Appendix K
Integrated Stormwater Quality and Quantity Assessment

PROJECT

INTEGRATED STORMWATER QUALITY AND QUANTITY ASSESSMENT, MARANA ST, BILAMBIL HEIGHTS, NEW SOUTH WALES

PREPARED FOR

GTH RESORTS NO. 20 PTY LTD (GEMLIFE)

DATE

JANUARY 2025

GILBERT SUTHERLAND

DOCUMENT CONTROL

DOCUMENT 12349_IWCMP_RCB1F.docx
TITLE Integrated Stormwater Quality and Quantity Assessment, Marana Street Bilambil Heights, New South Wales
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SYNOPSIS This report provides a conceptual assessment of stormwater quality and quantity management requirements for the Marana Street Development in Bilambil Heights, NSW. It provides a range of potential mitigation measures that could be implemented at the site to ensure Tweed Shire Council's stormwater management objectives can be met. Selection of mitigation measures and their detailed design will be undertaken as part of future development applications for the site.

REVISION HISTORY

REVISION #	DATE	EDITION BY	REVIEWED BY
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DISTRIBUTION

	REVISION NUMBER									
Distribution	1	2	3	4	5	6	7	8	9	10
GTH Resorts No. 20 Pty Ltd (Gemlife)	1									
Department of Planning, Housing and Infrastructure	1									
G&S file	1									

SUMMARY

Gilbert & Sutherland Pty Ltd (G&S) was commissioned by GTH Resorts No. 20 Pty Ltd, ('Gemlife') to prepare an Integrated Stormwater Quality and Quantity assessment for consideration by the Department of Planning, Housing and Infrastructure (DPHI) to modify the Major Project ('Concept Plan') Approval No. 08_0234.

The proposed modification to the Concept Plan Approval seeks to retain the approved 'Retirement Living' land use over the subject site while removing the building footprint and layout shown on a series of the approved plans. The proposed removal of the building footprints is intended to provide flexibility in the final design of the development to be assessed as part of a subsequent application to Council.

The proposed modification will not change to approved density of the development or building height. The application will introduce development requirements that will inform future building footprints to ensure a similar built form outcome.

Stormwater quality assessment

This integrated assessment of stormwater quality and quantity requirements (herein an 'SWA') provides a stormwater quality assessment in accordance with:

- Tweed Shire Council's (TSC) Development Design Specification, D7, 'Stormwater Quality' (D7);
- Healthy Waterways, Water Sensitive Urban Design Technical Guidelines dated June 2006;
- Water By Design Healthy Waterways Bioretention Technical Design Guidelines (2014); and
- Water by Design 'MUSIC Modelling Guidelines – Consultation Draft, Version 3 – 2018' (WBD 2018)

This report presents conceptual stormwater quality treatment proposals based on the adoption of proprietary devices or bioretention systems. Both strategies demonstrate that, with provision of suitable devices, the development can meet the pollutant load reduction targets required by TSC's Development Design Specification D7.

The final treatment strategy for the site will be based on detailed design and may not be limited to these options alone. Should alternative strategies become apparent during the planning and design process, or if detailed design indicates that some devices are impracticable, alternative treatment trains will be assessed, designed and proposed as part of the future Development Application for this site.

Stormwater quantity assessment

This SWA provides a conceptual assessment of peak flows in accordance with:

- TSC Development Design Specification, D5, 'Stormwater Drainage Design' (D5); and
- Australian Rainfall & Runoff 2019 guideline (ARR 2019).

Stormwater quantity will be managed across the site with adequate on-site detention where required to ensure no increase in peak flows and water depths at discharge points for all storm events up to and including the 1% Annual Exceedance Probability (AEP) event (formerly 100 years ARI). Further details on flood mitigation and management strategies as part of the future Development Application.

The site's stormwater management approach maintains the existing Lawful Points of Discharge (LPODs) — located at the north, south, and eastern perimeters of the development. Peak flows will be mitigated and discharged at each LPOD consistent with existing conditions. Preliminary investigations indicate sufficient downstream capacity to receive flows at all LPODs; however, detailed capacity assessments and further downstream analyses will be undertaken as part of the detailed design phase. These assessments will seek to confirm the adequacy of the downstream stormwater network and ensure compliance with applicable requirements.

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GLOSSARY

TERM	MEANING
Australian Height Datum (AHD)	National reference for relative height measurement in Australia.
(AEP) Annual Exceedance Probability	The probability of a defined event size occurring with a year, such as rainfall.
Average Recurrence Interval (ARI)	The average or expected length of time between exceedances of a given variable, such as rainfall.
Catchment	The area above a given point which contributes to the runoff.
Clay	Very fine-grained sediment or soil (often defined as having a particle size less than 0.002 mm, or 2 microns, in diameter).
Groundwater	The water contained in interconnected pores located below the watertable in an unconfined aquifer or located in a confined aquifer.
Sand	Sediment composed of particles within the size range 63 microns to 2 millimetres.
Sediment	Unconsolidated, fine-grained material (typically derived from the weathering of rocks), that is transported by water and settles on the floor of seas, rivers streams and other bodies of water.
Sub-catchment	A smaller area within a catchment drained by one or more tributaries of the main water body.
Suspended Solids (SS)	The concentration of filterable particles in water (retained on a 1.2µm filter) and reported by volume (mg/L).
Total Nitrogen (TN)	Total nitrogen is the sum of the nitrogen present in all nitrogen-containing components in the water column. The nutrients, nitrogen and phosphorus are essential for plant growth. High concentrations indicate potential for excessive weed and algal growth.
Total Phosphorus (TP)	Total phosphorus is the sum of the phosphorus present in all phosphorus-containing components in the water column. The nutrients, nitrogen and phosphorus are essential for plant growth. High concentrations indicate potential for excessive weed and algal growth.

1 Introduction

Gilbert & Sutherland Pty Ltd (G&S) was commissioned by GTH Resorts No. 20 Pty Ltd, ('Gemlife') to prepare an Integrated Stormwater Quality and Quantity assessment for consideration by the Department of Planning, Housing and Infrastructure (DPHI) to modify the Major Project ('Concept Plan') Approval No. 08_0234 for the Marana Street development.

The site is located at Marana Street, Bilambil Heights NSW 2486 (formally described as Lot 32//DP1085109.The site location is shown on Drawing No 12349.001 (Appendix 1).

The Major Project Approval No. 08_0234 was originally issued on 29 June 2010, with two subsequent modifications approved on 4 April 2018 (Mod 1) and 31 October 2022 (Mod 2). The proposed modification to the Concept Plan Approval seeks to retain the approved 'Retirement Living' land use over the subject site while removing the building footprint and layout shown on a series of the approved plans. The proposed removal of the building footprints is intended to provide flexibility in the final design of the development to be assessed as part of a subsequent application to Council.

1.1 Proposed development

The proposed modification will not change to approved density of the development or building height. The application will introduce development requirements that will inform future building footprints to ensure a similar built form outcome.

In summary, the proposed modified development provides for an outcome that:

- Retain the approved density of development at no more than 195 dwellings, plus community facilities
- Introduce consistent maximum building height provision of 13.6m and 4 storeys
- Introduce design parameters on the site that will facilitate a similar built form and building setbacks
- Continue to facilitate the development of the site for a retirement living/seniors housing land use
- Maintain access to the site from Marana Street.

The proposed changes to Precinct B will not impact on the current description of the approval. It is also acknowledged a separate modification application (Bilambil Heights Concept Plan Modification 3) is currently with the Department for approval. That application acknowledges there will continue to be 195 dwellings on Precinct B and therefore this change does not impact on that modification application.

1.2 Scope of report

This integrated assessment of stormwater quality and quantity requirements (herein an 'SWA') provides a stormwater quality assessment that incorporates the requirements of the following documents where appropriate and practicable;

- Tweed Shire Council's (TSC) Development Design Specification, D7, 'Stormwater Quality' (D7);
- Healthy Waterways, Water Sensitive Urban Design Technical Guidelines dated June 2006 (WSUD 2006);
- Water By Design Healthy Waterways Bioretention Technical Design Guidelines (WBD 2014); and
- Water by Design 'MUSIC Modelling Guidelines – Consultation Draft, Version 3 – 2018' (WBD 2018)

In addition to the assessment of stormwater quality treatment requirements, this SWA provides an assessment of peak flows and detention requirements incorporating the requirements of the following documents where appropriate and practicable:

- TSC Development Design Specification, D5, ‘Stormwater Drainage Design’ (D5); and
- Australian Rainfall & Runoff 2019 guideline (ARR 2019).

This report is divided into sections dealing with:

- a description of the physical characteristics of the site,
- an assessment of the site’s stormwater quality management requirements,
- an assessment of the developments peak flow and stormwater detention requirements.

2 Site description

2.1 Site location

The Marana St site is located in New South Wales just south of the border with Queensland and approximately 10km south-west of Tweed Heads in the township of Bilambil Heights. The site comprises Lot 32//DP1085109 as shown on Drawing No. 12349.001 (Appendix 1).

With an area of approximately 6.96 ha the development is characterised as gently inclined with elevations ranging from 137m to 161m Australian Height Datum (AHD).

It is noted that Concept Approval CP0_0234 also encompasses the following parcels under separate ownership:

- Lots owned by Greenland Development Pty Ltd being Lots 33 on DP1085109, Lot 31 on DP850230, Lot 2 on DP867486 and Lot 4 on DP822786;
- Lots owned by Tweed Shire Council specifically Lot 1 on DP1033810, Lot 1 on DP1033811 and Lot 1 on DP595529); and
- Crown Road separating Lot 2 on DP867486, Lot 33 on DP1085109 and Lot 2 on DP555026.

These land parcels are separate and excluded from this application.

2.2 Catchment description

The site straddles a ridge with two high points within the lot boundary. The site is bordered by private, residential properties to the North, East and South, and forms part of the old Terranora Lakes Golf Course to the West. The Northern boundary of the site is bordered by private residences along McAlisters Rd and the Southern boundary by private residences along Marana St. The majority of the site is sloped towards the North (McAlisters Rd) with a small portion in the South-Eastern part of the property sloped towards the South (Marana St).

2.3 Vegetation

The proposed development has been cleared of native vegetation for a golf course as shown on the aerial photograph in Drawing No. 12349_002, included in Appendix 1.

2.4 Geology

A review of the Geological Survey of Queensland Geology, 1:100,000 series – Murwillumbah sheet indicates that the site is underlain by the rock unit Tertiary Kyogle basalt. Kyogle basalt typically comprises greenish hawaiite with minor alkali olivine basalt and basanite and rare tholelitic basalt.

2.5 Soil landscapes

Soils in the region have been mapped and described in the 'Soil landscapes of the Murwillumbah – Tweed Heads 1:100,000 Sheet'[1] (Morand 1996). The relevant section is shown on Drawing No. 12349_003, included in Appendix 1. This mapping indicates that the development area is predominantly within the Disturbed (xx) landscape and partially within Carool (Ca).

The Carool Landscape is described as follows:

> **Carool Landscape** – rolling hills on Tertiary basalt caps which overlie hills of the Burringbar (bu) and Billinudgel (bi) soil landscapes. Overall relief is 200-250m, local relief 50-150; elevation 100-300 m; slopes 15-30%. Benching is characteristic. Ridges and crests are narrow (50-100m). Extensively cleared closed-forest (rainforest) and open-forest (wet sclerophyll).

The Disturbed Landscape is described as follows:

> **Disturbed Landscape** – made land varying from level plains to undulating terrain which has been disturbed by human activity to a depth of at least 100 cm. The original soil

[1] *Soil landscapes of the Murwillumbah – Tweed Heads 1:100,000 Sheet*, NSW Department of Land & Water Conservation, Morand D.T. 1996.

has been removed, greatly disturbed or buried. The original vegetation has been completely cleared.

The general soil profile over the site was described by Morand as friable clays overlying light medium to medium heavy clays or sandy clays.

Morand indicates that the topsoils are likely to have low to moderate erodibility (K=0.006) while the subsoils may have a very high erodibility (K=0.065 to 0.067).

These results indicate that the soils would be classified as 'Type D' soils in accordance with Section 3.2.7 of 'Managing Urban Stormwater, Soils and Construction, Volume 1'[2].

[2] *Managing Urban Stormwater, Soils and Construction* 4th Edition, Landcon, 2004.

3 Stormwater quality assessment – methods

An assessment of potential stormwater quality options for the Marana St Development was undertaken to identify treatment devices that may be appropriate for the site.

Rainwater tanks may form part of the development's stormwater strategy, collecting and storing roof runoff which can then be reused for toilet flushing, laundry cold water and outdoor uses such as landscape and open space irrigation.

Bioretention basins, vegetated swales, vegetated buffers, proprietary devices or other devices in accordance with WSUD guidelines may be used throughout the site in various combinations to achieve the stormwater quality treatment targets. These may be augmented by the inclusion of infiltration systems, water wise street trees, porous pavements and grassed filter strips where appropriate based on each catchments individual characteristics.

For this report, two (2) conceptual stormwater treatment proposals have been assessed;

1. Bioretention systems
2. ATLAN Vortceptors and Stormsacks

The final treatment strategy will be based on detailed design and may not be limited to these options alone. Should alternative strategies become apparent during the planning and design process, or if detailed design indicates that some devices are impracticable, alternative treatment trains will be assessed, designed and proposed as part of the Development Application process.

To assess the likely impacts of runoff from the proposed development on water quality in the receiving environment, the eWater '*Model for Urban Stormwater Improvement Conceptualisation*' (MUSIC) Version 6.3 computer model was used. MUSIC is a water resources package with components for generating surface and subsurface runoff, non-point source pollutant export and pollutant transporting and routing. It is used to analyse the effects of land use changes and for the evaluation of best management practice stormwater quality improvement devices. The input data requirements are described below.

3.1 Climate data

This model requires the input of rainfall and evapotranspiration data. The rainfall data must be in the form of six-minute time-step pluviometer records. This information was obtained from TSC's website. Suitable records were available for Station 58158 at Murwillumbah for the period from 16/10/1973 to 30/06/1984. The average rainfall for this period was 1,697 mm.

Average monthly potential areal evapotranspiration values were also adopted in accordance with D7 with an average annual evapotranspiration of 1,363 mm.

3.2 Runoff parameters

Relevant parameters for and urban land uses were sourced from Table A1.2 of WBD 2018 and are presented in Table 3.2.1.

Table 3.2.1 Rainfall runoff parameters

Parameter	Urban
Impervious area properties	
Rainfall threshold (mm)	1
Pervious area properties	
Soil storage capacity (mm)	500
Initial storage (% of capacity)	10
Field capacity (mm)	200
Infiltration capacity coefficient – a	211
Infiltration capacity exponent – b	5
Groundwater properties	
Initial depth (mm)	50
Daily recharge rate (%)	28
Daily baseflow rate (%)	27
Daily deep seepage rate (%)	0

3.3 Water quality parameters

The water quality parameters modelled were:

- total suspended sediment;
- total phosphorus;
- total nitrogen; and
- gross pollutants.

The sediment and nutrient export parameters were adopted from WBD 2018 and are reproduced in Table 3.3.1.

It should be noted that the rainfall to runoff model and the pollutant export expressions have not been calibrated for local catchments. This means the modelling results cannot be expected to produce accurate assessments of the amount of pollutants likely to be exported from the proposed development. However, the results do provide useful assessments which enable comparisons of the effectiveness of various stormwater management strategies.

An assessment of the pervious and impervious proportions for the urban areas in each catchment was carried out to provide input for the model using the recommendations in WBD 2018 Section 3.7.

3.4 Water quality objectives (WQOs)

The WQOs for the site runoff during the operational phase of the development have been based on the load reduction targets identified in Section 1.5 of the WSUD 2006 and Section D7.07A of the TSC D7 specification. These pollutant load reduction targets are detailed in Table 3.4.1.

Table 3.4.1 Developed Treated Case load reduction targets

	Suspended Solids	Total Phosphorus	Total Nitrogen	Gross Pollutants
Target	80%	60%	45%	90%

3.5 Modelling undertaken

The MUSIC model was used to develop a basic model for the stormwater treatment system by comparing the Untreated Developed Case with the Treated Developed Case during the operational phase (after completion of the construction phase). This process enabled verification that the water quality objectives (pollutant load reduction targets) would be satisfied by the proposed treatment devices.

The modelled scenarios were as follows:

- Developed Case WITHOUT treatment measures.
- Developed Case WITH treatment measures.

Details of the conceptual stormwater treatment train and the results of the MUSIC modelling are provided in Section 4.

3.6 Catchment breakdown

A review of aerial photographs of the site, indicates the site has been disturbed by previous clearing.

Table 3.3.1 Pollutant Export Parameters (Log_{10} values, from Tables 3.8 and 3.9 of WBD 2018)

Land use	Parameter	Suspended Sediment		Total Phosphorus		Total Nitrogen	
		Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow
Urban	Mean	1.00	2.18	-0.97	-0.47	0.20	0.26
	Std Deviation	0.34	0.39	0.31	0.32	0.20	0.23
Urban Roof	Mean	1.00	1.30	-0.97	-0.98	0.20	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.20	0.23
Urban Road	Mean	1.00	2.43	-0.97	-0.30	0.20	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.20	0.23
Urban Balance	Mean	1.00	2.18	-0.97	-0.47	0.20	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.20	0.23

Drawing No. 12349.103 (in Appendix 1) shows the catchment areas included in the MUSIC model. The modelled sub-catchment areas and properties are shown in Table 3.6.1.

All catchments within the site have been modelled as lumped urban residential in the developed case.

