PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

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Queensland Government

ARCADIS Design & Consultancy for natural and built assets

STORMWATER CONVEYANCE MASTER PLAN

NEW BEITH ROAD, NEW BEITH

New Beith Pty Ltd

NEW BEITH ROAD, NEW BEITH

STORMWATER CONVEYANCE MASTER PLAN

Author	Oliver Purton
Checker	Darlan Castro
Approver	Michael Wenzel

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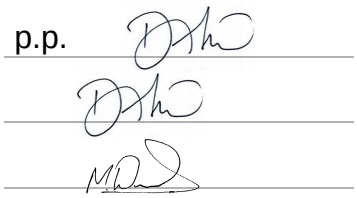

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1 EXECUTIVE SUMMARY

Arcadis has been engaged by New Beith Pty Ltd to complete a Stormwater Conveyance Master Plan (SCMP) for a proposed master-planned development in New Beith, QLD.

The New Beith site occupies approximately 598ha of land between existing New Beith residential areas, train line and Flagstone Creek within the Greater Flagstone Priority Development Area (PDA). Varying residential densities and supporting land uses such as educational and open space are proposed, complimentary to the land which features various drainage features, low to high steepness and other encumbrances such as roads.

This SCMP aims to demonstrate that the proposed development Context Plan can be achieved with major stormwater conveyance through the site in compliance with the relevant stormwater performance outcomes in accordance with Economical Development Queensland (EDQ) Engineering Standard Guidelines 13 and 15, State Planning Policy (SPP) and Logan City Council (LCC) requirements.

This report focuses on the management of existing stormwater conveyance through the site as summarised below:

> **The conveyance of existing stormwater through the site is not altered in a manner that may substantially damage a third party due to the proposed Context Plan development footprint.**

This SCMP has identified the key locations where stormwater enters and leaves the subject property. Retention of the major locations generally in their natural state is key to reducing the likelihood of significant hydraulic changes. Minor receiving and discharging locations will typically be accepted on site via modified open space areas or engineering infrastructure, designed to capture stormwater using culverts.

This SCMP outlines the limitations of the current assessment, primarily noting that internal detention basins have not been included at this stage. As a conservative approach, stormwater detention will be provided within the development footprint of each catchment. Should future stages consider online basins, in addition to hydraulic assessment coordination with Department of Agriculture and Fisheries (DAF) will be necessary due to the mapped waterway within the overland flow path, and geotechnical advice will be sought to address the presence of dispersive soils.

This assessment is only dealing with the conveyance of existing flows through the site and ensuring that the proposed development footprint does not encroach on these flow paths. It is noted that the proposed development will have to ensure that peak discharge rates are maintained at existing levels.

It is recognized that precinct/stage specific stormwater management plans and similar hydraulic based reports, would be provided subsequent to this SCMP, generally adopting this high-level strategy with the intent on demonstrating an acceptable outcome to EDQ, SPP and LCC's relevant planning guidelines.

1.1 Revision 2

Revision 2 of this report has been prepared in response to the Peer Review Memorandum by Water Technologies, dated 10 August 2023. The Memorandum contains a table that summarises the Peer Review comments, which has been included in Appendix C of this report. The updated table includes Arcadis' detailed responses to all the comments.

1.1 Revision 3

Revision 3 of this report has been prepared in response to the EDQ letter dated 9 October 2024 and the subsequent meeting on 17 October 2024. The report has been updated to include additional details on the hydrological assessment and the addition of Appendix E – Flood Level Maps.

2 SITE CHARACTERISTICS

2.1 SITE DESCRIPTION

The subject site is located at New Beith Road, New Beith within the Greater Flagstone Priority Development Area (PDA) over the following parcels of land:

- Lot 1 on SP318791 (317.299ha)
- Lot 58 on S312118 (64.75ha)
- Part of Lot 50 on SP293963 (28.908ha)
- Lot 8 on S312737 (67.722)
- Lot 1 on SP250186 (42.25ha)
- Lot 2 on SP250186 (29.7799)
- Lot 2 on RP25922 (47.017ha)

The site has a total area of 597.9789ha and in its current state, the project site consists of undeveloped vegetated land which is utilised for logging and cattle grazing.

The site is generally bordered by residential development to the north, Department of Transport and Main Roads Rail Corridor and rural land to the east and currently undveloped rural land to the west and south. The undeveloped land to the south is noted to be within the Priority Development Area and planned for urbanisation. Applications have been previously submitted for the site to varying levels of detail.

The Department of Transport and Main Roads Rail Corridor is noted to be planned for upgrade works as a part of the Salisbury to Beaudesert Rail Corridor works. Planning is understood to be in preliminary stages with proposed timing for upgrade works currently unknown.

A locality plan is provided in Figure 2-1 below.

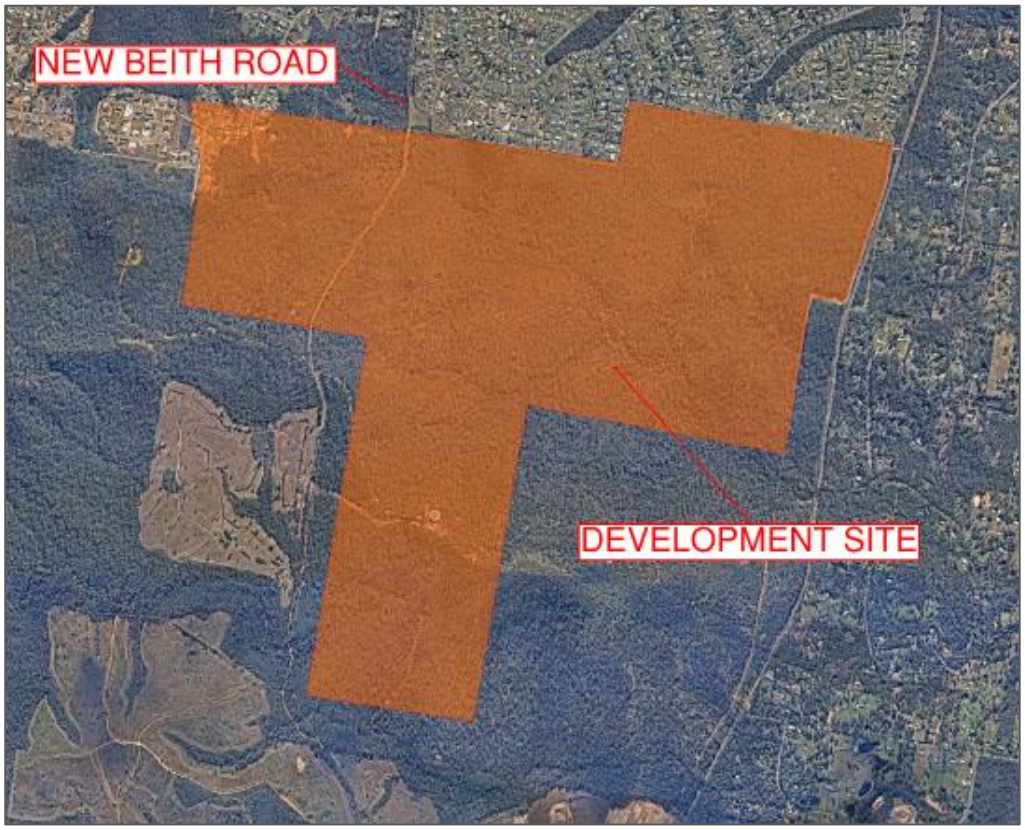


Figure 2-1 Site Locality Plan (Aerial Imagery Courtesy of Nearmap)

3 PROPOSED DEVELOPMENT

The proposal seeks to develop the site area for mixed uses, comprising of:

- Residential precincts of varying density
- Commercial areas
- School and educational precincts
- Open space areas
- Drainage reserve

Engineering infrastructure will be required to support the proposed development including, earthworks, roadworks, stormwater drainage and utilities.

An extract of the context plan of development is provided in Figure 3-1 below, with further plans provided in Appendix A.

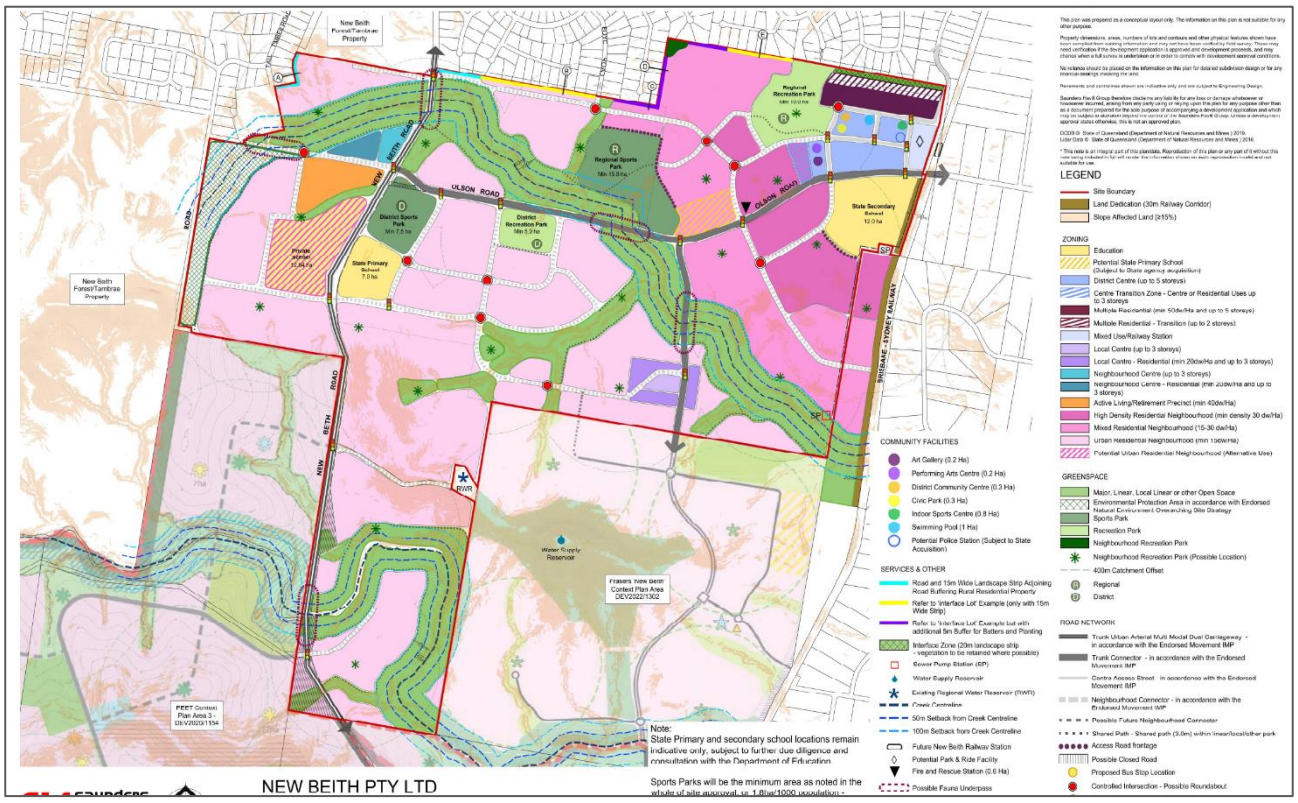


Figure 3-1 Extract of Development Context Plan (Courtesy of Saunders Havill Group)

4 EXISTING STORMWATER DRAINAGE

4.1 EXISTING TOPOGRAPHY AND DRAINAGE

The site topography consists of various crests and valley's ranging from approximately RL40m to RL110m. Runoff generated from the local area and external to the site's perimeter enters from multiple locations, consolidating into two key overland flow paths and approximately six other minor flow areas. The two main overland flow paths are characterised by a high crest through the site's lower third, and high points otherwise featured on neighbouring properties.

The key discharge locations are presented on Figure 4-1 below, with further detailed catchment planning, including locations where external flows are accepted by the site, best viewed on plans in Appendix A & B. It is noted that there will be more isolated areas of conveyance to and from the property, however these are not highlighted below.

