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WATER & ENVIRONMENT

75 Gurner Ave, Austral EAST

Stormwater Concept Plan and Flood Study

COMMERCIAL IN CONFIDENCE

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1 INTRODUCTION

This report has been prepared by Calibre Professional Services for Landcom to support the Development Application for the Eastern Site at 75 Gurner Avenue, Austral. The site is proposed to be developed into residential lots in addition to supporting local roads and drainage infrastructure.

This report details a stormwater management strategy for the Western site based on water sensitive urban design (WSUD) principles. The key objectives of the strategy are to:

- Link water infrastructure effectively to minimise the impact of the development upon the watercycle.
- Protect the subdivision and downstream development from flooding.
- Protect receiving water quality.
- Meet design requirements specified in this report at Section 2 – Relevant Policies and Guidelines.

1.1 SITE DESCRIPTION

The project site is located within the suburb of Austral, within the Austral and Leppington North Precinct of the South West Growth Centre of Sydney.

The site locality is shown in Figure 1-1. The figure has been adapted from the *Austral and Leppington North Indicative Layout Plan (ILP)* (Department of Planning & Infrastructure, 2013).

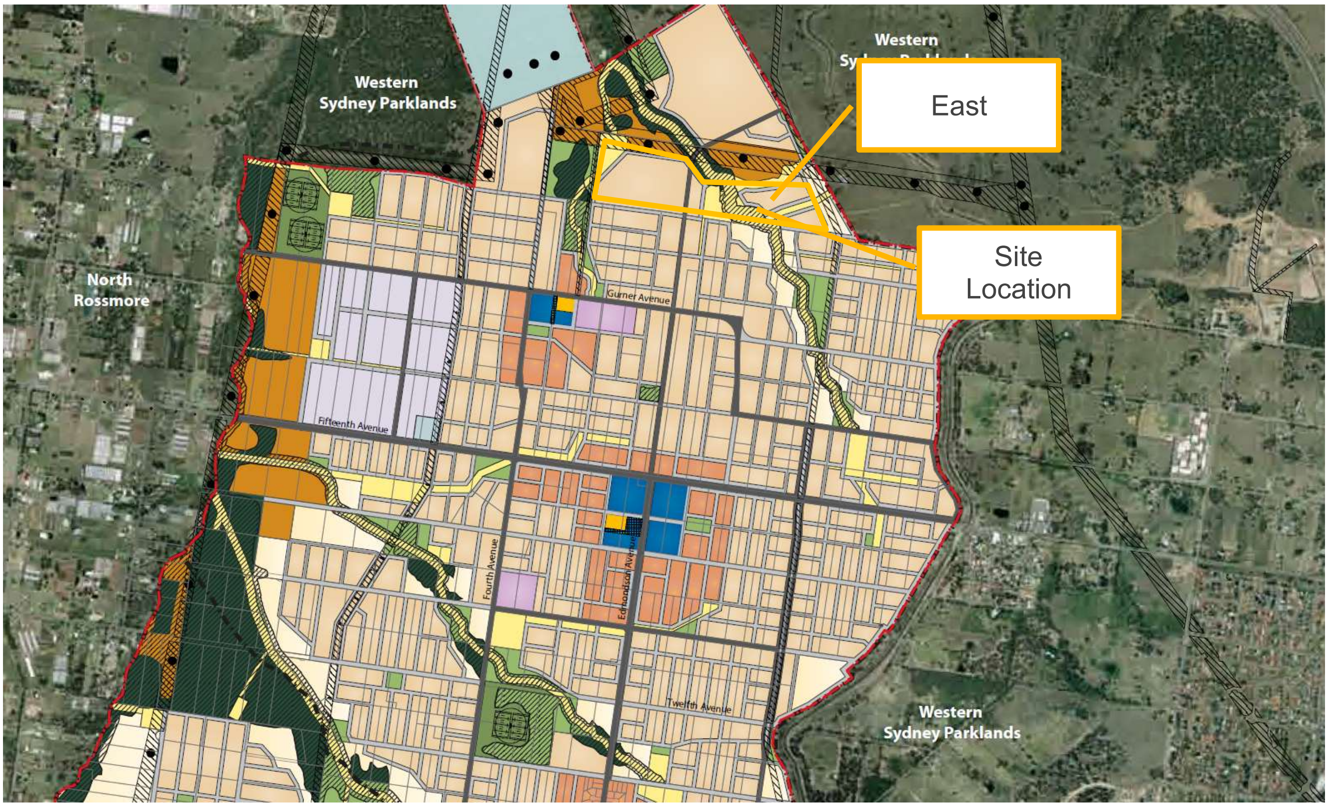

Figure 1-1: Site locality (Department of Planning & Infrastructure, 2013)

The existing land use includes houses, farm dams, crops, along with areas covered with vegetation characterised by grass and large trees.

2 RELEVANT POLICIES AND GUIDELINES

This section outlines the planning context and design criteria relevant to the subdivision. The section also provides a brief description of relevant Growth Centres Commission and Liverpool City Council publications.

2.1 LIVERPOOL CITY COUNCIL PUBLICATIONS

This specification contains technical data for the design of drainage infrastructure including detention basins. The design specifications include:

- Liverpool City Council – *Stormwater Drainage Design*
- Liverpool City Council – *Handbook for Drainage Design Criteria*
- Liverpool City Council – *On-site Stormwater Detention Policy*
- Liverpool City Council – *On-site Stormwater Detention Technical Specifications*

These documents contains the hydrologic parameters including rainfall intensity charts and runoff parameters for flow calculation. The documents also outlines hydraulic parameters and design requirements for pits, culverts and pipes.

2.2 *LIVERPOOL LOCAL ENVIRONMENTAL PLAN 2008* (LIVERPOOL CITY COUNCIL, 2008)

Local Environmental Plans (LEPs) are prepared in accordance with the requirements of the Environmental Planning and Assessment Act 1979. The LEPs sets out zoning for land within the local government area (LGA) and identifies planning objectives and development controls for each zone. This LEP will come into effect on 7 July 2015, replacing the previous LEP. Liverpool Local Environmental Plan and the Liverpool Development Control Plan do not apply to land that a Precinct Plan applies to, except where specifically referred to in the Growth Centres *State Environmental Planning Policy (Sydney Region Growth Centres) 2006* (SEPP) and this DCP.

2.3 *LIVERPOOL GROWTH CENTRE PRECINCTS DEVELOPMENT CONTROL PLAN MARCH 2013* (DEPARTMENT OF PLANNING & INFRASTRUCTURE, 2013)

The *Liverpool Growth Centre Precincts Development Control Plan* (Department of Planning & Infrastructure, 2013) applies to all land that is specified in the SEPP. The Austral and Leppington North Precincts fall within these lands.

The document sets out the planning, design and environmental objectives and controls that local councils will use to assess development applications within a defined site or precinct within the LGA. It also assists developers in designing proposed developments and preparing their applications to Council.

The detailed guidelines contained within Development Control Plans (DCPs) are to be read in conjunction with other legal planning instruments such as SEPPs or LEPs.

2.3.1 *SCHEDULE 1 AUSTRAL & LEPPINGTON NORTH PRECINCTS* (DEPARTMENT OF PLANNING & INFRASTRUCTURE, 2013)

The *Schedule 1 Austral & Leppington North Precincts* (Department of Planning & Infrastructure, 2013) applies specifically to the Austral & Leppington North Precincts and forms part of the *Liverpool Growth Centre Precincts Development Control Plan* (Department of Planning & Infrastructure, 2013). Where inconsistencies arise between the main DCP and Schedule 1, Schedule 1 takes precedence.