An impervious fraction of 80% was assumed for the entire development based on Water by Design 'MUSIC Modelling Guidelines – Consultation Draft, Version 3 – 2018' (WBD 2018).

Table 3.6.1 Modelled catchment areas and impervious fractions (urban residential lumped catchment)

Catchment	Area (ha)	Fraction Impervious (%)
N	4.656	80%
S	1.376	80%
E	0.926	80%

4 Stormwater quality assessment – results

The stormwater treatment train options have been selected to suit the opportunities and constraints presented by the site. The results of the conceptual assessment are presented below.

4.1 Developed untreated case

The average annual runoff quantities of suspended sediment, phosphorus and nitrogen predicted to be exported from the developed site with no stormwater treatment measures in place are shown in Table 4.1.1.

Table 4.1.1 Developed untreated case average annual loads

Catchment	SS (kg/year)	TP (kg/year)	TN (kg/year)	GP (kg/year)
N	14,400	27.8	134	1,430
S	4,140	8.14	39.4	421
E	2,800	5.66	26.7	284
Site	**21,340**	**41.60**	**200.1**	**2,135**

All simulations have been run with pollutant export estimation set to 'stochastic generation'. i.e., Table 4.1.1 shows results for the untreated scenario within the bioretention model, the results for the Atlan model will slightly differ.

4.2 Treatment measures adopted

The same areas as above were modelled under the same rainfall conditions in a developed state with treatment measures included. For the purpose of this conceptual assessment two options for were considered;

1. Bioretention systems
2. ATLAN Vortceptors and Stormsacks

The treatment trains described in the following sections are conceptual and subject to change at the detailed design stage. Nonetheless, they demonstrate that with an appropriate selection of treatment devices the site's stormwater can be managed to satisfy TSC's objectives.

4.2.1 Bioretention systems

The bioretention systems would be designed in accordance with the Queensland Urban Drainage Manual, Fourth Edition, 2016 (QUDM) and WBD 2018. It is envisaged that these devices would generally be dry at their surface. However, during (and for a short period after) wet weather they may contain water to a depth of 300 mm.

As the systems are not required to perform any peak flow detention function, a high flow bypass for flows in excess of $Q_{3months}$ would be installed. A combination of weir and pipe outlets would be provided based on the constraints of each individual device.

Each device would be drained by a system of subsurface perforated drains at 1.5 m maximum spacings. This will minimise the occurrence of boggy areas and ensure that the stored water is released within 36 hours.

A low flow drainage system would be provided in the bioretention systems to ensure that water is drained from the basin efficiently. Type 3 conventional bioretention basins would be implemented in all catchments.

Type 3 bioretention systems are free draining through the filter, transition and drainage layers and are not lined allowing exfiltration from the system.

Bioretention basins on steep topography would be carefully designed to manage the total footprint of the bioretention system as batter slopes can extend significant distances from the filter edge when tying into natural and final surfaces. Where possible, retaining walls would be avoided and embankments with slopes generally no steeper than 1 in 4 would be adopted where possible. If vertical walls are required, they will be designed with reference to Section 3.3.5.5 and Table 9 of the WBD 2014 guideline with appropriate review by a suitably qualified person.

Operating characteristics of the basins used in the MUSIC modelling are summarised in Table 4.2.1.

Table 4.2.1 Bioretention treatment requirements.

Parameter	Catchment		
	N	S	E
Inlet properties			
Low flow bypass (m^3/s)	0	0	0
High flow bypass (m^3/s)	100	100	100
Storage properties			
Extended detention depth (m)	0.30	0.30	0.30
Surface area (m^2)	430	135	90
Filter & media properties			
Filter area (m^2)	430	135	90
Unlined filter media perimeter (m)	0.01	0.01	0.01
Saturated hydraulic conductivity (mm/hr)	200	200	200
Filter depth (m)	0.50	0.5	0.5
TN content of filter media (mg/kg)	400	400	400
Orthophosphate content of filter media (mg/kg)	30	30	30
Infiltration properties			
Exfiltration rate (mm/hr)	0	0	0
Lining properties			
Is the base lined?	N	N	N
Vegetation properties			
Vegetated with effective nutrient removal plants?	Y	Y	Y
Outlet properties			
Overflow weir width (m)	45	13.5	9.0
Underdrain present?	Y	Y	Y
Submerged zone with carbon present?	N	N	N
Depth (m)	-	-	-

It is intended that the bioretention basins would be landscaped and planted out as 'rain gardens', rather than simply topsoiled and turfed. Species used would be selected from the list of approved species included in Healthy Waterways, WSUD Guidelines Appendix A, Table A1. Preferably, plants endemic to the area would be used. The landscape architects would provide details of the plant species selection, size and spacing.

Care would be taken to protect the basin filter media from excessive sediment loads during the construction (including house construction) phase. A stormwater management plan detailing the monitoring, management and mitigation actions to be followed at the site throughout the construction and operational phases of the development would be prepared and submitted as part of a future Development Application.

4.2.2 Pre-treatment measures

Additional pre-treatment measures are required to remove coarse pollutants upstream of the bioretention basins. These devices, the benefit of which have not been included in the MUSIC modelling, are described briefly below.

An inlet zone will be provided for coarse sediment removal at each piped inlet to the bioretention systems, where the contributing catchment area exceeds 2 hectares. Sizing will be undertaken in accordance with the requirements of the Water By Design Healthy Waterways Bioretention Technical Design Guidelines (2014).

4.2.3 Rainwater tanks

The installation of rainwater tanks for private or public use could form part of the stormwater management strategy. However, the benefit of those tanks has not been considered in this conceptual assessment of pollutant load reductions for the site.

4.2.4 Atlan System

Atlan (formerly SPEL) have designed a conceptual stormwater quality treatment train for the development in accordance with TSC's D7 specifications.

The treatment train is comprised of proprietary devices manufactured by Atlan. The proposed treatment train includes;

- Atlan Stormsacks fitted on inlet pits across each catchment for pre-treatment of runoff, and
- Atlan Vortceptor systems as end-of-line treatment devices for treatment of all site runoff prior to discharge.

Based on the modelling and advice from Atlan, details of the treatment measures required for each sub-catchment are given in Table 4.2.2. Product information is included in Appendix 2.

Table 4.2.2 Atlan stormwater device requirements

Catchment	No. of Atlan Stormsacks	No. of Atlan Vortceptors	Vortceptor Type
N	25	1	OVO.096
S	8	1	IVR.025
E	5	1	IVR.025
Site	**38**	**3**	**-**

A number of alternative proprietary devices are verified by Stormwater Australia under the stormwater quality improvement device evaluation protocol (SQIDEP) of which could be assessed and implemented at the detailed design stage.

4.3 Developed treated case outcomes

The same areas as above were modelled under the same rainfall conditions in a developed state with treatment measures included. The modelling results are shown in Table 4.3.1 and Table 4.3.2.

Table 4.3.1 Bioretention treatment train developed case average annual loads

Catchment	SS (kg/year)	TP (kg/year)	TN (kg/year)	GP (kg/year)
N	2,840	7.31	69.6	0
S	785	2.13	20.2	0
E	534	1.51	13.8	0
Site	**4,159**	**10.95**	**103.6**	**0**

Table 4.3.2 Proprietary Atlan treatment train developed case average annual loads

Catchment	SS (kg/year)	TP (kg/year)	TN (kg/year)	GP (kg/year)
N	2,770	6.1	65.7	5.83
S	816	1.78	19.6	1.43
E	467	0.969	12.3	1.08
Site	**4,053**	**8.849**	**97.6**	**8.34**

The pollutant load reduction achieved for the overall catchment are provided in Table 4.3.3 and Table 4.3.4.

Table 4.3.3 Bioretention treatment train developed case pollutant load reductions

Catchment	SS (%)	TP (%)	TN (%)	GP (%)
N	80.3	73.7	48.2	100
S	81	73.9	48.9	100
E	80.9	73.2	48.2	100
Site	**80.5**	**73.7**	**48.2**	**100**
WQO	80	60	45	90

Table 4.3.4 Atlan Vortceptor treatment train developed case pollutant load reductions

Catchment	SS (%)	TP (%)	TN (%)	GP (%)
N	80.5	78.4	51.0	99.6
S	80.0	78.3	50.4	99.7
E	83.7	82.4	53.6	99.6
Site	**80.8**	**78.9**	**51.2**	**99.6**
WQO	80	60	45	90

Based on these estimates, the quality of the stormwater runoff from the proposed development during the operational phase would meet the pollutant load reduction targets specified by TSC.

5 Stormwater quantity assessment

A hydrological assessment was undertaken to estimate peak site discharge prior to and following completion of the proposed development and to inform the conceptual design of peak flow mitigation measures required to offset the impacts of the development.

The assessment, described herein, utilised the Infoworks ICM computer modelling software to estimate site discharge during a range of rainfall events in accordance with Australian Rainfall and Runoff 2019 (ARR).

5.1 ICM modelling

Infoworks ICM is an event-based hydrologic model that calculates flood hydrographs from storm rainfall hyetographs. Whilst ICM, in this instance, has not modelled the details of piped drainage systems, it can be used for modelling natural, partially developed and fully developed catchments.

For developed catchments, it calculates runoff from pervious and impervious surfaces and routes it through the major system of open watercourses.

ICM can be used to generate hydrographs from an actual storm event and or a design storm utilising Intensity – Frequency – Duration (IFD) data together with dimensionless storm temporal patterns. The ICM model is flexible in its data requirements and is able to produce satisfactory results with the following data inputs:

- local intensity frequency duration data
- design temporal patterns
- sub-catchment areas
- impervious areas.

The net rainfall is routed through a network after appropriate losses (initial and continuing) and roughness factors are applied, resulting in a surface runoff hydrograph for each sub-catchment area.

5.1.1 Storm data

The rainfall intensities for the simulation of the design rainfall events were calculated in accordance with the procedure outlined in Australian Rainfall and Runoff 2016 (ARR2016) methodologies.

The ICM ARR Storm Generator allows importation of the ARR Data Hub information, including rainfall global database, infiltration global database, and global storm definitions, into ICM. Information such as the ARR Data Hub Text File, ARR Temporal Patterns Increments File, and Bureau of Meteorology (BOM) IFD table files are used to produce the Annual Exceedance Probability (AEP) and all of the durations for the given location, which are then analysed in the application.

Ten (10) temporal patterns were assessed for each of the following durations 10min, 15min, 20min, 30min, 45min, 1hr, 90min, 2hr, 3hr, 4.5hr and 6 hr for the 63.2% AEP through to the 1% AEP design event with the results statistically assessed using a box and whisker plot to determine the critical storm duration and temporal pattern for the catchment.

5.1.2 Rainfall losses

Initial Loss (IL) and Continuing Losses (CL) were sourced from the Australian Rainfall and Runoff (ARR2016) Data Hub[3] and were applied to the modelling. The catchments have been modelled with a variety of % impervious relative to their current land use. The following loss rates have been adopted for the entire area for all AEP events:

- IL = 15 mm;
- CL = 3.1 mm/hr.

5.2 Peak flow catchment characteristics

The physical characteristics of the catchment are described in Section 2 of this report.

[3] http://data.arr-software.org/

5.2.1 Existing case

The modelled catchments for existing site conditions are shown on the attached Drawing No. 12349.104 (in Appendix 1).

To define the existing site, four major catchments have been identified, being Catchment N1, N2 (discharge North), Catchment E1 (discharge East) and Catchment S1 (discharge South). While several other catchments define the external areas that influence the sites stormwater being Catchments Ext-N1 through to Ext-N5, Ext-E1 and Ext-S1. Note, that only the existing and post-development site catchments are shown graphically within the provided catchment plans as these relate to the detention modelling, while the external catchments are for further assessment of the downstream analysis (Section 5.7).

All catchments have been modelled and assessed separately in order to identify peak flows at their respective discharge reporting point being North, South and East. The total existing catchment area of the site is 6.96 hectares. The pre-developed state of the site is shown on Drawing 12349.104. An impervious fraction of zero percent has been adopted to represent the existing land condition prior to development, while external catchments range from 0 to 70% impervious.

The modelled properties for each sub-catchment are shown in Table 5.2.1.1.

Table 5.2.1.1 Existing Case sub-catchments

Catchment	Area (ha)	Impervious (%)
E1	0.872	0
N2	3.078	0
N1	2.485	0
S1	0.521	0
Ext-N2	2.509	0
Ext-N3	0.878	0
Ext-N4	0.921	70
Ext-N5	0.807	70
Ext-N6	1.158	70
Ext-N7	1.241	70
Ext-N1	1.703	20
Ext-E1	1.084	70
Ext-S1	0.905	70

5.2.2 Developed case

The modelled catchments for the developed case are shown on the attached Drawing No. 12349.105 (Appendix 1).

The developed site catchments were assumed to have an impervious percentage of 80%. Impervious area assumptions for the external catchments are unchanged from the existing case model.

The modelled properties for each developed sub-catchment are shown in Table 5.2.2.1.

Table 5.2.2.1 Developed case sub-catchments

Catchment	Area (ha)	Impervious (%)
E1	0.926	0
N2	2.306	0
N1	2.346	0
S1	1.376	0
Ext-N2	2.509	0
Ext-N3	0.878	0
Ext-N4	0.921	70
Ext-N5	0.807	70
Ext-N6	1.158	70
Ext-N7	1.241	70
Ext-N1	1.703	20
Ext-E1	1.084	70
Ext-S1	0.905	70

5.3 Model scenarios

For the purpose of this assessment, three specific development scenarios were addressed:

- the Existing Case, which considers the undeveloped site;
- the Developed Case, which considers the proposed development of the site with no peak flow mitigation measures in place; and
- the Attenuated Case, which has been used to determine detention requirements for the development.

The inputs and assumptions detailed above were incorporated into the ICM model to generate hydrographs for the subject site. Peak flows were estimated for storms with durations ranging from 10 minutes to 6hrs for each average recurrence interval (ARI).

5.4 Detention requirements

It is proposed that peak flow mitigation would be provided for site runoff from Catchments N1 & N2 (north discharge), S1 (south discharge) and E1 (east discharge) using detention devices.

Detention capacity for each device is summarised in Table 5.4.1 and shown on Drawing No. 12349.106.

Table 5.4.1 – Detention basin requirements

Catchment	Basin area ($m^{2)}$	Basin volume ($m^{3)}$
N Basin	2,500	2,878
S Basin	1,600	1,588
E Basin	530	436

5.5 ICM modelling summary

The modelling undertaken has considered three scenarios to depict the effect of the development on the peak flows discharging from the subject site. A comparison of the estimated 1% AEP peak flow rates before and after completion of the proposed development and subsequently including detention is shown in Table 5.5.1.

Table 5.5.1 – 1% AEP comparison of flows at each point of discharge

Location	Existing Q (m^3/s)	Developed Q (m^3/s)	Mitigated Q (m^3/s)
North	2.379	2.935	1.389
South	0.215	0.896	0.168
East	0.410	0.602	0.241

In summary, the results demonstrate that for the design flood events from AEP 1% to 63.2%, there will be no increase in peak catchment discharge, provided the appropriately sized detention systems are incorporated and subject to refinement during the detailed design phase.

5.6 Lawful Point of Discharge

Three primary Lawful Points of Discharge (LPODs) shown on Drawing 12349.105 (Appendix 1) have been identified for the site in the:

- north (LPOD North);
- south (LPOD South); and
- east (LPOD East).

These discharge points have been maintained as follows:

- North: The northern boundary of the site is characterised by a large sheeting catchment. A clearly defined easement shown on the Landsurv Pty Ltd Site Survey (Appendix 3) is located in the north-west corner serves as the existing LPOD (LPOD North), which connects to McAllisters Road. This road and its associated underground stormwater network, constructed during the adjacent 45-lot subdivision, form one of the two northern LPODs.
- The second LPOD is an existing 450 mm stormwater pipe located in the far north-western corner (refer to Dial before You Dig (DBYD) plans in Appendix 4). Although this assessment is conceptual, the proposed stormwater design will retain both northern LPODs. Peak flows will be mitigated, and both discharge points may be utilised during the detailed design phase.
- South: The site's cadastral boundary provides two potential LPODs along Marana Street. These points connect to the road and its associated underground stormwater network (refer to DBYD plans in Appendix 4). The southern LPOD will be preserved in the developed scenario, with proposed discharges mitigated based on the estimated detention volume. Detailed analysis of these connections will be performed during the detailed design phase.
- East: The eastern boundary adjoins McAllisters Road, providing a single LPOD through the road and its associated underground stormwater network (refer to DBYD plans in Appendix 4). This eastern

LPOD will be maintained, with proposed discharges mitigated based on the estimated detention volume. Further investigation of this connection will occur during the detailed design phase.

5.7 Downstream analysis

This report demonstrates that all proposed discharge outlets maintain their respective LPODs and preserve peak discharge at current rates. However, a detailed capacity assessment of the downstream stormwater network will be required as part of the detailed design phase of a future Development Application. This assessment will consider all three LPODs and model the capacity of downstream infrastructure and properties.

Preliminary investigations have gathered information from sources such as Landsurv Site Survey, Dial Before You Dig (DBYD) and Opus Stamped Construction Certificate Drawings (Appendix 3). While these sources provide initial insights, additional survey data, as-constructed information, and detailed design documentation will be compiled to comprehensively evaluate downstream capacity at the detailed design phase.

This conceptual analysis confirms that all three existing LPODs are capable of receiving proposed discharges in their current configurations.

6 Conclusions

This report provides a conceptual assessment of the stormwater quality and quantity management requirements for the proposed Marana Street development.