These discharge locations are generally mapped by Logan City Council as flood prone areas or waterways. Further information is provided in Section 5 of this report.

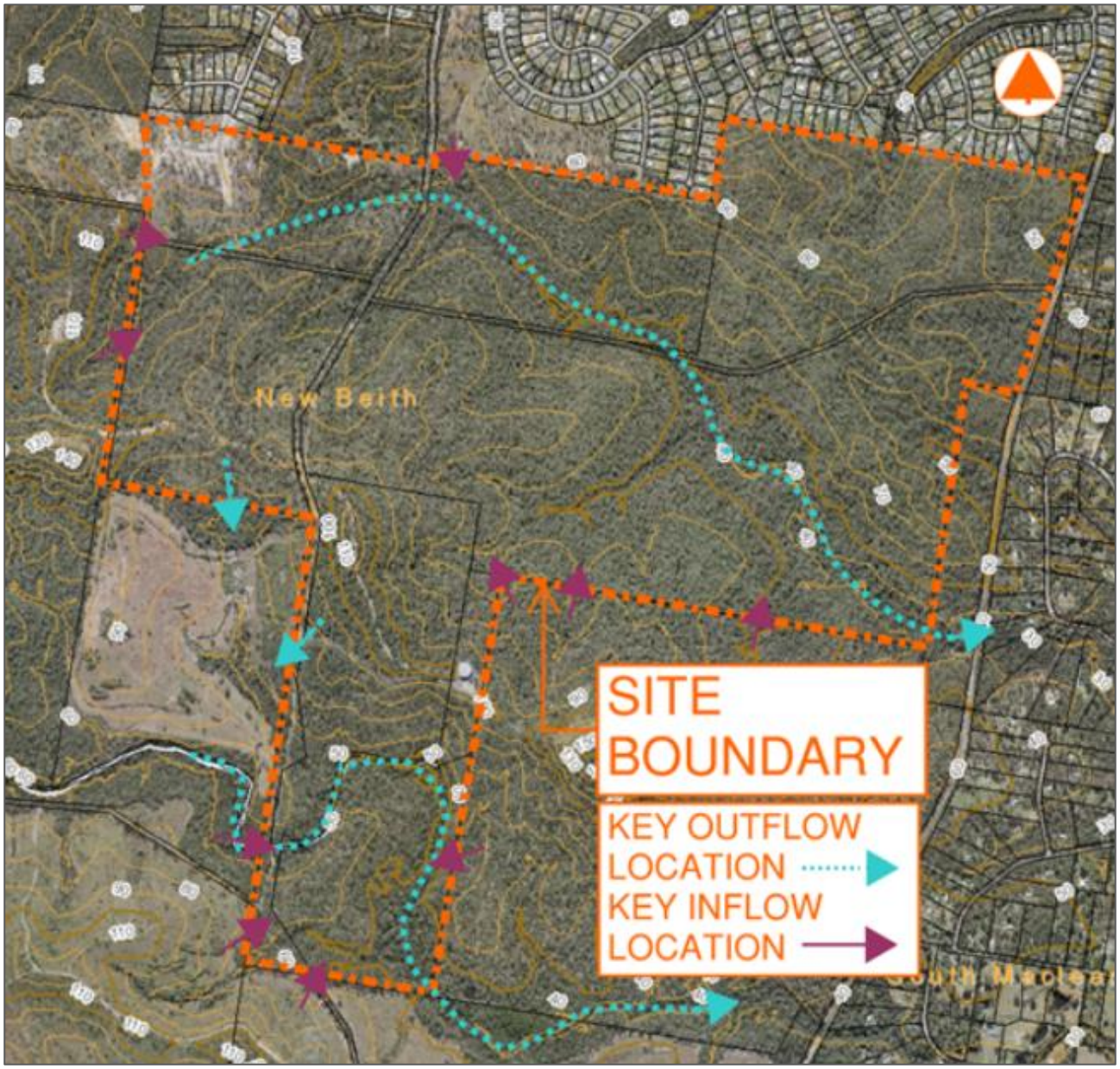


Figure 4-1 LCC Contour Map Extract with Key Inflow and Outflow Locations Identified (Courtesy LCC)

4.2 LAWFUL POINT OF DISCHARGE

The site's discharge locations (including downstream) are generally mapped as flood prone land or waterways to varying significance, therefore are recognized and protected discharge locations.

It is expected that two minor catchments may maintain discharge to existing roads or private property.

In accordance with LCC SC6.2.5 Planning Scheme Policy 5 – Infrastructure Section 3.6.2.3 (1), reference to Queensland Urban Drainage Manual (QUDM) is required and can be complied with on the basis of the management of stormwater generated on site, so that it's release does not have the potential to substantially damage a third-party property. This will be achieved via the implementation of various stormwater management devices, further described in this report.

On this basis, no further requirement to procure easements or owner's consent from specific properties is expected.

4.3 STORMWATER INFRASTRUCTURE PLAN

The delivery of infrastructure is a key component in facilitating work within the PDA. Key infrastructure is recognized under the Greater Flagstone Priority Development Area Development Charges and Offset Plan. With respect to stormwater and flooding, the Greater Flagstone Priority Development Area Development Charges and Offset Plan, Map 5: Transport (structures) – Trunk Infrastructure (dated 16/06/2022) identifies various culvert and bridge structures within the site.

An extract from this plan is provided in Figure 4-2 below, identifying approximately 5-6 structures.

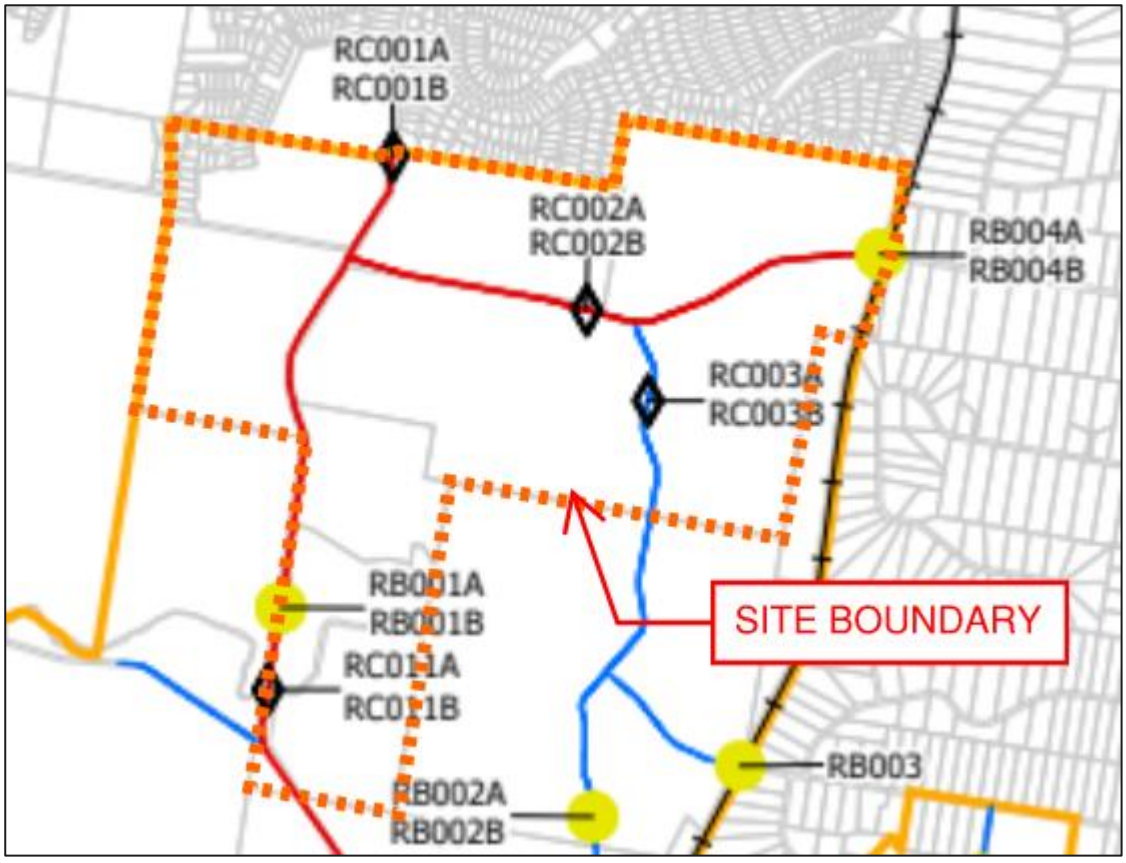


Figure 4-2 Extract from Bridges and Culverts Greater Flagstone Infrastructure Plan (Courtesy EDQ)

Potential infrastructure offsets for building this infrastructure should be discussed with EDQ in accordance with the framework provided in the Greater Flagstone Priority Development Area Development Charges and Offset Plan.

It is noted that the Sub-Regional Infrastructure Plan and LCC Priority Infrastructure Plan do not currently identify any other stormwater or flood related works.

5 FLOODING AND CONVEYANCE MANAGEMENT

5.1 EXISTING INFRASTRUCTURE

Development layout plans provided in Appendix A deliver clarity as to the extent of locations external flows enter the site. Particular emphasis on key drainage features is available via Logan City Council's overlay mapping for flooding and waterways. Extracts of this mapping are provided below with additional commentary on flooding and conveyance.

5.2 FLOOD

A review of the LCC Flood Hazard Trigger Overlay Map OM-05 has identified the site as being located inside the designated Flood Hazard Zone. The flooded areas are a result of the existing major drainage features which traverse the lower areas of the site.

In reference to plans included in Appendix A the proposed development footprint generally seeks to retain these existing drainage features which have been identified to flood. Bridges, other crossing structures, earthworks or infrastructure within these areas will be required to facilitate the proposal. Consideration of, EDQ Engineering Standards PDA Guideline No. 15, specifically the State Planning Policy and requirement of habitable floors in addition to Council's Flood Overlay Code, particularly measures such as the management of conveyance, storage and associated risk to life and property will be made.

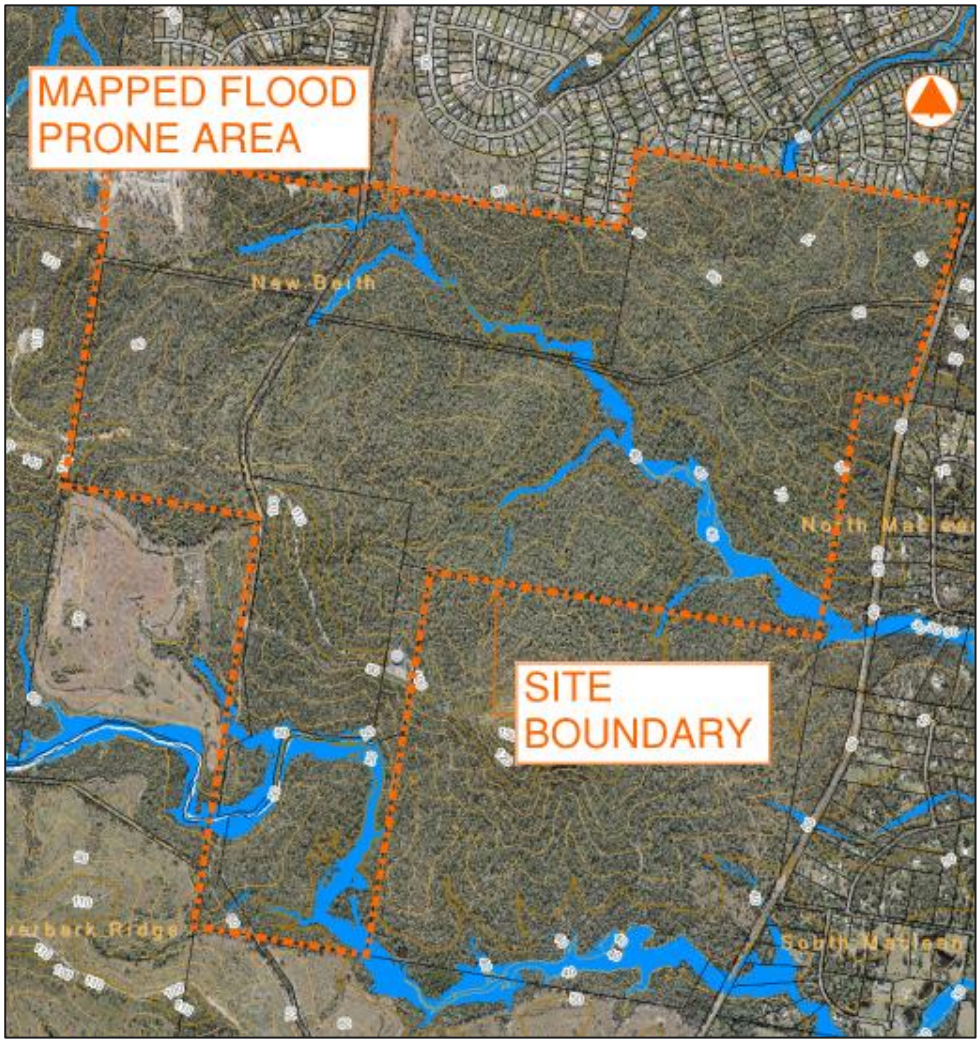


Figure 5-1 LCC Flood Map OM-05 Extract

5.3 WATERWAY MANAGEMENT

A review of the LCC Flood Hazard Trigger Overlay Map OM-13 has identified the site as being subject to various levels of waterway corridors. These areas are typically retained in their natural format where possible, with modifications required for:

- Bridge or culvert crossings
- Construction and maintenance of trunk infrastructure such as sewer
- Areas within upper reaches to facilitate earthworks and tie in

Works will be sensitive to these areas where possible – avoiding them, otherwise accommodating the recommendations of a suitably qualified professional in instances where the abovementioned infrastructure is required.

Figure 5-2 LCC Waterway Map OM-13 Extract

5.4 EXTERNAL CATCHMENTS

In addition to the defined flood and waterways discussed above, review of the local topography has identified multiple external catchments which enter the site. These are illustrated on Figure 4-1 and plans provided in Appendix B.

The magnitude of the external catchment will dictate appropriate measures as to how it will be accepted into the property and conveyed through the Legal Point of Discharge. Typically, and in order of magnitude the following will be used:

1. Retain natural drainage feature on site to upstream boundary.
2. Provide augmented open space link (or similar).
3. Provide road, pit and pipe system to capture and convey stormwater.

6 HYDROLOGICAL ASSESSMENT

6.1 OBJECTIVE

A hydrological assessment has been undertaken to determine the existing flood extents in order to inform the proposed development footprint. Therefore, only the existing state has been assessed in order to ensure that the proposed development footprint has no impact on the conveyance of existing flows throughout the site.

The management of local stormwater flows as a result of the proposed development will be dealt with in subsequent reports.

Only the 1% AEP has been taken into consideration for this assessment.

6.2 METHODOLOGY

The hydrological assessment presented in this report has been undertaken in accordance with the recently updated methodology documented in the Australia Rainfall & Runoff 2019. This methodology replaces the Average Variability Method (AVM) temporal patterns of ARR1987 with a fundamentally changed ensemble approach (ie. 10 temporal distribution per storm duration). This methodology also uses the updated design rainfall inputs sourced from the AR&R (2016) data hub.

Hydrographs extracted from the XP-RAFTS model have been used in the TUFLOW model in order to determine the median discharge flow rates downstream of the site for both pre and post development cases. This information was then used to inform proposed development footprint and indicative cross drainage infrastructure.

6.3 TEMPORAL PATTERNS

In accordance with ARR2019, Rainfall Intensities Frequency Duration data were obtained from The Bureau of Meteorology (http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016). The Latitude and Longitude of used for the site is summarised in **Table 6-1** below.

Table 6-1 Site Latitude & Longitude

Parameter	Value
Latitude	-27.773
Longitude	152.945

6.4 Modelling Parameters

Hydrological modelling parameters were obtained from the Australian Rainfall and Runoff Data Hub for the coordinates shown in Table 6-1 above.

An initial loss of 24 mm and a continuing loss of 1.6 mm/hr were applied to pervious areas, while values of 1 mm and 0 mm/hr were used for impervious areas.

The median pre-burst depths adopted in the model are listed in Table 6-2.

Table 6-2 Median Preburst Depths (mm)

Duration (hour)	% AEP					
	50	20	10	5	2	1
1	0.6	3	4.6	6.2	7.1	7.7
1.5	0.1	1.1	1.9	2.6	11.3	17.9
2	0	2.5	4.1	5.6	12.7	17.9
3	0.2	2.4	3.9	5.3	23.8	37.6
6	0.1	5.1	8.4	11.6	22.7	31
12	4.1	10.2	14.3	18.2	29.8	38.5
18	0.5	8.2	13.3	18.2	24.3	28.8
24	0.4	5.9	9.6	13.1	20.6	26.2
36	0.1	2.6	4.2	5.7	12.7	17.9
48	0	1.6	2.7	3.7	12.1	18.4
72	0	0	0	0	1.8	3.1

6.5 CATCHMENTS

All catchments have been assessed at their respective outlet locations. Refer to Appendix B for a graphical representation of the catchments.

6.6 MODEL CONDITION

One hydrologic condition has been modelled in order to appropriately demonstrate the stormwater hydraulics objective:

- **Existing Scenario** – The site in the existing state. (0% Imperviousness)
  - It should be noted that the existing scenario hydrological flows have also been used in the developed scenario, as the future development must detain flows to existing rates. Refer to Section 7 for further information.
- **Sensitivity 1** – The site has been adjusted to represent developed and un-detained flows (Site changed to 70% imperviousness). External Catchments have been maintained in the existing condition state.
- **Sensitivity 2** – The site and all external catchments have been adjusted to represent developed and un-detained flows (All catchments changed to have 70% imperviousness).

Table 6-3 below illustrates the catchment details used within XP-RAFTS for the purpose of the stormwater hydrology assessment.

Table 6-3 - XP-RAFTS Existing Catchment Details

Catchment	Area (ha)	Slope (%)	Manning's Value
Ex_5_18	16.20	5.99	0.08
Ex_5_19	23.14	4.35	0.08
Ex_5_20	10.03	5.4	0.08
Ex_5_17	24.57	4.38	0.08
Ex_5_16	25.90	4.29	0.08
Ex_5_21	27.12	5.06	0.08
Ex_5_24	14.80	3.66	0.08
Ex_5_23	17.82	5.95	0.08
Ex_5_26	12.05	4.71	0.08
Ex_5_25	6.13	3.49	0.08
Ext_5_12	36.12	5.5	0.08
Ext_5_4	36.06	10.64	0.08
Ext_5_3	6.40	7.73	0.08
Ex_5_27	9.93	5.22	0.08
Ext_5_2	21.22	15.3	0.08
Ex_5_28	5.95	5.5	0.08
Ex_5_32	6.71	6.08	0.08
Ex_5_33	17.98	4.52	0.08
Ex_5_15	18.02	4.06	0.08
Ex_5_34	20.75	6.66	0.08
Ex_5_31	10.68	5.7	0.08
Ex_5_29	8.61	8.6	0.08
Ex_5_30	11.24	10.63	0.08
Ext_5_1	5.46	8.2	0.08
Ex_5_8	15.23	5.59	0.08
Ex_5_7	5.96	8.1	0.08
Ex_5_6	5.97	6.38	0.08
Ex_5_9	15.73	4.99	0.08
Ex_5_14	11.84	5.44	0.08
Ex_5_13	8.21	7.5	0.08
Ex_5_12	4.39	2.3	0.08
Ex_5_11	7.09	5.48	0.08
Ex_5_10	5.56	6.37	0.08
Ex_6_1	95.85	4.63	0.08
Ext_5_8	2.51	13.02	0.08
Ext_5_7	4.79	12	0.08
Ex_5_5	1.49	8.66	0.08
Ex_5_4	1.72	9.89	0.08

Catchment	Area (ha)	Slope (%)	Manning's Value
Ex_5_2	3.56	8.11	0.08
Ext_5_6	3.91	13.2	0.08
Ext_5_5	10.10	12.6	0.08
Ex_5_1	5.47	13.4	0.08
Ext_6_1	971.5	3.1	0.08
Ex_6_2	12.90	2.91	0.08
Ex_6_3	10.55	8.08	0.08
Ex_6_4	5.84	2.87	0.08
Ex_6_5	9.53	11.98	0.08
Ex_6_7	3.95	5.12	0.08
Ext_6_12	15.03	12.4	0.08
Ex_6_6	4.59	3.42	0.08
Ex_6_9	1.28	5.81	0.08
Ex_6_13	4.83	11.3	0.08
Ex_6_11	1.85	7.23	0.08
Ex_6_8	5.33	4.7	0.08
Ex_6_10	7.28	4.77	0.08
Ex_6_12	6.56	4.73	0.08
Ex_6_20	3.47	7.4	0.08
Ext_6_14	30.03	6.96	0.08
Ex_6_14	12.50	14.18	0.08
Ext_5_9	3.17	12.4	0.08
Ext_5_10	33.29	6.28	0.08
Ext_5_11	4.08	6.4	0.08
Ex_5_8A	26.76	4.77	0.08
Ex_6_15	3.75	5.77	0.08

To represent the sensitivities scenarios mentioned above, the impervious percentage for the 'developed' catchments has been adjusted to 70% and Mannings n value changed to 0.03 for the pervious areas and 0.012 for the impervious area. All other parameters have been maintained.

It is important to highlight that both sensitivity assessments have been conducted to simulate an unlikely and unrealistic event. Both the proposed site and external catchment will need to implement measures to ensure that the proposed discharge rates are controlled and maintained at pre-development levels.

6.7 XP-RAFTS FLOW RATES

Flows from the XP-RAFTS model have been extracted for the existing conditions of each catchment and then applied in TUFLOW. The routing of these flows through the catchment area has been assessed in TUFLOW, with the assessment point located at the south-eastern boundaries, which are the existing points of discharge. This assessment includes all upstream catchments.

The flows extracted from TUFLOW have been checked at two specific locations, as shown in Figure 6-1 below. These flow rates have been validated against the Rational Method and the ARR Regional Flood Frequency Estimation (RFFE) model. The methodology and results of the rational method calculation and the RFFE model can be found in Appendix C. For a comparison of the 1% AEP flow rates at the two locations, please refer to Table 6-4 below.

It should be noted that the flow rates provided for the “XP-RAFTS / TUFLOW Routing” values were deemed to be the “critical” flow rates at each location. Section 7.2.2.7.1 of this report describes the methodology undertaken to generate MAXMED flood grids. The “SRC” files were used to determine a critical TP for each location, from which flow rates were extracted for this comparison.

Figure 6-1 Flow Extraction Locations

Table 6-4 Flow Comparison – Base Scenario (m^3/s)

Location	XP-RAFTS / TUFLOW Routing	RFFE	Rational Method
A – Subject Site Catchment	109.67 90m duration, TP6	109	96.88

Location	XP-RAFTS / TUFLOW Routing	RFFE	Rational Method
B – Main External Catchment	84.27 270m duration, TP2	96.2	83.37

From the above table, the modelling results undertaken appear to generally be consistent with the validation methods conducted.

7 HYDRAULIC ASSESSMENT

7.1 METHODOLOGY

The hydraulic assessment has been undertaken to evaluate how the proposed development will manage flows being conveyed through the site.

The hydraulic assessment of the proposed development required a detailed understanding of the hydraulic and hydrological characteristics under a series of storm events. To assess the complex flood behaviour around the site, a TUFLOW model for the catchment has been identified as the preferred method to accurately determine any impacts caused by the proposed development.