2.4 *WATER MANAGEMENT ACT 2000*

The key NSW legislation governing the management of the state's water resources are the *Water Management Act 2000* and the *Water Act 1912*. The *Water Management Act 2000* is progressively replacing the *Water Act 1912* which represented outdated principles in water management.

The objective of the *Water Management Act 2000* is to provide sustainable and integrated management of water resources for the benefit of both present and future generations (NSW Office of Water, 2014). The NSW Office of Water administers the *Water Management Act 2000* and regulates controlled activities carried out around and on waterfront land.

Amendments have been made to the legislation since it was passed by NSW parliament in December 2000. In 2012, the *Guidelines for Riparian Corridors on Waterfront Land* (NSW Office of Water, 2012) allowed construction of online detention basins in riparian corridors. The revision also streamlined the categorisation of streams and permitted activities around the riparian corridors.

2.5 GROWTH CENTRES DEVELOPMENT CODE (GROWTH CENTRES COMMISION, 2006)

The *Growth Centres Development Code* (Growth Centres Commision, 2006) was released by the Department of Environment and Conservation in 2006. The department no longer exists and the Growth Centres Commission formally took over planning for the Growth Centres.

The *Growth Centres Development Code* provides the basis for the planning and design of precincts and neighbourhoods in the Growth Centres. It is intended to be a reference work, to stimulate ideas and provide a guide to best practice. Sections of the *Growth Centres Development Code* that provide guidance relevant to the design are:

- B-2 Water Sensitive Urban Design and Stormwater Management

This section provides an introduction to WSUD which encompasses all aspects of urban water cycle management, including water supply, wastewater and stormwater management. It emphasises the importance of linking water infrastructure, landscape design and the urban built form, in a manner that is more attuned to natural hydrological and ecological processes than conventional design.

- B-3 Riparian Corridors.

The development guide provides guidance for the management of riparian corridors. These guidelines are considered to be superseded by the *Guidelines for Riparian Corridors on Waterfront Land* (NSW Office of Water, 2012).

2.6 OTHER RELEVANT SPECIFICATIONS

- *AS/NZ3500.3 Plumbing and Drainage - Stormwater Drainage*
- *Australian Rainfall & Runoff* (Engineers Australia)
- *Australian Runoff Quality* (Engineers Australia)
- Technical Note: *Interim Recommended Parameters for Stormwater Modelling – North-West and South-West Growth Centres*
- *Building Code of Australia Housing Provisions* (current edition)
- *Managing Urban Stormwater - Soils and Construction* (current edition)
- *Water Sensitive Urban Design in the Sydney Region Resource Kit* (2003)
- *Water Sensitive Urban Design Technical Guidelines for Western Sydney* (2004)
- Map of Salinity Potential in Western Sydney (2002)
- *Guidelines to accompany Map of Salinity Potential in Western Sydney* (2002)
- *WSROC Western Sydney Salinity Code of Practice* (2004)

- DNR Local Government Salinity Initiative Publications (various)
- *NSW Floodplain Development Manual* (2005)
- *MUSIC* Manual (Version 5)
- *XP-RAFTS* Manual (2009).

2.7 AUSTRAL & LEPPINGTON NORTH PRECINCTS – RIPARIAN CORRIDOR AND FLOODING ASSESSMENT (CARDNO, 2011)

The study (Cardno, 2011) presented a hydrologic and hydraulic assessment to define the potential extent of flood liable land, quantify the potential for the development of the precincts to impact on existing flood behaviour as well as the extent of the stormwater management infrastructure that would need to be implemented to mitigate any adverse flood impacts. The study included the development of an XP-RAFTS model to define catchment hydrology and a TUFLOW model to simulate flood hydraulics. These models were updated in the following year in response to post-exhibition submissions (Cardno, 2012).

2.8 AUSTRAL AND LEPPINGTON NORTH PRECINCTS – WATER CYCLE MANAGEMENT – WSUD REPORT (CARDNO, 2011)

The 'Austral and Leppington North Precincts, Water Cycle Management - WSUD Report' prepared by Cardno, 2011 addresses the water quality control strategy proposed for the development precinct. The study (Cardno, 2011) addressed the water quality control strategy required for the catchments draining to the detention basins. A treatment train approach was adopted to achieve the treatment targets for Gross Pollutants (GPs), Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN). Rainwater tanks were introduced at the upper-end of the treatment train to manage rainwater quality, while stormwater runoff quality was managed via GPTs and biofilters.

2.9 AUSTRAL AND LEPPINGTON NORTH PRECINCTS – WATER CYCLE MANAGEMENT –RESPONSES TO EXHIBITION SUBMISSIONS (CARDNO, 2012)

The Cardno 2012 Water Cycle Management report summarises additional assessments and revisions to the original WCM strategy that was proposed in the previous report (Cardno, 2011). This was in response to submissions received during the exhibition of the draft Precinct Plan for the Austral and Leppington North Precincts.

2.10 AUSTRAL AND LEPPINGTON NORTH DESIGN OF WATER MANAGEMENT INFRASTRUCTURE DRAFT DETAILED CONCEPT DESIGN REPORT (SMEC 2018)

In 2018 SMEC was engaged by Liverpool Council to update the previous Water Cycle Management strategy prepared by Cardno (2011/2012). The study identified 2 regional detention and water quality basin (Basin 25 and 27) within the western site to compensate for the eastern catchments in accordance with Figure 2.1.