Two conceptual stormwater quality treatment proposals have been presented incorporating conventional bioretention basins, ATLAN Vortceptors and Stormsacks to demonstrate that, with provision of suitable devices, the proposed development can meet the pollutant load reduction targets required by TSC's Development Design Specification D7.

The final treatment strategy for the site will be based on detailed design and may not be limited to these options alone. Should alternative strategies become apparent during the planning and design process, or if detailed design indicates that some devices are impracticable, alternative treatment trains will be assessed, designed and proposed as part of a future Development Application.

Stormwater quantity will be managed by providing on-site detention to ensure there is no increase in peak flows from the site for all storm events up to and including the 1% Annual Exceedance Probability (AEP) event (formerly 100 years ARI).

The site's stormwater management approach maintains the existing Lawful Points of Discharge (LPODs) — located at the north, south, and eastern perimeters of the development. Peak flows will be mitigated, and discharged at each LPOD consistent with existing conditions. Preliminary investigations indicate sufficient downstream capacity to receive flows at all LPODs; however, detailed capacity assessments and further downstream analyses will be undertaken as part of the detailed design phase. These assessments will seek to confirm the adequacy of the downstream stormwater network and ensure compliance with applicable requirements.

Further details on flood mitigation and management strategies, and stormwater system design will be developed and provided as part of a future Development Application.

7 Limitations of reporting

Gilbert & Sutherland Pty Ltd has made every effort to ensure that the information provided in this report is accurate. The interpretation of scientific data, however, involves professional judgment, and as such is open to error.

In recognising the potential for errors in scientific interpretation, Gilbert & Sutherland Pty Ltd does not guarantee that the information is totally accurate or complete and clients are advised not to rely solely on this information when making commercial decisions. Any representation, statement, opinion or advice, expressed or implied is made in good faith and on the basis that the authors, Gilbert & Sutherland Pty Ltd, their agents or employees are not liable (whether by reason of lack of care or otherwise) to any person for any damage or loss whatsoever which has occurred or may occur in relation to that person taking or not taking (as the case may be) action in respect of any representation, statement or advice referred to above.

Furthermore, this information should not be relied upon by any persons other than the client for whom this information was compiled. This information reflects the specific brief and the budget of the client concerned, who enjoys an individual tolerance of risk.

8 Appendix 1 – Drawings

ORIENTATION

SCALE

200 400 600 800 metres

ROBINA

PO Box 4115 Robina QLD4230 07 5578 9944
Email robina@access.gs **www.access.gs**

LEGEND

Site Boundary

SOURCES

Image: Near Map, image dated 04 October 2024

PROJECT

MOD APPLICATION - MARANA STREET, BILAMBIL HEIGHTS NSW

CLIENT

GTH RESORTS NO. 20 PTY LTD

DRAWING

SITE LOCATION

SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
1:16 000@A3	12/12/2024	CSB	ELH	12349	001	-

GILBERT SUTHERLAND

ORIENTATION

SCALE

25 50 75 100 125 metres

ROBINA

PO Box 4115 Robina QLD4230
Email robina@access.gs

07 5578 9944
www.access.gs

LEGEND

Site Boundary

SOURCES

Image: Near Map, image dated 04 October 2024

PROJECT

MOD APPLICATION - MARANA STREET, BILAMBIL HEIGHTS NSW

CLIENT

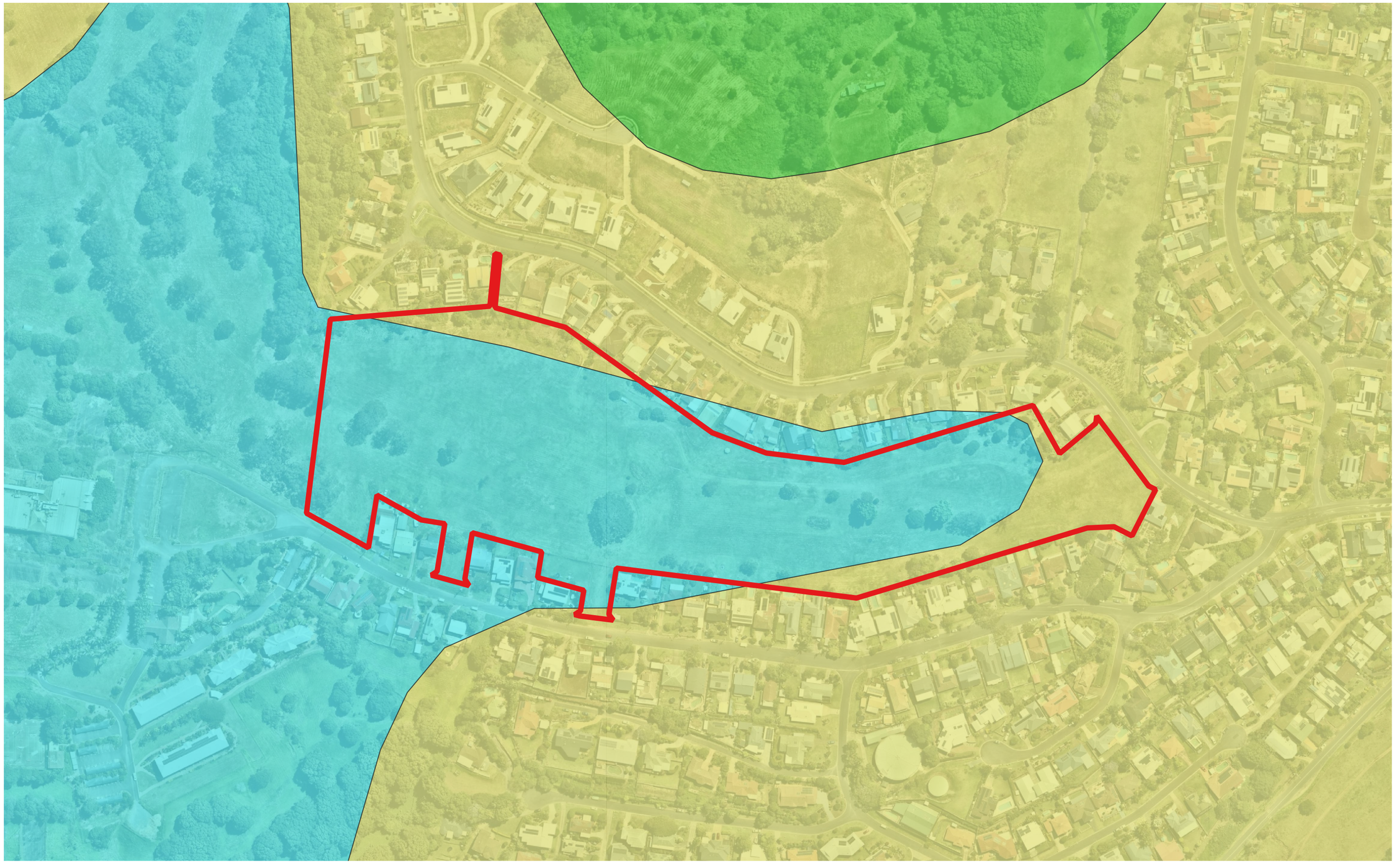
GTH RESORTS NO. 20 PTY LTD

DRAWING

LOT BOUNDARY

SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
1:2 500@A3	06/12/2024	CSB	ELH	12349	002	-

GILBERT SUTHERLAND



ORIENTATION

SCALE

25 50 75 100 125 metres

ROBINA

PO Box 4115 Robina QLD4230 07 5578 9944
Email robina@access.gs **www.access.gs**

LEGEND

Site Boundary

Soil Landscapes

- DTxx - Disturbed Terrain
- COca - Carool
- ERbu - Burringbar

SOURCES

Image: Near Map, image dated 04 October 2024

Soil Landscapes Sharing and Enabling Environmental Data, NSW Government

PROJECT
MOD APPLICATION - MARANA STREET, BILAMBIL HEIGHTS NSW

CLIENT
GTH RESORTS NO. 20 PTY LTD

DRAWING
SOIL LANDSCAPES

SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
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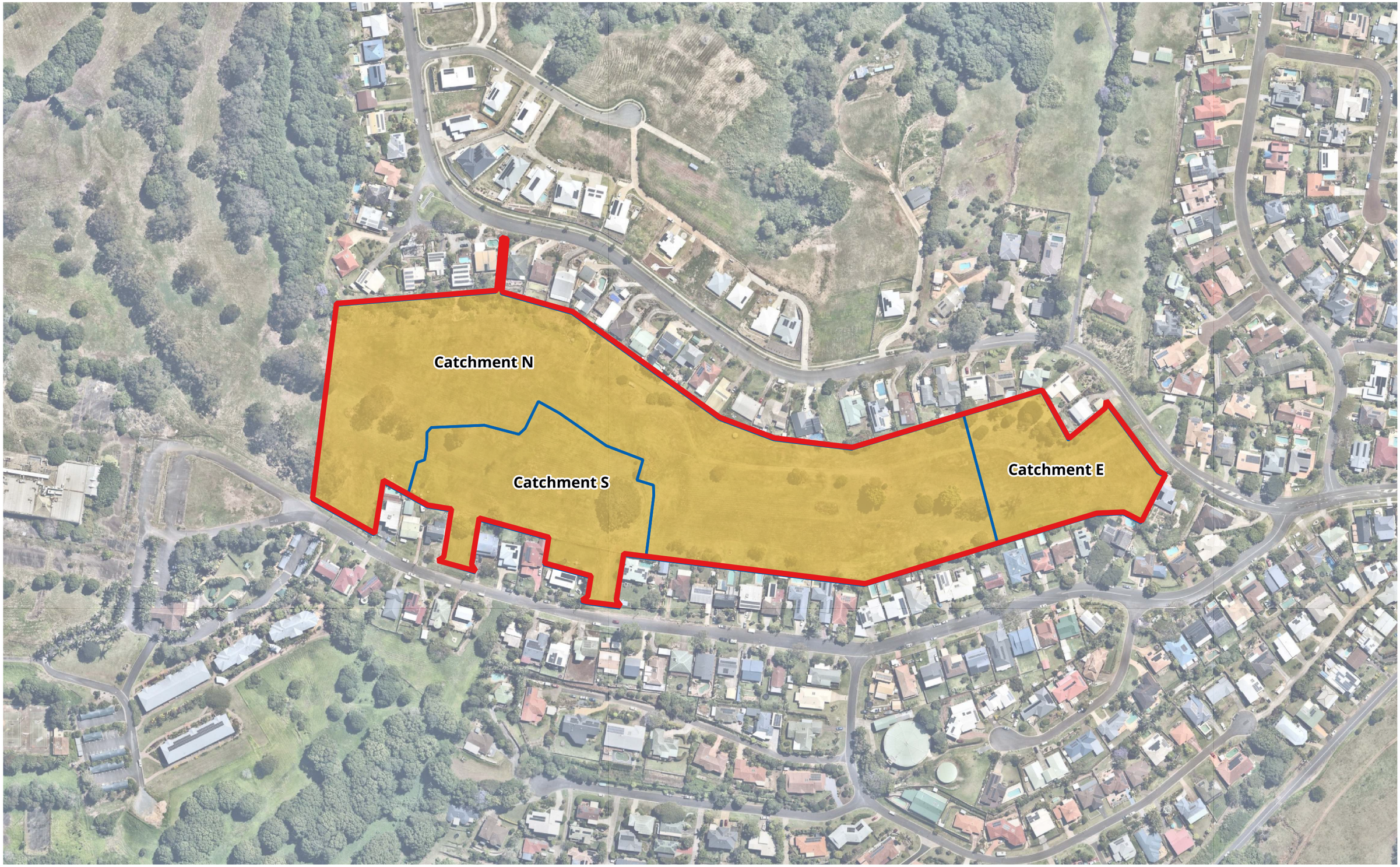
GILBERT SUTHERLAND



ORIENTATION

SCALE

25 50 75 100 125 metres

ROBINA
PO Box 4115 Robina QLD4230 07 5578 9944
Email robina@access.gs **www.access.gs**

LEGEND

- Site Boundary
- MUSIC Catchments
- Urban Residential (Lumped)

SOURCES

Image: Near Map, image dated 04 October 2024

PROJECT
MOD APPLICATION - MARANA STREET, BILAMBIL HEIGHTS NSW

CLIENT
GTH RESORTS NO. 20 PTY LTD

DRAWING
MUSIC Catchment Plan

SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
1:2 500@A3	12/12/2024	CSB	ELH	12349	103	-

GILBERT SUTHERLAND

ORIENTATION

SCALE

25 50 75 100 125
metres

ROBINA
PO Box 4115 Robina QLD4230
Email robina@access.gs
07 5578 9944
www.access.gs

LEGEND

- Site Boundary
- Pre-Developed Catchments

SOURCES

Image: Near Map, image dated 04 October 2024

PROJECT
MOD APPLICATION - MARANA STREET, BILAMBIL HEIGHTS NSW

CLIENT
GTH RESORTS NO. 20 PTY LTD

DRAWING
ICM EXISTING CATCHMENT PLAN

SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
1:2 500@A3	17/12/2024	CSB	ELH	12349	104	-

GILBERT SUTHERLAND

ORIENTATION

SCALE

25 50 75 100 125
metres

ROBINA
PO Box 4115 Robina QLD4230 07 5578 9944
Email robina@access.gs **www.access.gs**

LEGEND

- Site Boundary
- Developed Catchments

SOURCES

Image: Near Map, image dated 04 October 2024

PROJECT	CLIENT	DRAWING
MOD APPLICATION - MARANA STREET, BILAMBIL HEIGHTS NSW	GTH RESORTS NO. 20 PTY LTD	ICM DEVELOPED CATCHMENT PLAN

SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
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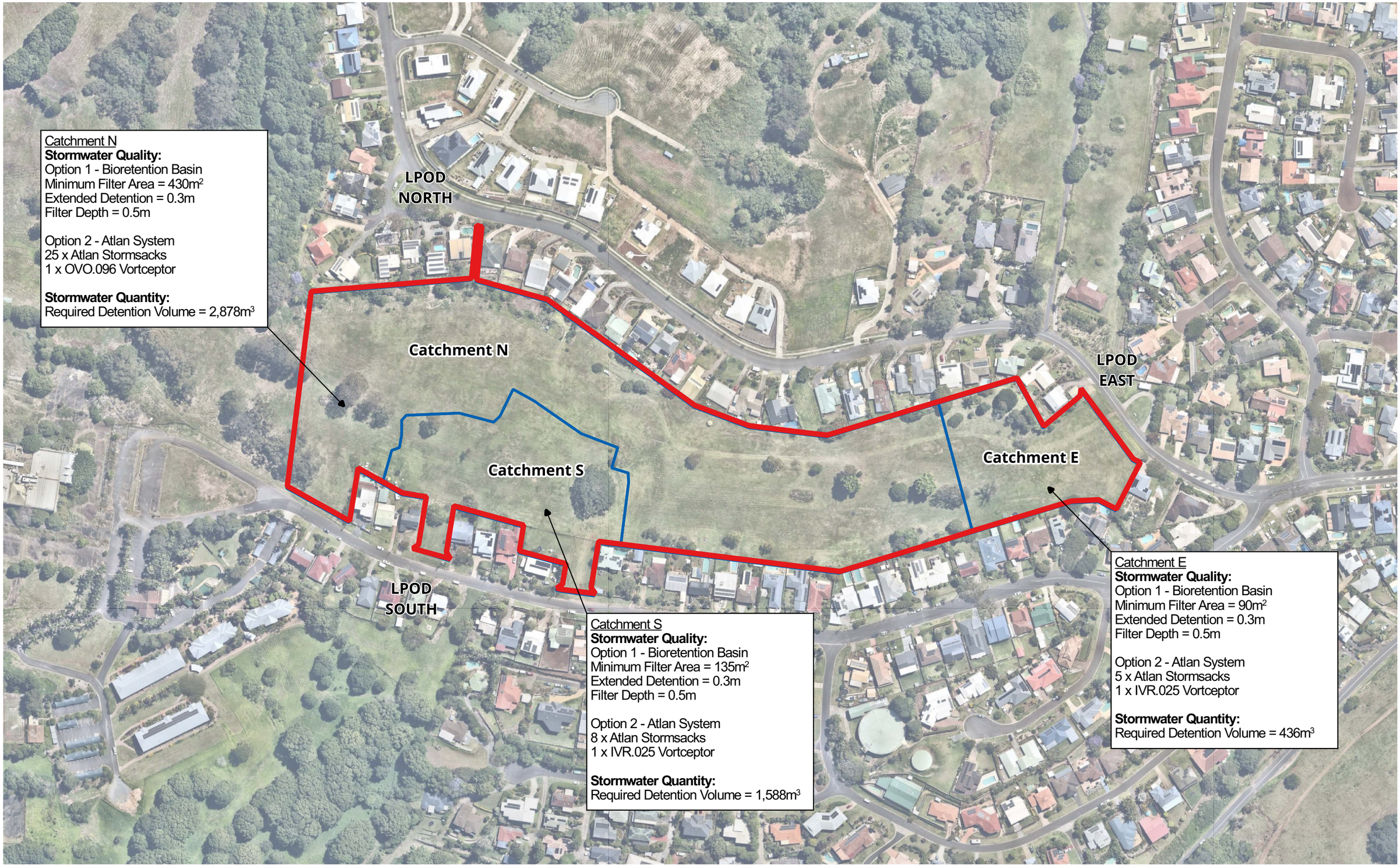
GILBERT SUTHERLAND



Catchment N
Stormwater Quality:
Option 1 - Bioretention Basin
Minimum Filter Area = 430m^2
Extended Detention = 0.3m
Filter Depth = 0.5m

