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Tallawong Station Precinct South

Deicorp Projects (Tallawong Station) Pty Ltd

15-Dec-2020

Flood Impact Assessment

Tallawong Station Precinct South

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Client: Deicorp Projects (Tallawong Station) Pty Ltd

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1.0 Introduction

1.1 Background and Purpose

The Tallawong Precinct South development site comprises around 7.8 ha of government owned land within the Area 20 precinct in the North Western Growth Centre. Located between Cudgegong Road, Tallawong Road, Schofields Road and the Metro corridor, the development (Area 1 and Area 2) will deliver residential, commercial and retail services as well as of 987 units.

This report is prepared to address the Secretary's Environmental Assessment Requirements (SSD9063) for flooding, specifically to:

Provide a detailed flood impact assessment in accordance with the NSW Floodplain Development Manual (2005) and consistent with the finding of the flood assessment undertaken as part of the SSI-5415 Identify minimum floor levels for buildings and flood evacuation strategies where necessary.

A Civil and Stormwater Report (AECOM, 2020) has been prepared to support the rezoning of the site and preparations for development and should be read in conjunction with this report. The WCMS provides detail on the proposed drainage network through the development site and connections to the existing stormwater network.

2.0 Flood Model Development

2.1 Software

The adopted software for this model is TUFLOW.

TUFLOW simulates depth-averaged, one and two-dimensional free-surface flows over a regular grid of square elements.

TUFLOW is very flexible in that it can readily input information and output results in a variety of different formats (data files are easily transferable). This allows models to be readily updated with new information such as survey, stormwater infrastructure or building developments/demolitions to keep the model updated. It also makes it easy to adjust the model for future developments and undertake relative impact assessments for different scenarios.

Version 2017-09-AC (Single Precision) of TUFLOW was used for this project.

2.2 Rainfall Data and Losses

Rainfall hyetographs are presented in Figure 1. Initial and continuing loss values were adopted in line with Blacktown City Council's design criteria and are summarised in Table 1.

Pervious land uses were delineated according to observed land use in aerial imagery for the existing scenario with adjustments based on land zoning data for the developed scenario. Rainfall data from ARR1987 has been adopted and hyetographs are provided at the end of this report.

Table 1 Adopted rainfall losses

Surface type	Initial Loss (mm)	Continuing Loss (mm/hr)
Rural and riparian corridor	15.0	2.5
Roads and development lots	1.0	0.0
Urban parkland	5.0	2.5

To minimise the volume of runoff trapped within building footprints due to high roughness and uneven terrain, these footprints were excluded from the direct rainfall application polygon. To account for the

excluded areas, the rainfall depth for the rest of the direct rainfall application polygon has been proportionally increased in the localised areas where roof drainage is expected to discharge to.

2.3 Extent and Grid Size

A cell size of 1 m by 1 m was adopted for this study. The extent of the model is shown in Figure A1 and Figure A2.

2.4 Terrain

The terrain adopted in the TUFLOW model was created using a layered approach to add detail where required from the sources of terrain made available during the model development process. Land and Property Information (LPI) NSW LiDAR dataset flown on 13-14/05/2011 formed the basis for the overall model topography.

Client supplied design TINs from Northwest Rapid Transit (NRT) were used to define the Tallawong Station enabling works, precinct roads and earthworks.

The design TINs were also used to represent the proposed development site.

Several terrain modifications were made to represent current site conditions in the model. These included:

- Various road crests and kerbs were enforced in the terrain to ensure their potential hydraulic impact is capture;
- The centreline of selected gullies and other small channels were enforced in the model topography to ensure appropriate representation of overland flow paths along the southern boundary of Area 2;
- The interface between different TINs was smoothed where necessary to allow for unobstructed flow paths and more stable transitions; and
- Runoff from within the proposed station and rail line was precluded from entering Council's networks which is consistent with the NRT drainage approach.

2.5 1D Network

The pit and pipe network includes all existing and proposed pits in precinct roads, station enabling works and the development site. These details were taken from as-built surveys or design plans from RMS/NRT or from digital designs in 12d software.

Standard entry and exit loss values were assigned to the pipe network as shown in Table 2. A blockage of 50% was applied to the piped drainage for all scenarios.

Table 2 Adopted entry and exit losses

Variable	Circular Pipe
Entry loss	0.5
Exit loss	1
Width contraction coefficient	1

2.6 Surface Roughness and Building Representation

The area of assessment is dominated by roads, car parks, grassed areas and public open space. Downstream areas of the site include grassed areas and floodplain.

Hydraulic roughness in the 2D model domain is applied using GIS layers which define the extent of unique land uses. In the 1D model domain the adopted roughness value is applied to each pipe as one of its attributes. The Manning's "n" values adopted for the study area, including flow paths

(overland, pipe and in-channel) are shown in Table 3. The spatially-varying roughness values for the model are shown in Figure A1 and Figure A2.

Note that the modelling approach has been to block out the proposed building footprints to ensure that no flood storage is modelled within buildings which are intended to remain flood free.

Table 3 Adopted hydraulic roughness coefficients

Surface type	Adopted roughness value
Concrete pipes	0.015
Road and car parks	0.02
Grassed, landscaped areas	0.03
Public open space parkland	0.045
Floodplain vegetation	0.065 – 0.10
Trees and shrubs	0.06
Commercial	0.025
Fenced properties	0.1

2.7 Boundary Conditions

Tail water levels in Second Ponds Creek were modelled as a static water level adopted from modelling carried out as part of the station enabling works assessment. These were taken from NRT flood maps prepared during the enabling works design and the Rouse Hill Flood Study.

Peak water levels shown in Table 4 were adopted for the following flood events under both existing and climate change scenarios.

Table 4 Adopted tailwater levels

Event	Adopted tailwater level (m AHD)
1 EY	46.1
0.5 EY	46.3
20% AEP	46.4
10% AEP	46.4
5% AEP	46.6
2% AEP	46.7
1% AEP	46.8
PMF	48.4

Modelling shows that the development is not sensitive to these levels, and adopting a static water level provides a reasonable boundary.

2.8 Design Flood Estimation

To determine the critical storm duration across the entire site, modelling of the full range of flood events was undertaken for design storm durations ranging from 15 minutes to 360 minutes.

The critical durations for each flood event are summarized in Table 5. Being a small catchment, different durations yield very similar maximum flood levels.

Table 5 Critical duration

Event	Critical Duration (min)
1 EY	120
0.5 EY	120
20% AEP	90
10% AEP	90
5% AEP	90
2% AEP	90
1% AEP	90
PMF	15

2.9 Scenarios

Flood Planning Levels

For the purposes of defining flood planning levels, the post development catchment condition includes the development of the Town Centre North, which has the potential to contribute runoff to Area 1 and Area 2 in large storm events.

Flood planning levels are provided for the PMF event and for the 1% annual exceedance probability (AEP) event with 15% increase in rainfall intensity and 50% blockage of all stormwater pipes.

Flood Impact

For the purposes of carrying out flood impacts, the existing development catchment condition includes the Tallawong Station enabling works, Conferta Avenue and Themeda Avenue and upgraded Cudgegong Road and Tallawong Roads.

The post development catchment condition excludes the development of the Town Centre North, which has the potential to contribute runoff to Area 1.

Flood impacts are determined for the critical 1% AEP event assuming ARR1987 rainfall and 50% blockage of all stormwater pipes.

3.0 Flood Model Results and Mapping

3.1 Validation of Rainfall on Grid Results

A stand-alone hydrologic model (DRAINS) has been developed to validate the runoff generation in the TUFLOW model.

The DRAINS model predicts a peak flow rate of 4.7 m^3/s east of Cudgegong Road under developed conditions

The TUFLOW model, which includes more rigorous hydraulic calculations and storage properties, predicts a peak flow rate of 4.6 m^3/s across Cudgegong Road.

Given the differences in model structure, a difference of 5% is good agreeance between models. Therefore the TUFLOW model is considered suitable for flood assessment purposes and for setting habitable floor levels.

3.2 Existing Flood Conditions

The existing flood depths for the range of flood events from the 20% to 1%AEPs and the PMF are shown in Figures B1 to B7.

For all flood events up to the 1%AEP flow from the northern portion of the development site (north of Conferta Avenue) is contained within the swale located within the development site boundary and discharges via a headwall in the south eastern corner of the site. External flows are largely contained within the road reserves surrounding the development, and no other external flow enters the northern site in storm events up to the 1%AEP.

The southern portion of the site, between Conferta Avenue and Schofields Road, has two main flow paths under existing conditions. Some external flow that is not captured by the drainage network enters from the car park to the west of the site. Flows are conveyed to the south eastern corner of the site where flow that isn't captured by the grated inlet pit is conveyed onto Cudgegong Road and Schofields Road.

Flood depths within the site boundary are generally below 0.15m at the 1%AEP. However, there are some locations which show flood depths are over 0.2m for the 1% AEP, these locations are:

- At the intersection of Aristida St and Conferta Avenue: maximum depth is 0.22m;
- Conferta Avenue: maximum depth is 0.36m; and
- At the intersection of Conferta Avenue and Cudgegong Road: maximum depth is 0.25m.

It is also noted that ponding occurs at the intersection of Cudgegong Road and Schofields Road with depths up to 0.42m for the 1%AEP.

Flow depths of under 0.10m can be seen throughout the site in the full range of flood events, with flow being conveyed to the south eastern corners of the northern and southern sites in all events as discussed above.

The flow is largely conveyed from the development site and surrounding carparks and roads to Cudgegong Road where it travels south and ponds at the Cudgegong Road and Schofields Road intersection. Table 6 shows a summary of maximum flood depths for the full range of flood events at three points along Cudgegong Road to the east of the development site.

Table 6 Summary of Maximum Flood Depths

Location	Maximum flood depth (m)				
	1%AEP	2%AEP	5%AEP	10%AEP	20%AEP
Themeda Avenue and Cudgegong Road	0.16	0.15	0.14	0.12	0.11
Conferta Avenue and Cudgegong Road	0.25	0.23	0.22	0.20	0.19

Location	Maximum flood depth (m)				
	1%AEP	2%AEP	5%AEP	10%AEP	20%AEP
Schofields Road and Cudgegong Road	0.42	0.40	0.39	0.37	0.35

3.3 Developed Case Flood Condition

The developed case flood planning levels for the site were determined under the following conditions:

- 50% blockage of stormwater pipes;
- Buildings blocked-out of the floodplain;
- Car parking in western areas of the site;
- Developed catchment conditions north of the station;
- No runoff from the station entering Council's stormwater network;
- Urban losses for parkland;
- 15% increase in 1% AEP rainfall depths to allow for future climate change, per council requirements; and
- Proposed drainage swale and overland flow path along the southern boundary of Site 2.

Flood depth and flood planning level from the 20%AEP to the 1%AEP events and PMF are shown in Figures C1 to C7.

Flood depth within the site in the developed scenario show generally less than 0.10m in the 1%AEP event. The following two locations in the site show larger flood depths in the 1% AEP event:

- Near the intersection of Cudgegong Road and Themeda Avenue in the northern site: maximum depth is 0.35m; and
- South of Conferta Avenue and east of the proposed road in the southern site: maximum depth is 0.62m.

These areas of ponding could be managed through local drainage measures at detailed design stage.

3.4 Flood Impacts

The flood impacts for the post development site were determined. Both pre and post development conditions assume 50% blockage condition of all pipes and no development north of the station and rail line, which has the potential to contribute some flows south of the rail line and along Cudgegong Road.

Figure D1 to D7 show the changes in maximum flood level between the developed case and the existing case for the 20% to 1% AEPs and PMF events. The 1% AEP flood impacts on lands external to the development site are confined to Council roads, current drainage lands (zoned SP2) and on the car park area west of Area 2 as shown in Figure D1 to D7. A discussion of these impacts is provided below.

Area 1 – Car Park 2

Under existing conditions, overland flow from Car Park 2 is shown to discharge into the south western corner of the proposed development. This results in sheet flow across the development site. Under post-development conditions, the proposed development will divert this overland flow south to the proposed drainage swale along Schofields Road. At the 1%AEP this will result in 0.25m of flood depth at the edge of the car park and low hydraulic hazard conditions on the NRT metro lands. This impact does not pose a safety risk to cars or pedestrians or private property.

In the future, and as a requirement of the re-development of the car park, stormwater drainage will be provided to prevent discharge onto the development site. This impact does not affect the future development potential of the car park site.

Area 2 – Conferta Avenue and Cudgegong Road

Under existing conditions, overland flow enters Conferta Avenue in a controlled manner via swales and sediment basins.

Under post-development conditions, the volume and flow rate of overland flow entering Conferta Avenue will increase but will be controlled via trunk drainage lines. At the 1% AEP this results in a minor increase in flow depths (up to 0.1m), giving a maximum water depth of 0.25m within the gutter and low hydraulic hazard conditions along Conferta Avenue.

On these grounds, the impact is considered to be acceptable.

Area 3 – Conferta Avenue and Cudgegong Road Intersection

The modelled 50% blockage scenario shows that additional discharge to Conferta Avenue may cause localised high hydraulic hazard conditions in the very invert of the southern kerb return. This flooding is isolated and surrounded by areas of low hazard which mitigates the risk of cars potentially being washed into buildings or waterways. This also demonstrates that the majority of the street would be trafficable in a 1% AEP event, even with 50% blockage of local pipes.

Given that this is a conservative scenario, the impact is considered to be acceptable.

Area 4 – Schofields Road

Under existing conditions, overland flow from Schofields Road will enter the development site across the southern boundary.

The proposed development will include a swale to prevent overland flow entering the site and is shown to result in a 0.03m increase in flow depth within the Schofields Rd kerb. Flow depths in Schofields Road (under a 50% blockage condition) are less than 0.25m and have a low flood hazard.

On these grounds, the impact is considered to be acceptable.

Area 5 – Council Owned SP2 Lands and Rouse Hill Switching Station

The proposed development will discharge more runoff to the drainage easement east of Cudgegong Road, resulting in slightly elevated flood levels (0.03m increase) when compared to existing conditions for the 1% AEP event. This is associated with a low hydraulic hazard and it is contained within SP2 drainage lands which are designated for a flood and drainage management purpose.

The Rouse Hill Switching Station shows no flood level impacts for the flood events up to the 1%AEP+15% climate change event. An increase of 0.12m can be seen in the SP2 lands near the Switching Station during the PMF event (Figure D7). It is notable that this impact is outside of the building footprint, and no detailed site survey, floor levels or fences were included in the modelling of the Switching Station.

In general, for the flood events up to the 1%AEP+15% climate change event, there is no worsening of the existing flood impacts on the nearby properties except the localised increased flood level on the eastern side of Cudgegong Road that it is contained within the SP2 Lands.

3.5 Flood Evacuation

The proposed development site sits outside the mainstream flood extents of Second Ponds Creek and there is no associated flood hazard to residents in either 1% or PMF events. Localised flooding will create relatively shallow flooding around proposed buildings in both 1% AEP and PMF events.

PMF flood levels around buildings is shown to be within 0.5m of the 1% AEP peak flood level with allowance for 1% AEP climate change. This means that the habitable floor level should also be above the PMF level and evacuation will not be required. Residents can safely shelter in place. It should be

noted that evacuation via Cudgegong Road and Conferta Avenue will be unsafe for passenger vehicles during PMF conditions. As such habitable floor levels 0.45m above the proposed raised ground level are acceptable flood protection for the buildings in the south of the site. As the northern block (Site 1) is not impacted by flooding, floor levels at grade with the proposed ground level are appropriate.

3.6 Flood Hazard

The flood hazards based on preliminary hazard as defined in Figure L2 of the Floodplain Development Manual (2005) for the full range of flood events were modelled across the existing roads and proposed development under 50% blockage criteria for the stormwater drainage network.

With the exception of the intersection of Conferta Avenue and Cudgegong Road, 1% AEP flood hazards are shown to be low.

Flood depths at the intersection of Conferta Avenue and Cudgegong Road imply unsafe conditions are limited to the very low point of the kerb, but these conditions do not extend across the entire road corridor. Flood hazard maps are provided for the full range of flood events in Figures E1 to E7.

