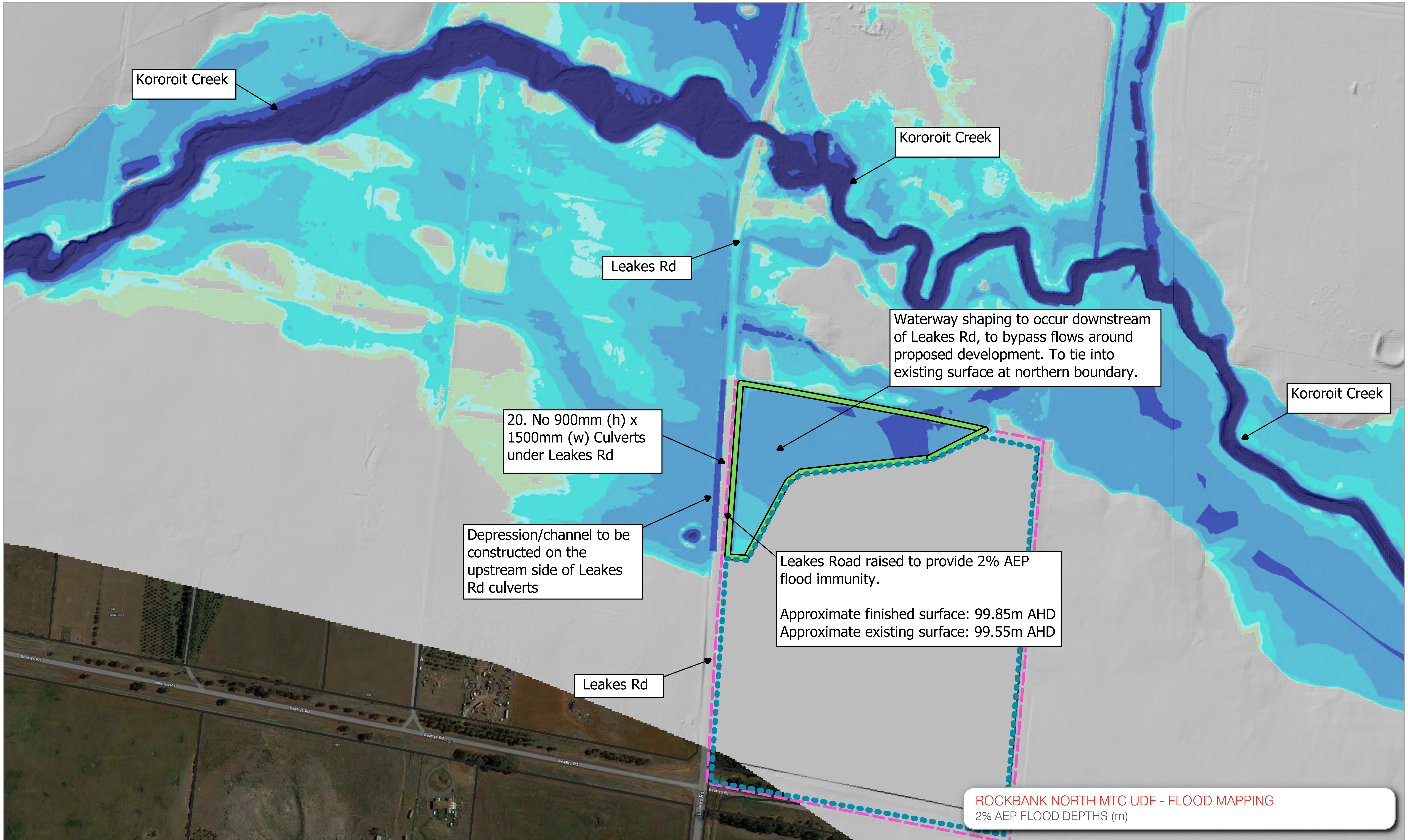

ROCKBANK NORTH MTC UDF - FLOOD MAPPING

2% AEP FLOOD DEPTHS (m)

NOTATIONS

File Ref: xxxxxx
Plan: W GIS xxx
Rev:
Date: 07.10.2022

Designed:
Checked:
Authorised:

Flood Results:
Data:

LEGEND

- Property Boundaries
- Subject Site
- WaterWay Extents
- Approx. Developable Area

Flood Depths (m)

- 0 - 0.05
- 0.05 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- >2.0

1:5,000

51 0 51 102 153 m

Coordinate System: GDA 1994 MGA Zone 55
Paper size A3 Landscape

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