Option 2 - Atlan System
25 x Atlan Stormsacks
1 x OVO.096 Vortceptor

Stormwater Quantity:
Required Detention Volume = 2,878m^3

Catchment S
Stormwater Quality:
Option 1 - Bioretention Basin
Minimum Filter Area = 135m^2
Extended Detention = 0.3m
Filter Depth = 0.5m

Option 2 - Atlan System
8 x Atlan Stormsacks
1 x IVR.025 Vortceptor

Stormwater Quantity:
Required Detention Volume = 1,588m^3

Catchment E
Stormwater Quality:
Option 1 - Bioretention Basin
Minimum Filter Area = 90m^2
Extended Detention = 0.3m
Filter Depth = 0.5m

Option 2 - Atlan System
5 x Atlan Stormsacks
1 x IVR.025 Vortceptor

Stormwater Quantity:
Required Detention Volume = 436m^3

ORIENTATION

SCALE
25 50 75 100 125 metres

ROBINA
PO Box 4115 Robina QLD4230 07 5578 9944
Email robina@access.gs **www.access.gs**

LEGEND
- Site Boundary
- SW Quality and Quantity Catchments

SOURCES
Image: Near Map, image dated 04 October 2024

PROJECT	CLIENT	DRAWING
MOD APPLICATION - MARANA STREET, BILAMBIL HEIGHTS NSW	GTH RESORTS NO. 20 PTY LTD	INDICATIVE STORMWATER QUALITY AND QUANTITY SIZING

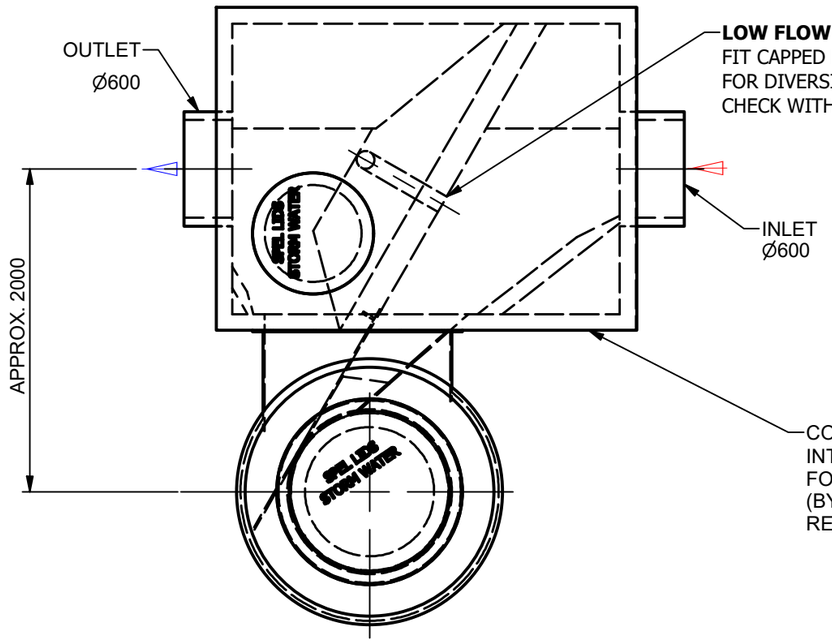
SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
1:2 500@A3	17/12/2024	CSB	ELH	12349	106	-

GILBERT SUTHERLAND

9 Appendix 2 – Atlan documentation

LEFT SIDE INFLOW

REVISION HISTORY				
REV	DESCRIPTION	DESIGNER	DATE	CHECKED BY
1	INITIAL RELEASE	M.MAKIN	19/06/2019	

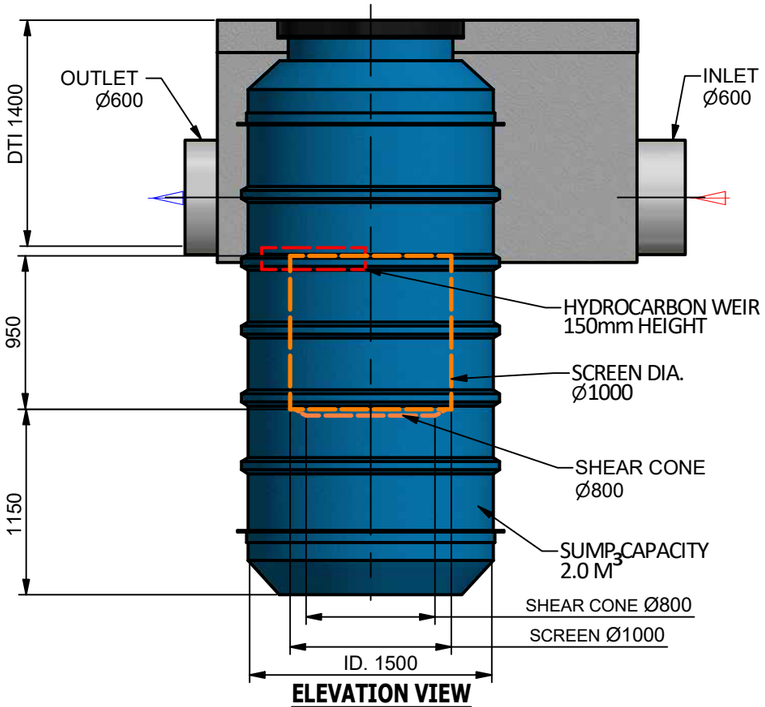


LOW FLOW BYPASS
FIT CAPPED PVC LOW FLOW BYPASS PIPE TO WEIR,
FOR DIVERSION OF LOW FLOWS DURING MAINTENANCE.
CHECK WITH CONSULTING ENGINEERS FOR SIZING & DESIGN DETAILS

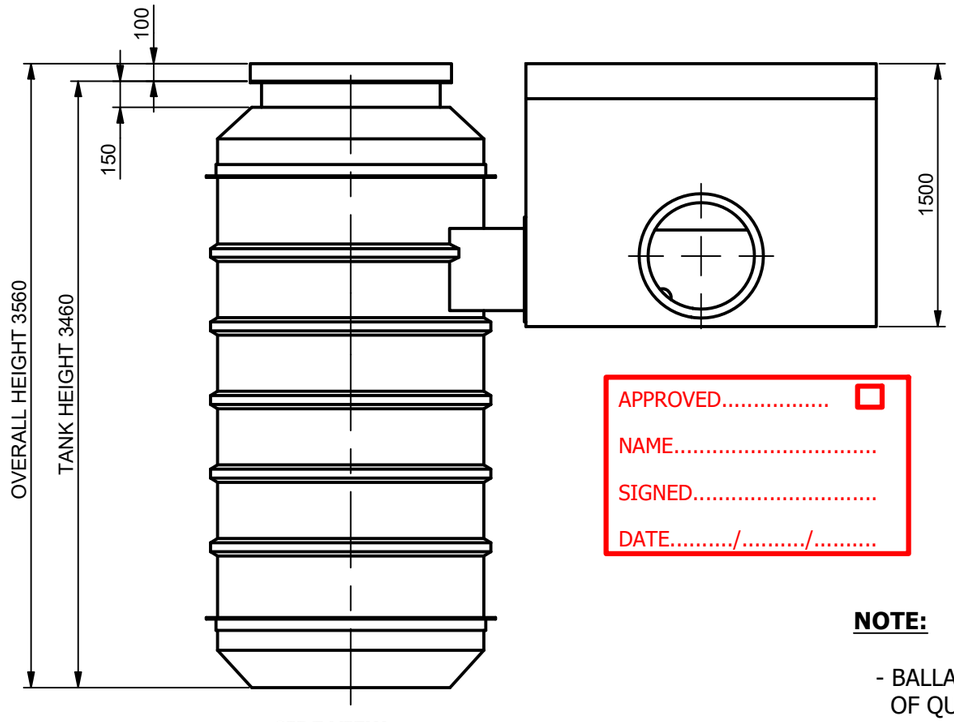
Site Level Confirmation		
Finished Surface Level (FSL)	RL:	
Access Cover Thickness		mm
Inlet Invert Level	RL:	
Outlet Invert Level	RL:	
Company:		
Name:		
Date:		

CONCRETE DIVERSION CHAMBER
INTERNAL SIZE : **2400 L x 1800 W x 1200 H**
FOR REPRESENTATION PURPOSE ONLY
(BY OTHERS)
REFER DWG : **SP19-VC16390-C**

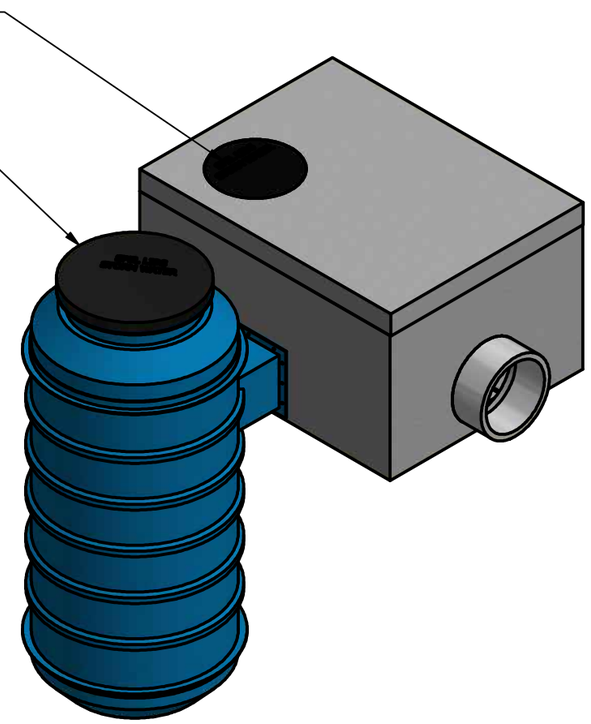
PLAN VIEW



ELEVATION VIEW



SIDE VIEW



ISOMETRIC VIEW

APPROVED.....
NAME.....
SIGNED.....
DATE...../...../.....

ISSUED FOR CONSTRUCTION

NOTE:

- BALLAST & BUOYANCY CALCULATIONS TO BE DONE AT TIME OF QUOTING
- BALLAST SUPPLIED BY OTHERS
- EDUCTION / VACUUM TYPE MAINTENANCE ONLY

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TOLERANCE: ALL DIMENSIONS 10mm UNLESS OTHERWISE STATED.

ALL INTERCONNECTING PIPEWORK, PITS AND ASSOCIATED DRAINAGE BY OTHERS

CLIENT:

DISTRIBUTOR :

Drawn	M.MAKIN	Date 19/06/2019
Check		Date
Verified		Date
Approved		Date
Request No.	RN41158	

SPEL ENVIRONMENTAL
INTEGRATED WATER SOLUTIONS
100 Silverwater Road Silverwater NSW 2128
PH: 1300 773 500 | E: sales@spel.com.au
www.spel.com.au

PROJECT :

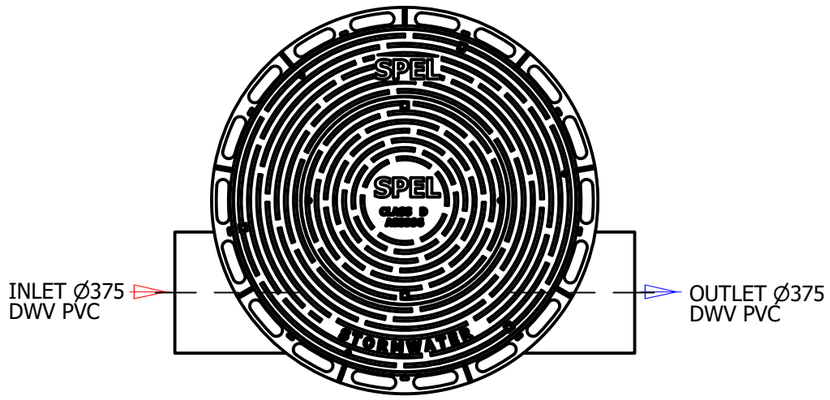
TITLE SPEL VORTCEPTOR OFF-LINE
SVO.096.L.600
GENERAL ARRAGNGEMENT

SCALE	SIZE	SHEET	REV
N.T.S	A3	1	1

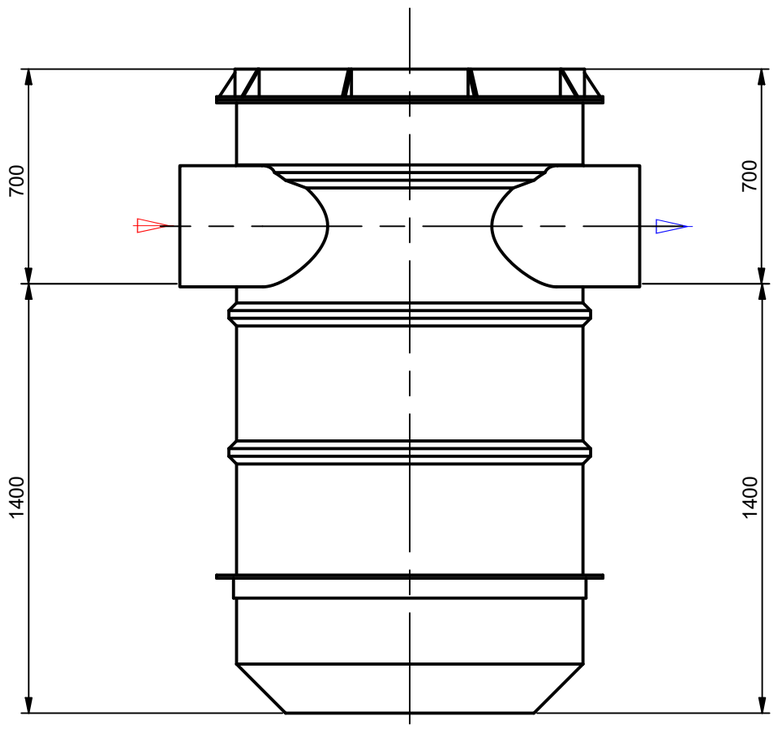
CUSTOMER CODE :

DWG No. SP19-VC12000-P

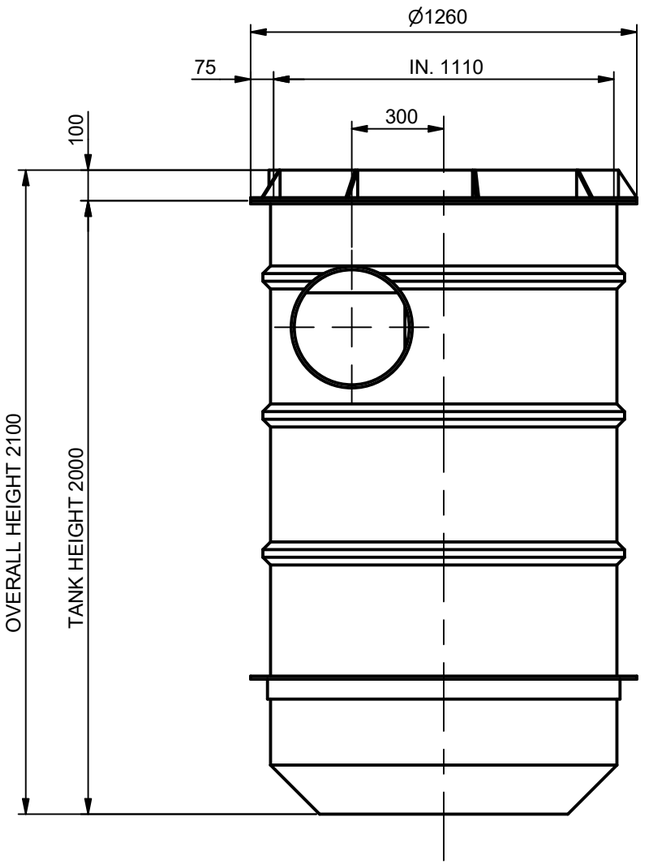
LEFT SIDE INFLOW



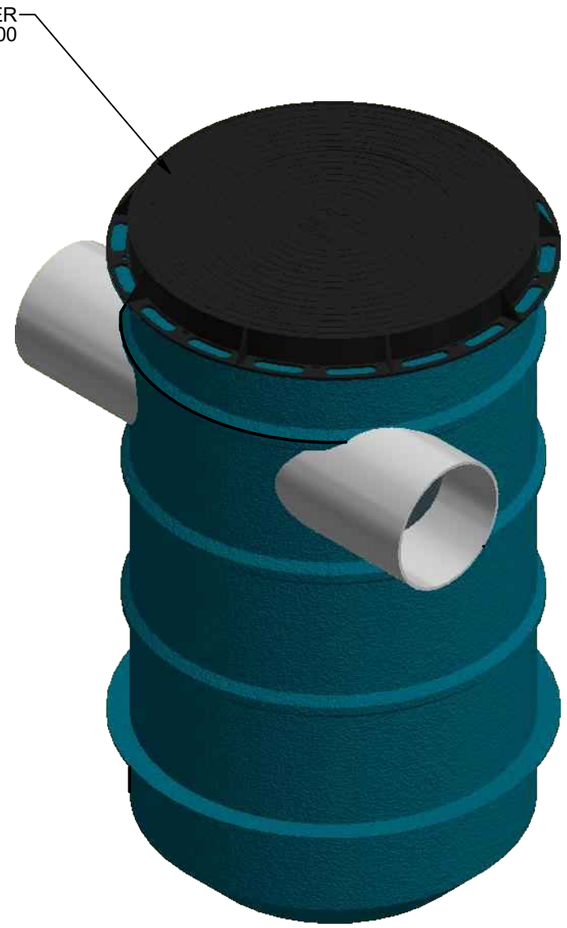
PLAN VIEW



ELEVATION VIEW



END VIEW
OUTLET



ISOMETRIC VIEW

ISSUE FOR APPROVAL
NOT FOR CONSTRUCTION

TOLERANCE: All Dimensions to Closest 10 mm & +/- 30 mm

ALL INTERCONNECTING PIPEWORK, PITS AND ASSOCIATED DRAINAGE BY OTHERS

REV	DESCRIPTION	DESIGNER	CREATION DATE	CHK
2	OVERALL HEIGHT CHANGED	M.MAKIN	07/07/2021	

CLIENT:

Drawn	M.MAKIN	Date 27/10/2020
Check		Date
Verified		Date
Approved		Date
Request No.		

spelstormwater
joy in water
spel.com.au

PROJECT :

TITLE
SPEL VORTCEPTOR
SVI.025.L.375.PVC DWV
GENERAL ARRANGEMENT

SCALE	SIZE	SHEET	REV
N.T.S	A3	1	2

CUSTOMER CODE :
DWG No. SP20-VC24830-S

E:\Vault Working Folder\Designs\SPEL\PRODUCTS\VORTCEPTOR\INLINE\SVI.025\STANDARD\VORTCEPTOR SVI.025 - REV102020\SP20-VC24830-S.idw

10 Appendix 3 – Reference drawings

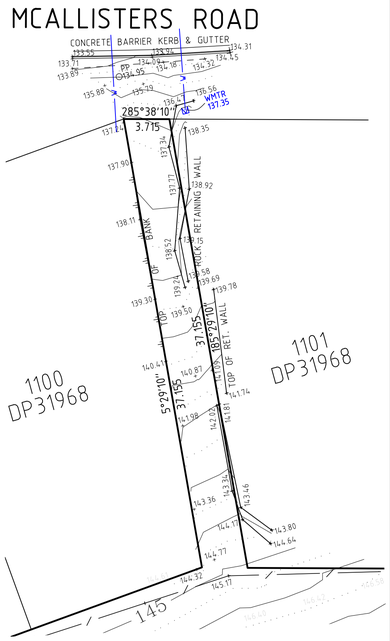


DIAGRAM A
SCALE 1:250 [A1]
SCALE 1:500 [A3]

LEGEND

- TOP OF BANK
- TOE OF BANK
- CHANGE OF GRADE
- DRAIN CENTRELINE
- FENCE
- MASONRY WALL / FENCE

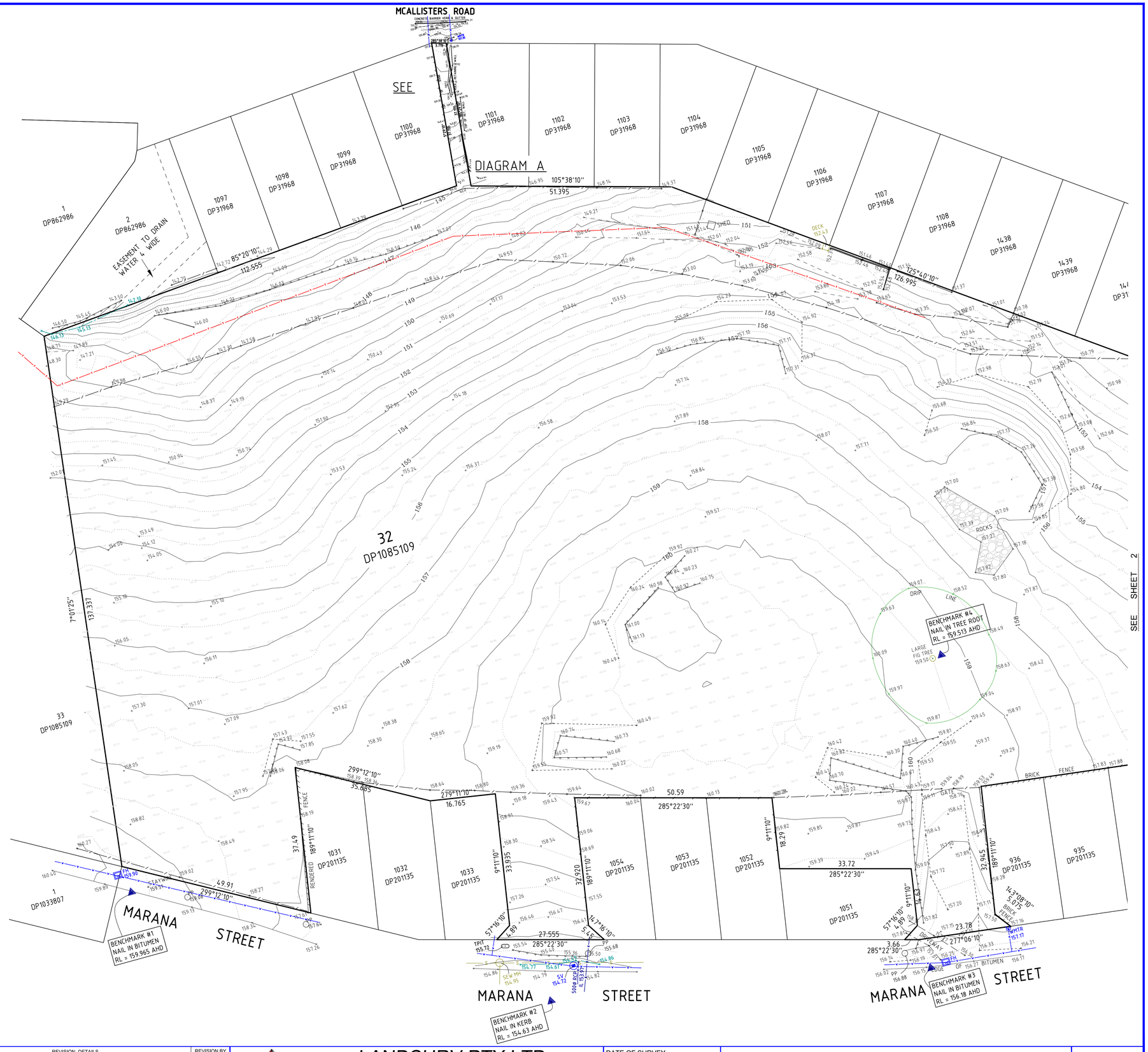
- GRATE T.44 — GRATED DRAINAGE PIT (LEVEL ON GRATE)
- WMTR — WATER METER
- SV — WATER VALVE
- FH — HYDRANT
- TPIT — TELSTRA PIT
- SEW MH — SEWER MANHOLE
- PP — POWER POLE
- D — UNDERGROUND DRAINAGE (PLOTTED FROM DBYD RECORDS)
- S — UNDERGROUND SEWER (PLOTTED FROM DBYD RECORDS)
- T — UNDERGROUND TELECOMMS (PLOTTED FROM DBYD RECORDS)
- W — UNDERGROUND WATER (PLOTTED FROM DBYD RECORDS)

NOTES

1. TREES HAVE NOT BEEN LOCATED AS PART OF THIS SURVEY, EXCEPT FOR THE LARGE FIG TREE. OTHER TREES AND VEGETATION EXIST ON SITE.
2. SERVICES HAVE BEEN LOCATED WHERE VISIBLE ONLY AND PLOTTED FROM DBYD RECORDS. UNDERGROUND SERVICES HAVE NOT BEEN LOCATED.
3. ALL SERVICES SHOULD BE LOCATED PRIOR TO COMMENCEMENT OF ANY WORKS OR EXCAVATION.
4. LEVEL DATUM IS AHD. ORIGIN OF LEVELS IS PM74550 RL = 141.649 AHD.
5. CONTOUR INTERVAL
   5.1. MAJOR = 1 m
   5.2. MINOR = 0.5 m
6. TOPOGRAPHIC SURFACE HAS BEEN COMPILED FROM GROUND SURVEY AND GROUND-TRUTHED & ADJUSTED LIDAR DATA FOR ENHANCED TOPOGRAPHIC RESOLUTION. AVERAGE DIFFERENCE BETWEEN SURVEY AND LIDAR = 0mm (AFTER ADJUSTMENT).
7. CONTOURS ARE INDICATIVE OF GENERAL TOPOGRAPHY. DO NOT INFER CRITICAL LEVELS FROM CONTOURS.
8. HORIZONTAL COORDINATE DATUM IS APPROXIMATE MGA ZONE 56 (GDA2020) ON GROUND DISTANCES (S.F=1). TO TRANSFORM TO MGA, ALL DATA MUST BE SCALED AROUND ORIGIN (EASTING: 546726.473 NORTHING: 6878773.231) USING COMBINED SCALE FACTOR = 0.999598.
9. PROPERTY BOUNDARIES HAVE BEEN DEFINED FOR DETAIL SURVEY PURPOSES ONLY. MORE EXTENSIVE SURVEY IS REQUIRED FOR FULL DETERMINATION OF BOUNDARIES.

0 10m 20m 30m 40m 50m 60m 70m 80m 90m 100m

SCALE 1:500 [A1]
SCALE 1:1000 [A3]



CLIENT: GEMLIFE	ALL UNDERGROUND SERVICES SHOULD BE LOCATED ON SITE BY RELEVANT AUTHORITIES BEFORE ANY WORK IS COMMENCED	DIAL BEFORE YOU DIG www.1100.com.au

REVISION /DATE	REVISION DETAILS	REVISION BY

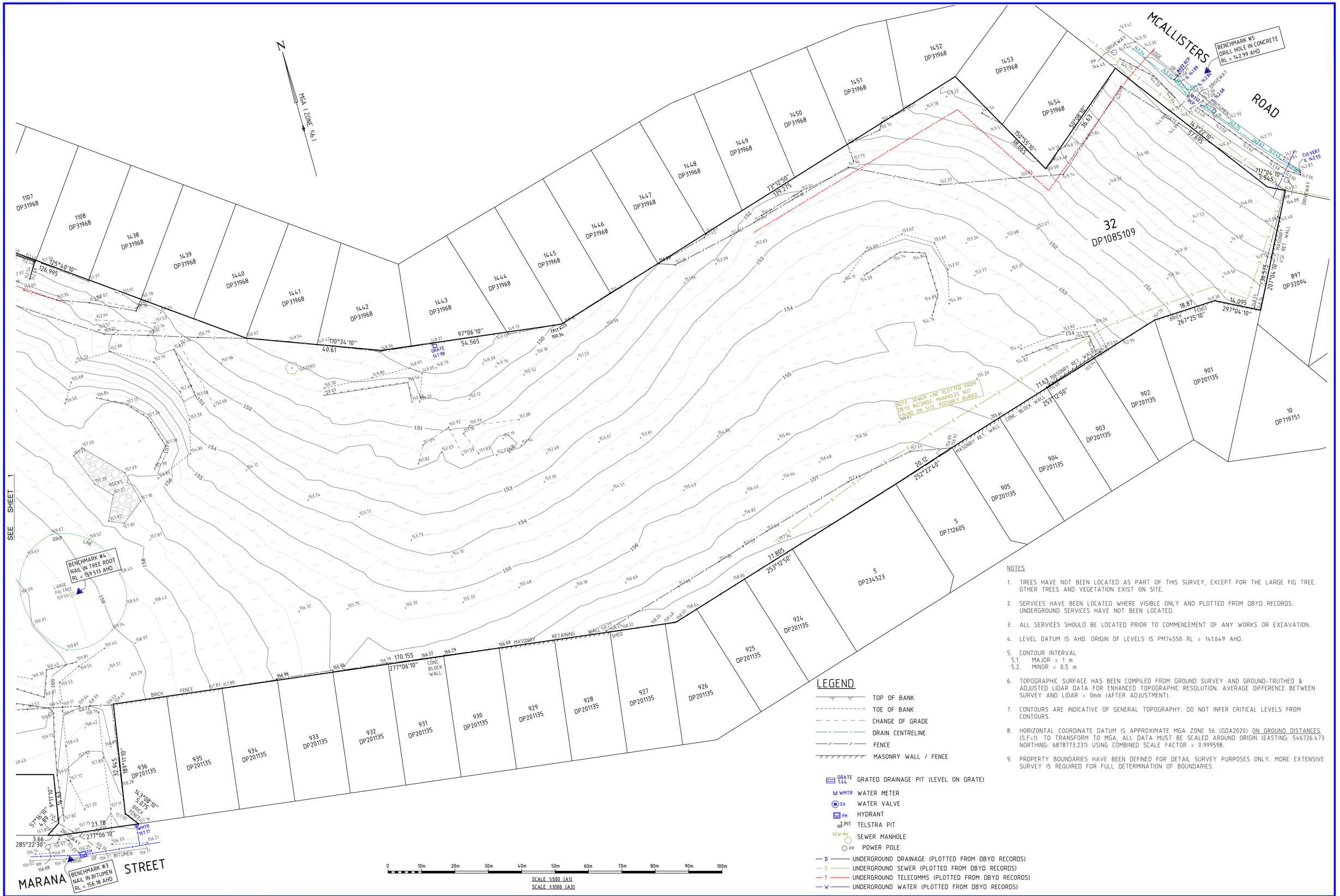
LANDSURV PTY LTD
REGISTERED SURVEYORS & DEVELOPMENT CONSULTANTS
14 ENID STREET TWEED HEADS NSW 2485
Ph. (07) 55366467 Fax (07)55367489 email: macsurv@landsurv.com.au

DATE OF SURVEY	12.10.21
DATE	19.10.21
DRAWN	CBS
CHECKED	BG
CAD FILE No.	40289_DET

CONTOUR AND DETAIL SURVEY OF LOT 32 ON DP1085109
MARANA STREET, BILAMBIL HEIGHTS, NSW

ORIGIN OF LEVELS: PM74550 RL 141.649 AHD

SCALE 1: 500 [A1]
REVISION:
SHEET 1 OF 2
JOB No 40289



LEGEND

- TOP OF BANK
- TOE OF BANK
- CHANGE OF GRADE
- DRAIN CENTRELINE
- FENCE
- MASONRY WALL / FENCE

GRATE 1.44 GRATED DRAINAGE PIT (LEVEL ON GRATE)
WMTR WATER METER
SV WATER VALVE
FH HYDRANT
PIT TELSTRA PIT
SEW MH SEWER MANHOLE
PP POWER POLE

- D UNDERGROUND DRAINAGE (PLOTTED FROM DBYD RECORDS)
- S UNDERGROUND SEWER (PLOTTED FROM DBYD RECORDS)
- T UNDERGROUND TELECOMMS (PLOTTED FROM DBYD RECORDS)
- W UNDERGROUND WATER (PLOTTED FROM DBYD RECORDS)

NOTES

1. TREES HAVE NOT BEEN LOCATED AS PART OF THIS SURVEY, EXCEPT FOR THE LARGE FIG TREE. OTHER TREES AND VEGETATION EXIST ON SITE.
2. SERVICES HAVE BEEN LOCATED WHERE VISIBLE ONLY AND PLOTTED FROM DBYD RECORDS. UNDERGROUND SERVICES HAVE NOT BEEN LOCATED.
3. ALL SERVICES SHOULD BE LOCATED PRIOR TO COMMENCEMENT OF ANY WORKS OR EXCAVATION.
4. LEVEL DATUM IS AHD. ORIGIN OF LEVELS IS PM74550 RL = 141.649 AHD.
5. CONTOUR INTERVAL
   5.1. MAJOR = 1 m
   5.2. MINOR = 0.5 m
6. TOPOGRAPHIC SURFACE HAS BEEN COMPILED FROM GROUND SURVEY AND GROUND-TRUTHED & ADJUSTED LIDAR DATA FOR ENHANCED TOPOGRAPHIC RESOLUTION. AVERAGE DIFFERENCE BETWEEN SURVEY AND LIDAR = 0mm (AFTER ADJUSTMENT).
7. CONTOURS ARE INDICATIVE OF GENERAL TOPOGRAPHY. DO NOT INFER CRITICAL LEVELS FROM CONTOURS.
8. HORIZONTAL COORDINATE DATUM IS APPROXIMATE MGA ZONE 56 (GDA2020) ON GROUND DISTANCES (S.F.=1). TO TRANSFORM TO MGA, ALL DATA MUST BE SCALED AROUND ORIGIN (EASTING: 546726.473 NORTHING: 6878773.231) USING COMBINED SCALE FACTOR = 0.999598.
9. PROPERTY BOUNDARIES HAVE BEEN DEFINED FOR DETAIL SURVEY PURPOSES ONLY. MORE EXTENSIVE SURVEY IS REQUIRED FOR FULL DETERMINATION OF BOUNDARIES.