4.0 References

AECOM 2020, *Integrated Water Cycle Management Strategy*

Department of Infrastructure, *Planning and Natural Resources 2005, Floodplain Development Manual, the management of flood liable land*

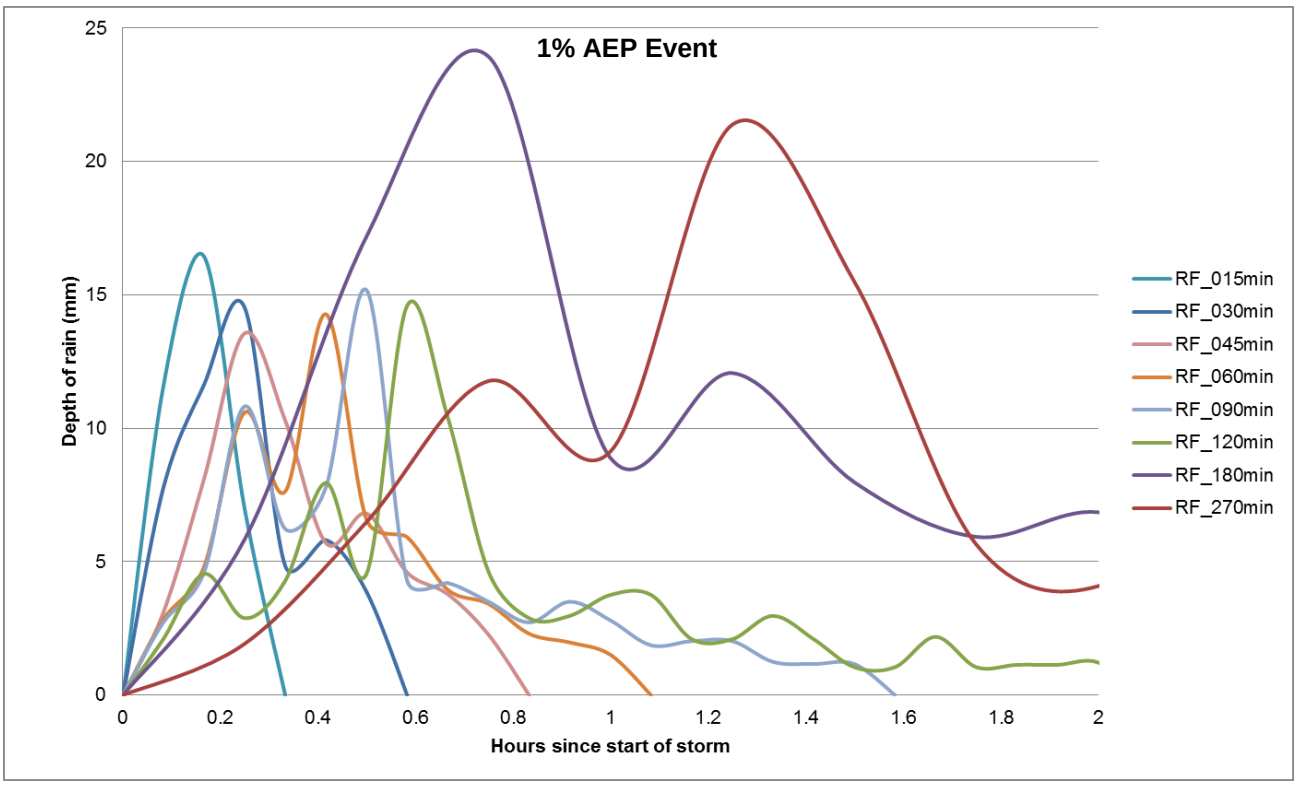

Figure 1 1% AEP hyetographs (ARR1987)

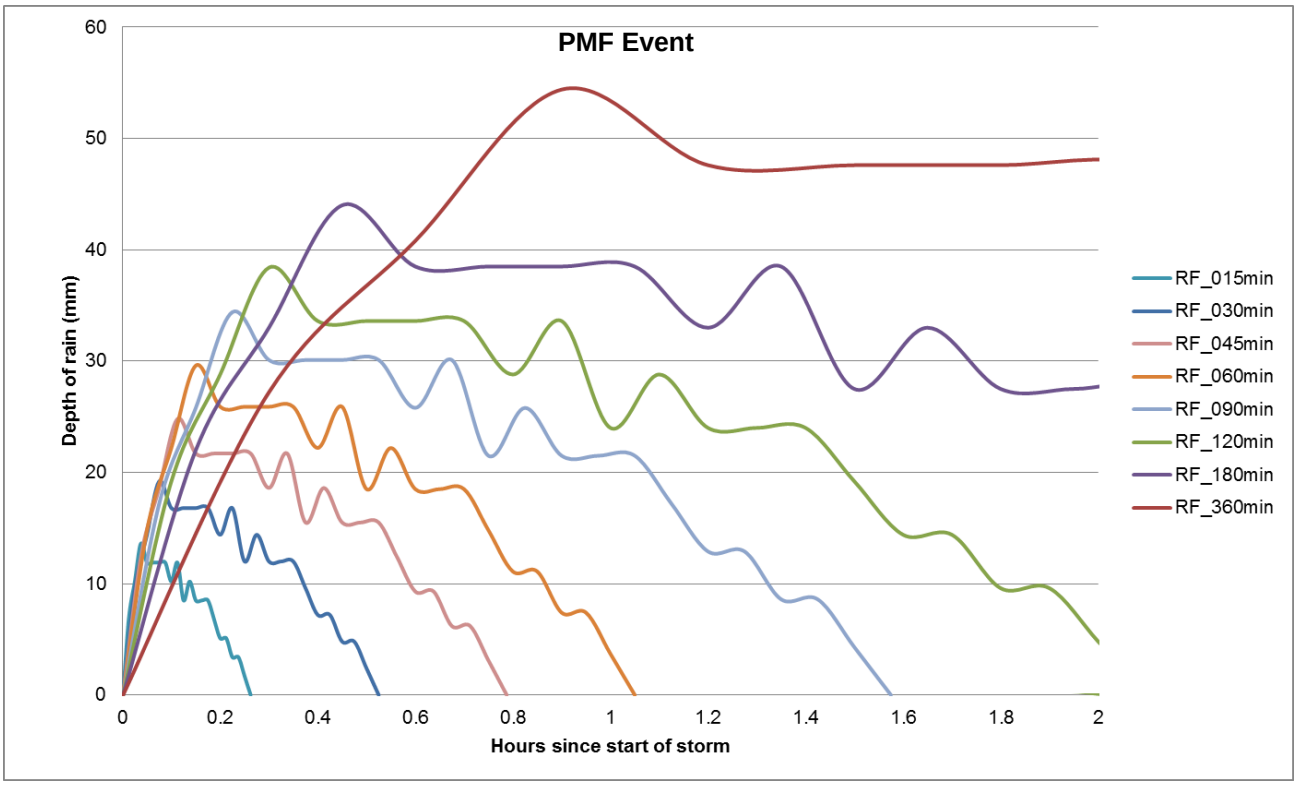

Figure 2 PMF hyetographs (ARR987)

Appendix A

Figures

Appendix A Figures

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B4	Flood results existing case – 2% AEP
B5	Flood results existing case – 1% AEP
B6	Flood results existing case – 1% AEP + 15%
B7	Flood results existing case – PMF
C1	Flood results developed case – 20% AEP
C2	Flood results developed case – 10% AEP
C3	Flood results developed case – 5% AEP
C4	Flood results developed case – 2% AEP
C5	Flood results developed case – 1% AEP
C6	Flood results developed case – 1% AEP + 15%
C7	Flood results developed case – PMF
D1	Flood level difference – 20% AEP
D2	Flood level difference – 10% AEP
D3	Flood level difference – 5% AEP
D4	Flood level difference – 2% AEP
D5	Flood level difference – 1% AEP
D6	Flood level difference – 1% AEP + 15%
D7	Flood level difference – PMF
E1	Flood hazards developed case – 20% AEP
E2	Flood hazards developed case – 10% AEP
E3	Flood hazards developed case – 5% AEP
E4	Flood hazards developed case – 2% AEP
E5	Flood hazards developed case – 1% AEP
E6	Flood hazards developed case – 1% AEP + 15%
E7	Flood hazards developed case – PMF

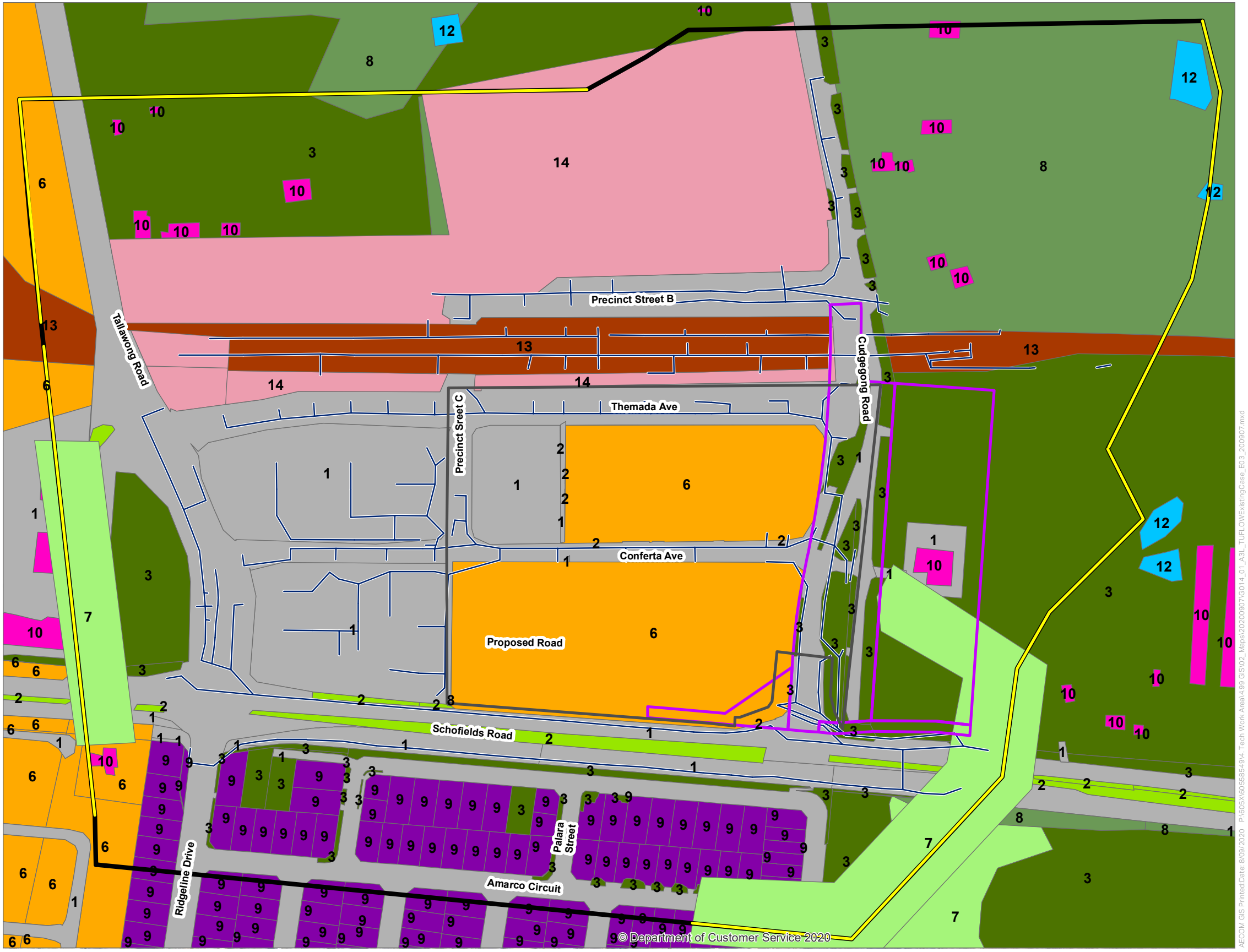

FIGURE A1 TUFLOW MODEL EXISTING CASE

KEY

- TUFLOW Model Extent
- TUFLOW Boundary
- Site Boundary
- SP2 zoned land
- Existing stormwater pipe
- 1 Asphalt
- 2 Well Maintained Grass Cover
- 3 Non Maintained Grass Cover
- 4 Trees
- 5 Wetland Area
- 6 Sand
- 7 Medium Density Vegetation
- 8 Mildly Dense Vegetation
- 9 Fenced Properties
- 10 Buildings
- 11 River Bed
- 12 Water
- 13 Rails
- 14 Commercial

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0 25 50 m

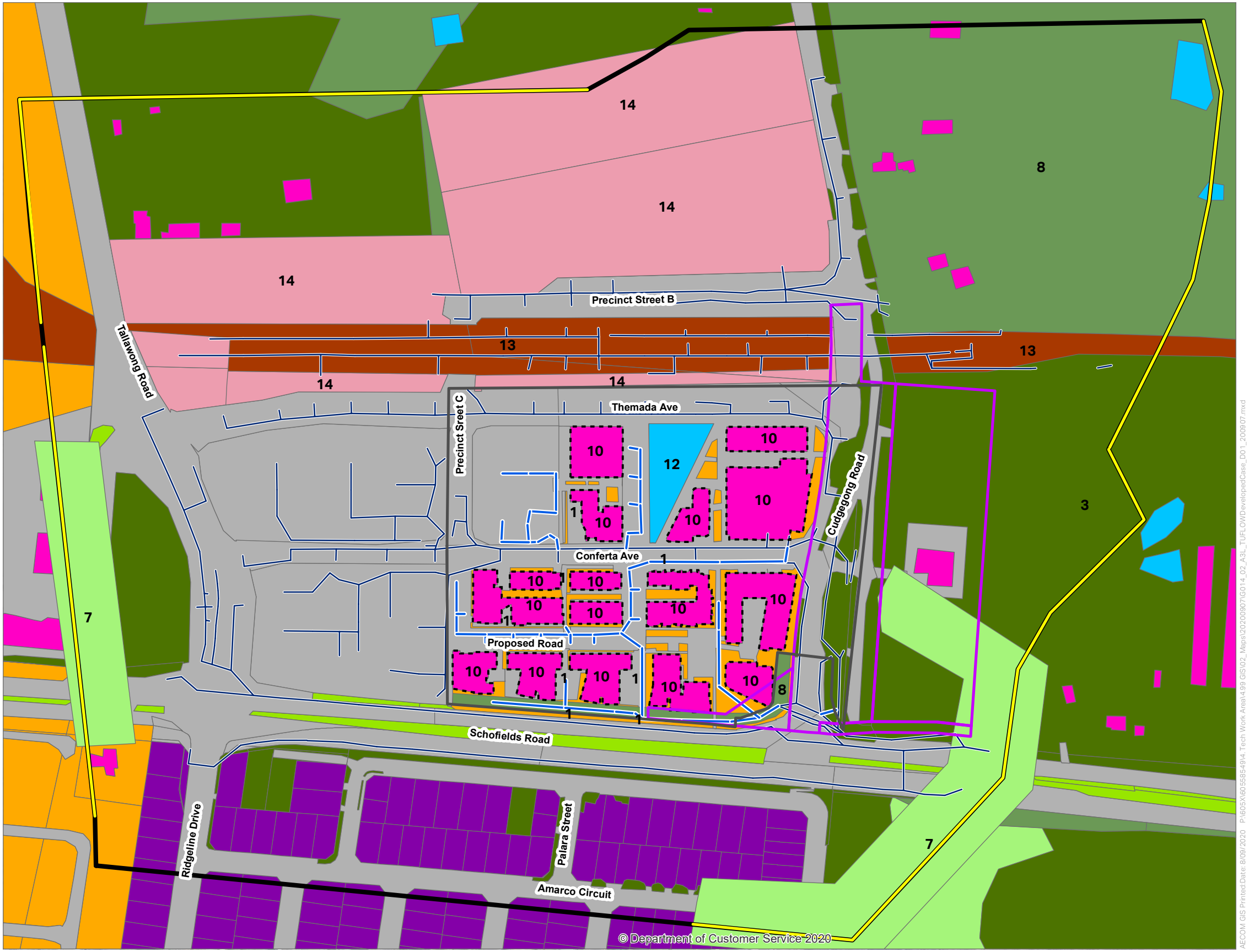

FIGURE A2 TUFLOW MODEL DEVELOPED CASE

KEY

- TUFLOW Model Extent
- TUFLOW Boundary
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe
- 1 Asphalt
- 2 Well Maintained Grass Cover
- 3 Non Maintained Grass Cover
- 4 Trees
- 5 Wetland Area
- 6 Sand
- 7 Medium Density Vegetation
- 8 Mildly Dense Vegetation
- 9 Fenced Properties
- 10 Buildings
- 11 River Bed
- 12 Water
- 13 Rails
- 14 Commercial

AECOM

0 25 50 m

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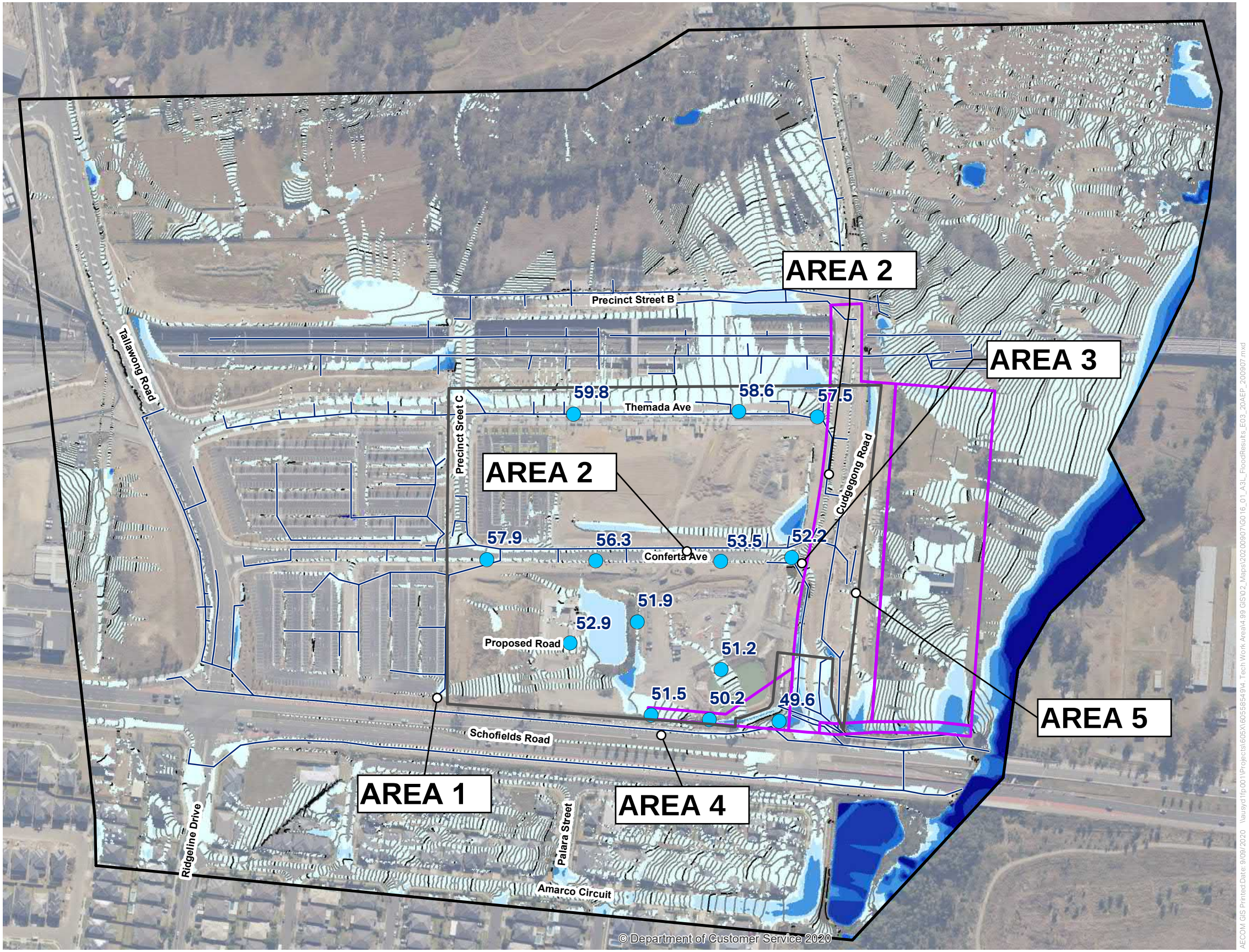

FIGURE B1 FLOOD RESULTS EXISTING CASE - 20% AEP

KEY

- TUFLOW Model Extent
- Flood Level 1m Contour
- Spot Height
- Site Boundary
- SP2 zoned land
- Existing stormwater pipe