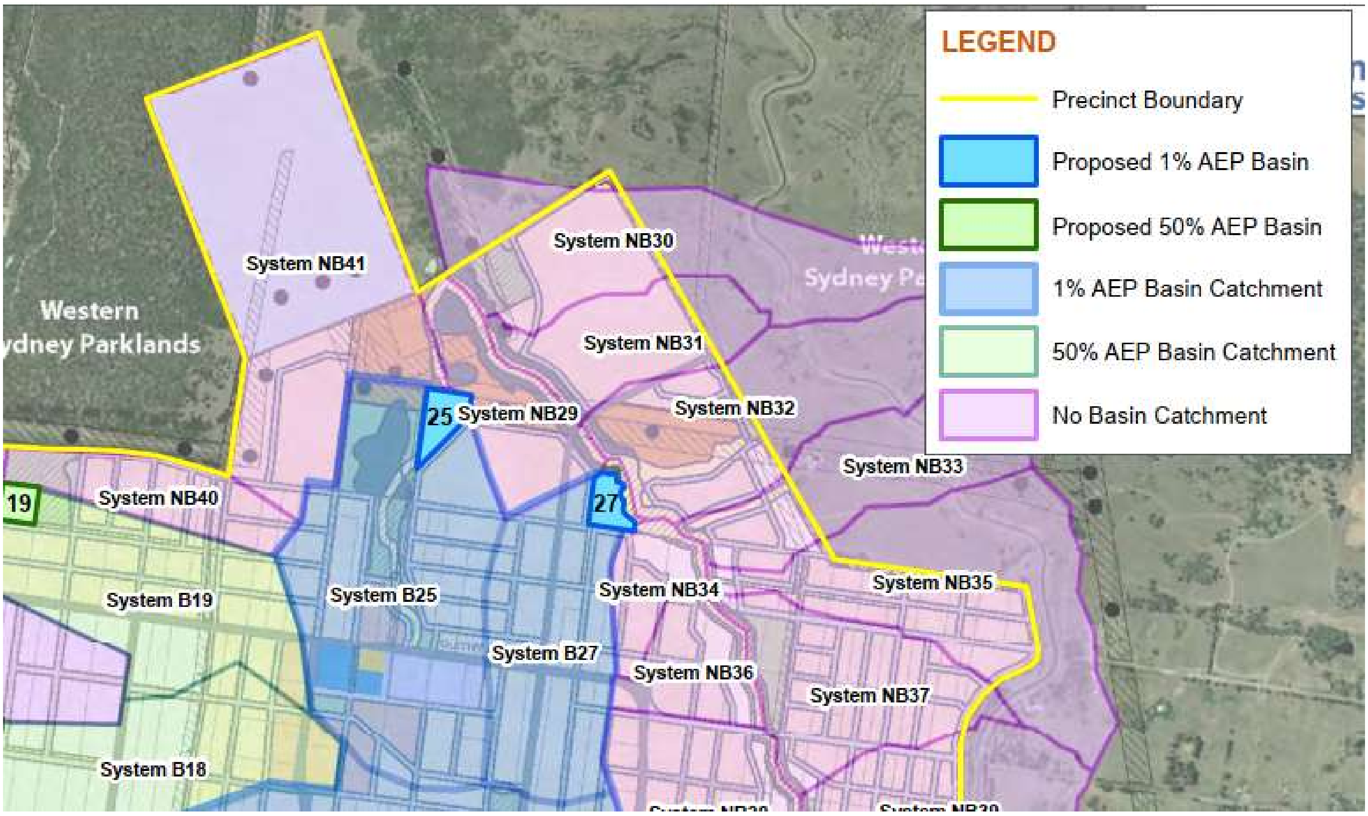

Figure 2.1 Map of Basin Catchments (SMEC 2018)

3 STORMWATER QUANTITY MANAGEMENT

Urbanised catchments are characterised with increased impervious areas which are smoother and allow stormwater to flow and concentrate faster. As a result, post-development catchments discharge greater stormwater volumes at higher flow rates leading to more frequent high flow events when stormwater runoff is not managed. The potential impacts of increased stormwater runoff quantity include:

- Increases in channel forming flows. The increased frequency of high flow events changes the channel forming flow and affects channel shape. This may damage or destroy important in-stream and bank habitats
- Increases in peak flows. Increased peak flows increase downstream flood risks and place greater pressure on downstream drainage infrastructure
- Increases in flood levels. Higher flood levels may pose risks to public safety and subdivision assets

As a result, a stormwater quantity management strategy is required to mitigate the risks and consequences of urbanisation on the existing catchments.

The stormwater quantity management strategy aims to match post-development peak runoff to the permissible site discharge (PSD) in all storm events up to and including the 100 year storm event in accordance to Liverpool City Council's requirement for stormwater quantity. This will mitigate large scale flooding while maintaining the smaller channel forming flows and in-stream environments.

3.1 REGIONAL BASINS

The Water Cycle Management for the Austral and Leppington Precinct identified 2 regional basins within the western site to compensate for the eastern catchments. The catchments draining to Basin 25 (figure 3.1) and basin to Basin 27 (figure 3.3) compensate for the Eastern site.

3.1.1 BASIN 25

Basin 25 is located at the Northern end of the precinct on the western boundary of the site. The basin serves a 49.54ha catchment with a detention volume of 17,365m^3 and a bioretention filter of 2,829m^2

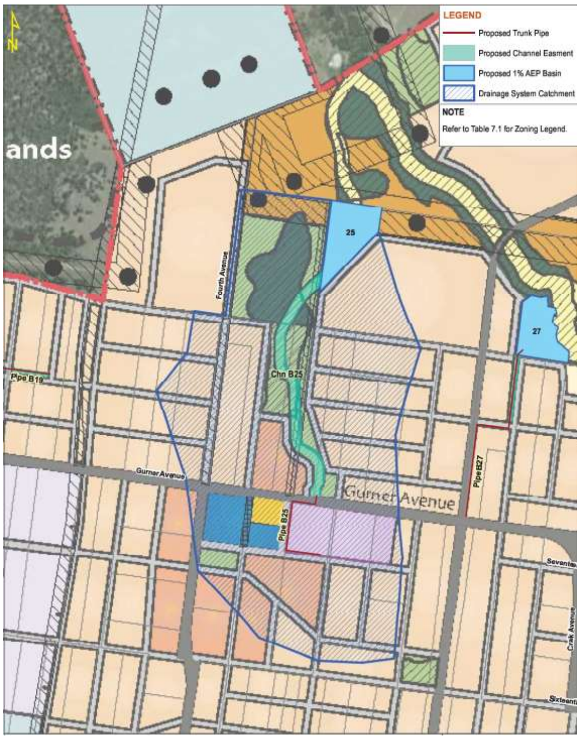

Figure 3.1 Map of Basin 25 Catchment (SMEC 2018)

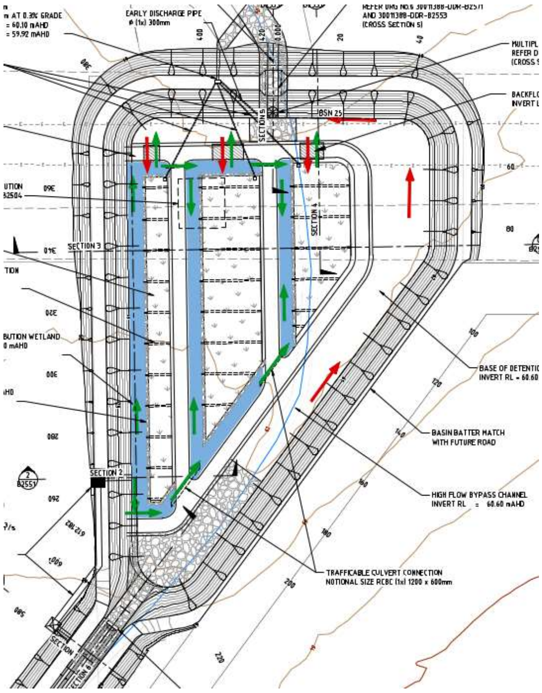

Figure 3.2 Basin 25 (SMEC 2018)

3.1.2 BASIN 27

Basin 27 is located at the Northern end of the precinct on the west of the Kemps Creek Tributary. The basin serves a 27.4ha catchment with a detention volume of 12,143m^3 and a bioretention filter of 1,587m^2

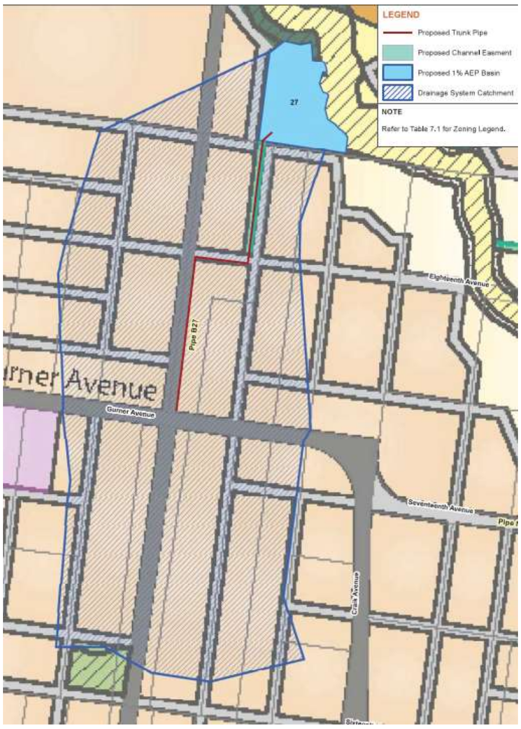

Figure 3.3 Map of Basin 27 Catchment (SMEC 2018)