CLIENT:
GEMLIFE

ALL UNDERGROUND SERVICES SHOULD BE LOCATED ON SITE BY RELEVANT AUTHORITIES BEFORE ANY WORK IS COMMENCED

DIAL BEFORE YOU DIG www.1100.com.au

REVISION /DATE	REVISION DETAILS	REVISION BY

LANDSURV PTY LTD
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14 ENID STREET TWEED HEADS NSW 2485
Ph. (07) 55366467 Fax (07)55367489 email: macsurv@landsurv.com.au

DATE OF SURVEY	12.10.21
DATE	19.10.21
DRAWN	CBS
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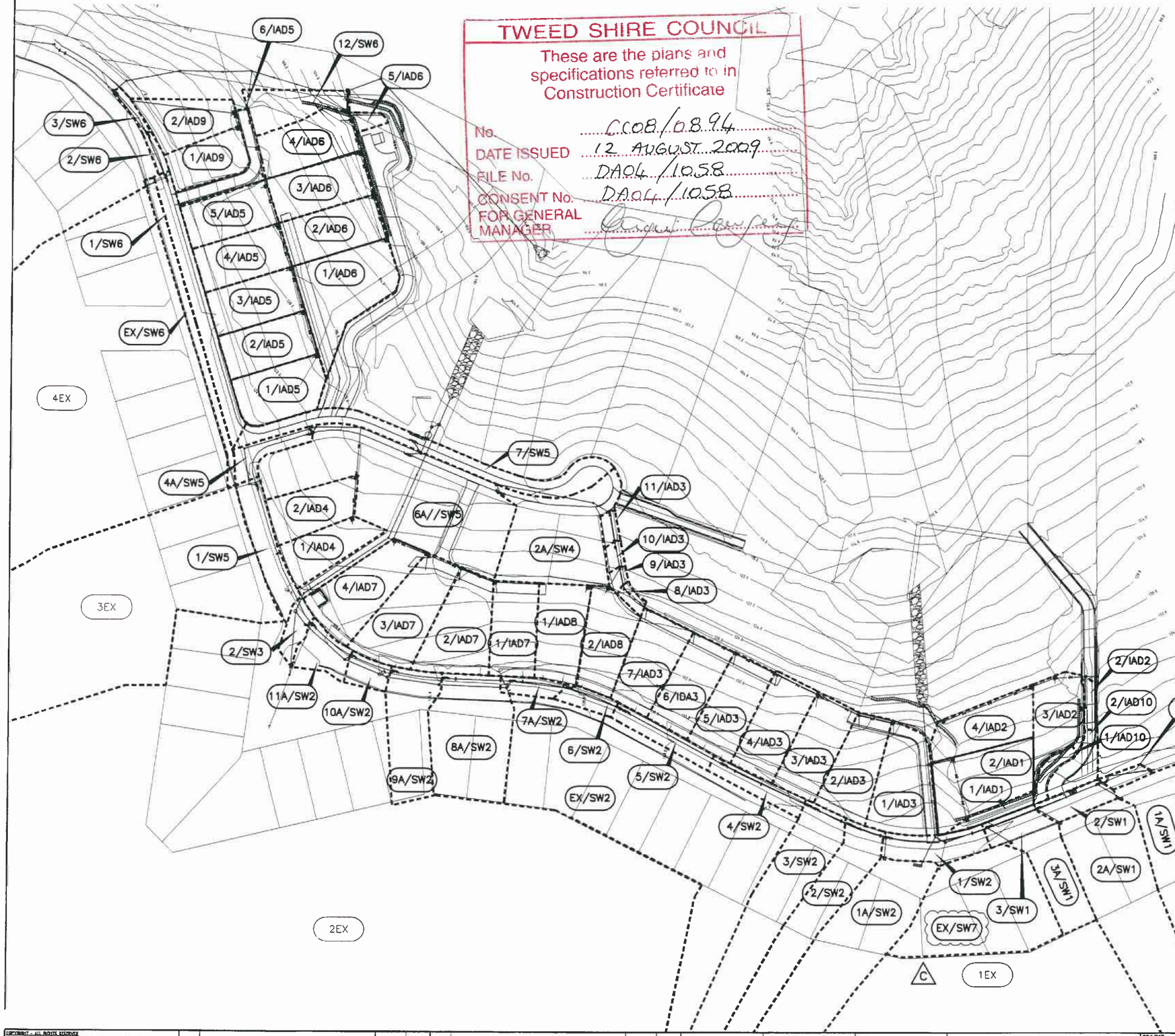
CAD FILE No.	40289_DET

CONTOUR AND DETAIL SURVEY OF LOT 32 ON DP1085109
MARANA STREET, BILAMBIL HEIGHTS, NSW

ORIGIN OF LEVELS: PM74550 RL 141.649 AHD

SCALE 1: 500 [A1]
REVISION:
SHEET 2 OF 2
JOB No 40289



TWEED SHIRE COUNCIL

These are the plans and specifications referred to in Construction Certificate

No. CC08/0894

DATE ISSUED 12 AUGUST 2009

FILE No. DA04/1058

CONSENT No. DA04/1058

FOR GENERAL MANAGER

NAME	AREA
1/IAD1	0.019
1/IAD10	0.024
1/IAD2	0.001
1/IAD3	0.112
1/IAD4	0.071
1/IAD5	0.088
1/IAD6	0.139
1/IAD7	0.082
1/IAD8	0.086
1/IAD9	0.064
1/SW1	0.012
1/SW2	0.035
1/SW5	0.086
1/SW6	0.085
10/IAD3	0.001
10/SW2	0.024
11/IAD3	0.001
11/SW2	0.039
12/SW6	0.042
1A/SW1	0.491
1A/SW2	0.517
2/IAD1	0.137
2/IAD10	0.039
2/IAD2	0.029
2/IAD3	0.091
2/IAD4	0.074
2/IAD5	0.081
2/IAD6	0.087
2/IAD7	0.111

NAME	AREA
2/IAD8	0.087
2/IAD9	0.078
2/SW1	0.028
2/SW2	0.274
2/SW6	0.009
2A/SW1	0.425
2A/SW4	0.185
3/IAD2	0.096
3/IAD3	0.090
3/IAD5	0.080
3/IAD6	0.087
3/IAD7	0.120
3/SW1	0.031
3/SW2	0.326
3/SW6	0.009
3A/SW1	0.081
4/IAD2	0.073
4/IAD3	0.091
4/IAD5	0.080
4/IAD6	0.089
4/IAD7	0.111
4/SW2	0.036
4A/SW5	0.032
5/IAD3	0.091
5/IAD5	0.078
5/IAD6	0.015
5/SW2	0.036
6/IAD3	0.086
6/IAD5	0.014

NAME	AREA
6/IAD5	0.014
6/SW2	0.021
6A/SW5	0.393
7/IAD3	0.089
7/SW2	0.020
7/SW5	0.122
8/IAD3	0.001
8/SW2	0.180
9/IAD3	0.001
9/SW2	0.110
EX/SW7	0.247

C

CATCHMENT TABLES

LEGEND

-107.0——— DESIGN CONTOURS

– – – – – INTERNAL CATCHMENT BOUNDARY

2/SW1 CATCHMENT AREA LABEL

NOTE: REFER 207023-63 FOR EXTERNAL CATHCMENTS

ISSUE	AMENDMENT	DATE	INITIALS
C	CATCHMENTS REVISED	05/09	CJM
B	CATCHMENT LABELS REVISED, EXTERNAL	02/09	MDF
	CATCHMENTS SHOWN		
A	CATCHMENTS REVISED/CONTOURS AMENDED	11/08	CJM

North

M.D.F. DRAWN	C.J.M. DESIGNED
M.A.F. PROJECT ENGINEER	M.A.F. DESIGN VERIFICATION
M.A.F. PROJECT DIRECTOR	12/09/2008 DATE

OPUS QANTEC McWILLIAM
A.B.N. 79 086 342 065
1/10 Rivendell
PO Box 6389
Tweed Heads South NSW 2486
Telephone: (07) 5523 1755
Facsimile: (07) 5523 9664
E-Mail: tweedheads@opusqmcw.com.au

PROJECT
PROPOSED 45 LOT SUBDIVISION
38 & 142 McALLISTERS ROAD
BILAMBIL HEIGHTS, NSW

DRAWING TITLE
STORMWATER CATCHMENT PLAN
INTERNAL CATCHMENTS

CLIENT
MR SHANE HARRIS

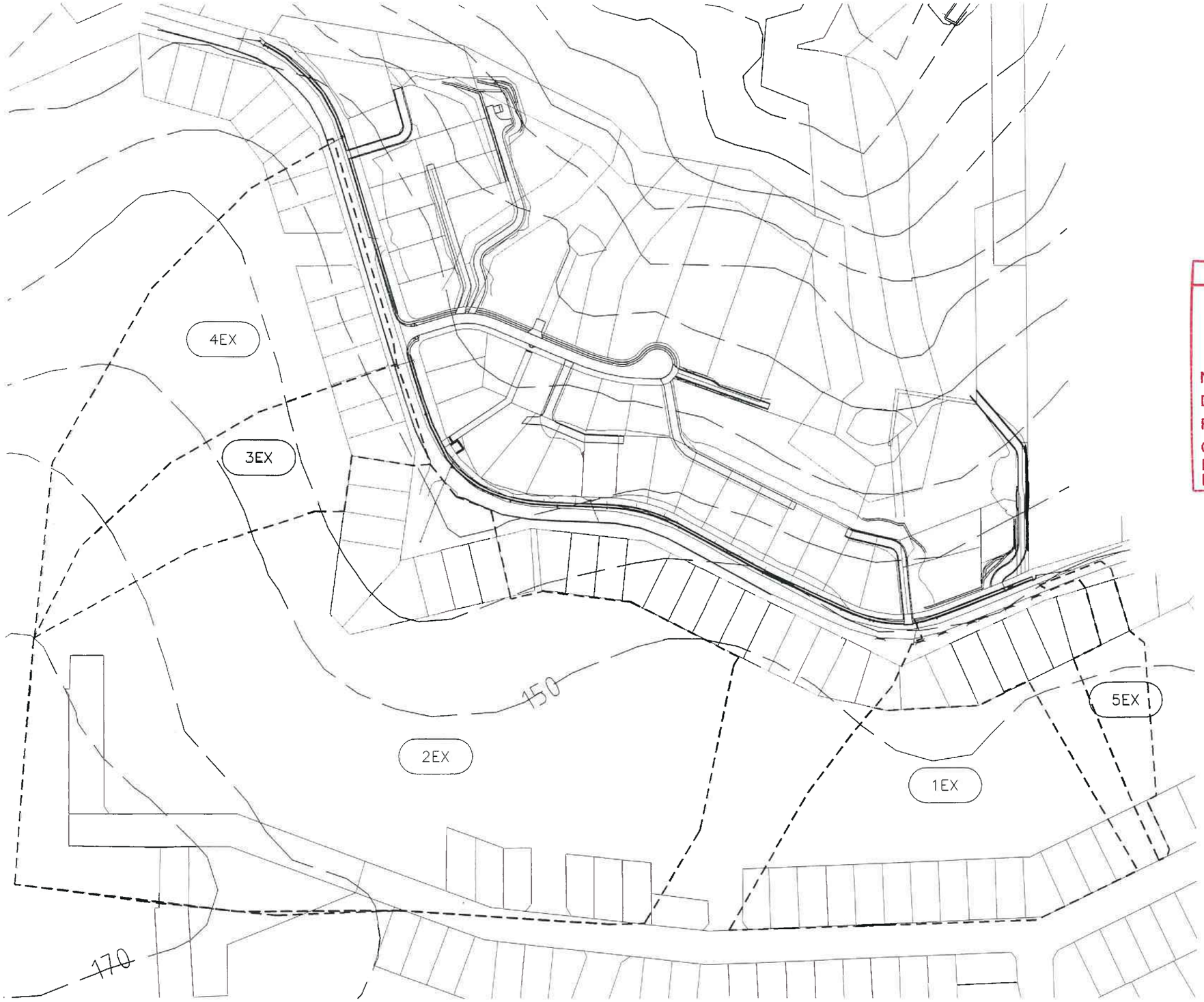
SCALES

CLIENT PROJECT No.

SURVEYOR
B & P SURVEYS PTY LTD

DRAWING No. 207023-62

ISSUE C



TWEED SHIRE COUNCIL

These are the plans and specifications referred to in Construction Certificate

No. CC08/0894

DATE ISSUED 12 AUGUST 2009

FILE No. DA04/1058

CONSENT No. DA04/1058

FOR GENERAL MANAGER

NAME	AREA (Ha)
1EX	2.28
2EX	8.5
3EX	1.22
4EX	3.5
5EX	0.42

C

CATCHMENT TABLE

LEGEND

—107.0— EXISTING CONTOURS
NOTE: CONTOURS DERIVED FROM CURRUMBIN TOPOGARPHIC DATA

EXTERNAL CATCHMENT BOUNDARY

2EX CATCHMENTS AREA LABEL

ISSUE	AMENDMENT	DATE	INITIALS	ISSUE	AMENDMENT	DATE	INITIALS
C	CATCHMENT '1EX' AMENDED	05/09	CJM				
B	CATCHMENT '2EX' & '5EX' AMENDED	02/09	CJM				
A	CATCHMENT TABLE AMENDED	09/08	CJM				

North

M.D.F. DRAWN	C.J.M. DESIGNED
M.A.F. PROJECT ENGINEER	M.A.F. DESIGN VERIFICATION
M.A.F. PROJECT DIRECTOR	12/09/2008 DATE | Copyright | ©

OPUS QANTEC McWILLIAM
A.B.N. 79 686 342 065
1/10 Rivendell
PO Box 6389
Tweed Heads South NSW 2486
Telephone: (07) 5523 1755
Facsimile: (07) 5523 9664
E-Mail: tweedheads@opusqmcw.com.au

PROJECT: PROPOSED 45 LOT SUBDIVISION
38 & 142 McALLISTERS ROAD
BILAMBIL HEIGHTS, NSW

DRAWING TITLE: STORMWATER CATCHMENT PLAN
EXTERNAL CATCHMENTS

CLIENT: MR SHANE HARRIS

SURVEYOR: B & P SURVEYS PTY LTD

SCALES:

CLIENT PROJECT No.:

DRAWING No. 207023-63

ISSUE C

LOCATION				TIME	SUB-CATCHMENT RUNOFF							INLET DESIGN																					HEADLOSSES				PART FULL				DESIGN LEVELS					
				tc	I	C	A	C*A	+CA	Q					Qg	Qb		tc	I	+CA	Qt	Qm	Qs	Qp	L	S							V2/2g	Ku	hu	Kl	hl	Kw	hw	Sf	hf		Vp					
DESIGN ARI	STRUCTURE No.	DRAIN SECTION	SUB-CATCHMENTS CONTRIBUTING	SLOPE OF CATCHMENT	SUB-CATCHMENT TIME OF CONC.	RAINFALL INTENSITY / CO-EFFICIENT OF RUNOFF	SUB-CATCHMENT AREA	EQUIVALENT AREA	SUM OF (C * A)	SUB-CATCHMENT DISCHARGE	FLOW IN K&C (INC. BYPASS)	ROAD GRADE AT INLET	MINOR FLOW ROAD CAPACITY	INLET TYPE	FLOW INTO INLET	BYPASS FLOW	BYPASS STRUCTURE No.	CRITICAL TIME OF CONC.	RAINFALL INTENSITY	TOTAL (C * A)	MAJOR TOTAL FLOW	MAJOR SURFACE FLOW CAPACITY	MAJOR SURFACE FLOW	PIPE FLOW	REACH LENGTH	PIPE GRADE	PIPE / BOX DIMENSIONS (CLASS)	FLOW VELOCITY	TIME OF FLOW IN REACH	STRUCTURE RATIOS FOR K' VALUE CALCULATIONS	VELOCITY HEAD	U/S HEADLOSS COEFFICIENT	U/S PIPE STRUCT. HEADLOSS	LAT. HEADLOSS CO-EFFICIENT	LAT. PIPE STRUCT. HEADLOSS	W.S.E CO-EFFICIENT	CHANGE IN W.S.E	PIPE FRICTION SLOPE	PIPE FRICTION HEADLOSS (L * Sf)	DEPTH	VELOCITY	OBVERT LEVELS	DRAIN SECTION H.G.L	UPSTREAM H.G.L	LAT. H.G.L	W.S.E.	SURFACE OR K&C INVERT LEVEL	STRUCTURE No.
yrs				%	min	mm/h	ha	ha	ha	l/s	l/s	%	l/s		l/s	l/s		min	mm/h	ha	l/s	l/s	l/s	l/s	m	%	mm	m/s	min		m		m		m		m	m	m	m/s	m	m	m	m	m	m	
5 100	10/SW2	10/SW2 to 11/SW2	6EX to 7/SW2;8/SW2;9/SW2;10/SW2											22				21.09 21.09	111 177	1.691 2.131	1048			535 (Pipe flow= Sum upstr atten flows)	22.871	4.81		750(3)	1.19	0.32	Qo 0.535 Do 750 Flow 10A/SW2 made eqv grate flow Flow 9/SW2 made eqv grate flow CHRT 32: Vo2/2gDo 0.10 H/Do Kg side flow 7.95 end flow 6.10 K' vals above for stepped pipes as grate flow grate flow decreased by 0.521 from 9/SW2 Angle 19 Chart 38 S/Do 2.5 chart Du/Do 1.00 KO 1.51 K0.5 1.86 Qu/Qo 0.97 Cg 0.07 K 1.53	0.072	1.86	0.134		2.31 S/Do 2.0 K0 1.79 K0.5 2.07 K 1.81 S/Do 1.5 K0 2.11 K0.5 2.54 K 2.14 Interp val for S/Do 1.22 Kw 2.31 CHART 35 S/Do 2.0 K0 1.55 K0.5 1.74 K 1.56 S/Do 1.5 K0 1.75 K0.5 1.80 K 1.75 Interp val for S/Do 1.22 Ku 1.86 K vals step pipes as pipe flow Ku 1.86 Kw 2.31	0.167	0.22	0.051	0.238	4.42	129.296 128.196	129.296 128.196	129.430		129.463	130.740	10/SW2
5 100	11A/SW2	11A/SW2 to 11/SW2	11/SW2	5.50	13.00 13.00	139 217	0.84 1.00	0.039	0.033 0.039	0.033 0.039	13 FLOW WIDTH 0.045m (0.027m 3 month)	18	7.08	205	6F.8	14	4	1A/SW5	13.00 13.00	139 217	0.033 0.039	24	205	10 (Pipe flow= Grate flow)	14	3.080	1.30	375(2)	0.13	0.05	Qg 0.014 Qo 0.014 Do 375 CHRT 32: Vo2/2gDo 0.00 H/Do Kg side flow 10.81 end flow 7.54 Part full downstream pipe	0.001	1.00	0.005		Upstream HGL 127.942 pipe obv 128.145 Set Kp to 1	1.00	0.005	0.01 below outlet	0.000	0.067	1.04	128.145 128.105	127.937 128.105	127.942		127.942	129.147	11A/SW2
5 100	11/SW2	11/SW2 to 12A/SW2	6EX to 10/SW2;11/SW2															21.41 21.41	111 175	1.724 2.170	1055			546 (Pipe flow= Sum upstr atten flows)	10.340	4.06		750(3)	1.22	0.14	Qo 0.546 Do 750 Flow 10/SW2 made eqv grate flow Flow 11A/SW2 made eqv grate flow CHRT 32: Vo2/2gDo 0.10 H/Do Kg side flow 7.91 end flow 6.03 K' vals above for stepped pipes as grate flow grate flow decreased by 0.535 from 10/SW2 Angle 24 Chart 36 S/Do 2.5 chart Du/Do 1.00 KO 1.51 K0.5 1.85 Qu/Qo 0.98 Cg 0.05 K 1.53	0.076	1.86	0.141		2.30 S/Do 2.0 K0 1.79 K0.5 2.07 K 1.81 S/Do 1.5 K0 2.11 K0.5 2.54 K 2.13 Interp val for S/Do 1.23 Kw 2.30 CHART 35 S/Do 2.0 K0 1.55 K0.5 1.74 K 1.56 S/Do 1.5 K0 1.75 K0.5 1.80 K 1.75 Interp val for S/Do 1.23 Ku 1.86 K vals step pipes as pipe flow Ku 1.86 Kw 2.30	0.174	0.23	0.024	0.251	4.19	127.796 127.376	127.796 127.376	127.937		127.970	129.200	11/SW2
5 100	2EX	2EX to EX/SW3	2EX		16.00 16.00	126 199	1.00 1.00	6.375 8.080	6.375 8.080	6.375 8.080	2231 4466							16.00 16.00	126 199	6.375 8.080	4466			2231				900(3																				2EX
5 100	EX/SW3	EX/SW3 to 12A/SW2	2EX;EX/SW3		16.00 16.00	126 199	0.74 0.94	0.800	0.592 0.752	0.592 0.752	207 FLOW WIDTH 0.150m (0.090m 3 month)	207	1.73	1307		207	0	1A/SW5	16.00 16.00	126 199	6.967 8.832	4882			2438 (Pipe flow= Sum upstr atten flows)	52.466	2.78		1200(2)	2.09	0.42	Part full downstream pipe Upstream HGL 127.735 below outlet pipe obv 128.159 Set Kp to 0.2	0.223	0.20	0.290			0.20	0.290	0.36	0.189	0.505	5.33	128.159 126.699	127.445 126.699	127.735		127.735	129.450	EX/SW3
5 100	12A/SW2	12A/SW2 to 12/SW2	6EX to 10/SW2;11/SW2;2EX;EX/SW3											22				21.55 21.55	110 175	8.691 11.002	5348			2670 (Pipe flow= Sum upstr atten flows)	5.652	0.51		1200(3)	2.33	0.04	Part full downstream pipe Upstream HGL 126.639 below outlet pipe obv 126.639 Set Kp to 0.68	0.277	0.68	0.276			0.68	0.276	0.46	0.026	0.931	2.82	126.639 126.610	126.363 126.610	126.639		126.639	128.210	12A/SW2
5 100	12/SW2	12/SW2 to 13/SW2	6EX to 10/SW2;11/SW2;2EX;EX/SW3											22				21.59 21.59	110 175	8.691 11.002	5348			2670 (Pipe flow= Sum upstr atten flows)	7.230	2.99		1200(3)	2.33	0.05		0.277	1.21	0.335			1.26	0.349	0.46	0.033	0.524	5.61	125.983 125.767	125.983 125.767	126.318		126.332	128.224	12/SW2
5 100	13/SW2	13/SW2 to 14/SW2	6EX to 10/SW2;11/SW2;2EX;EX/SW3											22				21.64 21.64	110 175	8.691 11.002	5348			2670 (Pipe flow= Sum upstr atten flows)	18.501	2.40		1200(3)	2.33	0.13	Part full downstream pipe Upstream HGL 123.874 below outlet pipe obv 124.251 Set Kp to 0.2	0.277	0.20	0.273			0.20	0.273	0.46	0.084	0.557	5.17	124.251 123.807	123.601 123.807	123.874		123.874	126.188	13/SW2
5 100	14/SW2	14/SW2 to 15/SW2	6EX to 10/SW2;11/SW2;2EX;EX/SW3											22				21.77 21.77	110 174	8.691 11.002	5316			2670 (Pipe flow= Sum upstr atten flows)	18.502	2.40		1200(3)	2.33	0.13	Part full downstream pipe Upstream HGL 123.138 below outlet pipe obv 123.365 Set Kp to 0.31	0.277	0.31	0.423			0.31	0.423	0.46	0.084	0.557	5.17	123.365 122.921	122.715 122.921	123.138		123.138	125.250	14/SW2
5 100	1/IAD7	1/IAD7 to 2/IAD7	1/IAD7	22.00	7.17 7.17	175 272	0.76 0.96	0.082	0.063 0.079	0.063 0.079	31 60	31	6.88	393#1	3L1.8A.36F	8 31	0	2/IAD7	7.17 7.17	175 272	0.063 0.079	60		31 (Pipe flow= Grate flow)		16.370	6.06	225(2)	0.75	0.27		0.029	0.57	0.016			0.57	0.016	0.43	0.071	0.081	2.37	126.105 125.113	126.105 125.113	126.121		126.121	126.758	1/IAD7
5 100	2/IAD7	2/IAD7 to 3/IAD7	1/IAD7;2/IAD7	19.00	7.38 7.38	174 268	0.76 0.96	0.111	0.084 0.107	0.084 0.107	41 80	41	9.87	393#1	3L1.8A.36F	8 41	0	3/IAD7	7.44 7.44	173 269	0.147 0.186	139		71 (Pipe flow= Sum upstr atten flows)		15.703	6.14	225(2)	1.73	0.15		0.153	0.57	0.087			0.57	0.087	2.31	0.362	0.130	2.97	125.093 124.129	125.093 124.129	125.180		125.180	125.681	2/IAD7
5 100	3/IAD7	3/IAD7 to 4/IAD7	1/IAD7;2/IAD7;3/IAD7	19.00	7.38 7.38	174 269	0.76 0.96	0.120	0.091 0.115	0.091 0.115	44 86	44	2.70	393#1	3L1.8A.36F	8 44	0	4/IAD7	7.59 7.59	172 267	0.238 0.301	223		114 (Pipe flow= Sum upstr atten flows)		15.798	2.72	300(2)	1.62	0.16	Part full downstream pipe Upstream HGL 124.120 below outlet pipe obv 124.170 Set Kp to 0.2	0.134	0.20	0.061			0.20	0.061	1.40	0.222	0.189	2.46	124.170 123.740	124.059 123.740	124.120		124.120	124.985	3/IAD7
5 100	4/IAD7	4/IAD7 to 15/SW2	1/IAD7;2/IAD7;3/IAD7;4/IAD7	12.00	8.09 8.09	168 261	0.76 0.96	0.111	0.084 0.107	0.084 0.107	39 77	39	2.70	393#1	3L1.8A.36F	8 39	0		8.09 8.09	168 261	0.322 0.408	296	267	145 (Pipe flow= Sum upstr atten flows)	151	3.093	5.98	300(2)	2.13	0.02		0.231	0.42	0.097			0.42	0.097	2.44	0.075	0.174	3.54	123.665 123.480	123.665 123.480	123.762		123.762	124.281	4/IAD7
5 100	15/SW2	15/SW2 to 16/SW2	6EX to EX/SW3;1/IAD7;2/IAD7;3/IAD7;4/IAD7											22				21.90 21.90	109 174	9.012 11.410	5515			2744 (Pipe flow= Sum upstr atten flows)	15.041	2.10		1350(2)	1.86	0.13		0.176	2.03	0.357			2.03	0.357	0.24	0.036	0.551	4.94	121.459 121.143	121.459 121.143	121.816		121.816	124.121	15/SW2
5 100	16/SW2	16/SW2 to 17/SW2	6EX to EX/SW3;1/IAD7;2/IAD7;3/IAD7;4/IAD7											22				22.03 22.03	109 173	9.012 11.410	5483			2744 (Pipe flow= Sum upstr atten flows)	15.269	2.10		1350(3)	1.89	0.13		0.182	1.75	0.319			1.87	0.340	0.25	0.039	0.553	4.94	119.312 118.991	119.312 118.991	119.631		119.652	122.653	16/SW2
5 100	17/SW2	17/SW2 to 18/SW2	6EX to EX/SW3;1/IAD7;2/IAD7;3/IAD7;4/IAD7											22				22.16 22.16	109 173	9.012 11.410	5483			2744 (Pipe flow= Sum upstr atten flows)	24.172	2.01		1350(3)	1.89	0.21		0.182	1.48	0.286			1.57	0.286	0.25	0.061	0.560	4.86	117.632 117.145	117.632 117.145	117.898		117.918	119.485	17/SW2

C:\PROJECTS 2007\207023 - McAllisters Road\207023 PCDrain\207023 FINAL\PCDtable4.DXF

CALCULATIONS TABLE

REFER 207023-70 FOR PIT CODING TABLE

ISSUE	AMENDMENT	DATE	INITIALS
D	TITLE AMENDED	06/09	MDF
C	CALC TABLES AMENDED	05/09	CJM
B	CALC TABLES AMENDED	02/09	MDF
A	CALC TABLES AMENDED	11/08	CJM

North

M.D.F. DRAWN	C.J.M. DESIGNED
M.A.F. PROJECT ENGINEER	M.A.F. DESIGN VERIFICATION
M.A.F. PROJECT DIRECTOR	12/09/2008 DATE [Copyright] ©

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Tweed Heads South NSW 2486
Telephone: (07) 5523 1755
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E-Mail: tweedheads@opusqmcw.com.au

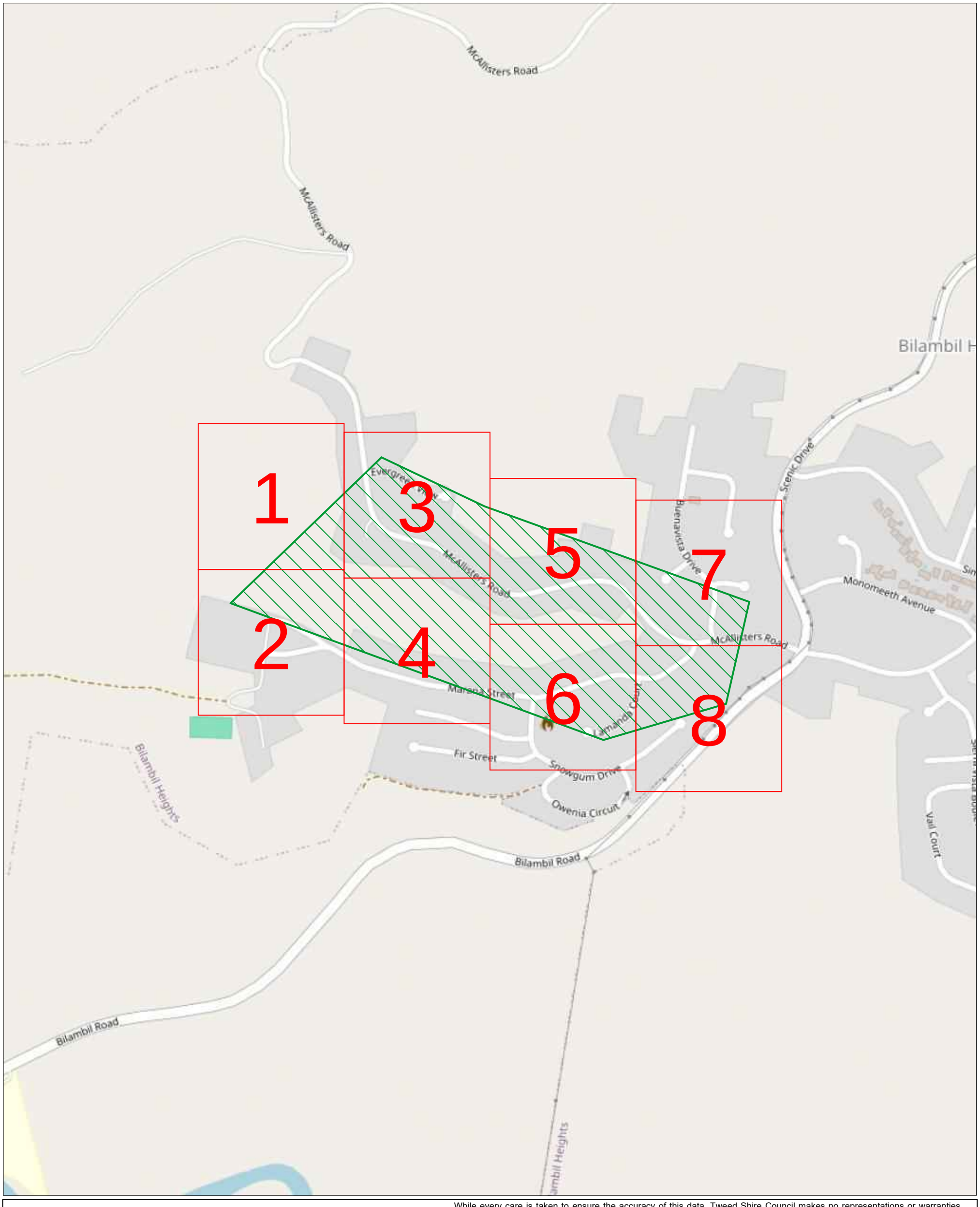
PROJECT: PROPOSED 45 LOT SUBDIVISION 38 & 142 McALLISTERS ROAD BILAMBIL HEIGHTS, NSW
CLIENT: MR SHANE HARRIS
SURVEYOR: B & P SURVEYS PTY LTD
DRAWING TITLE: STORMWATER CALCULATION TABLE SHEET 4 OF 11
SCALES:
CLIENT PROJECT No.:
DRAWING No.: 207023-67
ISSUE: D

11 Appendix 4 Dial before you dig documentation

Overview Map

Sequence No: 248308311
43 McAllisters Road Bilambil Heights

Date: 03/12/2024



1:5000 @ A3 Portrait

Legend:
BYDA Work Area

Imagery sourced from OpenStreetMaps

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Map 1

Sequence No: 248308311
43 McAllisters Road Bilambil Heights

TWEED SHIRE COUNCIL

Date: 03/12/2024

Sewer Pipeline
- Sewer Rising Main
- Sewer Rising Main (Abandoned)
- Sewer Rising Main (Private)
- Sewer Gravity Main (Abandoned)
- Sewer Gravity Overflow
- Sewer Gravity Main (Private)
- Sewer Service Connection

Sewer Gravity Mains
- 0- 200
- 225 - 600
- 700- 900

Sewer Node
- End Cap
- Public Manhole
- Public Property Pump
- Public Pump Station
- Vacuum Chamber
- Vent Stack

Communication
- Communication Node
- Communication Cables

Stormwater Pipe (Survey)
- Stormwater Pipe (Survey)
- Stormwater Culvert (Survey)

Stormwater Pipe
- Stormwater Pipe
- Stormwater Pipe (Abandoned)
- Stormwater Pipe (Private)
- Stormwater Culvert
- Stormwater Culvert (Abandoned)
- Stormwater Channel
- Stormwater Channel (Abandoned)

Stormwater Node (Survey)
- Manhole
- Drop Inlet
- Kerb Inlet
- Wingwall

Stormwater Node
- Manhole
- Drop Inlet
- Kerb Inlet
- Wingwall
- Private Stormwater Point

Water Pipe Location
- Water Main
- Water Main (Abandoned)
- Water Main (Private)
- Water Main (Recycled)
- Water Service Connections

Water Node
- Gate Valve
- Hydrant
- Pressure Reducing Valve
- Pressure Sustaining Valve
- Pump
- Reservoir
- Scour Valve

SCIMS Survey Marks
- CP
- CR
- GB
- MM
- PM
- SS
- TS

General
- Property Boundary
- BYDA Work Area
- Flood Levee

N

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Boundaries shown should be considered approximate only