Depth (m)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

AECOM

0 25 50 m

imagery © nearmap (2017)

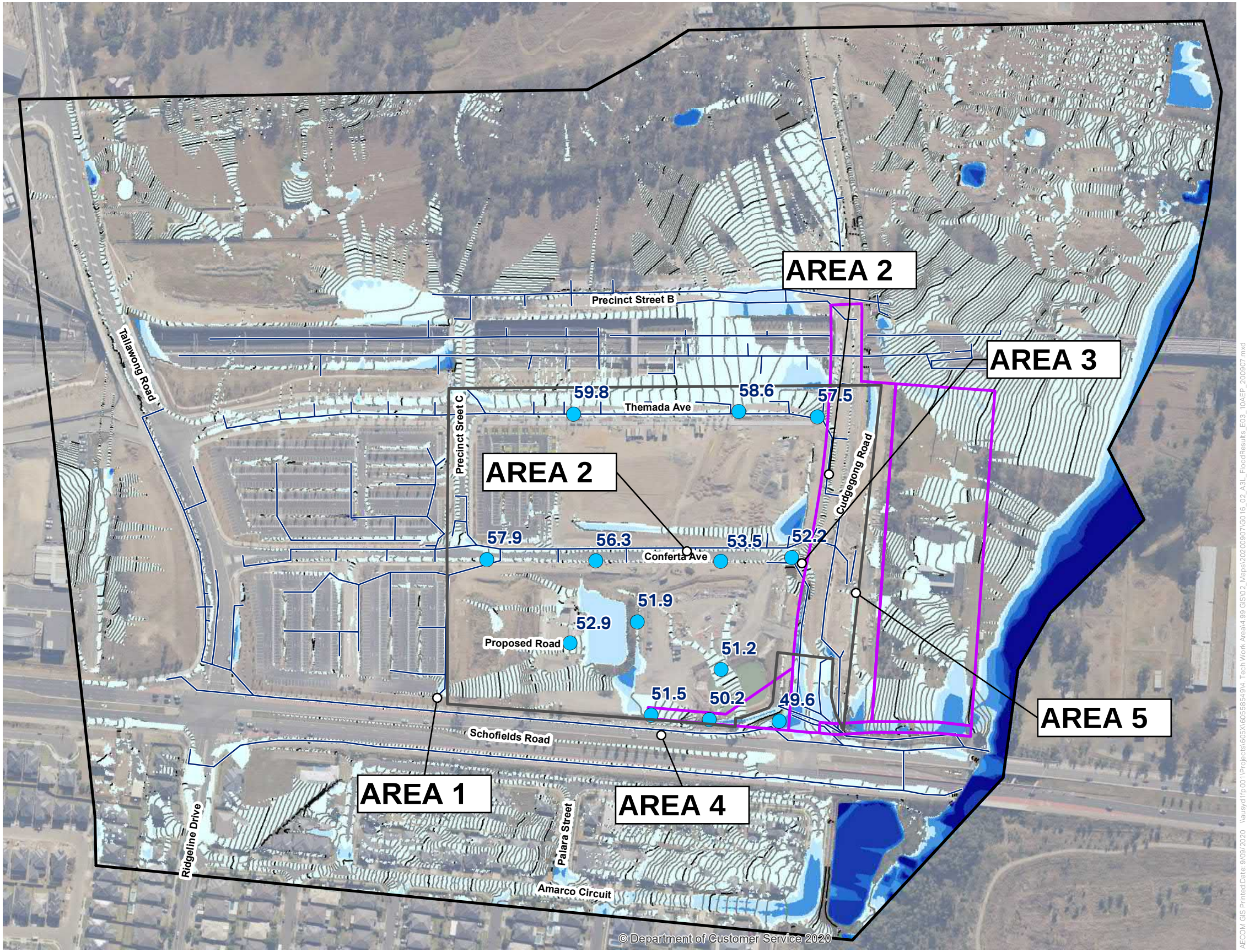

FIGURE B2 FLOOD RESULTS EXISTING CASE - 10% AEP

KEY

- TUFLOW Model Extent
- Flood Level 1m Contour
- Spot Height
- Site Boundary
- SP2 zoned land
- Existing stormwater pipe

Depth (m)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

AECOM

0 25 50 m

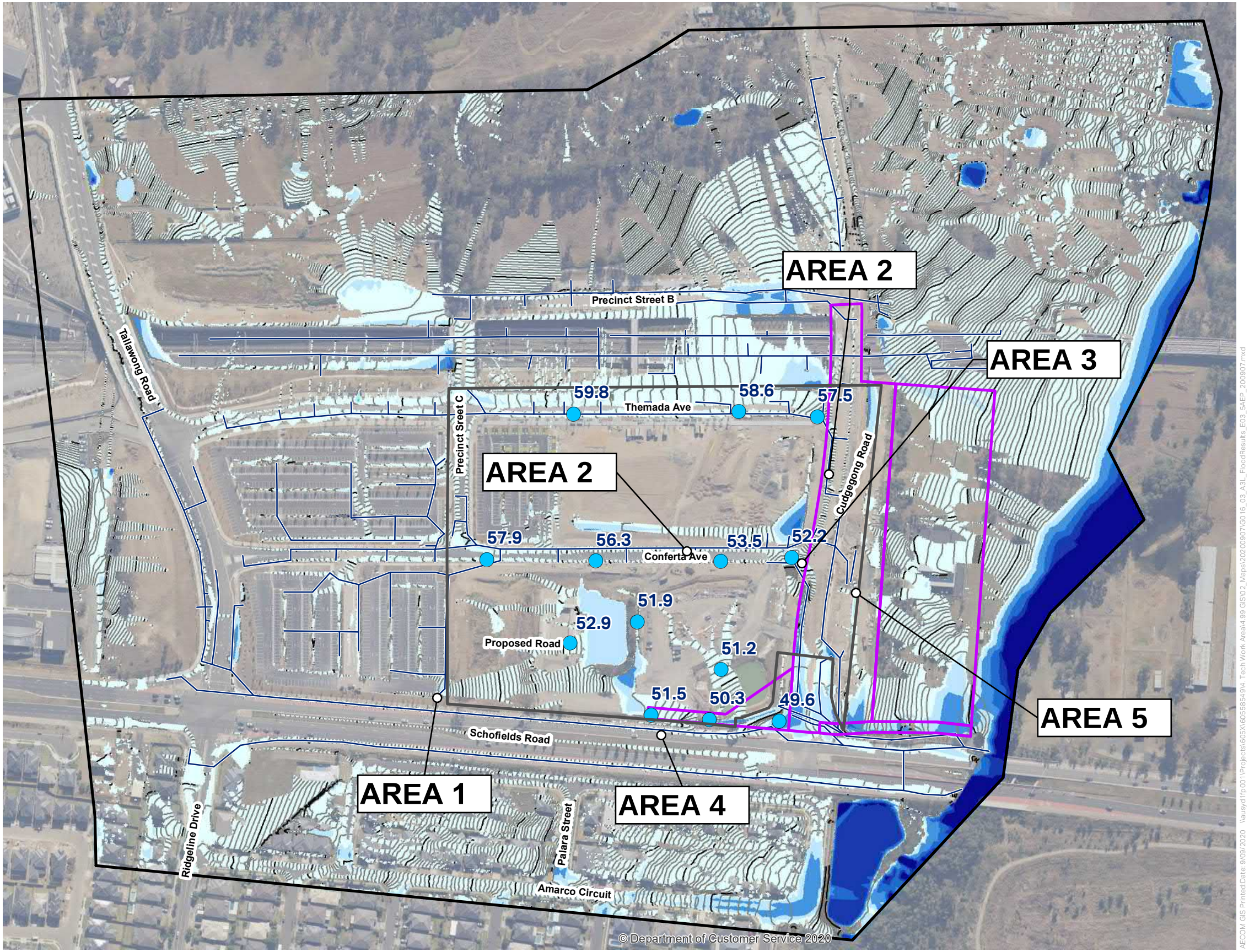

FIGURE B3 FLOOD RESULTS EXISTING CASE - 5% AEP

KEY

- TUFLOW Model Extent
- Flood Level 1m Contour
- Spot Height
- Site Boundary
- SP2 zoned land
- Existing stormwater pipe

Depth (m)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

AECOM

0 25 50 m

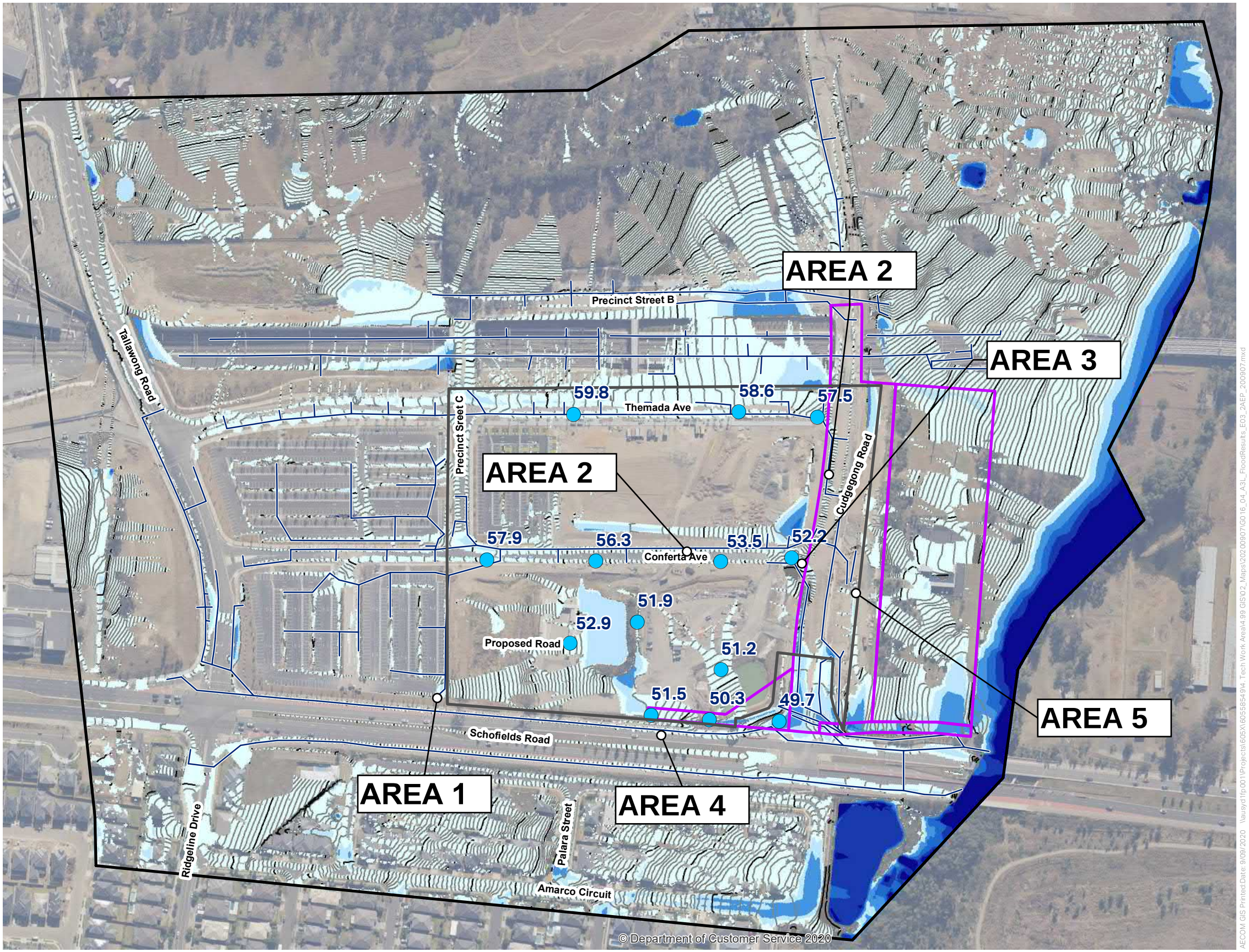

FIGURE B4 FLOOD RESULTS EXISTING CASE - 2% AEP

KEY

- TUFLOW Model Extent
- Flood Level 1m Contour
- Spot Height
- Site Boundary
- SP2 zoned land
- Existing stormwater pipe

Depth (m)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

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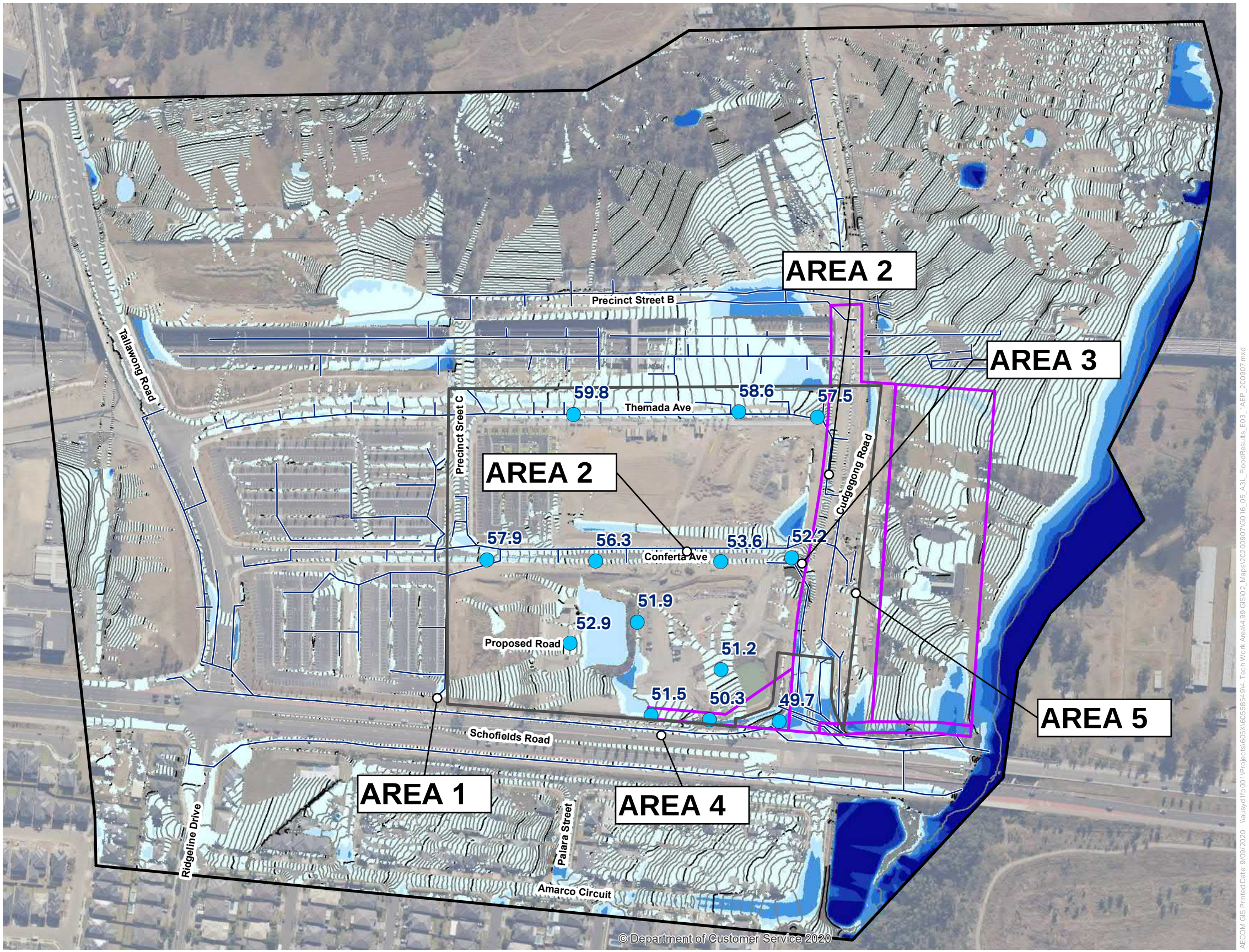

FIGURE B5 FLOOD RESULTS EXISTING CASE - 1% AEP

KEY

- TUFLOW Model Extent
- Flood Level 1m Contour
- Spot Height
- Site Boundary
- SP2 zoned land
- Existing stormwater pipe

Depth (m)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

AECOM

0 25 50 m

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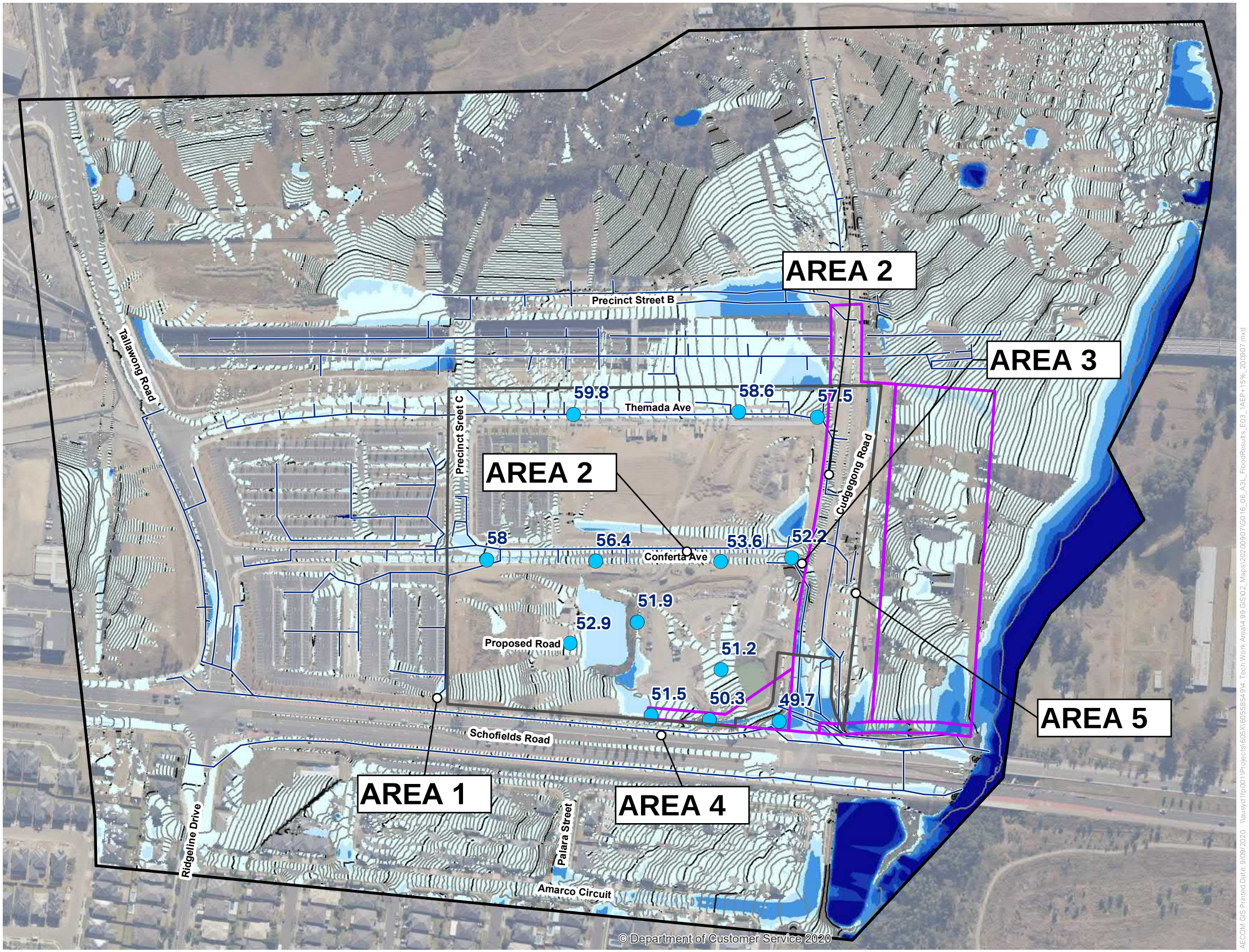