The hydraulic and hydrological impact assessment undertaken via a two-dimensional model presents more accurate results through utilising a grid to represent the catchment topography and complex existing flow distribution. The results are particularly relevant around the inflow and outflow locations of the site, determining peak flow rates, the extent of flood inundation as well as flow distribution.

7.2 DRAINAGE CORRIDOR ASSESSMENT

7.2.1 OBJECTIVES

The primary objective of this assessment is to ensure the stormwater peak 1%AEP discharge must be safely conveyed through the site. Appropriate stormwater infrastructure is therefore required to ensure that there is no encroachment of proposed development into overland flow paths and infrastructure can be provided to convey flows.

7.2.2 MODEL SET UP AND ADOPTED DATA

The following sections provide discussion on the adopted inputs into the TUFLOW model:

7.2.2.1 BOUNDARY CONDITIONS

The upstream boundary conditions have been set at various locations along the site's western, northern and southern boundary, whilst the downstream boundary conditions have been set along the eastern boundary of the site. As shown previously in Figure 4-1.

7.2.2.2 MODEL ROUGHNESS

A Manning's value of 0.1 which represents a densely vegetated area has been adopted to the modelled waterways. Roads traversing the site have adopted a Manning's value of 0.02.

7.2.2.3 GRID SIZE

A 5m grid has been adopted in the model to accurately represent the hydraulic features of the drainage corridor.

7.2.2.4 DRAINAGE INFRASTRUCTURE

Free flowing culverts have been included in the model throughout the development site to allow for flows to freely drain through the site. Future modelling shall be undertaken to refine culvert extents and sizes.

7.2.2.5 MODEL SCENARIO

The existing terrain has been represented based on LiDAR information for the area and included in the model for use. Model surface roughness has been determined by Arcadis.

7.2.2.6 MODEL BLOCKAGE VALUES

The model incorporates 1-D hydraulic structures with no blockage values.

7.2.2.7 HYDROLOGY

An XP-RAFTS rainfall runoff model for the catchments was used to determine the hydrograph for the 1% AEP. The results for this model were then used to give an indication of which duration would be critical at the assessment point, however, the routing of flows through the catchment and determination of median temporal pattern has been undertaken in TUFLOW.

7.2.2.7.1 Determination of Critical Durations and Median Temporal Pattern

TUFLOW was run initially for the storm durations ranging from 10 minutes to 540 minutes using all 10 temporal patterns based on the results of the XP-RAFTS modelling. It was found that the critical durations vary from 45min to 360min.

Once the critical durations were selected, the simulation output was processed as follows:

- For each storm duration, the median flood grid was extracted from the 10 temporal pattern flood grids using the TUFLOW utility asc_to_asc.exe, -statMedian switch.
- The median flood grids for each of the simulated durations were combined to form the maximum median flood grid for each AEP (referred to as MAXMED within this report).

Figure 7-1 and Figure 7-2 below provide an example of the critical duration output and median temporal output respectively.

The MAXMED in Figure 7-1 highlights that for Location B the 270 minutes storm duration is the critical and as Shown in Figure 7-2, TP2 has been determined to be the median temporal pattern. The same approach has been used to determine the critical duration and temporal patter for Location A

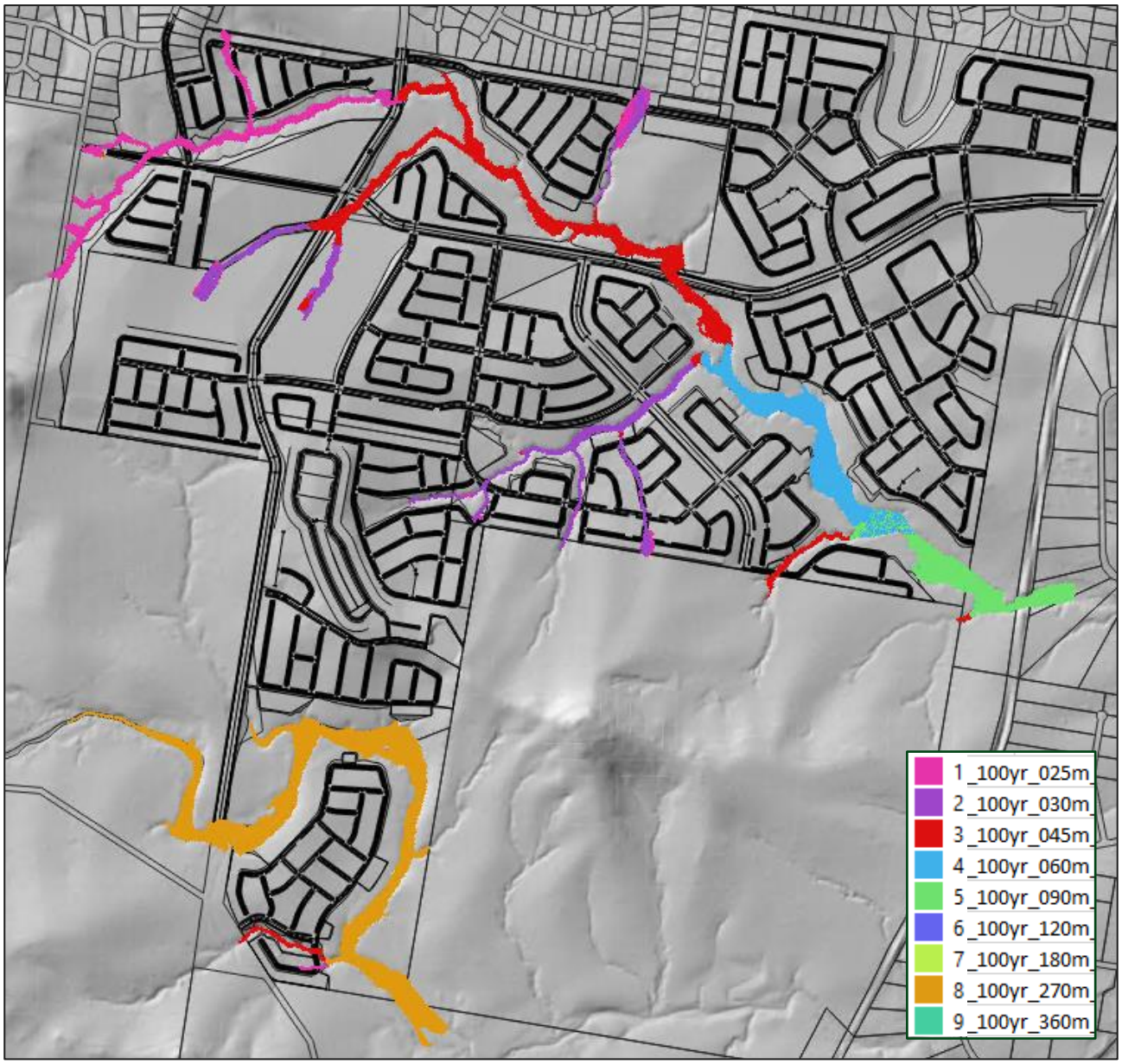


Figure 7-1 - Critical Duration Output - Base Scenario

Figure 7-2 - Median Temporal Pattern Output - 270m Duration - Base Scenario

7.2.3 ASSUMPTIONS AND LIMITATIONS

7.2.3.1 KEY LIMITATIONS

7.2.3.1.1 LiDAR Ground Survey & Model Roughness

The model topography has been based on LiDAR survey information. Arcadis have adopted the surface roughness values in the model based on survey and aerial imagery.

7.2.3.1.2 Climate Change

Climate change has not been considered in this assessment.

7.2.3.1.3 Upstream Model Results

It should be noted that this report focuses on the design of the conveyance of flow through the development site. This report and associated mapping does not show accurate extents of flooding or changes to existing flooding behaviour upstream of the proposed structures. Future development upstream of the site should include individual flood studies to ensure any development is sufficiently protected from stormwater within the drainage corridor as a result of unmitigated development within the regional catchment.

7.2.3.2 KEY ASSUMPTIONS

7.2.3.2.1 Proposed Development

The proposed development will implement measures to ensure no increase in peak discharge rate. No significant changes to discharge locations and no redirection of major catchment areas have been undertaken. It must be noted that all pipe/culvert sizes included within the model are indicative only and subject to future design.

7.2.4 MODEL RESULTS

The stormwater conveyance assessment was conducted by comparing the existing flood extents with the proposed development footprint. The 1% AEP results indicate that the proposed development footprint does not impede the conveyance of existing flows through the development site.

A sensitivity assessment was also conducted, demonstrating that the determination of development extents is not influenced by attenuation of post development peak flows for the proposed development site and external catchments conveyed through the site. It is noted that future basins will need to be provided to ensure no downstream impacts; however, addressing this is beyond the scope of this report.

Appendix E presents flood levels for the base case and the sensitivity scenarios discussed in Section 6.6.

7.2.4.1 FLOOD DEPTHS

Figure 7-3, Figure 7-4 and Figure 7-5 below provide the 1% AEP peak flood water depth and flood extents for all assessed scenarios for the MAXMED.