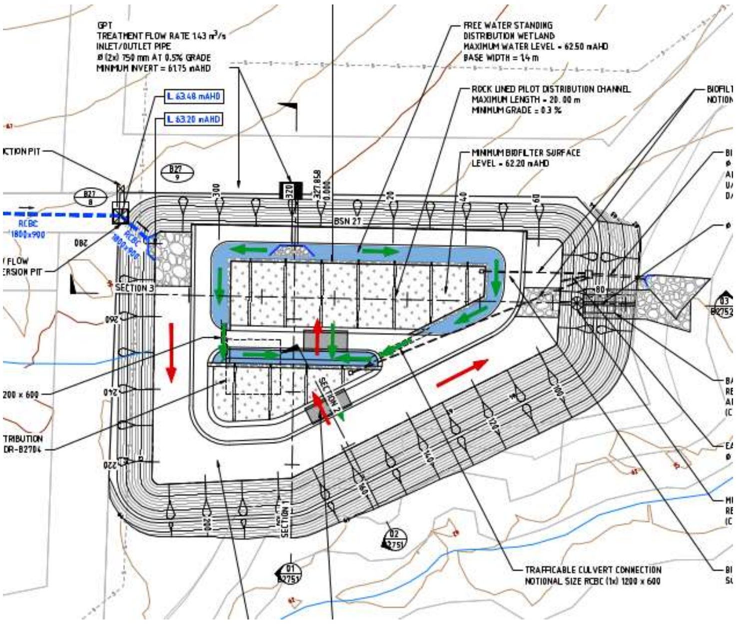

Figure 3.4 Basin 27 (SMEC 2018)

3.2 STORMWATER MANAGEMENT

Until such time as the regional basins are in operation to compensate for the proposed development, the eastern site will provide temporary water quality and detention basins. Two basins have been proposed, the basin have been nominated as Eastern Temp Basin 1 and Eastern Temp Basin 2.

3.3 HYDROLOGICAL MODELLING

The hydrological analysis for this study was undertaken using the rainfall-runoff and flow routing computer program *XP-RAFTS* (Version 2018). The *XP-RAFTS* model was used to analyse both the pre-development catchments to obtain the pre-development flows as well as the post-development catchments, to estimate the post-development peak flows after the proposed subdivisions are constructed. The pre-development peak flows are modelled as the Permissible Site Discharge (PSD) which the post-development peak flows must not exceed.

3.4 CATCHMENTS

The sub-catchment breakup was determined from the topology of the land taken from both land survey and contour maps. The post-development catchments were delineated based on the proposed street and lot layouts of the subdivisions and follow the designed pipe and overland flow path routes. The catchments are shown in Figure 3-1. The arrows indicate the direction of flow.

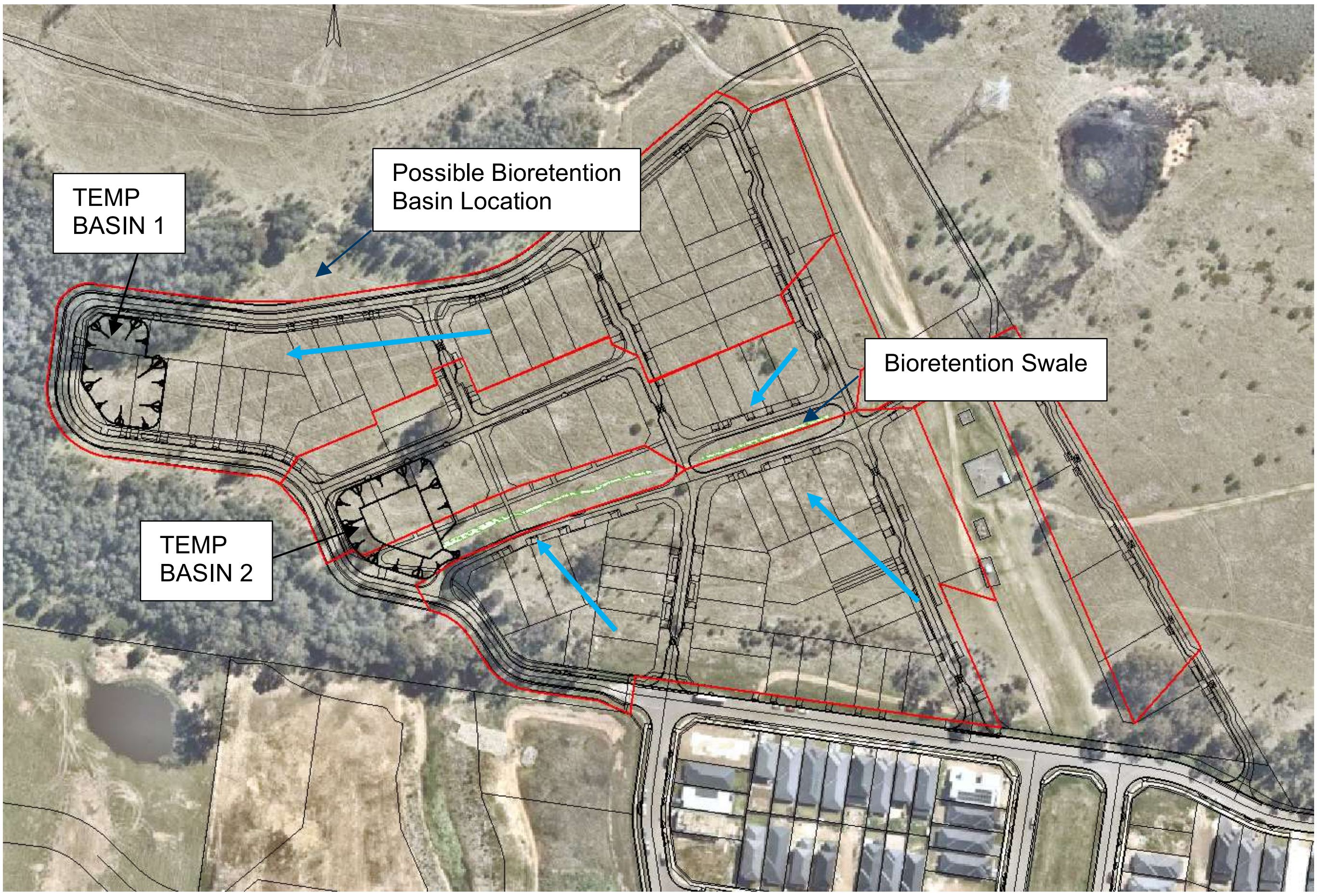

Figure 3-1: Catchments

The temporary basins have been sized and presented in table 3-1

Table 3-1: Basin Volumes

Basin	Basin Stage (m)	Detention (m^3)
Temp Basin 1	1	400
Temp Basin 2	1	1,000

The proposed temporary basin ensure that the post-development peak discharges do not exceed the PSD for all modelled storm events. This indicates that the concept basin design has been designed to meet Council requirements until the regional stormwater infrastructure is operational.