FIGURE B6 FLOOD RESULTS EXISTING CASE - 1% AEP + 15%

KEY

- TUFLOW Model Extent
- Flood Level 1m Contour
- Spot Height
- Site Boundary
- SP2 zoned land
- Existing stormwater pipe

Depth (m)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

AECOM

0 25 50 m

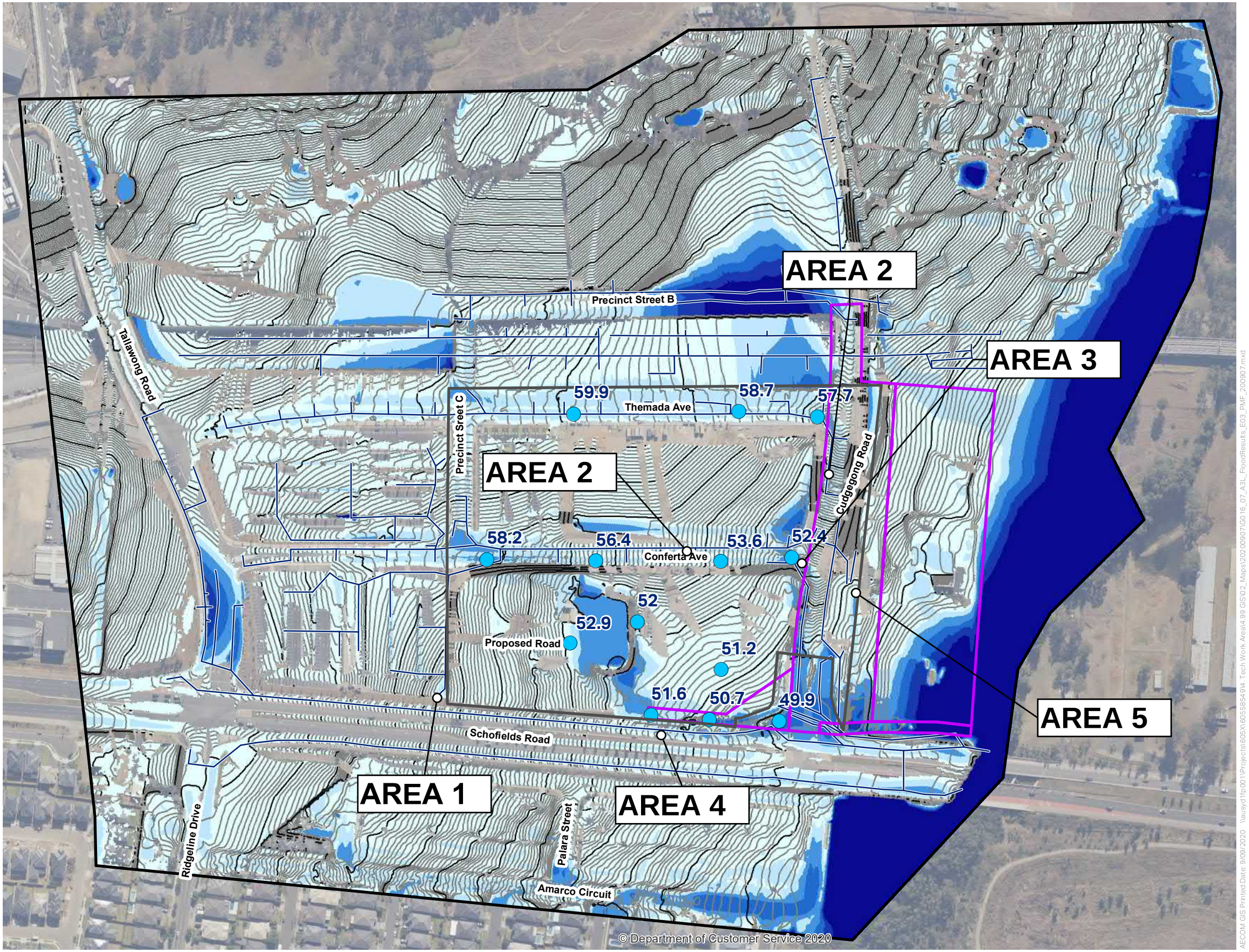

FIGURE B7 FLOOD RESULTS EXISTING CASE - PMF

KEY

- TUFLOW Model Extent
- Flood Level 1m Contour
- Spot Height
- Site Boundary
- SP2 zoned land
- Existing stormwater pipe

Depth (m)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

AECOM

0 25 50 m

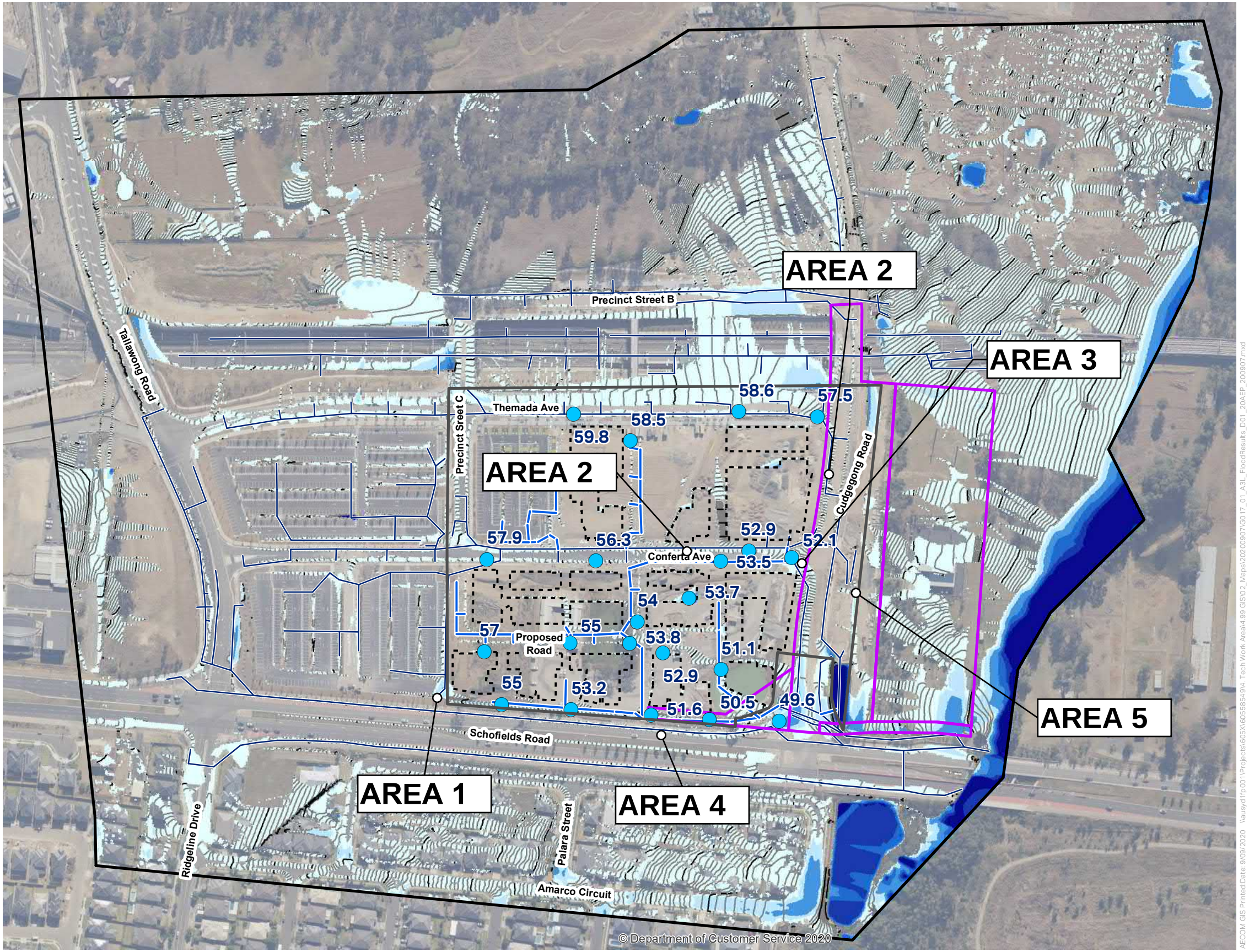

FIGURE C1 FLOOD RESULTS DEVELOPED CASE - 20% AEP

KEY

- TUFLOW Model Extent
- Flood Level 1m Contour
- Spot Height
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Depth (m)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

AECOM

0 25 50 m

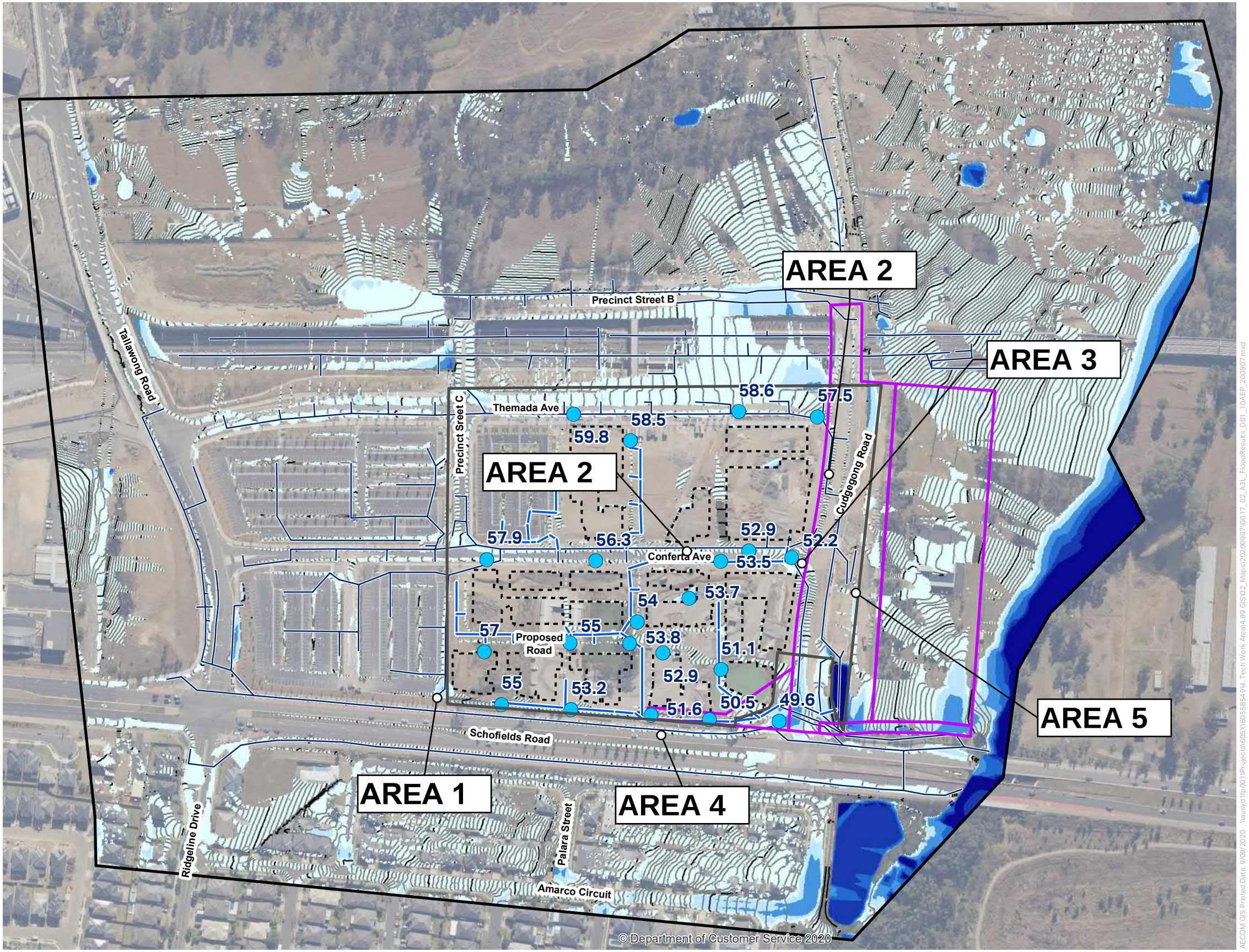

FIGURE C2 FLOOD RESULTS DEVELOPED CASE - 10% AEP

KEY

- TUFLOW Model Extent
- Flood Level 1m Contour
- Spot Height
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Depth (m)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

AECOM

0 25 50 m

imagery © nearmap (2017)

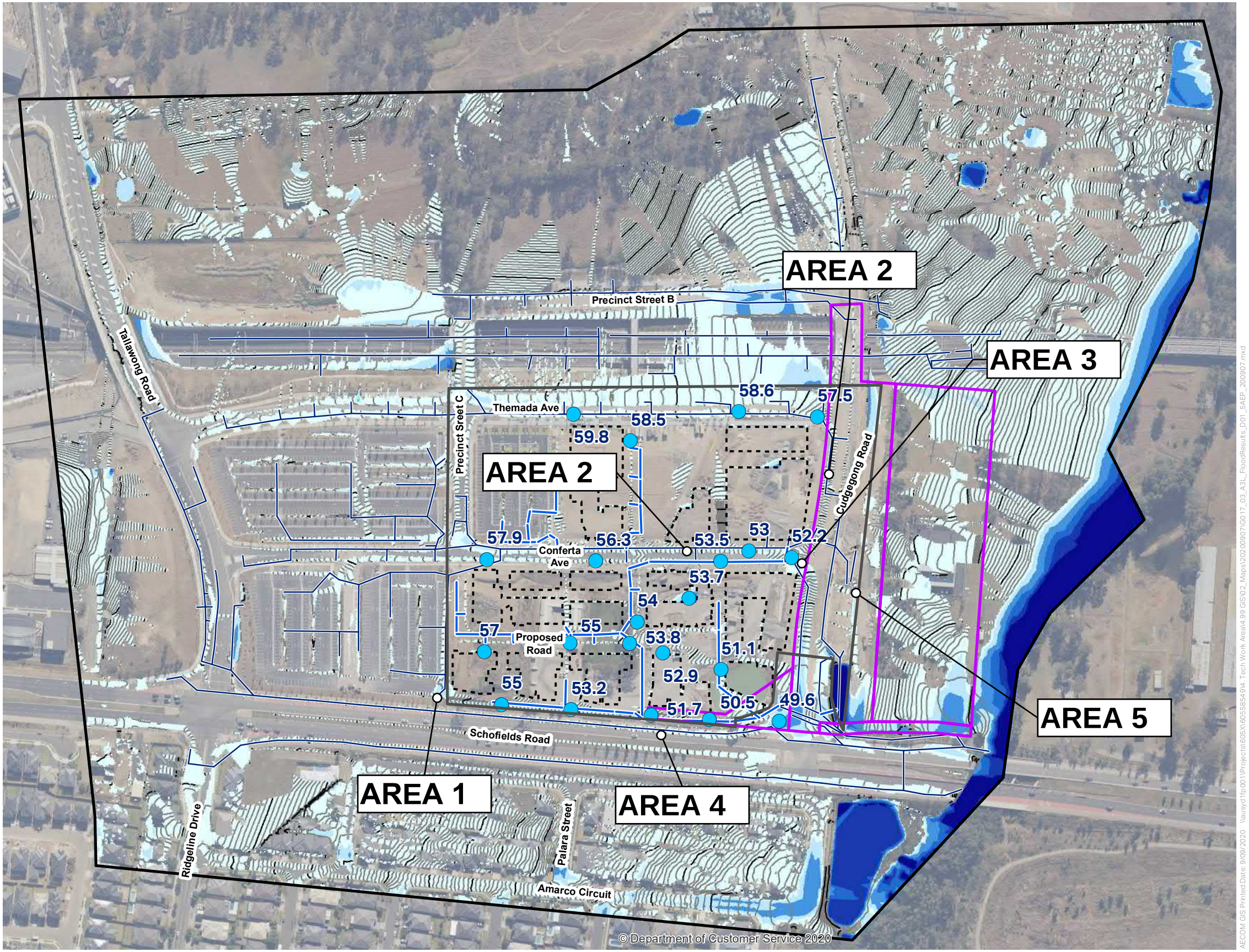

FIGURE C3 FLOOD RESULTS DEVELOPED CASE - 5% AEP

KEY

- TUFLOW Model Extent
- Flood Level 1m Contour
- Spot Height
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Depth (m)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