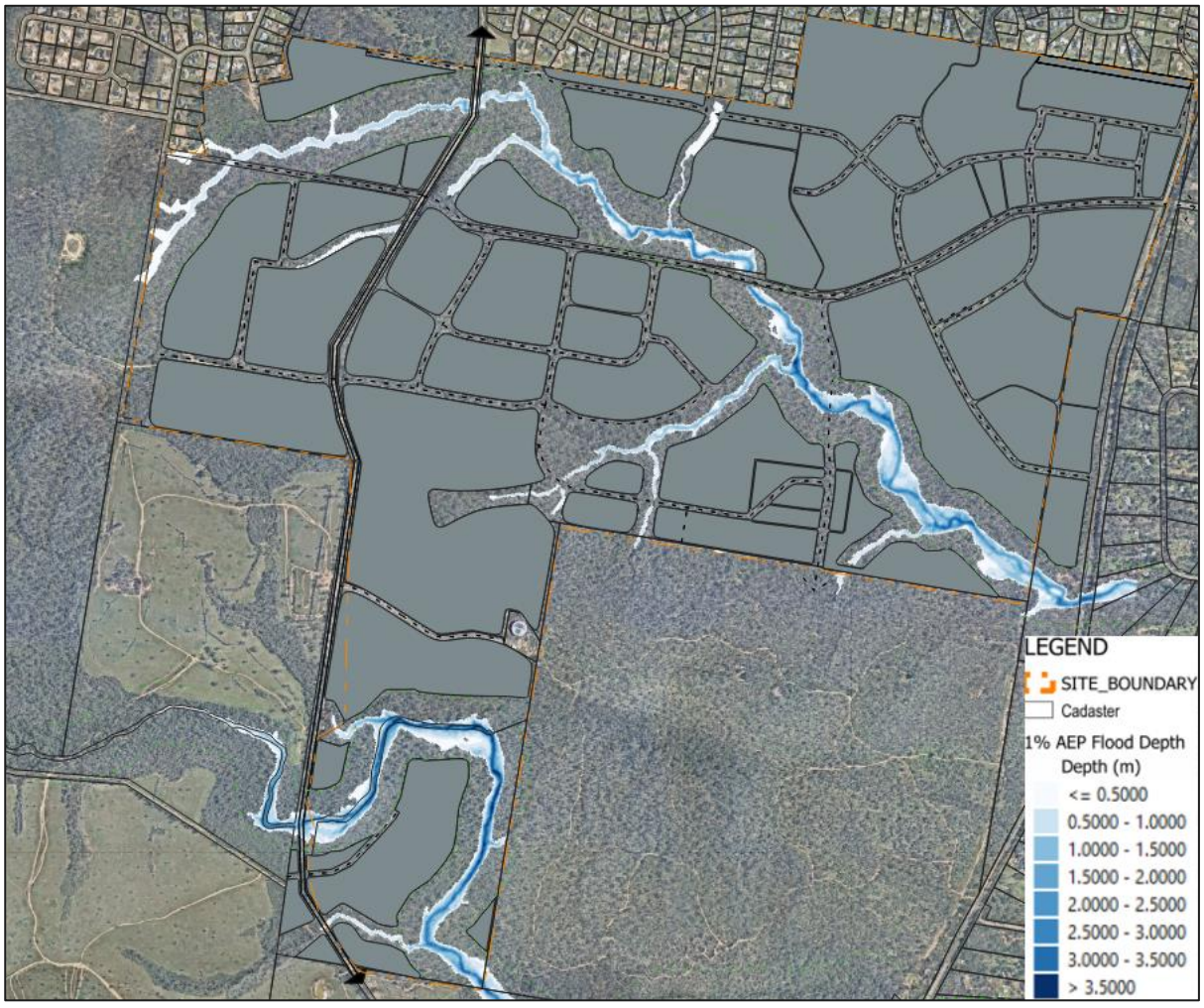


Figure 7-3 - Peak Water Depth - 1% AEP

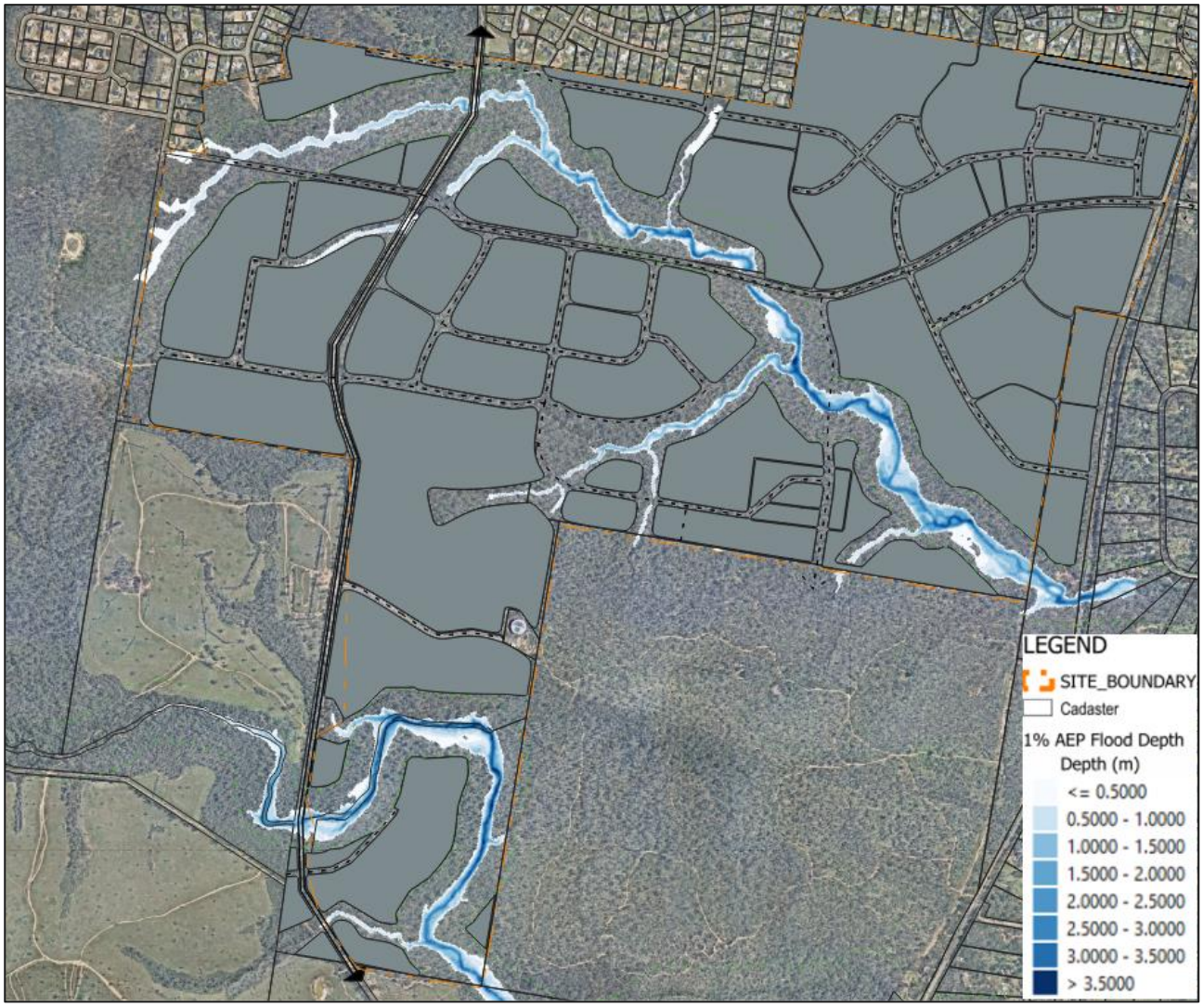


Figure 7-4 - Peak Water Depth - 1% AEP – Sensitivity 1

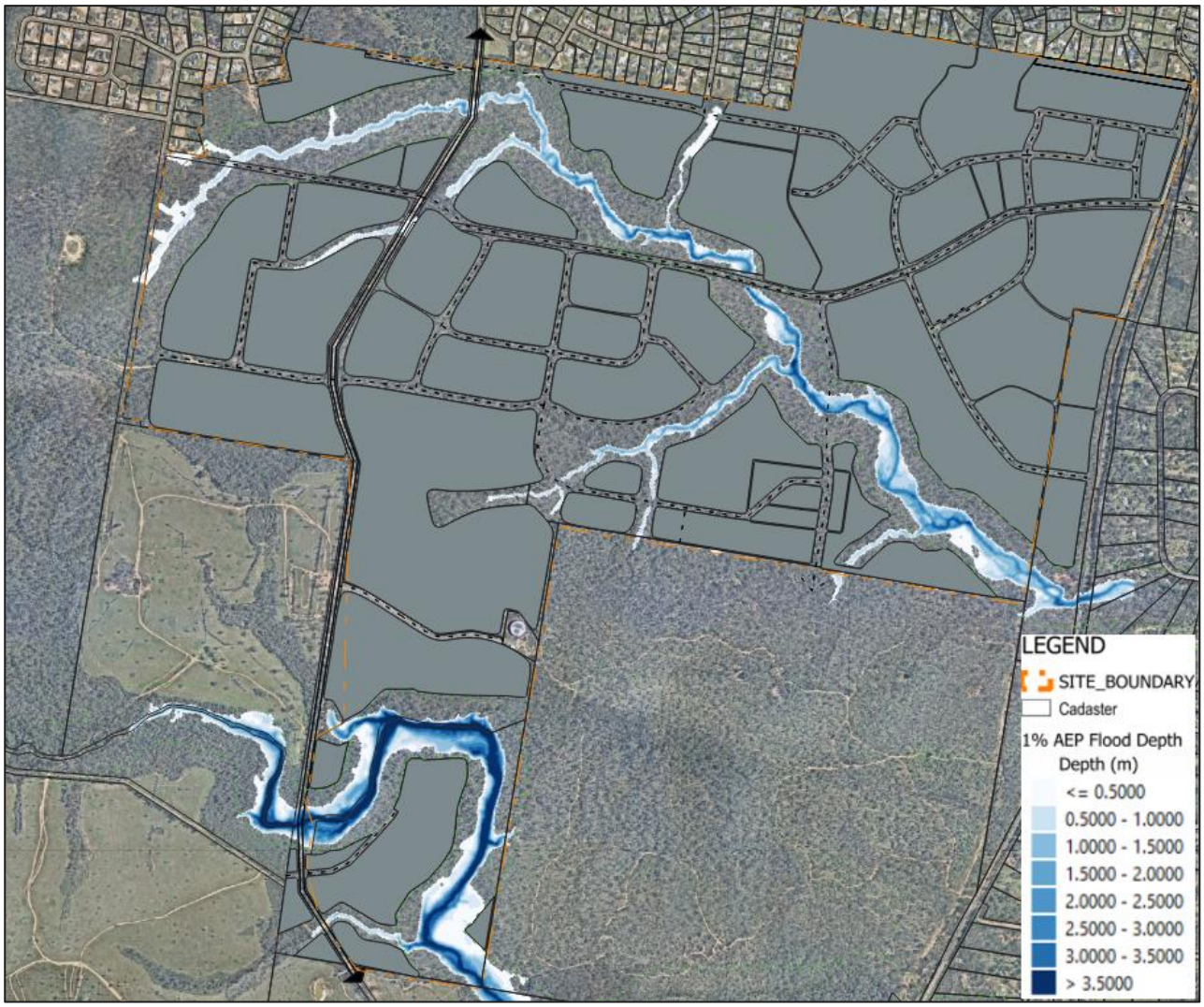


Figure 7-5 - Peak Water Depth - 1% AEP Sensitivity 2

The results indicate that the proposed development does not encroach upon the flood extents. Even when considering the development of both the site and all external areas without detention (see Figure 7-5), flows remain contained within the corridor and are unaffected by the proposed development footprint. For detailed extents and flood levels, refer to Appendix E.

7.3 OBJECTIVE DISCUSSION

The objective of this assessment was to ensure that the proposed development extents identified in the Context Plan do not encroach into the flood extents allowing existing flow conveyance to be maintained through the site.

8 CONCLUSION

Arcadis has been engaged by New Beith Pty Ltd to complete a Stormwater Conveyance Master Plan (SCMP) for a proposed master-planned development in New Beith, QLD.

The New Beith site occupies approximately 598ha of land between existing New Beith residential areas, train line and Flagstone Creek within the Greater Flagstone Priority Development Area (PDA). Varying residential densities and supporting land uses such as educational and open space are proposed, complimentary to the land which features various drainage features, low to high steepness and other encumbrances such as roads.

This SCMP has demonstrated that the proposed Context Plan for the development makes suitable allowance for major flow conveyance that should enable compliance with the relevant stormwater performance outcomes in accordance with Economical Development Queensland (EDQ) Engineering Standard Guidelines 13 and 15, State Planning Policy (SPP) and Logan City Council (LCC) requirements. The SCMP includes the assessment of sensitivity scenarios, considering the conveyance of unmitigated flows through the development site to further confirm suitability of the context plan footprint.

This report focuses on the management of existing stormwater conveyance through the site as summarised below:

> **The conveyance of existing stormwater through the site is not altered in a manner that may substantially damage a third party due to the proposed Context Plan development footprint.**

This SCMP has identified the key locations where stormwater enters and leaves the subject property. Retention of the major locations generally in their natural state is key to reducing the likelihood of significant hydraulic changes. Minor receiving and discharging locations will typically be accepted on site via modified open space areas or engineering infrastructure, designed to capture stormwater using culverts.

This SCMP outlines the limitations of the current assessment, primarily noting that internal detention basins have not been included at this stage. As a conservative approach, stormwater detention will be provided within the development footprint of each catchment. Should future stages consider online basins, in addition to hydraulic assessment coordination with Department of Agriculture and Fisheries (DAF) will be necessary due to the mapped waterway within the overland flow path, and geotechnical advice will be sought to address the presence of dispersive soils.

This assessment is only dealing with the conveyance of existing flows through the site and ensuring that the proposed development footprint does not encroach on these flow paths. It is noted that the proposed development will have to ensure that peak discharge rates are maintained at existing levels.