3.5 Attenuated Post-Development Modelling

The detention basin was incorporated into the post-development *XP-RAFTS* model. An iterative process was undertaken within the *XP-RAFTS* model to design the outlet control structures and to meet Council design requirements.

The *XP-RAFTS* model with attenuation was used to confirm that the stormwater management provided by the temporary basin would meet requirements. The results are shown in Table 3-.

Table 3-2: Modelling results for critical storm event

ARI (Years)	Permissible Site Discharge (m^3/s)	Attenuated Site Discharge (m^3/s)	Basin Stage (RL m)	Storage Utilised (m^3)
2	0.985	0.983	64.47 (basin1) 65.15 (basin2)	171 (basin1) 360 (basin2)
10	1.98	1.94	64.66 (basin1) 65.6 (basin2)	260 (basin1) 830 (basin2)
20	2.27	2.18	64.75 (basin1) 65.89 (basin2)	307 (basin1) 1235 (basin2)
100	3.05	2.69	64.9 (basin1) 66 (basin2)	401 (basin1) 1430 (basin2)

The results show that the post-development peak discharges do not exceed the PSD for all modelled storm events. This indicates that the concept basin design has been designed to meet Council requirements until the regional stormwater infrastructure is operational.

4 STORMWATER QUALITY MANAGEMENT

A temporary water quality treatment strategy is required to reduce stormwater pollutant loads until the regional stormwater management infrastructure is operational. The stormwater quality objectives established by Liverpool City Council will be achieved by treating frequent stormwater runoff flows. The treated flows will then drain to the creek.

The proposed temporary basin 1 will provide a temporary bioretention basin, a permanent bioretention swale will be located in the landscaped median (refer to figure 3-1)

4.1 BIORETENTION TREATMENT

A bioretention basin will be utilised as part of the water quality treatment strategy for the site and to receive flows from the minor drainage system. Bioretention basins remove sediments and attached pollutants through filtration via an engineered filter media and nutrient uptake via plant and vegetation root areas. The proposed bioretention basin will be located clear of the core riparian zones.

The bioretention basin incorporate an extended detention storage above the filter media. A typical detail is shown in Figure 4-1.

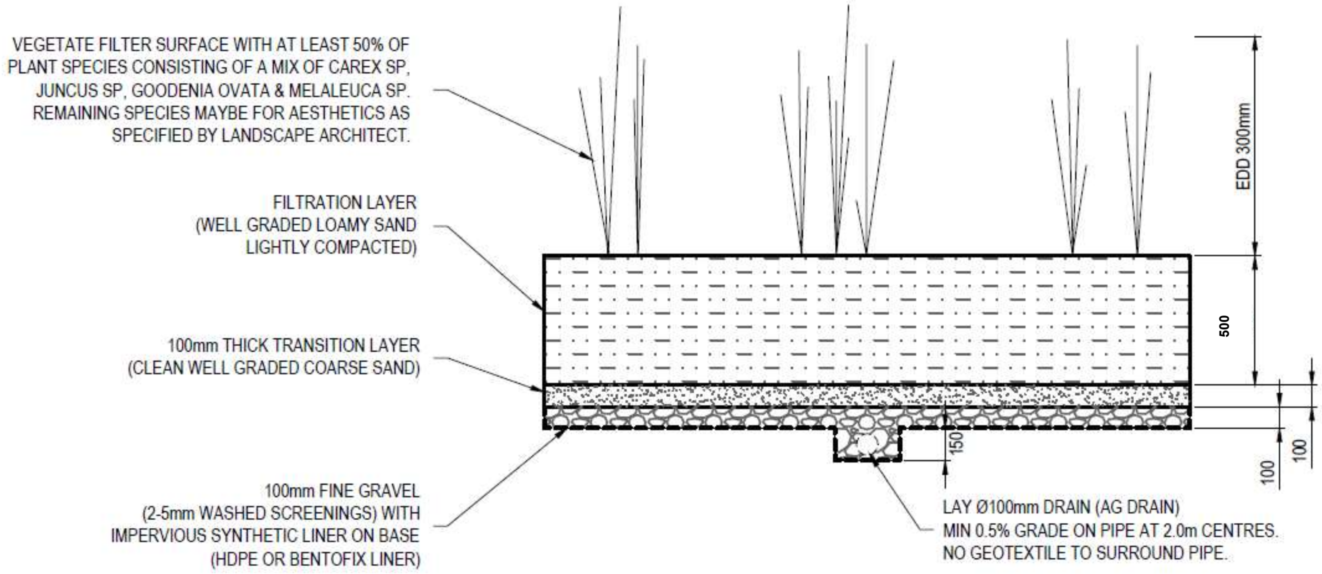

Figure 4-1: Typical bioretention detail

The proposed filter depth and extended detention depth for this basin are nominated in Table 4-2.

Plantings within bioretention basins must be complementary to the adjacent local native plant communities of the riparian corridor and be able to withstand periods of inundation and some long dry periods between rain events. Suitable littoral or transitional plant species (DLWC, 1998) for the bioretention basins could include species such as: *Baumea juncea, Carex appressa, Carex fascicularis, Cyperus exaltatus, Carex polystachyus, Gahnia sieberana, Juncus prismatocarpus, Juncus usitatus, Lomandra longifolia, Paspalum distichum, and Schoenus brevifolius*.

Sediment must be controlled during construction at the source to prevent the filter from being clogged prematurely from construction run-off. Prior to installation of the filter media, the bioretention basin will typically be used as a sediment control basin and be turfed.

4.2 BIORETENTION BASIN CONSTRUCTION STAGING

4.2.1 PHASE 1: CONSTRUCTION OF BULK EARTHWORKS

The earthworks will utilise swales to direct flows to the bulk earthworks basins in accordance to *Managing Urban Stormwater – Soils and Construction* (Landcom, 2004) which is also commonly known as the Landcom 'Blue Book'. Sedimentation control during construction is critical to protect the downstream environment of the creek system.

4.2.2 PHASE 2: CIVIL WORKS PHASE

Initially the proposed bulk earthworks basins will be used as sediment basins during the construction of the civil works within the developments. Silt fences are to be erected around the outside of the disturbed areas to exclude silt and fencing around the basins to ensure access is restricted. It is proposed that the swales and sediment basins will manage sediments and pollutants off the site during the construction process.

Protective erosion and sediment control measures are to remain in place and function as temporary sediment basins for the duration of the construction phase, or until sufficient upstream sediment controls have been installed. Access to the sediment basins is to be restricted throughout construction.

4.2.3 PHASE 3: BUILDING CONSTRUCTION PHASE

Road and drainage construction has been completed and the upstream construction work is at an advanced stage (approximately 90%). Earthworks and shaping to create the layout and functional elements of the sediment basins will be undertaken. The basin batters and base will be turfed and outlet configuration altered to provide dry sedimentation basins and detention volume to support the roads.

4.2.4 PHASE 4: OPERATIONAL PHASE

When all upstream building activities have been substantially completed (approximately 80%) the bioretention basins are to be commissioned. The following works are to be undertaken:

- Remove from site any silt and sediment, temporary turf and underlay (if installed during interim basin construction phase), install subsoil drainage, outlet structures and filter media.
- Supply, replacement and shape sandy-loam media for infiltration bed to establish final media bed level.
- Undertake final planting of media bed with nominated emergent aquatic species.