AECOM

0 25 50 m

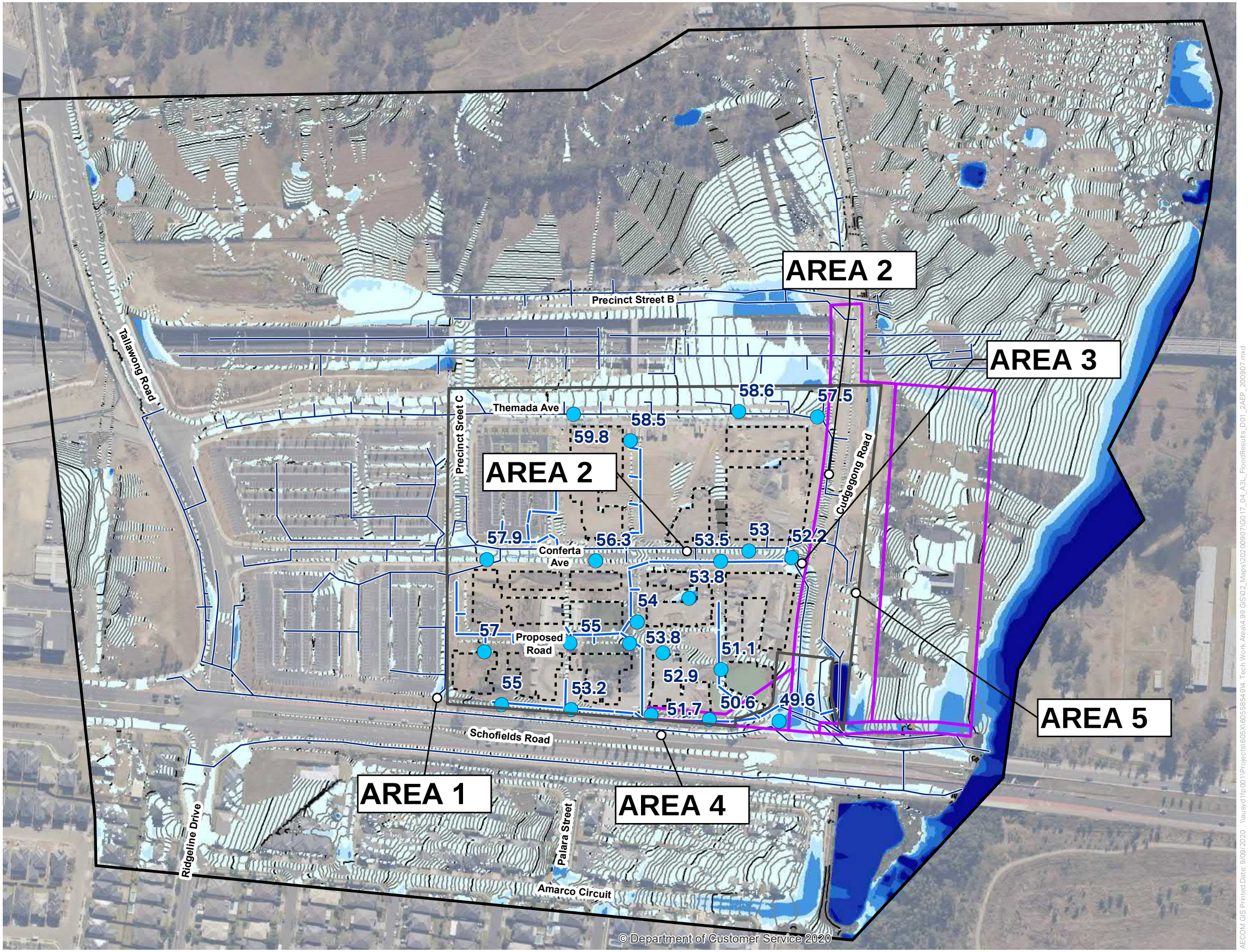

FIGURE C4 FLOOD RESULTS DEVELOPED CASE - 2% AEP

KEY

- TUFLOW Model Extent
- Flood Level 1m Contour
- Spot Height
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Depth (m)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

AECOM

0 25 50 m

imagery © nearmap (2017)

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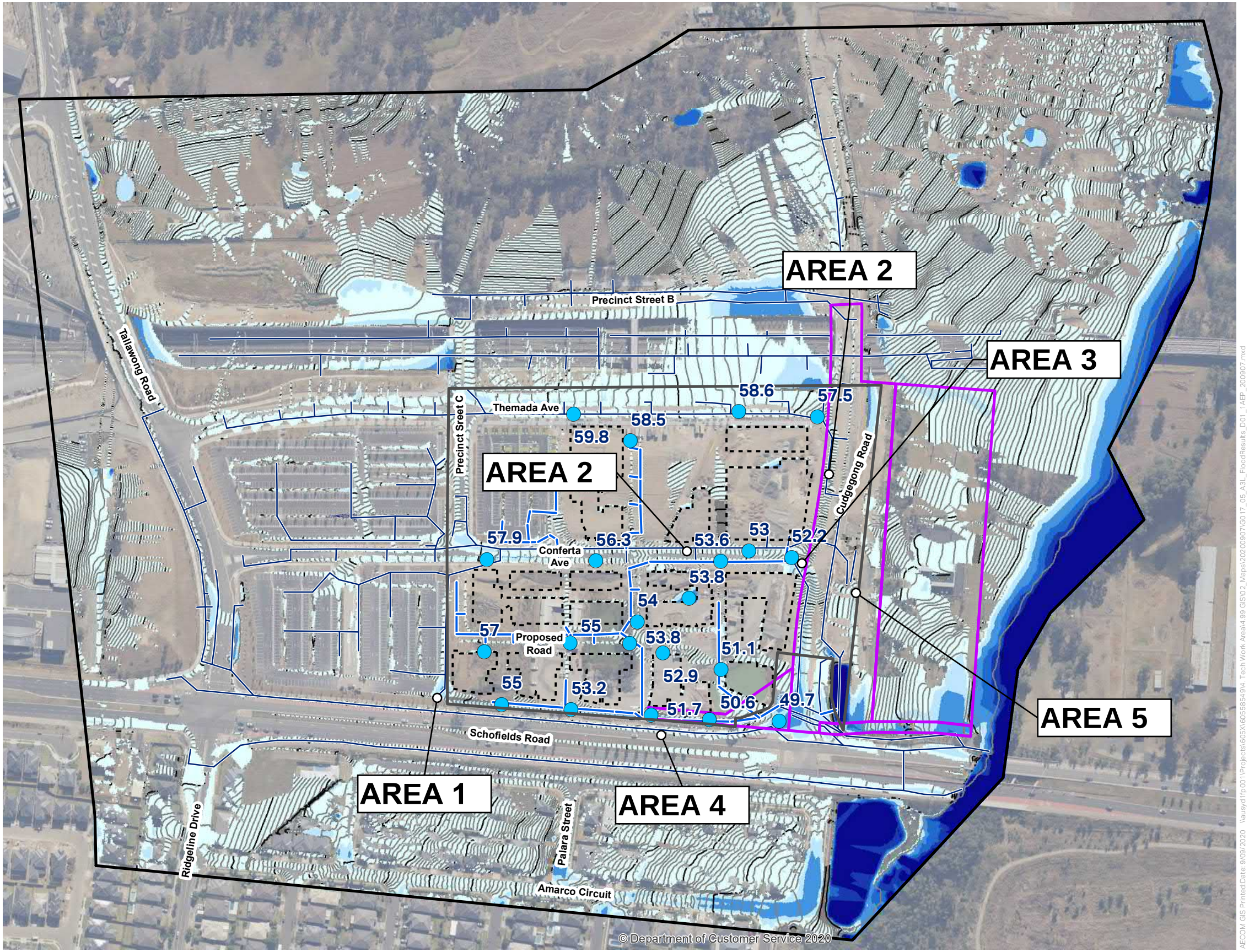

FIGURE C5 FLOOD RESULTS DEVELOPED CASE - 1% AEP

KEY

- TUFLOW Model Extent
- Flood Level 1m Contour
- Spot Height
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Depth (m)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

AECOM

0 25 50 m

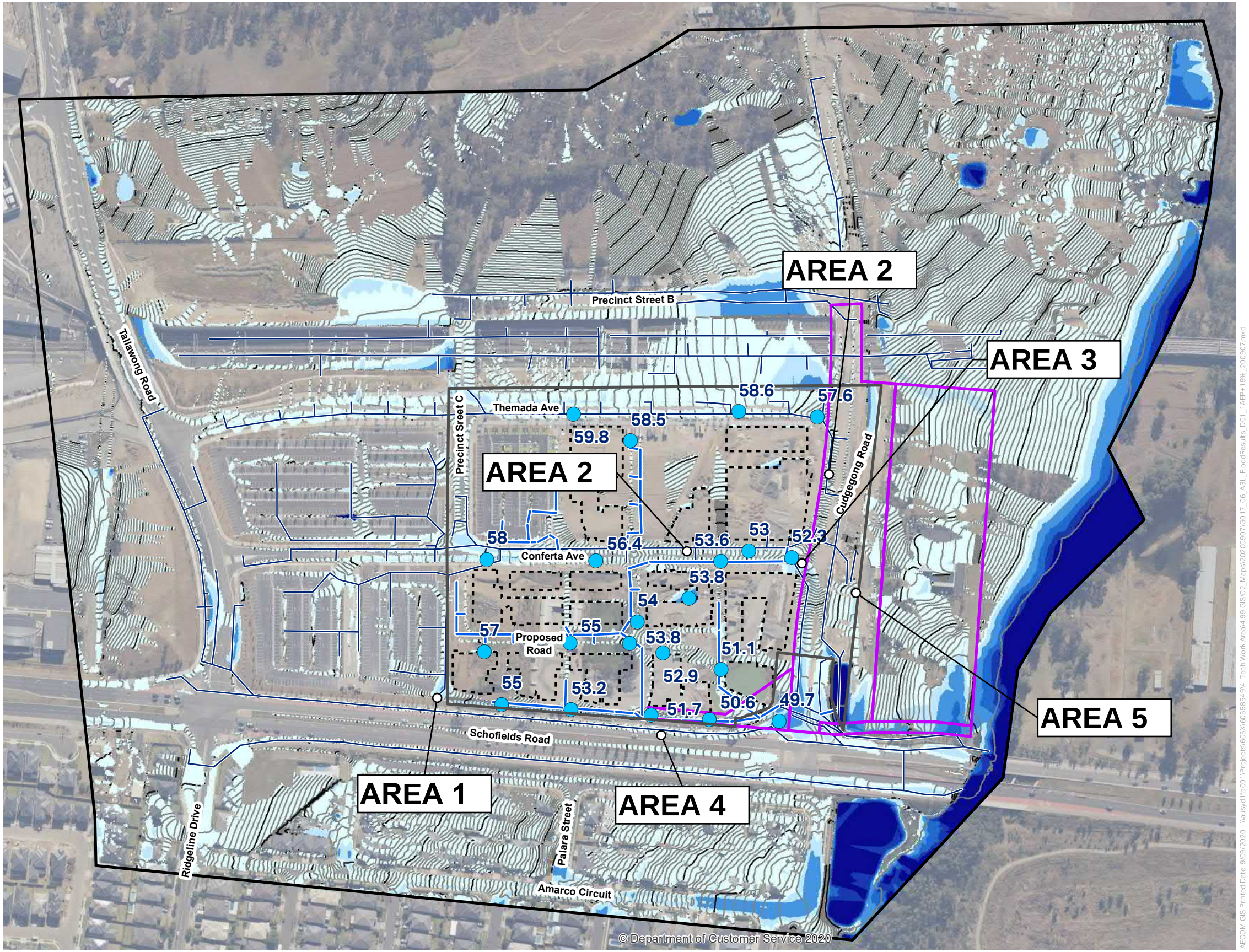

FIGURE C6 FLOOD RESULTS DEVELOPED CASE - 1% AEP + 15%

KEY

- TUFLOW Model Extent
- Flood Level 1m Contour
- Spot Height
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Depth (m)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

AECOM

0 25 50 m

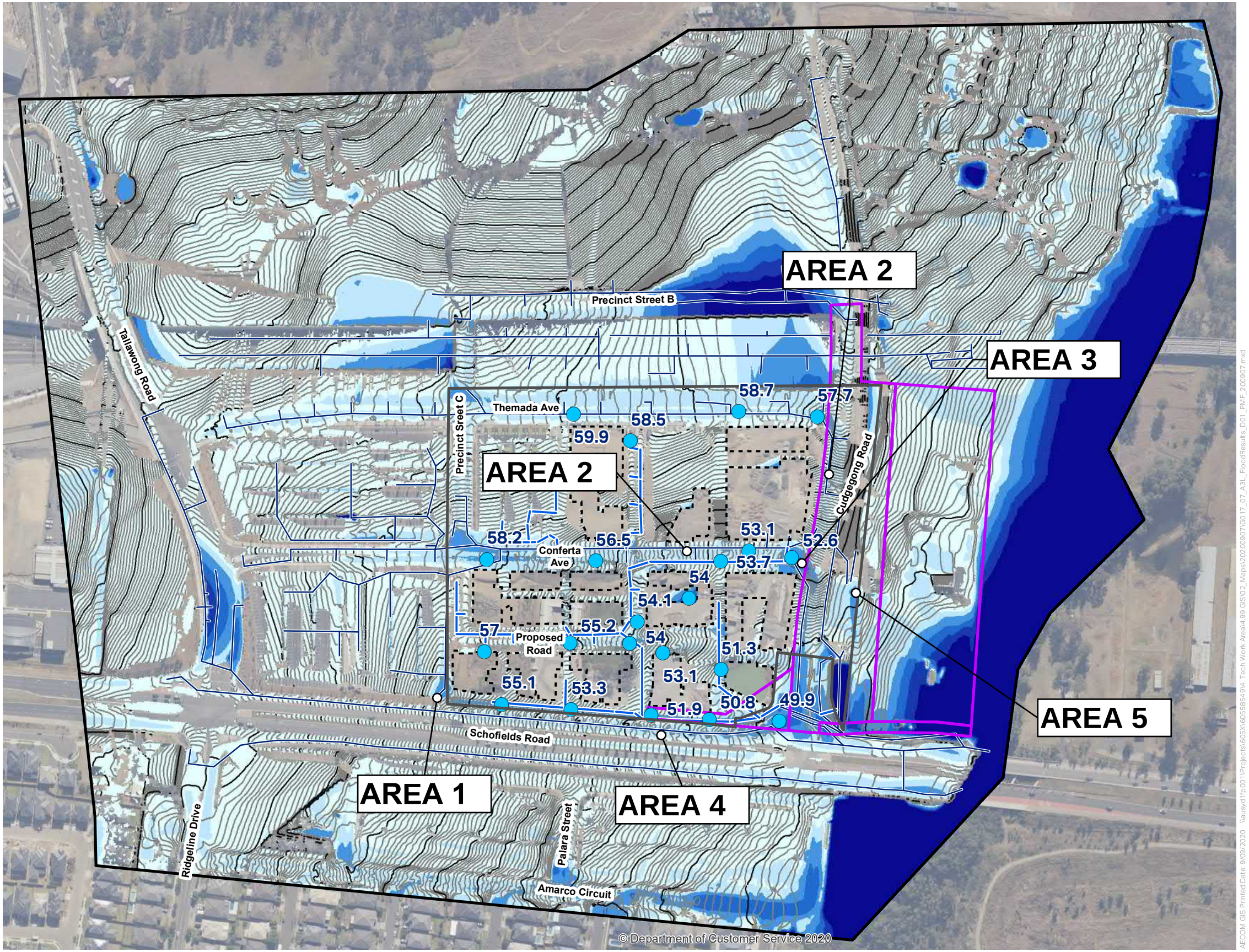

FIGURE C7 FLOOD RESULTS DEVELOPED CASE - PMF

KEY

- TUFLOW Model Extent
- Flood Level 1m Contour
- Spot Height
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Depth (m)

- < 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- > 1

AECOM

0 25 50 m

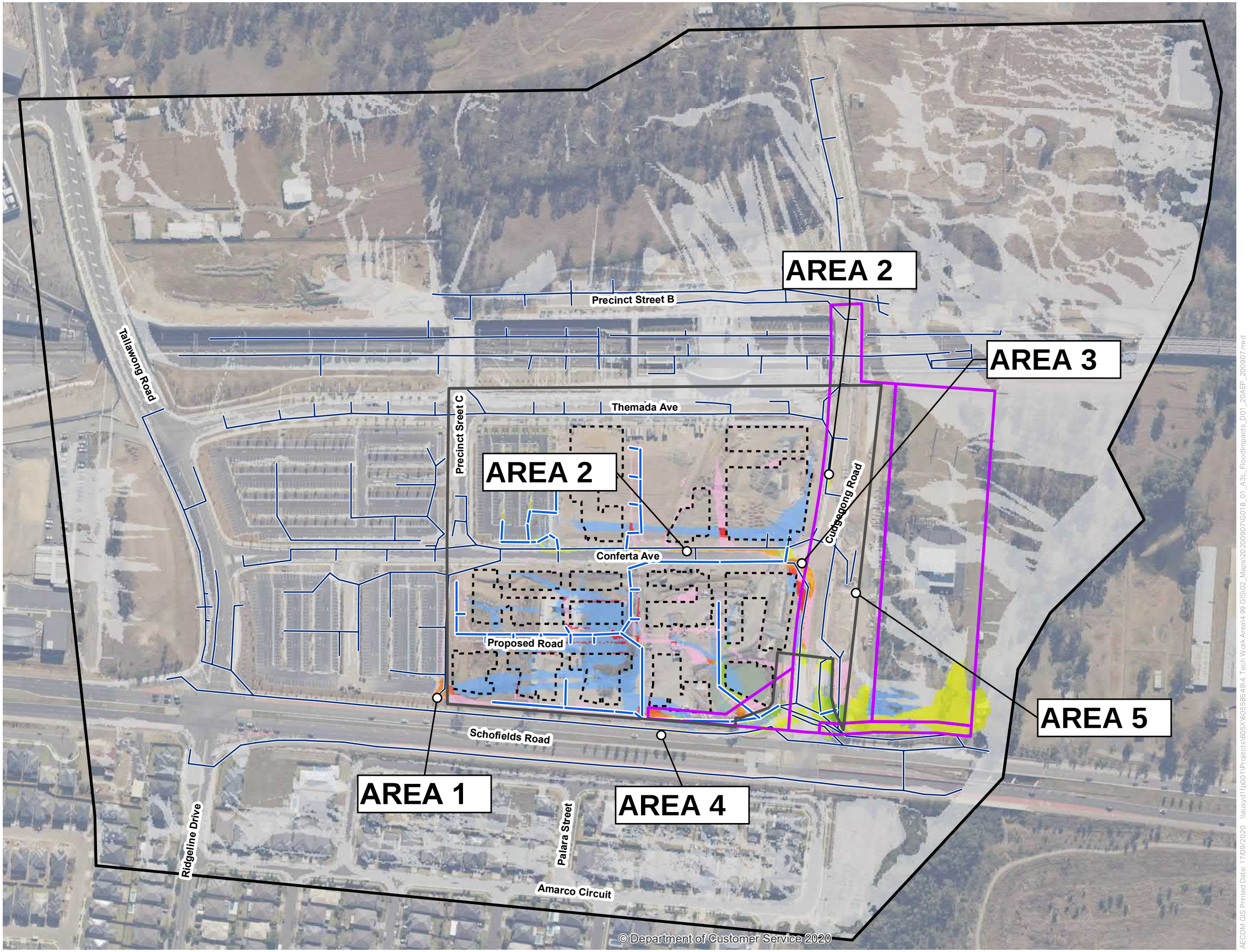

FIGURE D1 FLOOD LEVEL DIFFERENCE – 20% AEP

KEY

- TUFLOW Model Extent
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Impacts (m)	
-2.8 - -2.3	0.01 - 0.03
-2.3 - -0.5	0.03 - 0.1
-0.5 - -0.25	0.1 - 0.25
-0.25 - -0.1	0.25 - 0.5
-0.1 - -0.03	0.5 - 1.2
-0.03 - -0.01	**Wet Dry**
-0.01 - 0.01	Was wet, now dry
	Was dry, now wet