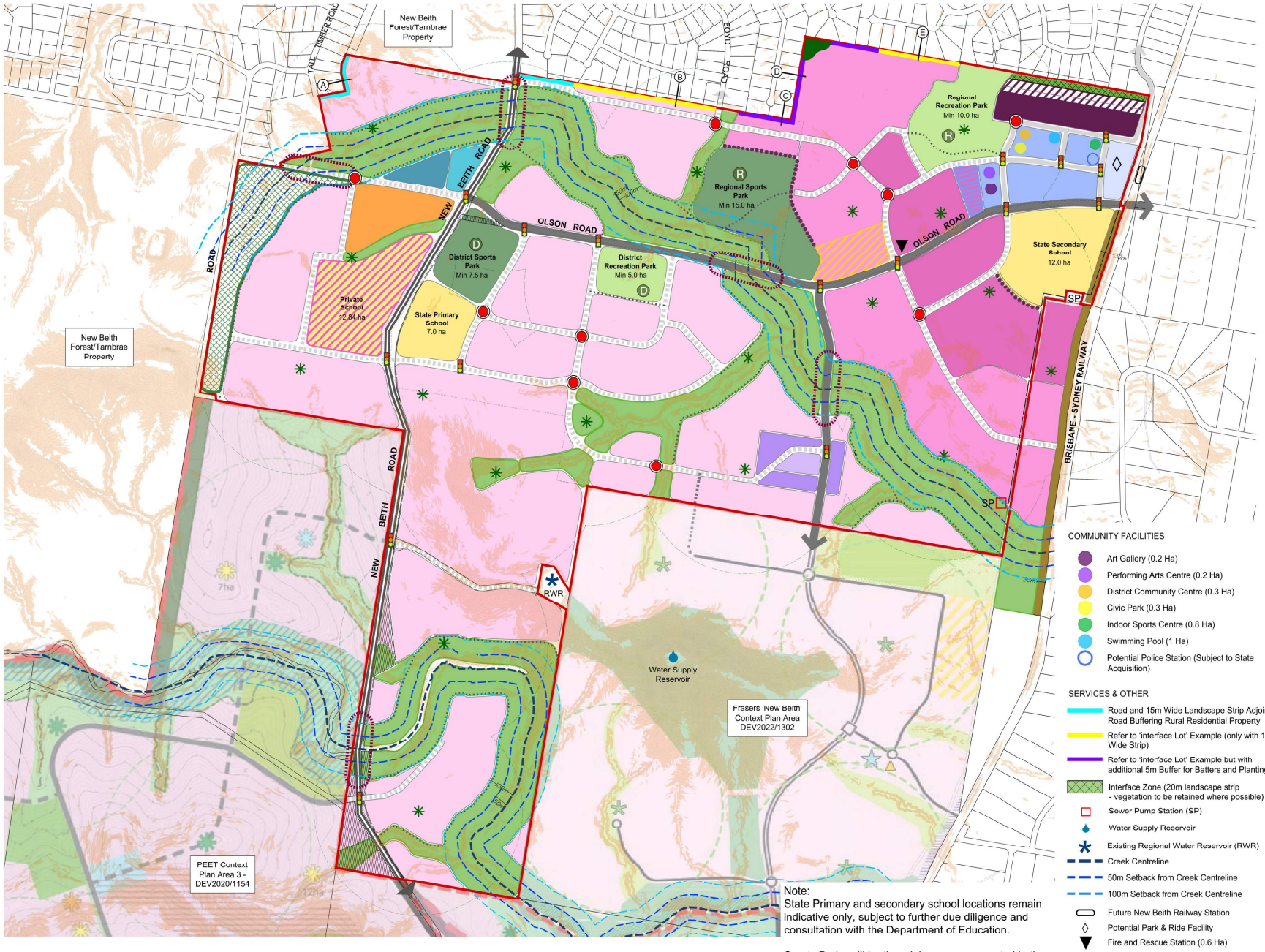
It is recognized that precinct/stage specific stormwater management plans and similar hydraulic based reports, would be provided subsequent to this SCMP, generally adopting this high-level strategy with the intent on demonstrating an acceptable outcome to EDQ, SPP and LCC's relevant planning guidelines.

APPENDIX A

CONTEXT PLAN

Context Plan (Overall)

NOT TO BE USED FOR ENGINEERING DESIGN OR CONSTRUCTION



Note:
State Primary and secondary school locations remain indicative only, subject to further due diligence and consultation with the Department of Education.

Sports Parks will be the minimum area as noted in the whole of site approval, or 1.8ha/1000 population - whichever is greater.

NOTES

This plan was prepared as a conceptual layout only. The information on this plan is not suitable for any other purpose.

Property dimensions, areas, numbers of lots and contours and other physical features shown have been compiled from existing information and may not have been verified by field survey. These may need verification if the development application is approved and development proceeds, and may change when a full survey is undertaken or in order to comply with development approval conditions.

No reliance should be placed on the information on this plan for detailed subdivision design or for any financial dealings involving the land.

Pavements and centrelines shown are indicative only and are subject to Engineering Design.

Saunders Havill Group therefore disclaims any liability for any loss or damage whatsoever or howsoever incurred, arising from any party using or relying upon this plan for any purpose other than as a document prepared for the sole purpose of accompanying a development application and which may be subject to alteration beyond the control of the Saunders Havill Group. Unless a development approval states otherwise, this is not an approved plan.

LEGEND

- Site Boundary
- Land Dedication (30m Railway Corridor)
- Slope Affected Land (≥15%)

ZONING

- Education
- Potential State Primary School (Subject to State agency acquisition)
- District Centre (up to 5 storeys)
- Centre Transition Zone - Centre or Residential Uses up to 3 storeys
- Multiple Residential (min 50dw/Ha and up to 5 storeys)
- Multiple Residential - Transition (up to 2 storeys)
- Mixed Use/Railway Station
- Local Centre (up to 3 storeys)
- Local Centre - Residential (min 20dw/Ha and up to 3 storeys)
- Neighbourhood Centre (up to 3 storeys)
- Neighbourhood Centre - Residential (min 20dw/Ha and up to 3 storeys)
- Active Living/Retirement Precinct (min 40dw/Ha)
- High Density Residential Neighbourhood (min density 30 dw/Ha)
- Mixed Residential Neighbourhood (15-30 dw/Ha)
- Urban Residential Neighbourhood (min 15dw/Ha)
- Potential Urban Residential Neighbourhood (Alternative Use)

COMMUNITY FACILITIES

- Art Gallery (0.2 Ha)
- Performing Arts Centre (0.2 Ha)
- District Community Centre (0.3 Ha)
- Civic Park (0.3 Ha)
- Indoor Sports Centre (0.8 Ha)
- Swimming Pool (1 Ha)
- Potential Police Station (Subject to State Acquisition)

SERVICES & OTHER

- Road and 15m Wide Landscape Strip Adjoining Road Buffering Rural Residential Property
- Refer to 'interface Lot' Example (only with 15m Wide Strip)
- Refer to 'interface Lot' Example but with additional 5m Buffer for Batters and Planting
- Interface Zone (20m landscape strip - vegetation to be retained where possible)
- Sewer Pump Station (SP)
- Water Supply Reservoir
- Existing Regional Water Reservoir (RWR)
- Creek Centreline
- 50m Setback from Creek Centreline
- 100m Setback from Creek Centreline
- Future New Beith Railway Station
- Potential Park & Ride Facility
- Fire and Rescue Station (0.6 Ha)
- Possible Fauna Underpass

GREENSPACE

- Major, Linear, Local Linear or other Open Space
- Environmental Protection Area in accordance with Endorsed Natural Environment Overarching Site Strategy
- Sports Park
- Recreation Park
- Neighbourhood Recreation Park
- Neighbourhood Recreation Park (Possible Location)
- 400m Catchment Offset
- Regional
- District

ROAD NETWORK

- Trunk Urban Arterial Multi Modal Dual Carriageway - in accordance with the Endorsed Movement IMP
- Trunk Connector - in accordance with the Endorsed Movement IMP
- Centre Access Street - in accordance with the Endorsed Movement IMP
- Neighbourhood Connector - in accordance with the Endorsed Movement IMP
- Possible Future Neighbourhood Connector
- Shared Path - Shared path (3.0m) within linear/local/other park
- Access Road frontage
- Possible Closed Road
- Proposed Bus Stop Location
- Controlled Intersection - Possible Roundabout
- Controlled Intersection - Possible Signalised Intersection

saunders havill group

NEW BEITH PTY LTD

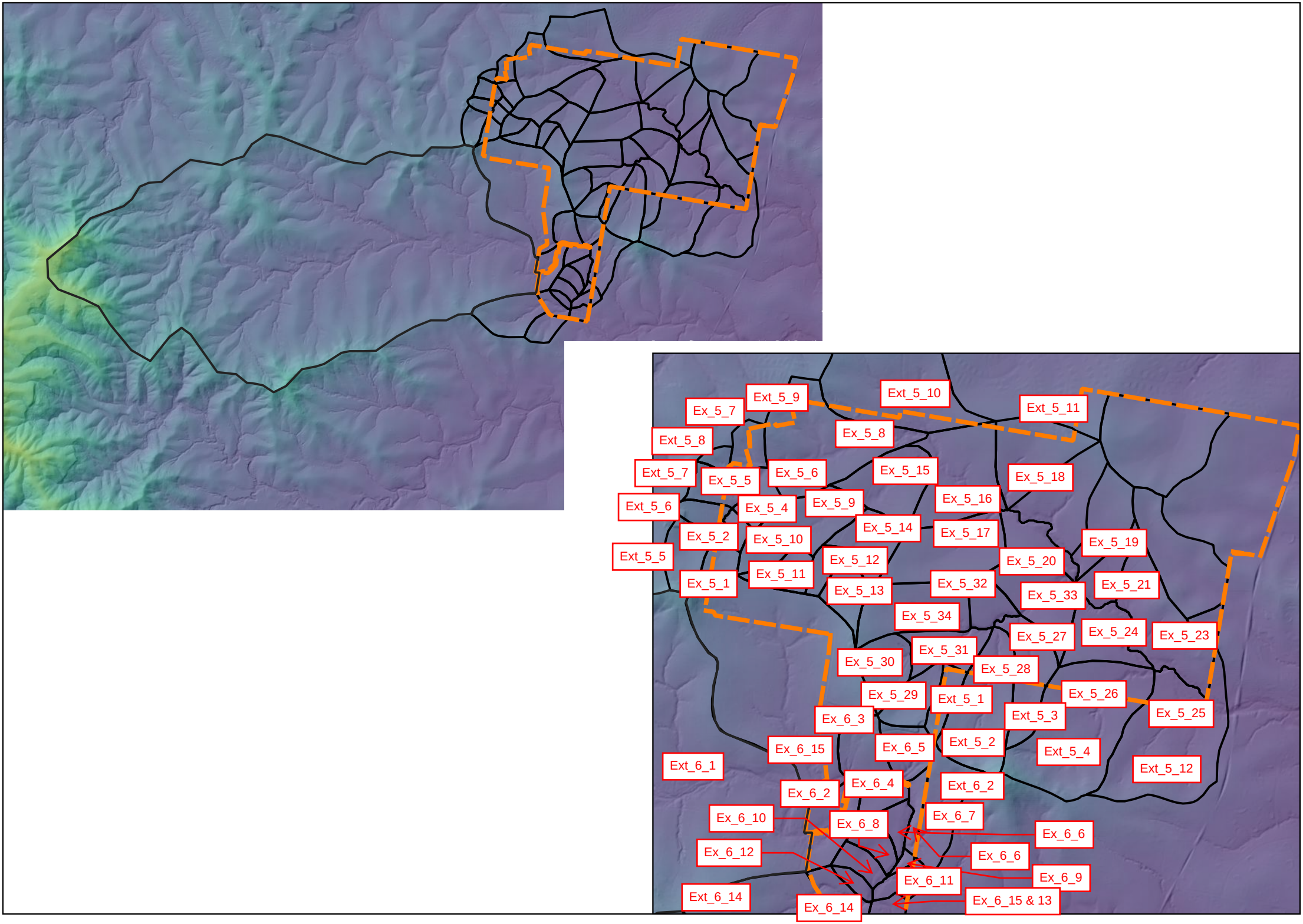
SCALE @A1 1:7500 @A3 1:15000 - LENGTHS ARE IN METRES