Following construction activities regular inspections of the bioretention basins are required to ensure that the vegetation establishes and the properties of the filter media remain effective.

4.3 WATER QUALITY MODELLING

The performance of the proposed water quality treatment strategy has been modelled using the *MUSIC* water quality program (Version 6.2). Liverpool City Council do not specify *MUSIC* modelling parameters. As a result, the *MUSIC* modelling was undertaken based on parameters and land use types specified in the *Developer Handbook for Water Sensitive Urban Design* (Blacktown City Council, 2013).

The water quality objectives applicable to the development site are outlined in the *Liverpool Growth Centre Precincts Development Control Plan 2013* (Liverpool City Council, 2013) and are shown in Table 4-1.

Table 4-1: Water quality objectives (Liverpool City Council, 2008)

Pollutant	Reduction target
Total suspended solids	85 %
Total phosphorus	65 %
Total nitrogen	45 %

Modelling will be undertaken to prepare a stormwater quality management strategy that could meet the reduction targets. The bioretention configuration summarised in Table 4-2 and 4-3 are the minimum required to achieve the stormwater quality objectives.

Table 4-2: Bioretention Configuration – Temporary Basin 1

Parameter	Bioretention Basin
Filter Area	320 m^2
Extended Detention Depth	300 mm
Filter Depth	500 mm

Table 4-3: Bioretention Configuration – Vegetated swale/Temporary Basin 2

Parameter	Bioretention Basin
Filter Area	420 m^2
Extended Detention Depth	300 mm
Filter Depth	500 mm

The configuration of the proposed basin was determined through iterations using the *MUSIC* model to meet the required pollution reduction targets established by Liverpool City Council.

4.4 WATER QUALITY MODELLING RESULTS

The results of modelling the water quality treatment system are shown in Table 4-4.

Table 4-4: Pollutant Removal Rates – *MUSIC* Modelling Results

Pollutant	Removal target (%)	Pre-treatment load (kg/year)	Post-treatment load (kg/year)	Removal achieved (%)
Total suspended solids	85	4890	783	85
Total phosphorous	65	11.5	4.1	65
Total nitrogen	45	110	44.5	59.7

The results of the *MUSIC* modelling outlined in this report indicate that the treatment train has been designed in accordance with water quality objectives.

5 HYDRAULIC MODELLING

5.1 EXISTING STUDY

An existing flood model for the precinct has been undertaken by Cardno on behalf of Liverpool City Council in 2012. The existing Flood modelling undertaken by Cardno Flood modelling was undertaken as part of the precinct planning to ensure that the 1% AEP are confined within the waterway banks.

Figure 5.1 1% AEP (Cardno 2012)

At the start of the previous modelling the creek system adjacent to the proposed development starts dry without any existing water levels in the creek system. Therefore, any changes to the riparian system and overland flow paths will be caused by the proposed bulk earthworks.

5.2 EXISTING TERRAIN AND MODEL PARAMETERS

This study was undertaken using the existing terrain surface across the total model area from the prior Cardno flood study.

Additional survey of 75 Gurner Ave was undertaken and was utilised in the supplied model to ensure that the current existing site landform was modelled accurately and had been used as the basis for the design landform. No additional survey of the surrounding area has been undertaken as part of this modelling, nor has any additional existing culvert elements been added to the existing Cardno Model.

Site inflows were retained from the existing model, these involve the applying the inflows to all cells within the inflow polygons. Therefore, the development area these locations will not impact the inflow and the inflow polygons could be retained unchanged.

Material mapping and material roughness used within the TUFLOW model has been retained from the prior Cardno model.

As inflows have been distributed across all cells within the inflow polygons, this caused water to show in all areas, therefore the results have had flood depths below 150mm deep removed for clarity. Flow paths and ponding below 150mm in depth is considered to be shallow sheet flow off sites or contained within proposed curb and gutter systems.

5.3 DEVELOPED TERRAIN AND MODEL PARAMETERS

The development of the design surface was undertaken using the 12D 3d engineering package and was exported as a TIN in a .12da format file to be incorporated into the developed flood model.

Given the size of the site within the entire model extent, the sizes of the sub catchments, and that on-site detention is to be provided to reduce post development flows to existing rates. Any percentage change in impervious area would not cause a noticeable change in flows within the creek.

Site inflows were retained from the existing model, these involve the applying the inflows to all cells within the inflow polygons. Therefore, the development area these locations will not impact the inflow and the inflow polygons could be retained unchanged.

As inflows have been distributed across all cells within the inflow polygons, this caused water to show in all areas, therefore the results have had flood depths below 150mm deep removed for clarity. Flow paths and ponding below 150mm in depth is considered to be shallow sheet flow off sites or contained within proposed curb and gutter systems.

Material mapping on the proposed development area will not impact flow in the riparian corridors. Therefore, material mapping and material roughness used within the TUFLOW model has been retained from the prior Cardno model.

The proposed OSD basins are included in the developed TIN as exported from the 12d design. These have been included as bulk earthworks formations only, the basin outlet control, stage/ storage, and discharge rates have not been included. It is standard practice in flood modelling to consider that hydraulic structures such as the basin outlets have been conservatively assumed as fully blocked.

The proposed culvert running through the eastern development has been included as

5.4 EXISTING CASE RESULTS

In the Appendix are the figures for the existing case modelling for the site.

The mapping attached in the appendix show flood depths, 150mm nulling has been applied to the flood modelling results, though typically flooding below 150mm deep is considered as sheet flow or below gutter levels.

These results demonstrate that flows are contained within riparian corridors and corollate with the results presented within the prior Cardno Study.

5.5 DEVELOPED CASE RESULTS

In the Appendix are the figures for the developed case modelling for the site.

The mapping attached in the appendix show flood depths, 150mm nulling has been applied to the flood modelling results, though typically flooding below 150mm deep is considered as sheet flow or below gutter levels.

These results demonstrate that flows are contained within riparian corridors and adverse flood afflux are located within the developed precinct and dissipate rapidly.

The flood extents on the adjacent southern properties has not been increased as result of the proposed development on 75 Gurner Avenue. Flood water surface levels on these adjacent properties have been retained to within 10mm of the current existing level or improved, as shown in the afflux maps in the appendices.

6 CONCLUSION

Hydrological modelling has shown the need to implement stormwater management measures in the Gurner Avenue, Austral development to meet Liverpool Council requirements with respect to stormwater management. A stormwater management strategy has been designed to protect the receiving waters from both water quantity and quality impacts until the regional stormwater management infrastructure is operational in future.

The strategy addresses the requirements detailed in Section 2 – Relevant Policies and Guidelines. The strategy incorporates:

- Setting appropriate permissible site discharge rates at the discharge locations. These flow rates are taken as the peak pre-development flow rates.
- Attenuating the post-development flows to the permissible site discharge with stormwater detention components within temporary basins. Hydrological modelling of the stormwater management strategy indicates that the attenuated post-development peak flow rates do not exceed the permissible site discharge rates.
- Treating post-development stormwater runoff quality with water sensitive urban design features such as the bioretention basin. The *MUSIC* modelling indicates that the designed water quality treatment train has been designed in accordance with specifications by Liverpool City Council.

Modelling of the drainage network and overland flow paths demonstrate viability that the pipe and road drainage system can adequately convey storm events up to the 1% AEP. The proposed external catchments have been included as part of the overflow path and pipe drainage assessment. The detailed design will include further modelling and refinement of the drainage network.