AECOM

0 25 50 m

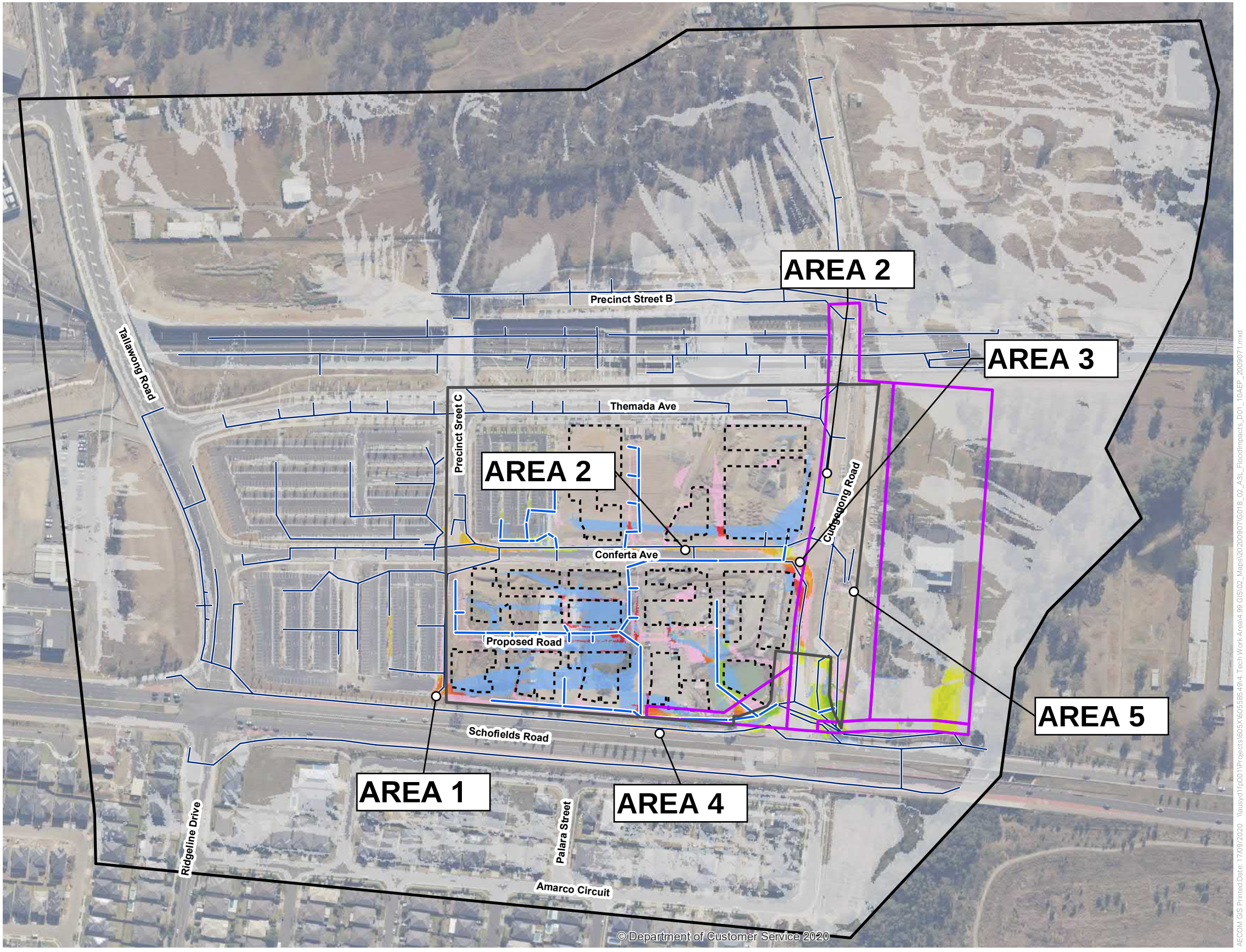

FIGURE D2 FLOOD LEVEL DIFFERENCE – 10% AEP

KEY

- TUFLOW Model Extent
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Impacts (m)	
-2.8 - -2.3	0.01 - 0.03
-2.3 - -0.5	0.03 - 0.1
-0.5 - -0.25	0.1 - 0.25
-0.25 - -0.1	0.25 - 0.5
-0.1 - -0.03	0.5 - 1.2
-0.03 - -0.01	**Wet Dry**
-0.01 - 0.01	Was wet, now dry
	Was dry, now wet

AECOM

0 25 50 m

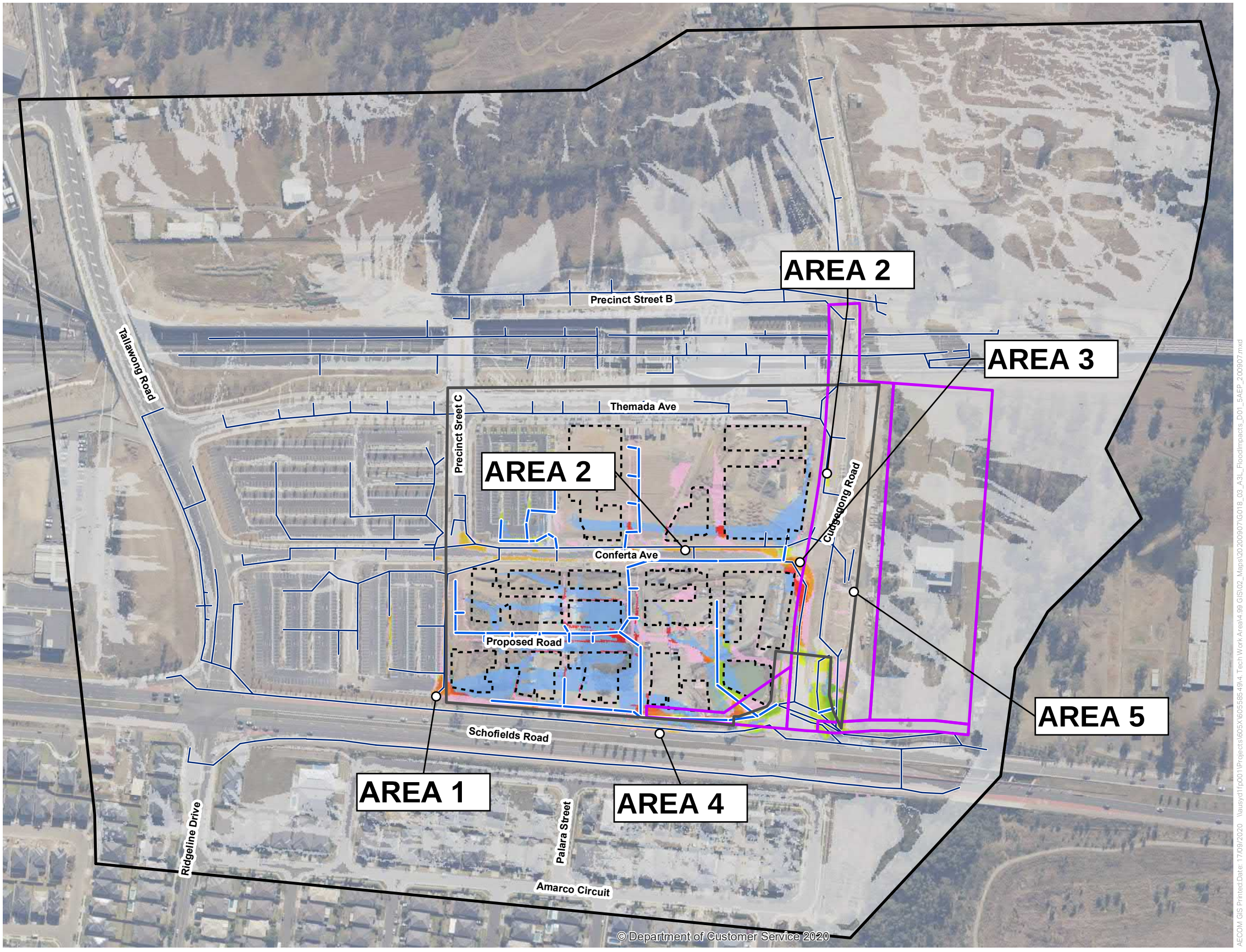

FIGURE D3 FLOOD LEVEL DIFFERENCE – 5% AEP

KEY

- TUFLOW Model Extent
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Impacts (m)	
-2.8 - -2.3	0.01 - 0.03
-2.3 - -0.5	0.03 - 0.1
-0.5 - -0.25	0.1 - 0.25
-0.25 - -0.1	0.25 - 0.5
-0.1 - -0.03	0.5 - 1.2
-0.03 - -0.01	**Wet Dry**
-0.01 - 0.01	Was wet, now dry
	Was dry, now wet

AECOM

0 25 50 m

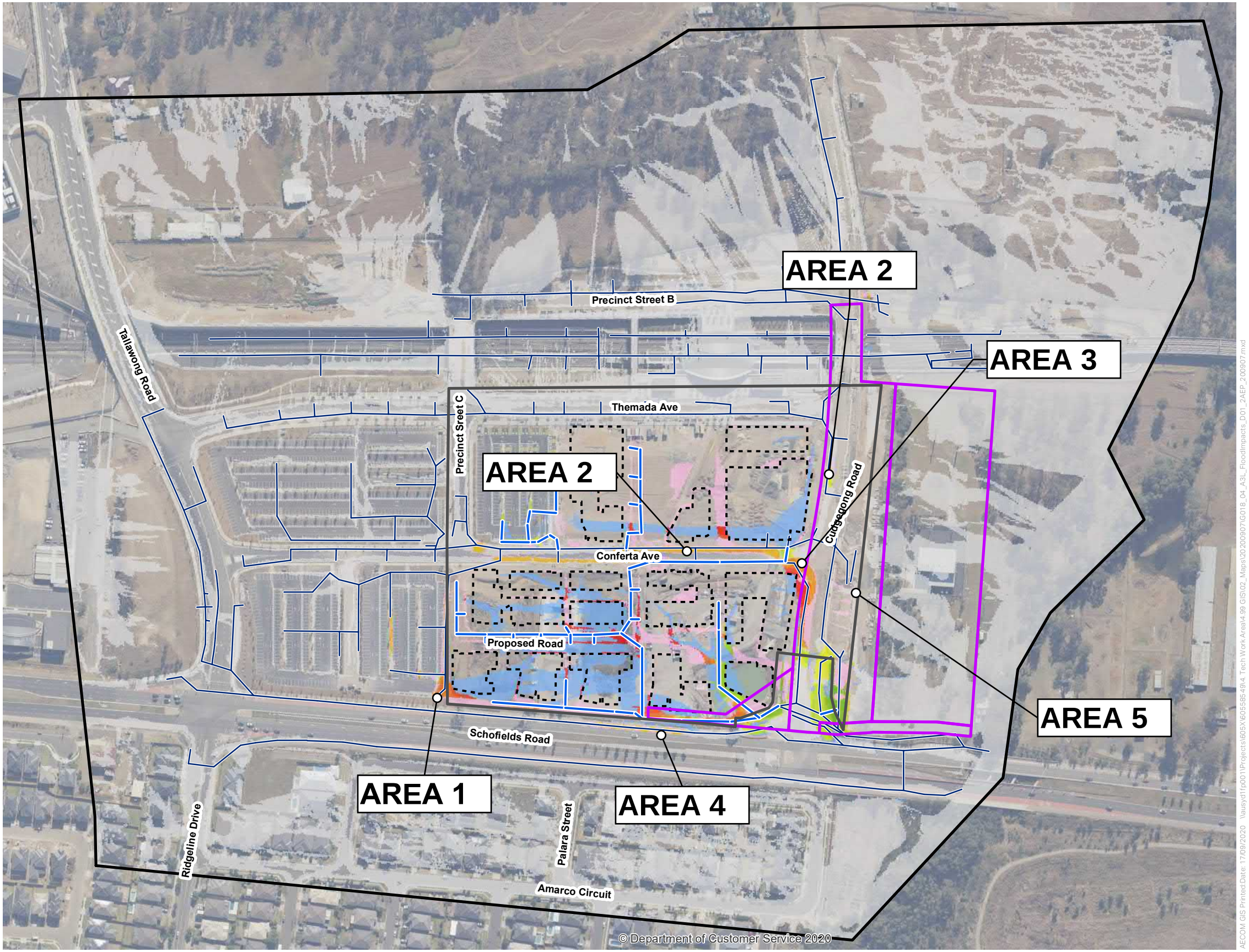

FIGURE D4 FLOOD LEVEL DIFFERENCE – 2% AEP

KEY

- TUFLOW Model Extent
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Impacts (m)	
-2.8 - -2.3	0.01 - 0.03
-2.3 - -0.5	0.03 - 0.1
-0.5 - -0.25	0.1 - 0.25
-0.25 - -0.1	0.25 - 0.5
-0.1 - -0.03	0.5 - 1.2
-0.03 - -0.01	Wet Dry
-0.01 - 0.01	Was wet, now dry
	Was dry, now wet

AECOM

0 25 50 m

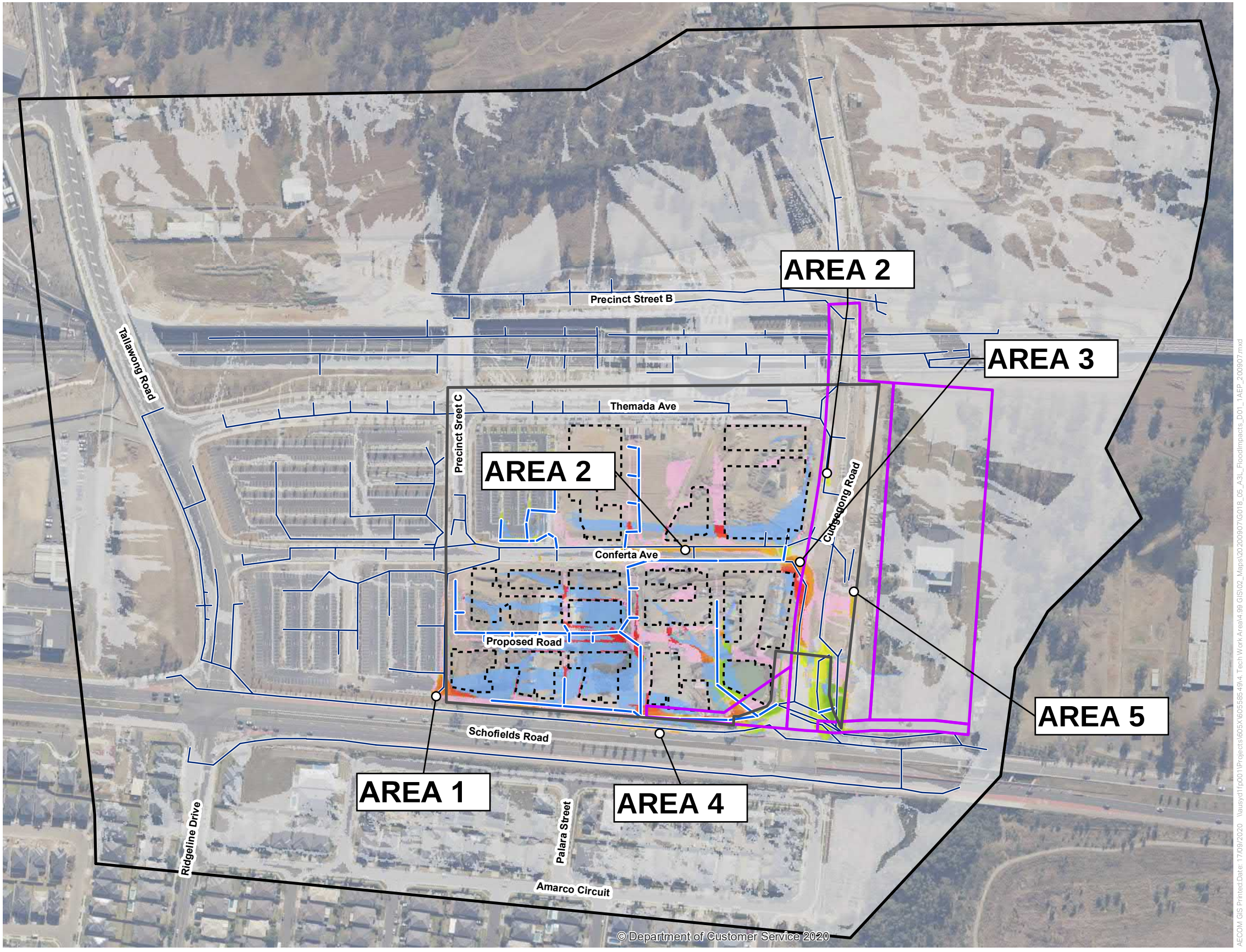

FIGURE D6 FLOOD LEVEL DIFFERENCE – 1% AEP

KEY

- TUFLOW Model Extent
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Impacts (m)	
-2.8 - -2.3	0.01 - 0.03
-2.3 - -0.5	0.03 - 0.1
-0.5 - -0.25	0.1 - 0.25
-0.25 - -0.1	0.25 - 0.5
-0.1 - -0.03	0.5 - 1.2
-0.03 - -0.01	**Wet Dry**
-0.01 - 0.01	Was wet, now dry
	Was dry, now wet