100 0 100 200 300 400 500 600 700 800 900

NEW BEITH ROAD, NEW BEITH • 17/10/2024 • 8905 P 17 Rev Q - SK 01

APPENDIX B

STORMWATER CATCHMENT PLAN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Ext_5_10
Ext_5_11
Ex_5_7
Ex_5_8
Ext_5_8
Ext_5_7
Ex_5_5
Ex_5_6
Ex_5_15
Ex_5_18
Ext_5_6
Ex_5_4
Ex_5_9
Ex_5_16
Ex_5_2
Ex_5_14
Ex_5_17
Ex_5_19
Ex_5_10
Ext_5_5
Ex_5_12
Ex_5_20
Ex_5_1
Ex_5_11
Ex_5_13
Ex_5_32
Ex_5_33
Ex_5_21
Ex_5_34
Ex_5_27
Ex_5_24
Ex_5_23
Ex_5_31
Ex_5_30
Ex_5_28
Ex_5_29
Ext_5_1
Ex_5_26
Ex_6_3
Ext_5_3
Ex_5_25
Ex_6_15
Ex_6_5
Ext_5_2
Ext_5_4
Ext_6_1
Ex_6_4
Ext_5_12
Ex_6_2
Ext_6_2
Ex_6_10
Ex_6_8
Ex_6_7
Ex_6_6
Ex_6_12
Ex_6_6
Ex_6_11
Ex_6_9
Ext_6_14
Ex_6_14
Ex_6_15 & 13

APPENDIX C

STORMWATER FLOW COMPARISON

METHOD 1 – RFFE

A – Subject Site Catchment

RESULTS FROM ARR RFFE 2015 MODEL

Datetime: 2023-08-24 14:37
Region name: East Coast
Region code: 1
Site name: Catchment2
Latitude at catchment outlet (degree) = -27.775922
Longitude at catchment outlet (degree) = 152.96212
Latitude at catchment centroid (degree) = -27.769176
Longitude at catchment centroid (degree) = 152.945891
Distance of the nearest gauged catchment in the database (km) = 5.2
Catchment area (sq km) = 5.77
Design rainfall intensity, 1 in 2 AEP and 6 hr duration (mm/h): 9.677624
Design rainfall intensity, 1 in 50 AEP and 6 hr duration (mm/h): 23.259978
Shape factor of the ungauged catchment: 0.73

ESTIMATED FLOOD QUANTILES:

AEP (%)	Expected quantiles (m^3/s)	5% CL m^3/s	95% CL m^3/s
50	17.7	8.19	38.3
20	33.4	15.8	71.0
10	47.1	20.6	107
5	62.8	24.7	159
2	87.4	29.4	257
1	109	32.8	359

DATA FOR FITTING MULTI-NORMAL DISTRIBUTION FOR BUILDING CONFIDENCE LIMITS:

1 Mean (loge flow) = 2.938
2 St dev (loge flow) = 0.687
3 Skew (loge flow) = 0.111

Moments and correlations:

No	Most probable	Std dev	Correlation		
1	2.938	0.472	1.000		
2	0.687	0.312	-0.330	1.000	
3	0.111	0.030	0.170	-0.280	1.000

This is the end of output file.

B – Main External Catchment

RESULTS FROM ARR RFFE 2015 MODEL

Datetime: 2023-08-24 14:32
Region name: East Coast
Region code: 1
Site name: Catchment1
Latitude at catchment outlet (degree) = -27.783502
Longitude at catchment outlet (degree) = 152.935738
Latitude at catchment centroid (degree) = -27.781707
Longitude at catchment centroid (degree) = 152.907229
Distance of the nearest gauged catchment in the database (km) = 5.83
Catchment area (sq km) = 9.57
Design rainfall intensity, 1 in 2 AEP and 6 hr duration (mm/h): 9.597052
Design rainfall intensity, 1 in 50 AEP and 6 hr duration (mm/h): 22.943232
Shape factor of the ungauged catchment: 0.91

ESTIMATED FLOOD QUANTILES:

AEP (%)	Expected quantiles (m^3/s)	5% CL m^3/s	95% CL m^3/s
50	15.1	6.99	32.6
20	28.7	13.6	61.0
10	40.7	17.8	92.4
5	54.6	21.5	138
2	76.5	25.8	224
1	96.2	28.9	315

DATA FOR FITTING MULTI-NORMAL DISTRIBUTION FOR BUILDING CONFIDENCE LIMITS:

1 Mean (loge flow) = 2.794
2 St dev (loge flow) = 0.687
3 Skew (loge flow) = 0.111

Moments and correlations:

No	Most probable	Std dev	Correlation		
1	2.794	0.472	1.000		
2	0.687	0.312	-0.330	1.000	
3	0.111	0.030	0.170	-0.280	1.000

This is the end of output file.

METHOD 2 – RATIONAL METHOD

Parameter	A – Subject Site Catchment	B – Main External Catchment
Area (ha)	577.2	971.0
USIL (m AHD)	142.66	304.625
DSIL (m AHD)	33.365	51.6
Fall (m)	109.295	253.025
Longest run (m)	4836	7810
Avg Slope	2%	3%
n (Horton's) *	0.035	0.035
Max flow (m) **	50	50
Sheet time (mins) ***	13	13
Stream Velocity (m/s) #	2	1
Travel time (mins)	40.3	130.2
Total time (mins)	53	143
1 I 10 (mm/h)	56.8	56.8
C10 ##	0.53	0.53
Fy (1% AEP)	1.2	1.2
Cy	0.636	0.636
I (mm/h)	95	48.6
Q (m3/s)	96.88	83.37

* QUDM Table 4.64

** QUDM Table 4.65

*** QUDM Figure 4.4

QUDM Table 4.6.6

QUDM Table 4.5.4

APPENDIX D

PEER REVIEW COMMENTS

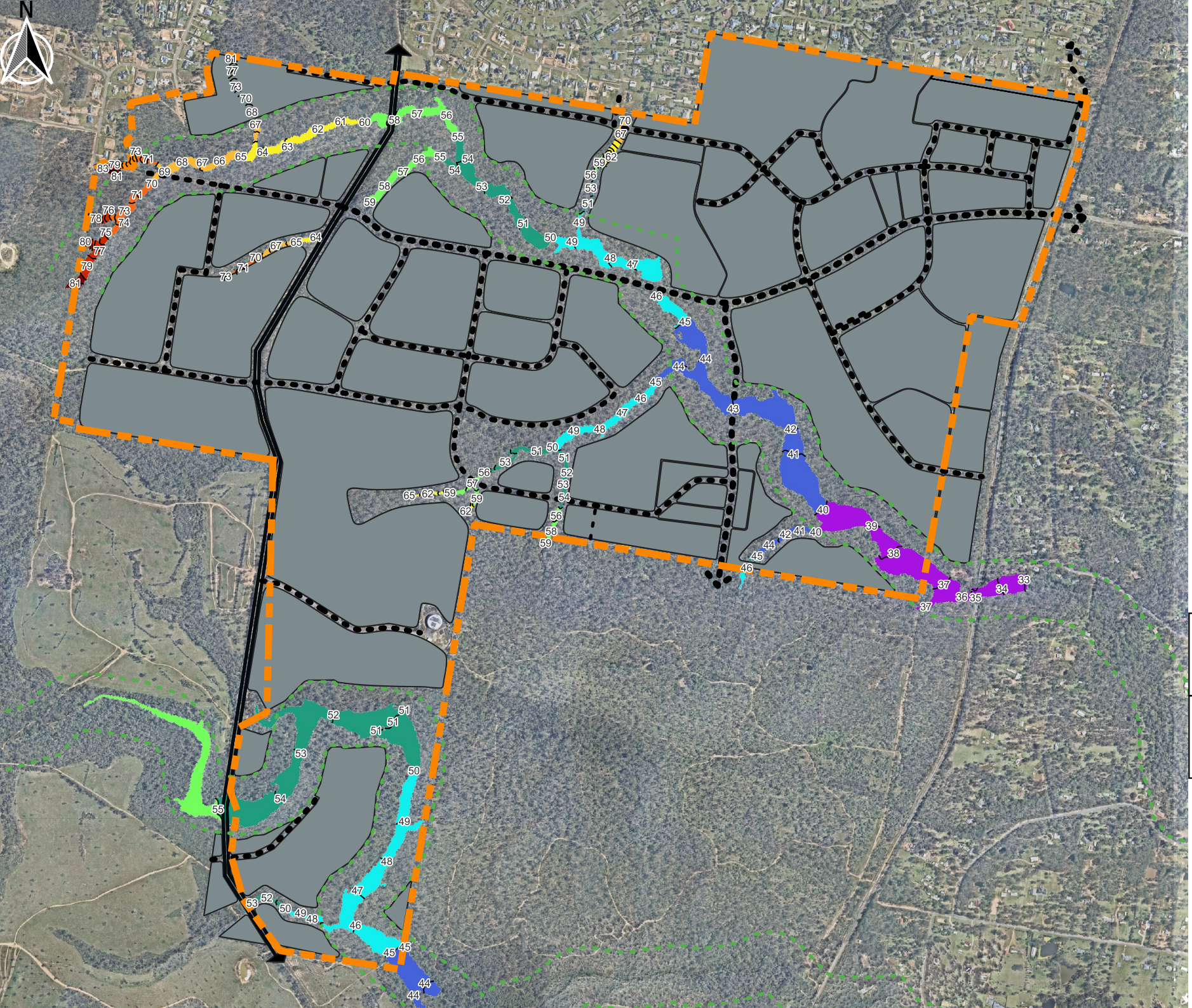
Item	Observation	Response	Peer Review Comments	Response October 2024
1	Report is lacking in technical detail and does not provide sufficient information for the work to be reproduced. As an example there is no reporting of peak flows or peak flood levels within the site which should be the bare minimum reporting for a flood assessment of this nature.	A flow comparison is included within Section 6.7 of this report.	Addition of the peak flow comparison provides peak discharges at two locations. No water level information is provided in Section 7 of the report. It is noted that additional information is provided including reference to the preburst data adopted for the study. However, the report still lacks detail on other inputs and assumptions including IFD rainfall data, losses and assumptions for impervious fractions. Further there is no mapping of flood levels, velocities or hazard nor is there consideration of the affects of climate change or freeboard provisions for the different dvelopment areas. The report also relies on other documentation to show the locations of the basins. It is recommended to include all relevant material within this document showing all basin locations and sizing.	Water level maps are now provided in Appendix E. Additional information is provided in Section 6.4 of the report. Whilst there is no Climate change Sensitivity, a more conservative sensitivity has been provided in the form of increased imperviousness without detention for internal and external catchments. The intent of this report has been clarified in meeting with EDQ on the 17th of October 2024 being to confirm the proposed Context Plan development footprint does not impact the existing stormwater conveyance through the development. It has been agreed that basins will be provided within the development footprint and sized at a later stage of development assessment to demonstrate peak flow attenuation as a result of the development.
2	Peak flows within the site have not been validated. Recommended to compare to RFFE or Rational Method.	Peak Flow comparison is now provided within Section 6.7 of this report. Appendix C provides the full calculations / inputs.	Addition of the peak flow comparison is acknowledged and provides confidence in the peak discharges estimated with the XP-RAFTS model.	Noted - Closed
3	On review of the 2019 SIMP, the assumption within the conveyance masterplan that the basins are outside of the flood corridor does not appear valid with many basins within the waterway corridor. The overall detention strategy of the masterplan and the stormwater conveyance assessment should ideally be linked in strategies. Clarification is sought as to the validity of this assumption.	While there are only a few locations where basins are currently within the waterway corridor, these basins will either be adjusted to be outside of the flood extent within the corridor or moved into the development footprint. Final basin locations will be dependent of ROL development layouts and associated grading.	Acknowledged. It is important that the final stormwater management strategy be linked with the Stormwater Conveyance Master Plan to ensure that placement of the development layout and associated infrastructure does not impact flood behaviour within the waterway corridors. It is recommended that basin locations within the waterway corridor are identified and adjusted accordingly using the results of this analysis. If basins are in the waterway corridor they could significantly increase water levels locally and compromise development freeboards.	As discussed in the meeting with EDQ on 17th October 2024, the primary intent of this report is to confirm the proposed Context Plan development footprint does not impact the existing stormwater conveyance through the development. At this preliminary stage, detention basins are proposed to be located within the designated development footprint only. We acknowledge that if online basins or locations within the waterway corridor are considered in future stages, a comprehensive assessment would be necessary to evaluate their impacts on flood behaviour.