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8 APPENDICIES

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LEGEND

Legend
ELEVATION (mAHD)
75
60

NOTES:
-

40 0 40 80 120 m
1:4,000 (A3)
N

PROJECT:
21-000381 GURNER AVE, AUSTRAL

CLIENT:
LANDCOM

DrawingTitle:
EXISTING DEM

DRAWINGNO: 01

ISSUE: 01

ISS	BY	CHK	DATE	DETAILS
01	DKH	-	18/11/22	ISSUED FOR DA

EPSG:28356

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calibre

LEGEND

Legend
ELEVATION (mAHD)
75
60

NOTES:

-

40 0 40 80 120 m

1:4,000 (A3)

N

PROJECT:
21-000381 GURNER AVE, AUSTRAL

CLIENT:
LANDCOM

DrawingTitle:
DEVELOPED DEM

DRAWINGNO: 02

ISSUE: **01**

ISS	BY	CHK	DATE	DETAILS
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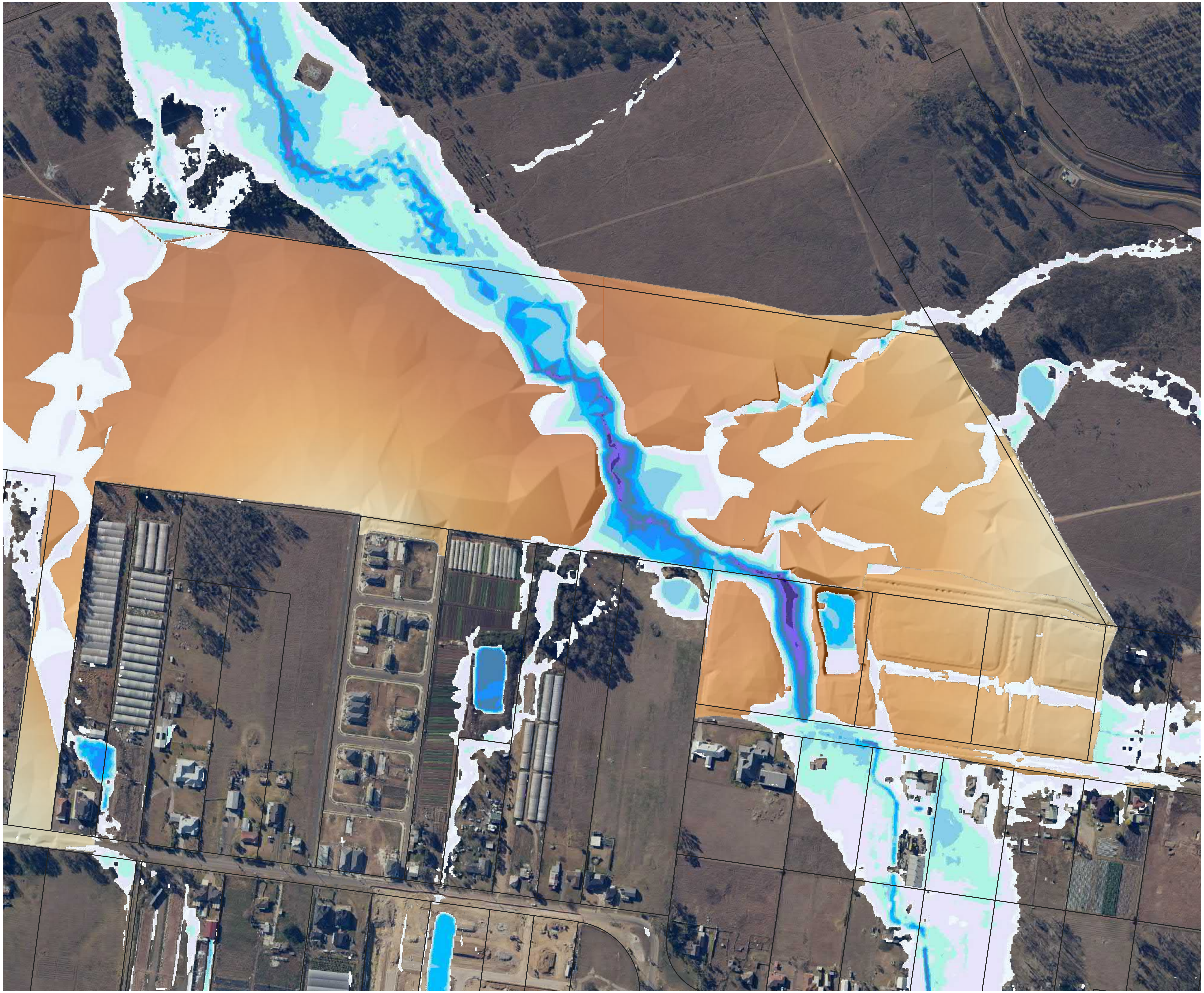

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calibre

LEGEND

Legend

ELEVATION (mAHD)

75
60

EXISTING DEPTH (m)

- 0.00 - 0.15 (nulled)
- 0.15 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 2.00
- 2.00 - 2.50
- 2.50 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- > 5.00

NOTES:

-

40 0 40 80 120 m

1:4,000 (A3)