AECOM

0 25 50 m

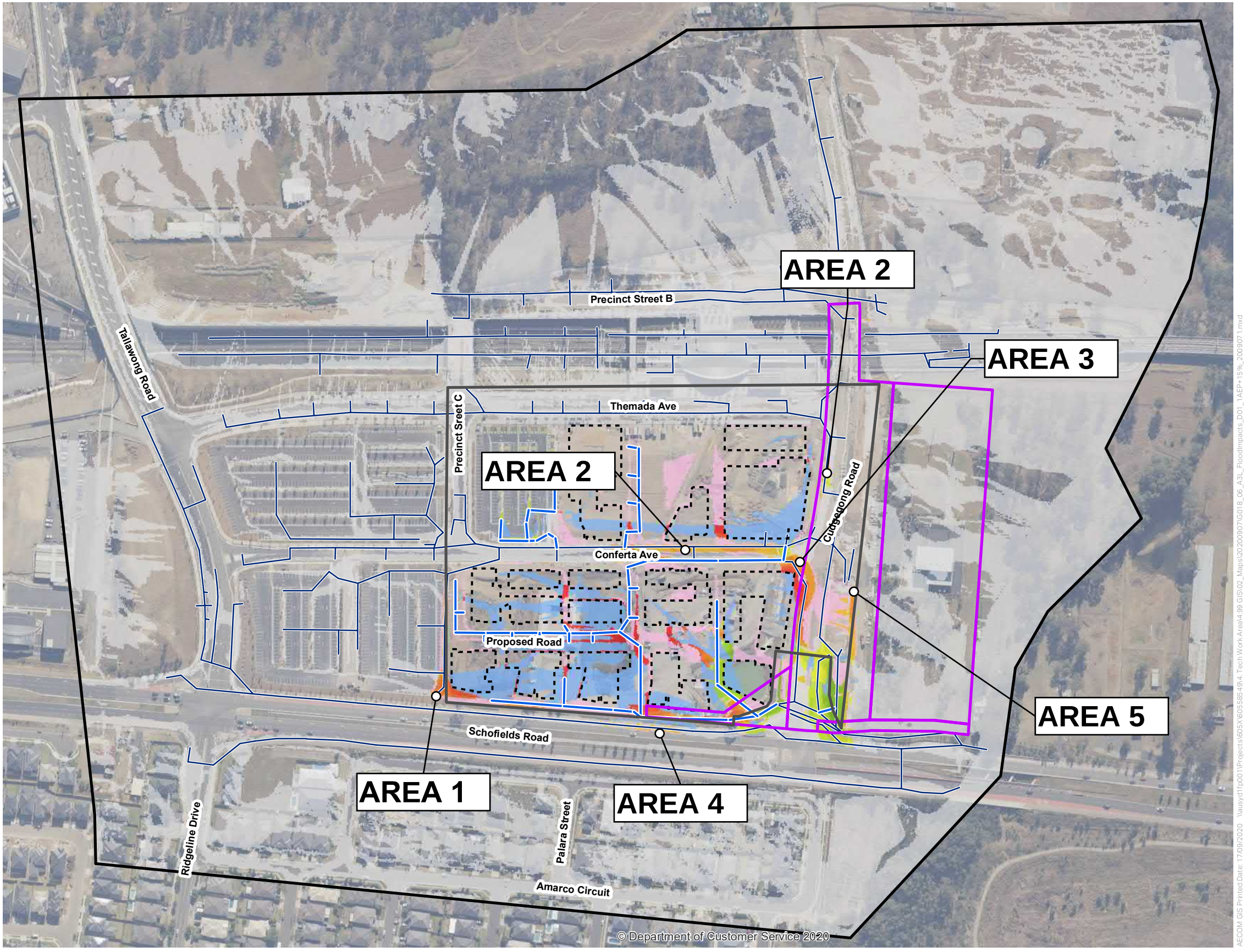

FIGURE D6 FLOOD LEVEL DIFFERENCE – 1% AEP + 15%

KEY

- TUFLOW Model Extent
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Impacts (m)	
-2.8 - -2.3	0.01 - 0.03
-2.3 - -0.5	0.03 - 0.1
-0.5 - -0.25	0.1 - 0.25
-0.25 - -0.1	0.25 - 0.5
-0.1 - -0.03	0.5 - 1.2
-0.03 - -0.01	**Wet Dry**
-0.01 - 0.01	Was wet, now dry
	Was dry, now wet

AECOM

0 25 50 m

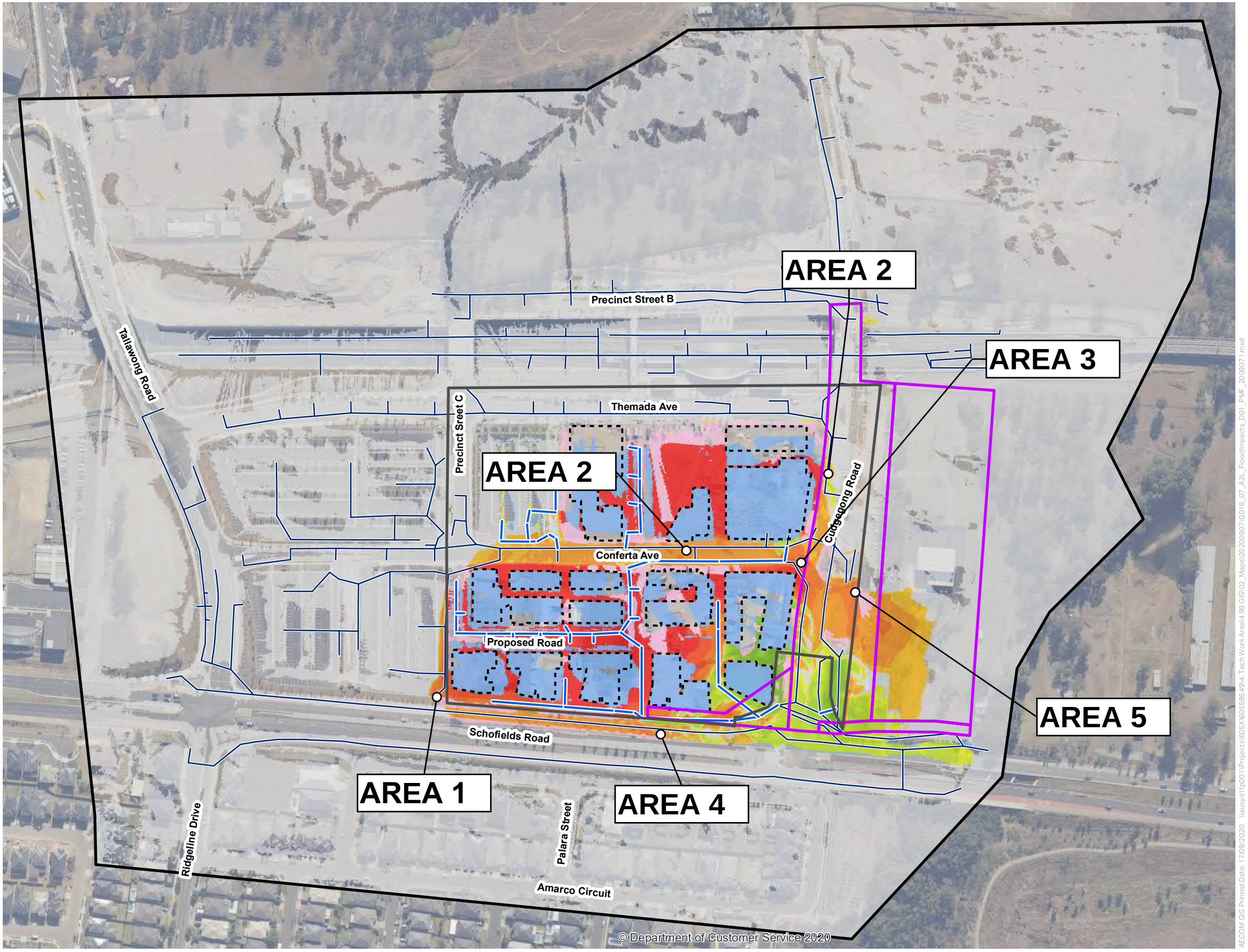

FIGURE D7 FLOOD LEVEL DIFFERENCE – PMF

KEY

- TUFLOW Model Extent
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Impacts (m)	
-2.8 - -2.3	0.01 - 0.03
-2.3 - -0.5	0.03 - 0.1
-0.5 - -0.25	0.1 - 0.25
-0.25 - -0.1	0.25 - 0.5
-0.1 - -0.03	0.5 - 1.2
-0.03 - -0.01	**Wet Dry**
-0.01 - 0.01	Was wet, now dry
	Was dry, now wet

AECOM

0 25 50 m

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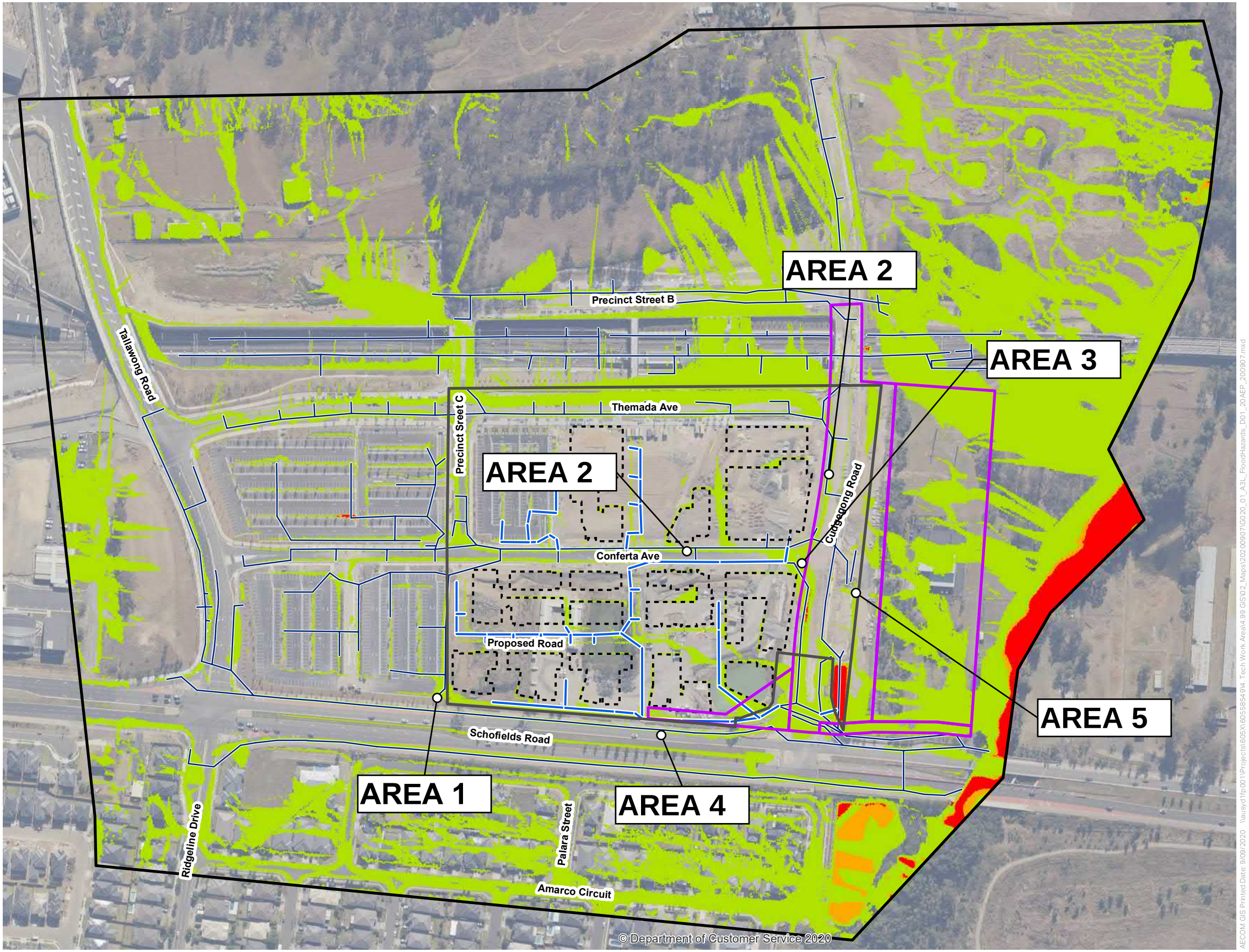

FIGURE E1 FLOOD HAZARDS DEVELOPED CASE – 20% AEP

KEY

- TUFLOW Model Extent
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Flood Hazard Category

- Low Hazard
- Intermediate Hazard
- High Hazard

AECOM

0 25 50 m

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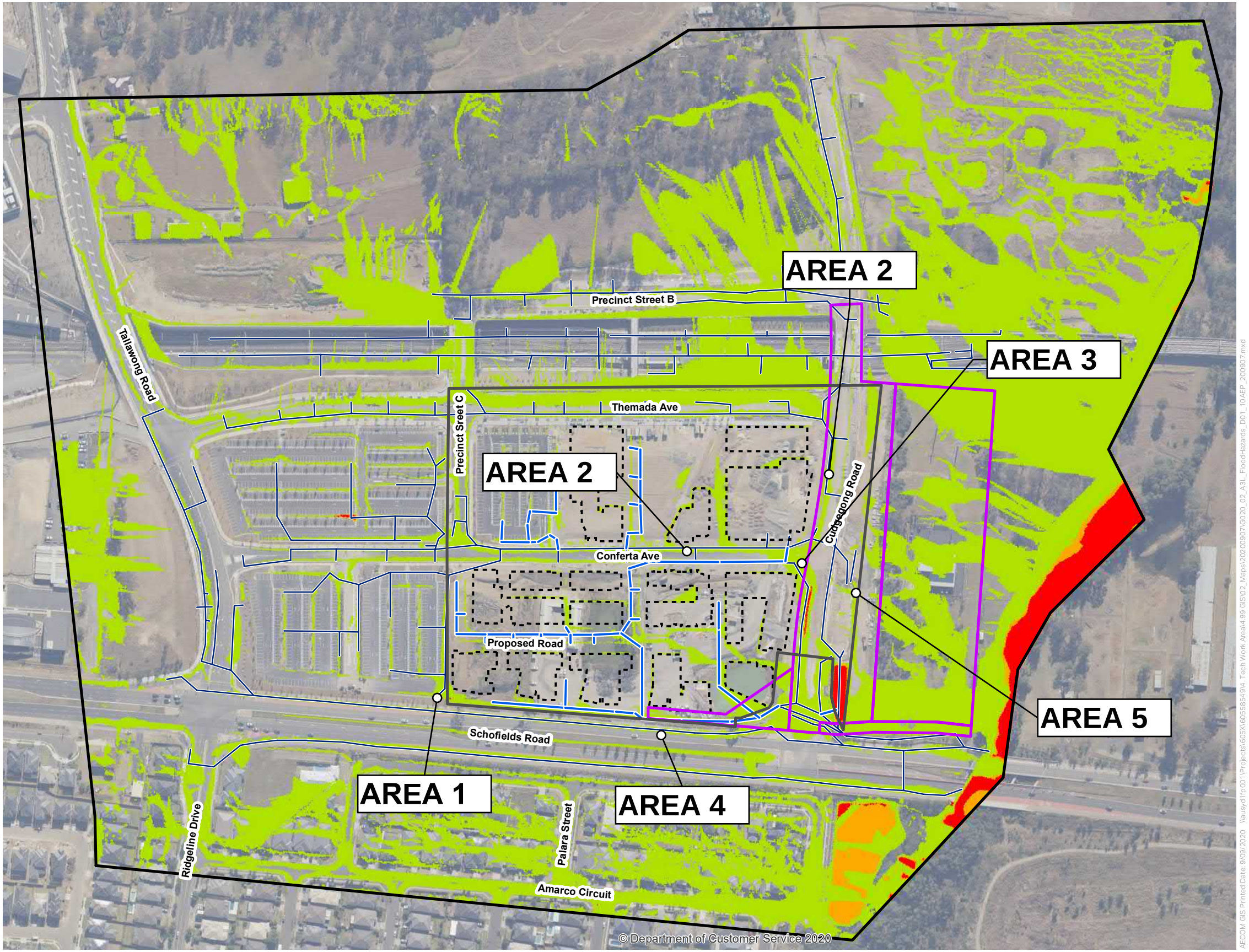

FIGURE E2 FLOOD HAZARDS DEVELOPED CASE – 10% AEP

KEY

- TUFLOW Model Extent
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Flood Hazard Category

- Low Hazard
- Intermediate Hazard
- High Hazard

AECOM

0 25 50 m

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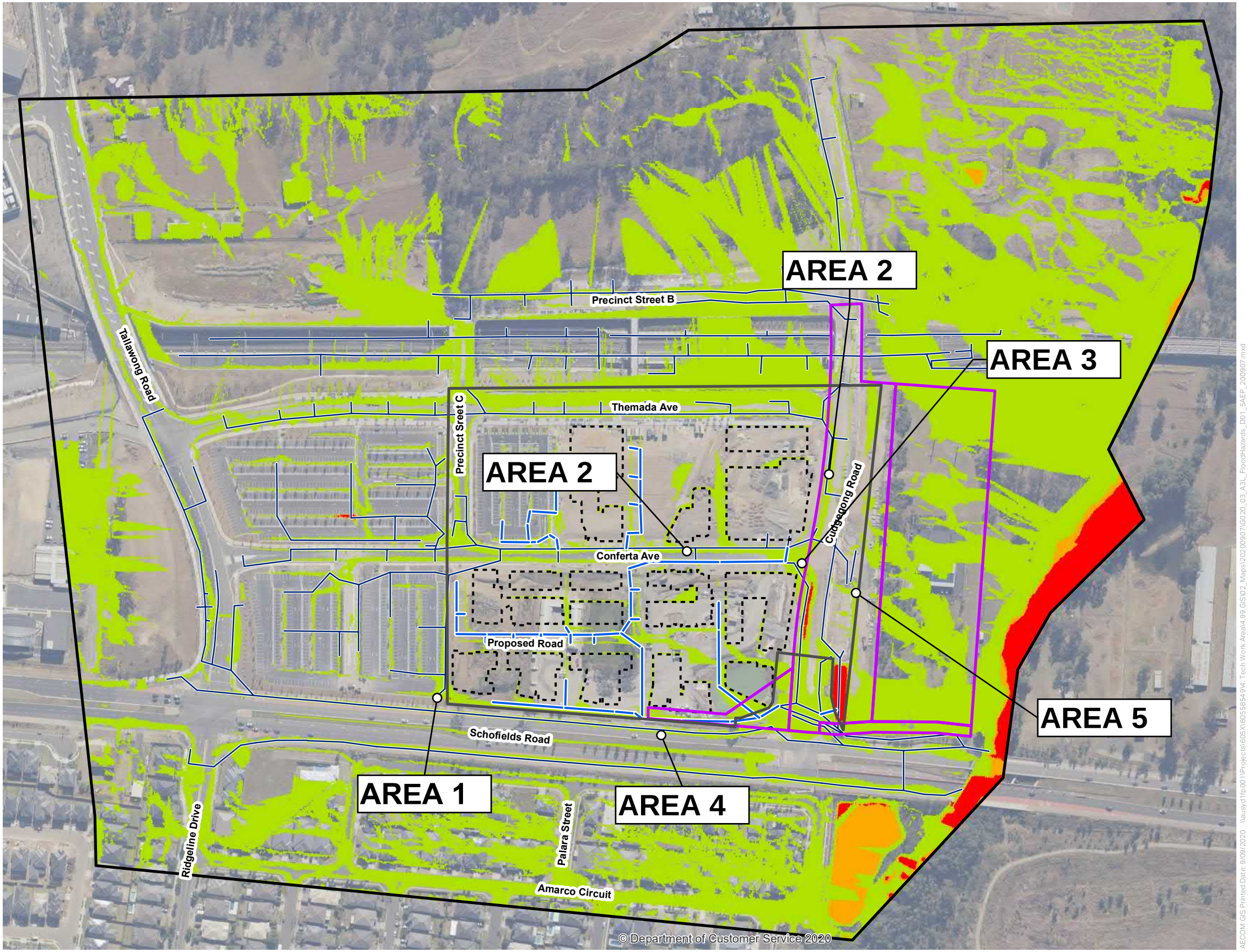