4	It is recommended that an overall detention strategy is based on dynamic hydrological modelling (considering ARR 2019 design storms and the interaction of all the individual basins) rather than simplistic volumetric calculations for each subcatchment area. The adopted approach has potential to coincide developed basin outlet peak flows and increase flood discharges downstream.	There are uncertainties at this stage in relation to development layout with the current intent to confirm context plan only. Final basin locations will be dependent of ROL development layouts and associated grading. A sensitivity assessment is now provided showing developed and unretained flows. Refer Section 6.6 and 7.2.4.	Acknowledged. It is important that the final stormwater management strategy be linked with the Stormwater Conveyance Master Plan to ensure that placement of the development layout and associated infrastructure does not impact flood behaviour within the waterway corridors. The study has not demonstrated that downstream peak flows have been mitigated and therefore the study has not demonstrated that the site can convey stormwater without damaging third parties. Our comment regarding the timing of the basins has not been addressed. It is recommended further modelling is undertaken to demonstrate that there will be no increase in peak flow downstream of the Development.	Refer above item for agreed intent of this assessment. We note that at future stages basins will be sized at a later stage of development assessment to demonstrate peak flow attenuation as a result of the development.
4	The detention strategy documented in the SIMP (2019) involves up to 31 basins which would be a maintenance burden for future asset operators. It is recommended to consider a more consolidated basin approach which utilises online detention systems to reduce assets/maintenance for future infrastructure owners.	We agree that this option is preferred for consolidation of the basins however, we haven't adopted online basins at current as a conservative approach to the context plan. We note that consideration of online basins will include coordination with DAF as the overland flow path is a mapped waterway. In adiditon geotechnical advice would be required due to the presence of dispersive soils.	Acknowledged although the report should state this limitation and if the opinion of the consultant is that this is a better outcome then the report should clearly state this. This allows future iterations of the design to consider this option.	Noted - Aditional discussion is now inlcuded
5	The high-level conveyance assessment does not consider that peak discharges within the development site boundary can be increased over the existing case. Based on this, there is uncertainty that the waterway corridor provisions are adequate. It is recommended to add	Agreed. Refer item 4	Sensitivity analysis is acknoweldged and the different peak flood depth maps have been reviewed. However, there is no discussion on how sensitive the model is to these scenarios or how flood depths and levels vary in each scenario. There is also no discussion or justification of the selection of zero percent blockage for the 1-d structures.	Noted - Aditional discussion is now inlcuded

	discussion in the report addressing this and considerations of sensitivity analysis or freeboard discussions.			

APPENDIX E

FLOOD MAPS



LEGEND

Site Boundary

Site Boundary

Cadastre

Cadastre

Flood Level

m (AHD)

<= 40.0000

40.0000 - 45.0000

45.0000 - 50.0000

50.0000 - 55.0000

55.0000 - 60.0000

60.0000 - 65.0000

65.0000 - 70.0000

70.0000 - 75.0000

75.0000 - 80.0000

> 80.0000

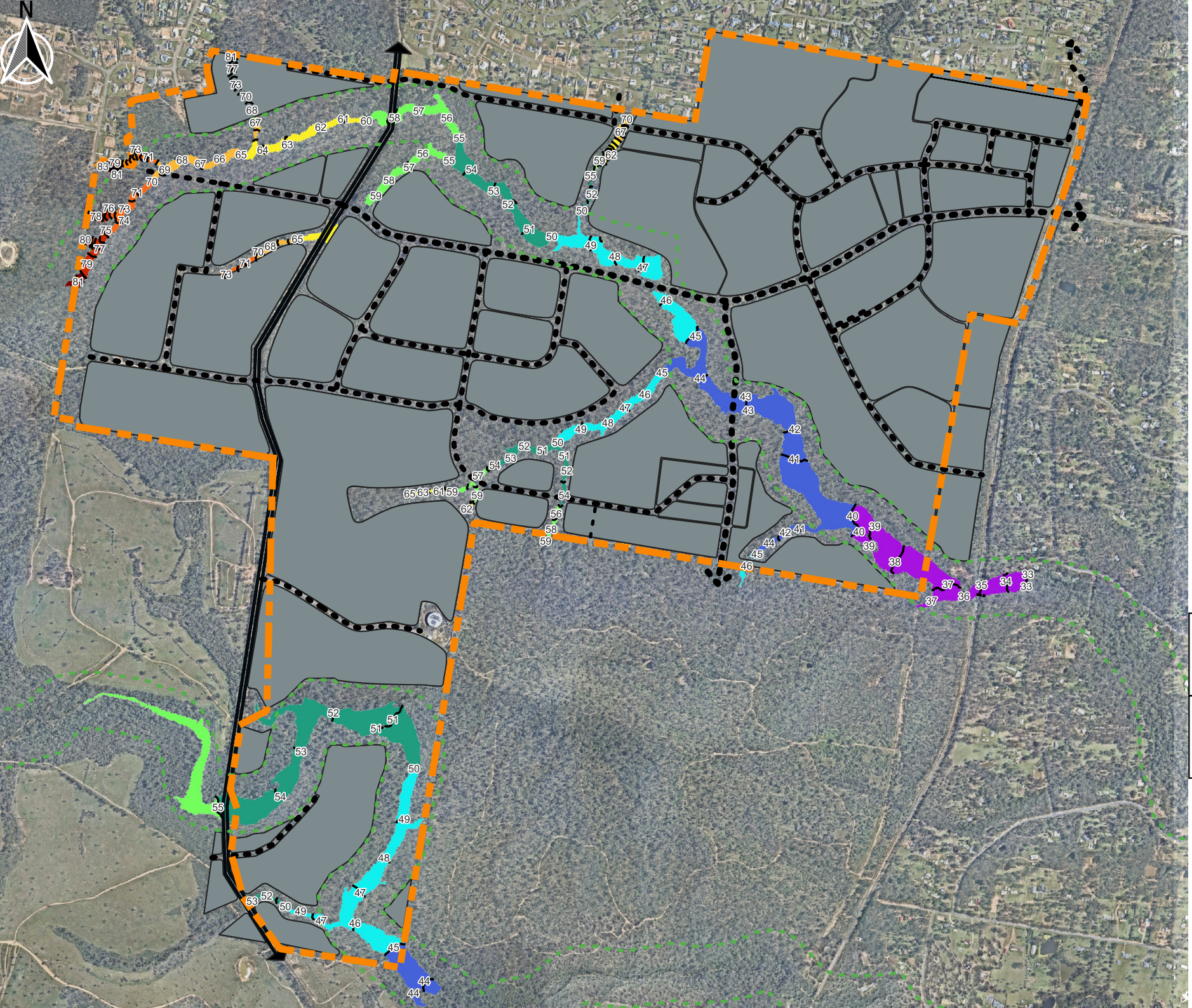
NEW BEITH ROAD, NEW BEITH

Figure E1 - 1% AEP Flood Levels - Developed

0 250 500 m

Scale

ARCADIS



LEGEND

Site Boundary

Site Boundary

Cadastre

Cadastre

Flood Level

m (AHD)

- <= 40.0000
- 40.0000 - 45.0000
- 45.0000 - 50.0000
- 50.0000 - 55.0000
- 55.0000 - 60.0000
- 60.0000 - 65.0000
- 65.0000 - 70.0000
- 70.0000 - 75.0000
- 75.0000 - 80.0000
- > 80.0000

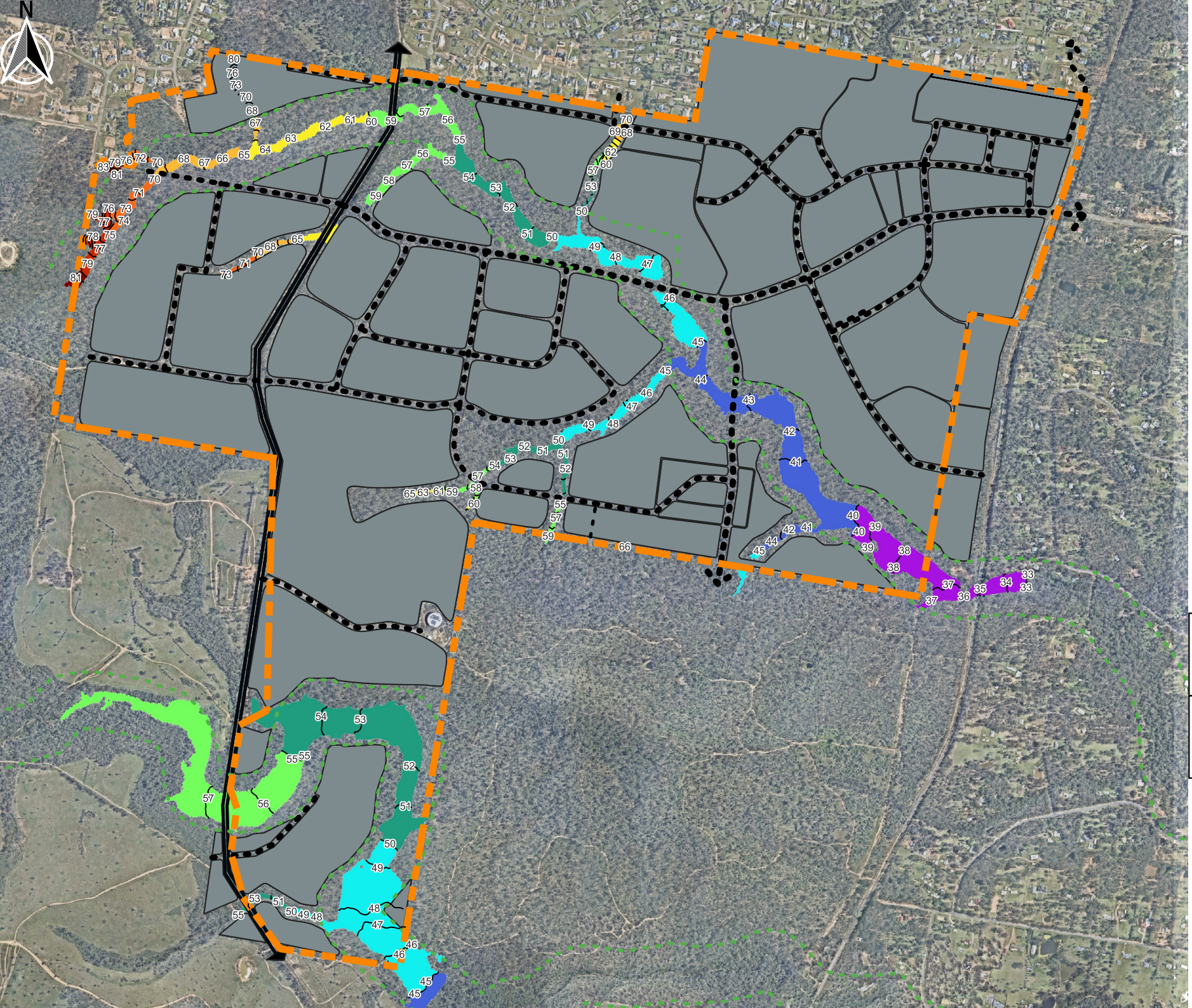
NEW BEITH ROAD, NEW BEITH

Figure E2 - 1% AEP Flood Levels - Developed Sensitivity 1

0 250 500 m

Scale

ARCADIS



LEGEND

Site Boundary

Site Boundary

Cadastre

Cadastre

Flood Level

m (AHD)

- <= 40.0000
- 40.0000 - 45.0000
- 45.0000 - 50.0000
- 50.0000 - 55.0000
- 55.0000 - 60.0000
- 60.0000 - 65.0000
- 65.0000 - 70.0000
- 70.0000 - 75.0000
- 75.0000 - 80.0000
- > 80.0000

NEW BEITH ROAD, NEW BEITH

Figure E3 - 1% AEP Flood Levels - Developed Sensitivity 2

0 250 500 m

Scale

ARCADIS