N

PROJECT:
21-000381 GURNER AVE, AUSTRAL

CLIENT:
LANDCOM

DrawingTitle:
EXISTING FLOOD DEPTH

DRAWINGNO: 03

ISSUE: **01**

ISS	BY	CHK	DATE	DETAILS
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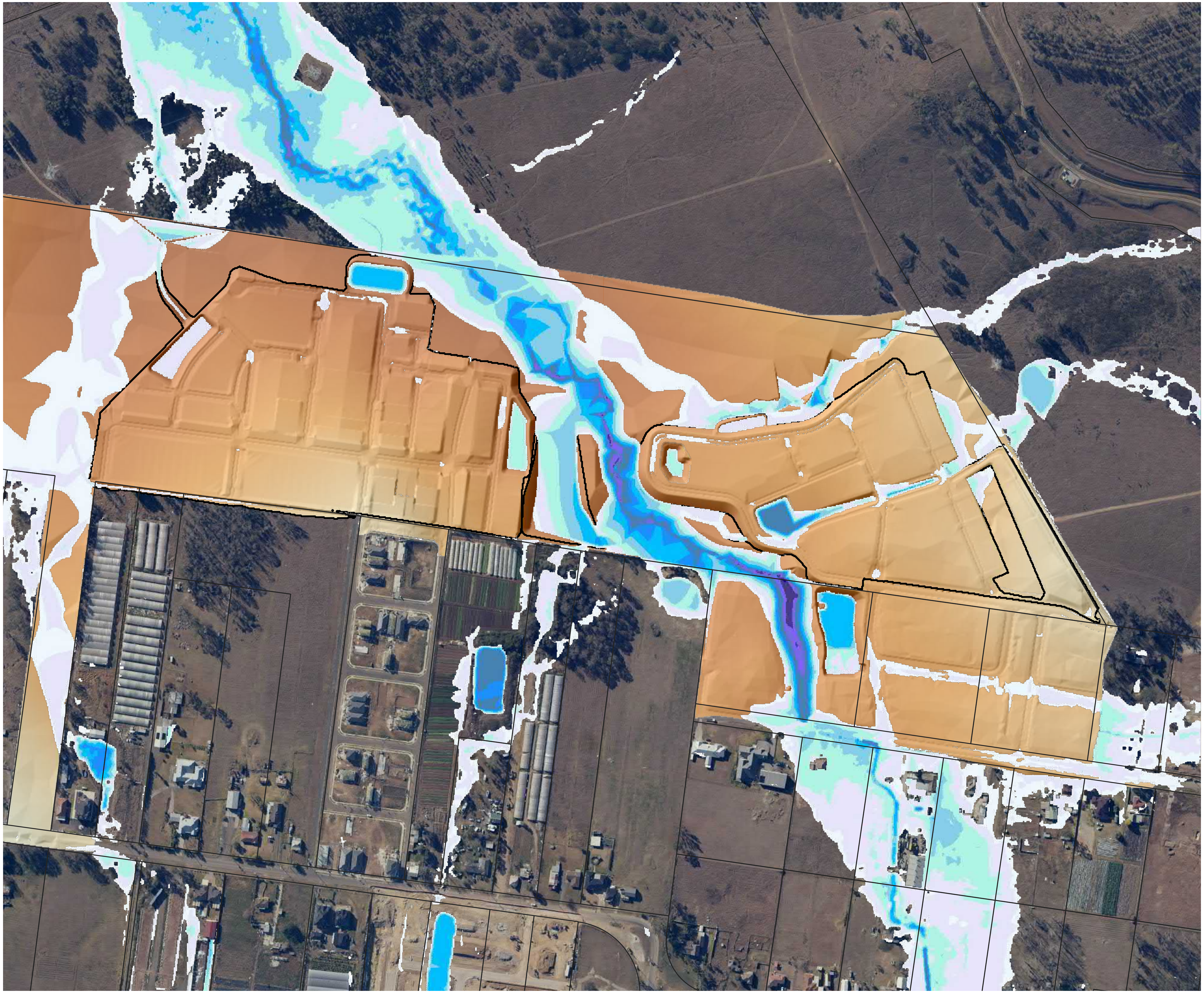

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LEGEND

Legend

ELEVATION (mAHD)

- 75
- 60

DEVELOPED DEPTH (m)

- 0.00 - 0.15 (nulled)
- 0.15 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 2.00
- 2.00 - 2.50
- 2.50 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- > 5.00

NOTES:

-

40 0 40 80 120 m

1:4,000 (A3)

N

PROJECT:
21-000381 GURNER AVE, AUSTRAL

CLIENT:
LANDCOM

DrawingTitle:
DEVELOPED FLOOD DEPTH

DRAWINGNO: 04

ISSUE: **01**

ISS	BY	CHK	DATE	DETAILS
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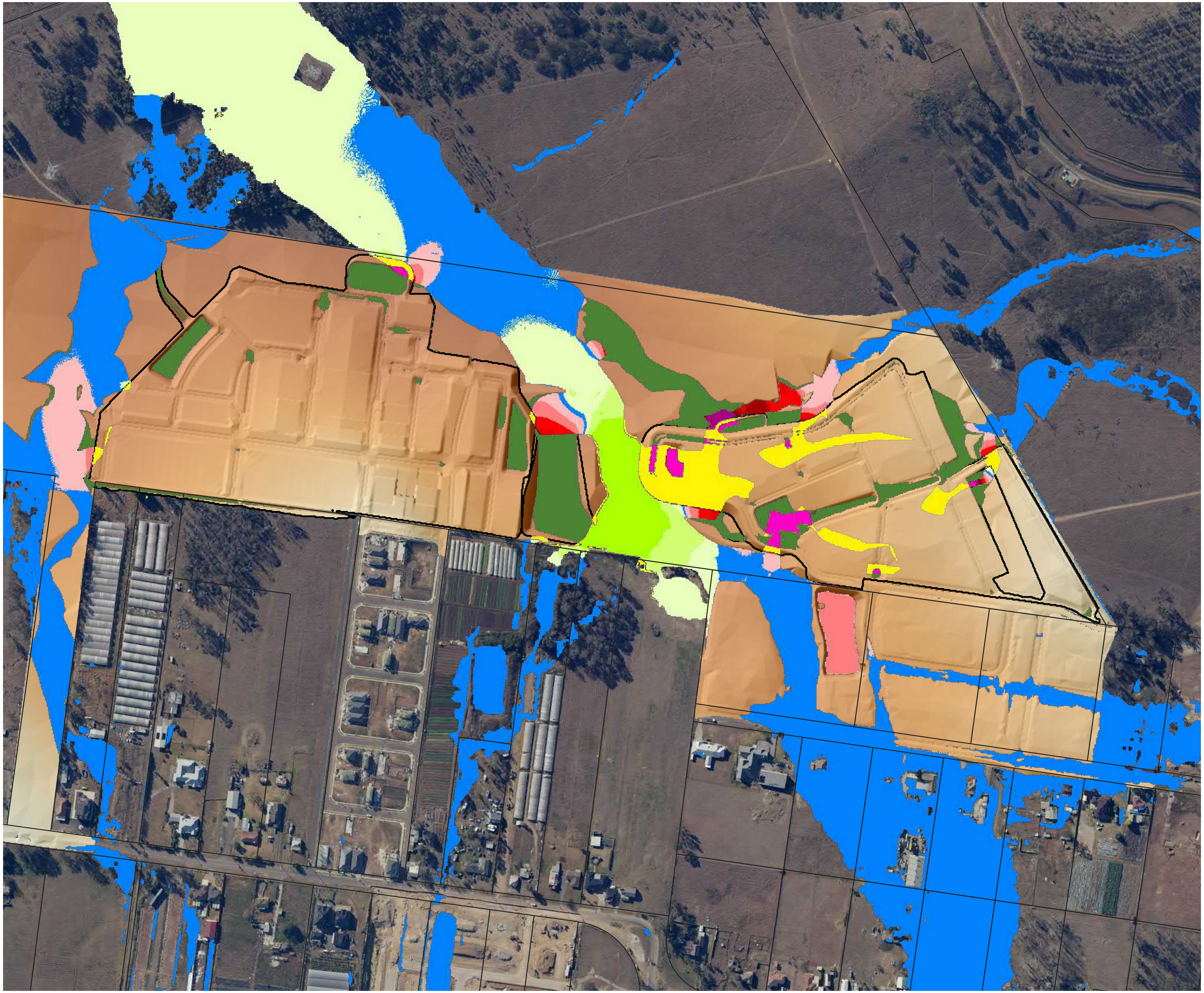

EPSG:28356

calibre

LEGEND

Legend

ELEVATION (mAHD)

- 75
- 60

DEVELOPED AFFLUX (m)

- < -0.1
- -0.1 - -0.05
- -0.05 - 0.01
- -0.01 - 0.00
- 0.00 - 0.01
- 0.01 - 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.25
- 0.25 - 0.3
- 0.3 - 0.4
- > 0.4

DEVELOPED FLOOD CHANGE

- Areas Now Flood Free
- Areas Now Flooded

40 0 40 80 120 m

1:4,000 (A3)

N

PROJECT:
21-000381 GURNER AVE, AUSTRAL

CLIENT:
LANDCOM

DrawingTitle:
DEVELOPED FLOOD AFFLUX

DRAWINGNO: 05

ISSUE: 01

ISS	BY	CHK	DATE	DETAILS
01	DKH	-	18/11/22	ISSUED FOR DA

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