FIGURE E3 FLOOD HAZARDS DEVELOPED CASE – 5% AEP

KEY

- TUFLOW Model Extent
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Flood Hazard Category

- Low Hazard
- Intermediate Hazard
- High Hazard

AECOM

0 25 50 m

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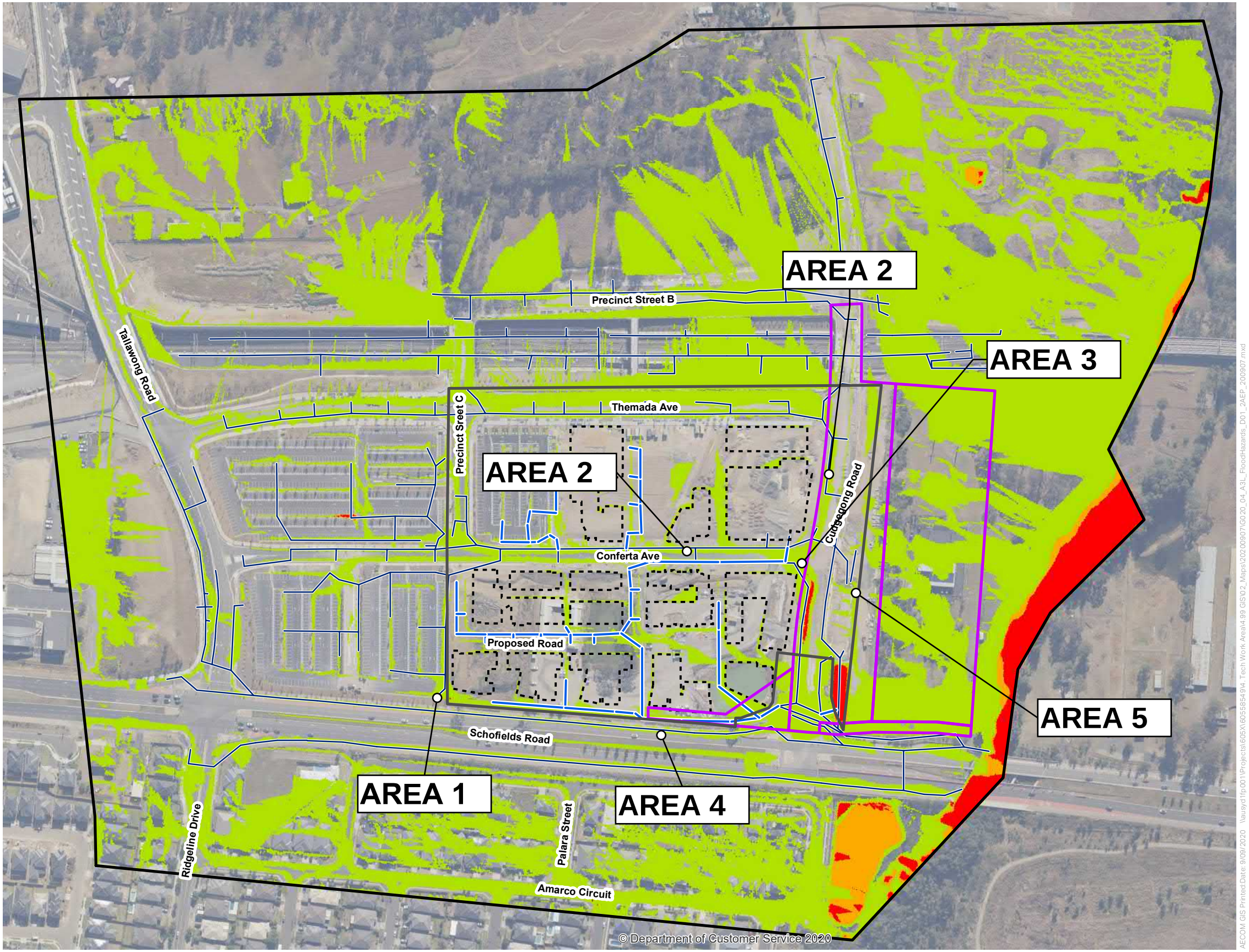

FIGURE E4 FLOOD HAZARDS DEVELOPED CASE – 2% AEP

KEY

- TUFLOW Model Extent
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Flood Hazard Category

- Low Hazard
- Intermediate Hazard
- High Hazard

AECOM

0 25 50 m

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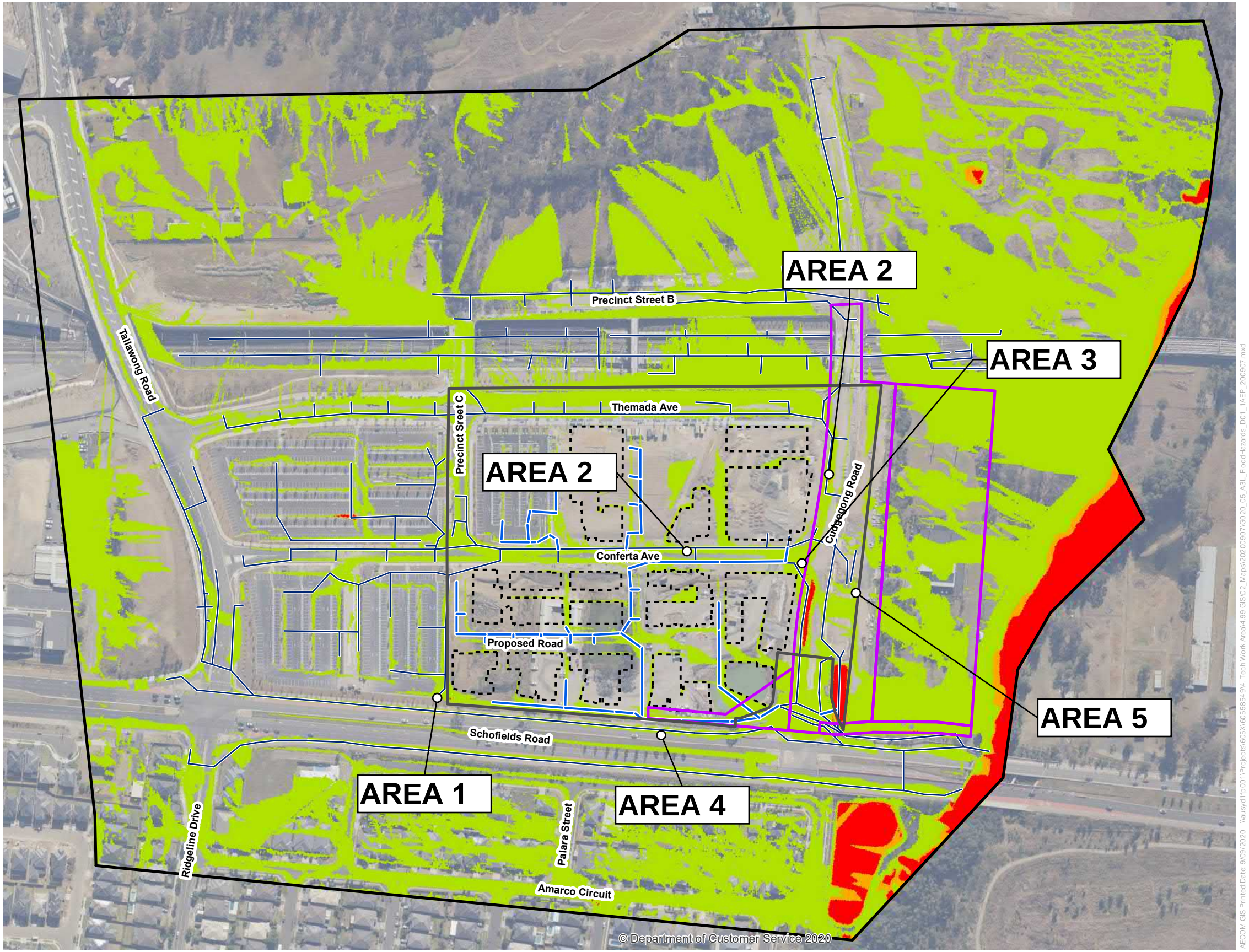

FIGURE E5 FLOOD HAZARDS DEVELOPED CASE – 1% AEP

KEY

- TUFLOW Model Extent
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Flood Hazard Category

- Low Hazard
- Intermediate Hazard
- High Hazard

0 25 50 m

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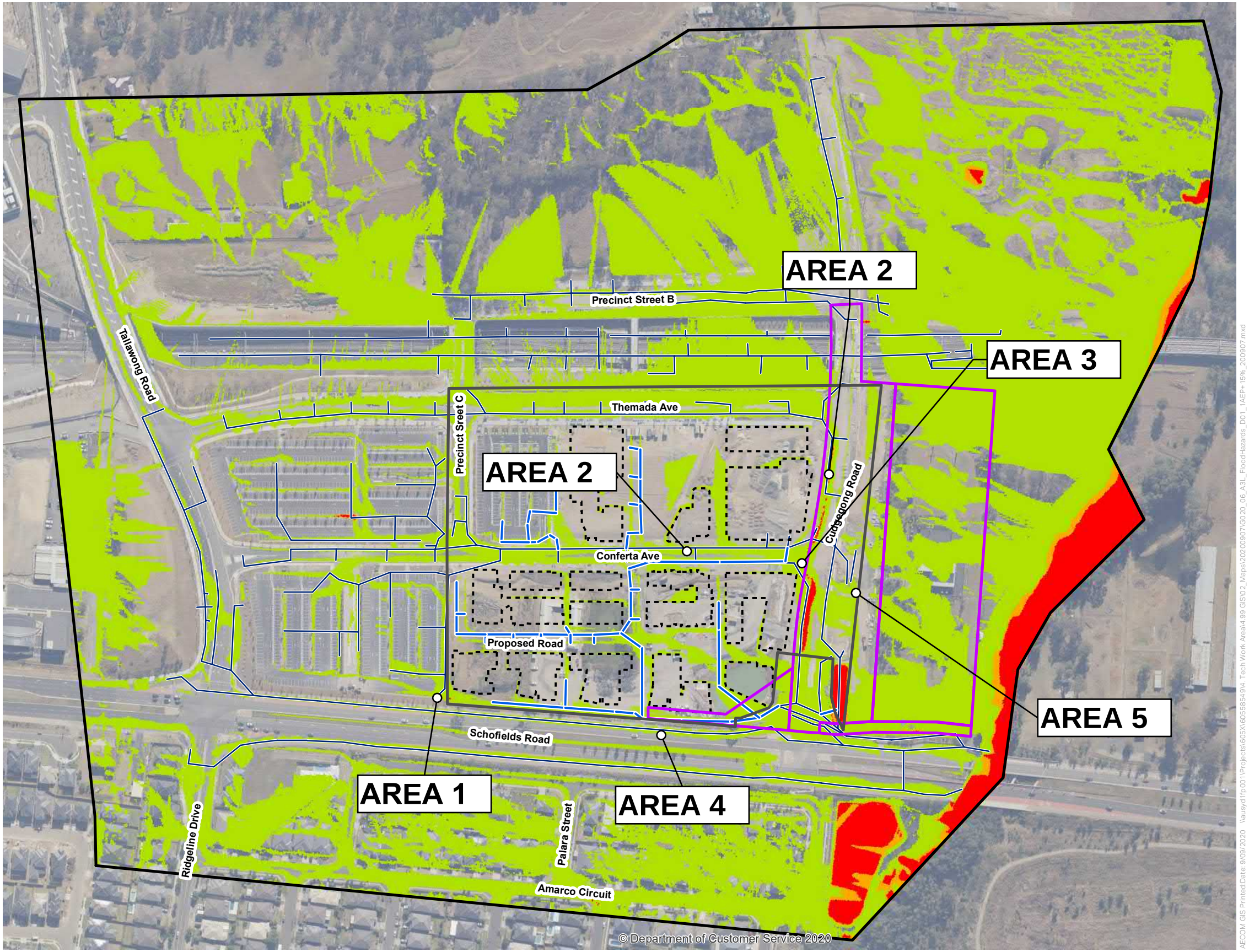

FIGURE E6 FLOOD HAZARDS DEVELOPED CASE – 1% AEP + 15%

KEY

- TUFLOW Model Extent
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Flood Hazard Category

- Low Hazard
- Intermediate Hazard
- High Hazard

AECOM

0 25 50 m

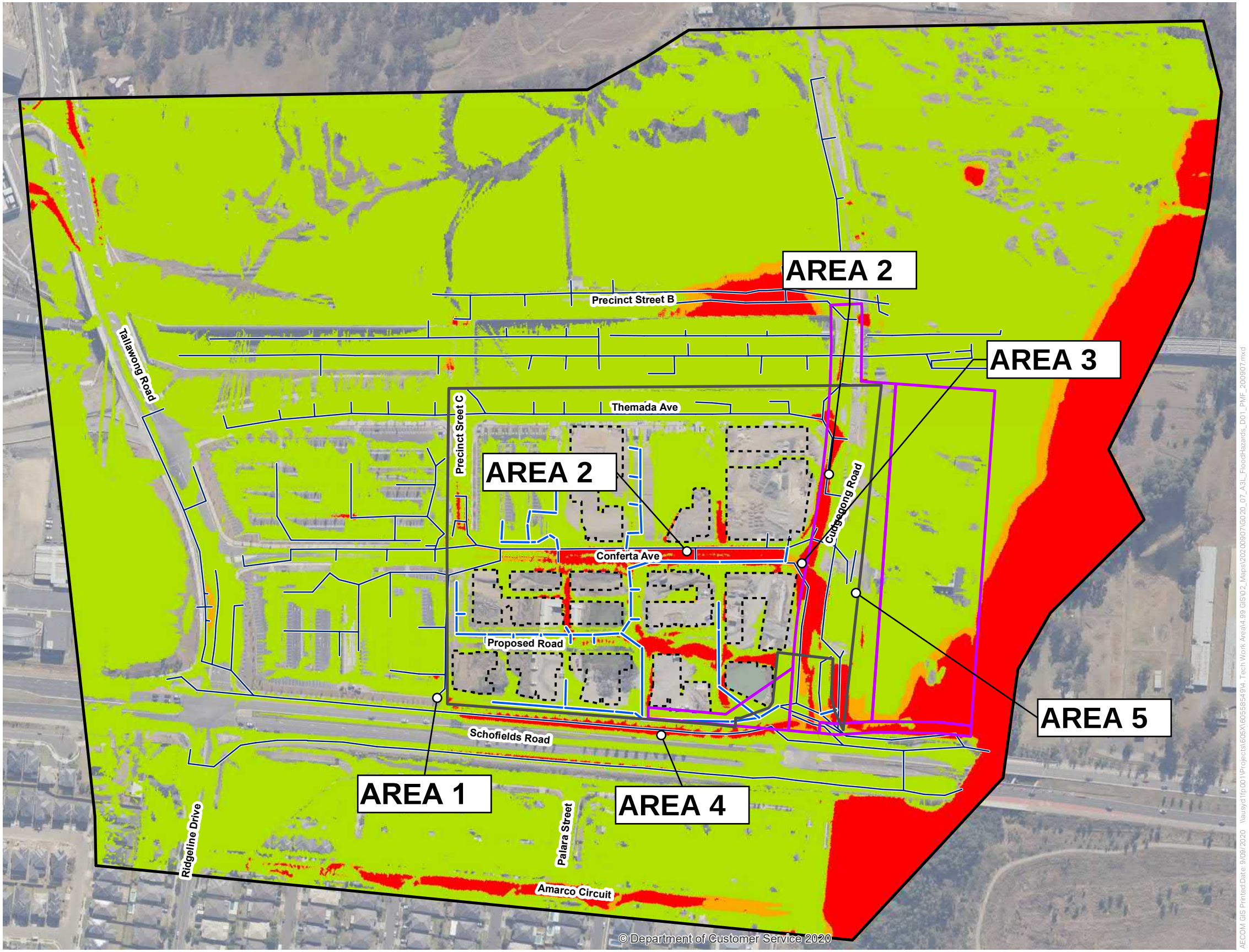

FIGURE E7 FLOOD HAZARDS DEVELOPED CASE – PMF

KEY

- TUFLOW Model Extent
- Site Boundary
- SP2 zoned land
- Buildings
- Proposed stormwater pipe
- Existing stormwater pipe

Flood Hazard Category

- Low Hazard
- Intermediate Hazard
- High Hazard

AECOM

0 25 50 m

AECOM GIS Printed:Date: 9/09/2020 \\ausyd1fp0011\Projects\605X\605585494\4. Tech Work Area\4.99 GIS\02_Maps\20200907\G020_07_A3L_FloodHazards_D01_PMF_200907.mxd