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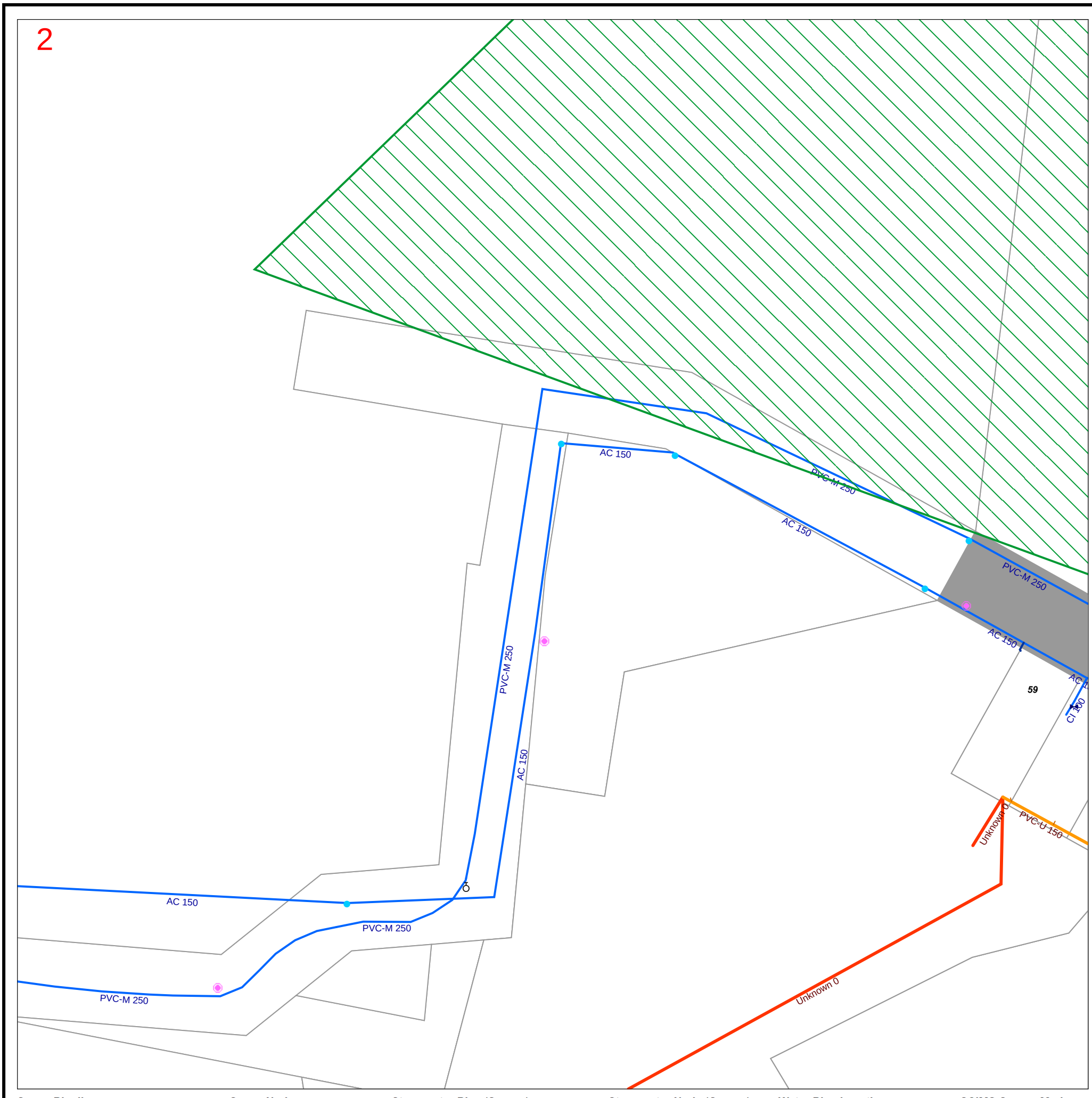
Map 2

Sequence No: 248308311
43 McAllisters Road Bilambil Heights

TWEED SHIRE COUNCIL
Date: 03/12/2024



Sewer Pipeline
- Sewer Rising Main
- Sewer Rising Main (Abandoned)
- Sewer Rising Main (Private)
- Sewer Gravity Main (Abandoned)
- Sewer Gravity Overflow
- Sewer Gravity Main (Private)
- Sewer Service Connection

Sewer Gravity Mains
- 0- 200
- 225 - 600
- 700- 900

Sewer Node
- End Cap
- Public Manhole
- Public Property Pump
- Public Pump Station
- Vacuum Chamber
- Vent Stack

Communication
- Communication Node
- Communication Cables

Stormwater Pipe (Survey)
- Stormwater Pipe (Survey)
- Stormwater Culvert (Survey)

Stormwater Pipe
- Stormwater Pipe
- Stormwater Pipe (Abandoned)
- Stormwater Pipe (Private)
- Stormwater Culvert
- Stormwater Culvert (Abandoned)
- Stormwater Channel
- Stormwater Channel (Abandoned)

Stormwater Node (Survey)
- Manhole
- Drop Inlet
- Kerb Inlet
- Wingwall

Stormwater Node
- Manhole
- Drop Inlet
- Kerb Inlet
- Wingwall
- Private Stormwater Point

Water Pipe Location
- Water Main
- Water Main (Abandoned)
- Water Main (Private)
- Water Main (Recycled)
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Water Node
- Gate Valve
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- Pressure Reducing Valve
- Pressure Sustaining Valve
- Pump
- Reservoir
- Scour Valve

SCIMS Survey Marks
- CP
- CR
- GB
- MM
- PM
- SS
- TS

General
- Property Boundary
- BYDA Work Area
- Flood Levee

N

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Map 3

Sequence No: 248308311
43 McAllisters Road Bilambil Heights

TWEED SHIRE COUNCIL

Date: 03/12/2024

Sewer Pipeline
- Sewer Rising Main
- Sewer Rising Main (Abandoned)
- Sewer Rising Main (Private)
- Sewer Gravity Main (Abandoned)
- Sewer Gravity Overflow
- Sewer Gravity Main (Private)
- Sewer Service Connection

Sewer Gravity Mains
- 0- 200
- 225 - 600
- 700- 900

Sewer Node
- End Cap
- Public Manhole
- Public Property Pump
- Public Pump Station
- Vacuum Chamber
- Vent Stack

Communication
- Communication Node
- Communication Cables

Stormwater Pipe (Survey)
- Stormwater Pipe (Survey)
- Stormwater Culvert (Survey)

Stormwater Pipe
- Stormwater Pipe
- Stormwater Pipe (Abandoned)
- Stormwater Pipe (Private)
- Stormwater Culvert
- Stormwater Culvert (Abandoned)
- Stormwater Channel
- Stormwater Channel (Abandoned)

Stormwater Node (Survey)
- Manhole
- Drop Inlet
- Kerb Inlet
- Wingwall

Stormwater Node
- Manhole
- Drop Inlet
- Kerb Inlet
- Wingwall
- Private Stormwater Point

Water Pipe Location
- Water Main
- Water Main (Abandoned)
- Water Main (Private)
- Water Main (Recycled)
- Water Service Connections

Water Node
- Gate Valve
- Hydrant
- Pressure Reducing Valve
- Pressure Sustaining Valve
- Pump
- Reservoir
- Scour Valve

SCIMS Survey Marks
- CP
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- MM
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- SS
- TS

General
- Property Boundary
- BYDA Work Area
- Flood Levee

N

1:750 @ A3 Portrait

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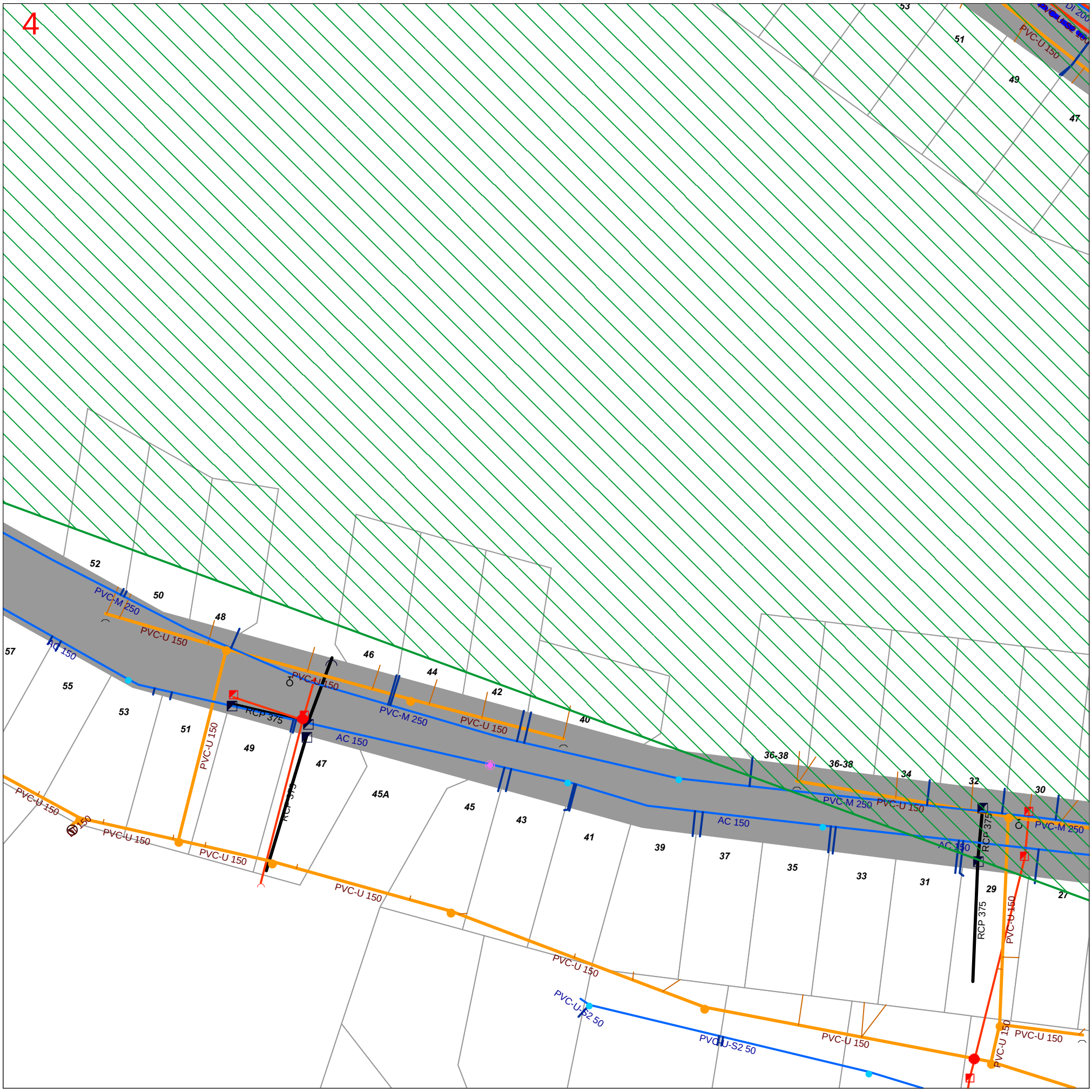
Map 4

Sequence No: 248308311
43 McAllisters Road Bilambil Heights

Date: 03/12/2024



Sewer Pipeline
- Sewer Rising Main
- Sewer Rising Main (Abandoned)
- Sewer Rising Main (Private)
- Sewer Gravity Main (Abandoned)
- Sewer Gravity Overflow
- Sewer Gravity Main (Private)
- Sewer Service Connection

Sewer Gravity Mains
- 0- 200
- 225 - 600
- 700- 900

Sewer Node
- End Cap
- Public Manhole
- Public Property Pump
- Public Pump Station
- Vacuum Chamber
- Vent Stack

Communication
- Communication Node
- Communication Cables

Stormwater Pipe (Survey)
- Stormwater Pipe (Survey)
- Stormwater Culvert (Survey)

Stormwater Pipe
- Stormwater Pipe
- Stormwater Pipe (Abandoned)
- Stormwater Pipe (Private)
- Stormwater Culvert
- Stormwater Culvert (Abandoned)
- Stormwater Channel
- Stormwater Channel (Abandoned)

Stormwater Node (Survey)
- Manhole
- Drop Inlet
- Kerb Inlet
- Wingwall

Stormwater Node
- Manhole
- Drop Inlet
- Kerb Inlet
- Wingwall
- Private Stormwater Point

Water Pipe Location
- Water Main
- Water Main (Abandoned)
- Water Main (Private)
- Water Main (Recycled)
- Water Service Connections

Water Node
- Gate Valve
- Hydrant
- Pressure Reducing Valve
- Pressure Sustaining Valve
- Pump
- Reservoir
- Scour Valve

SCIMS Survey Marks
- CP
- CR
- GB
- MM
- PM
- SS
- TS

General
- Property Boundary
- BYDA Work Area
- Flood Levee

1:750 @ A3 Portrait

Date printed: 03/12/2024

Boundaries shown should be considered approximate only

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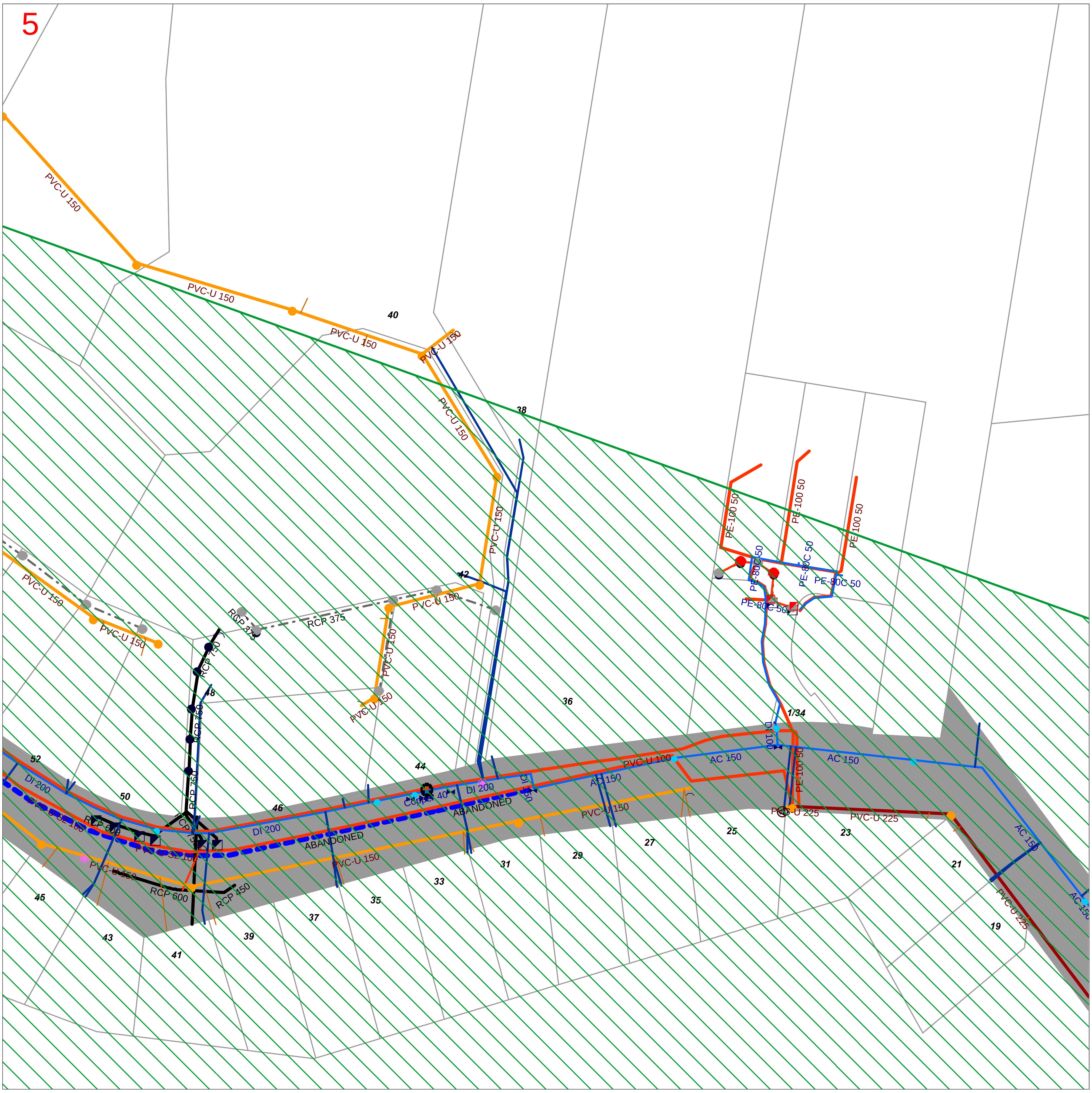
Please note that water pipes and sewer rising mains operate under high pressure and present a significant risk for any work around them while live. These mains will have associated thrust blocks that should also be considered in design/construction clearances.

Map 5

Sequence No: 248308311
43 McAllisters Road Bilambil Heights

Date: 03/12/2024



Sewer Pipeline	Sewer Node	Stormwater Pipe (Survey)	Stormwater Node (Survey)	Water Pipe Location	SCIMS Survey Marks
Sewer Rising Main	End Cap	Stormwater Pipe (Survey)	Manhole	Water Main	CP
Sewer Rising Main (Abandoned)	Public Manhole	Stormwater Culvert (Survey)	Drop Inlet	Water Main (Abandoned)	CR
Sewer Rising Main (Private)	Public Property Pump	**Stormwater Pipe**	Kerb Inlet	Water Main (Private)	GB
Sewer Gravity Main (Abandoned)	Public Pump Station	Stormwater Pipe	Wingwall	Water Main (Recycled)	MM
Sewer Gravity Overflow	Vacuum Chamber	Stormwater Pipe (Abandoned)	**Stormwater Node**	Water Service Connections	PM
Sewer Gravity Main (Private)	Vent Stack	Stormwater Pipe (Private)	Manhole	**Water Node**	SS
Sewer Service Connection	**Communication**	Stormwater Culvert	Drop Inlet	Gate Valve	TS
Sewer Gravity Mains	Communication Node	Stormwater Culvert (Abandoned)	Kerb Inlet	Hydrant	**General**
0- 200	Communication Cables	Stormwater Channel	Wingwall	Pressure Reducing Valve	Property Boundary
225 - 600		Stormwater Channel (Abandoned)	Private Stormwater Point	Pressure Sustaining Valve	BYDA Work Area
700- 900				Pump	Flood Levee
				Reservoir	
				Scour Valve	

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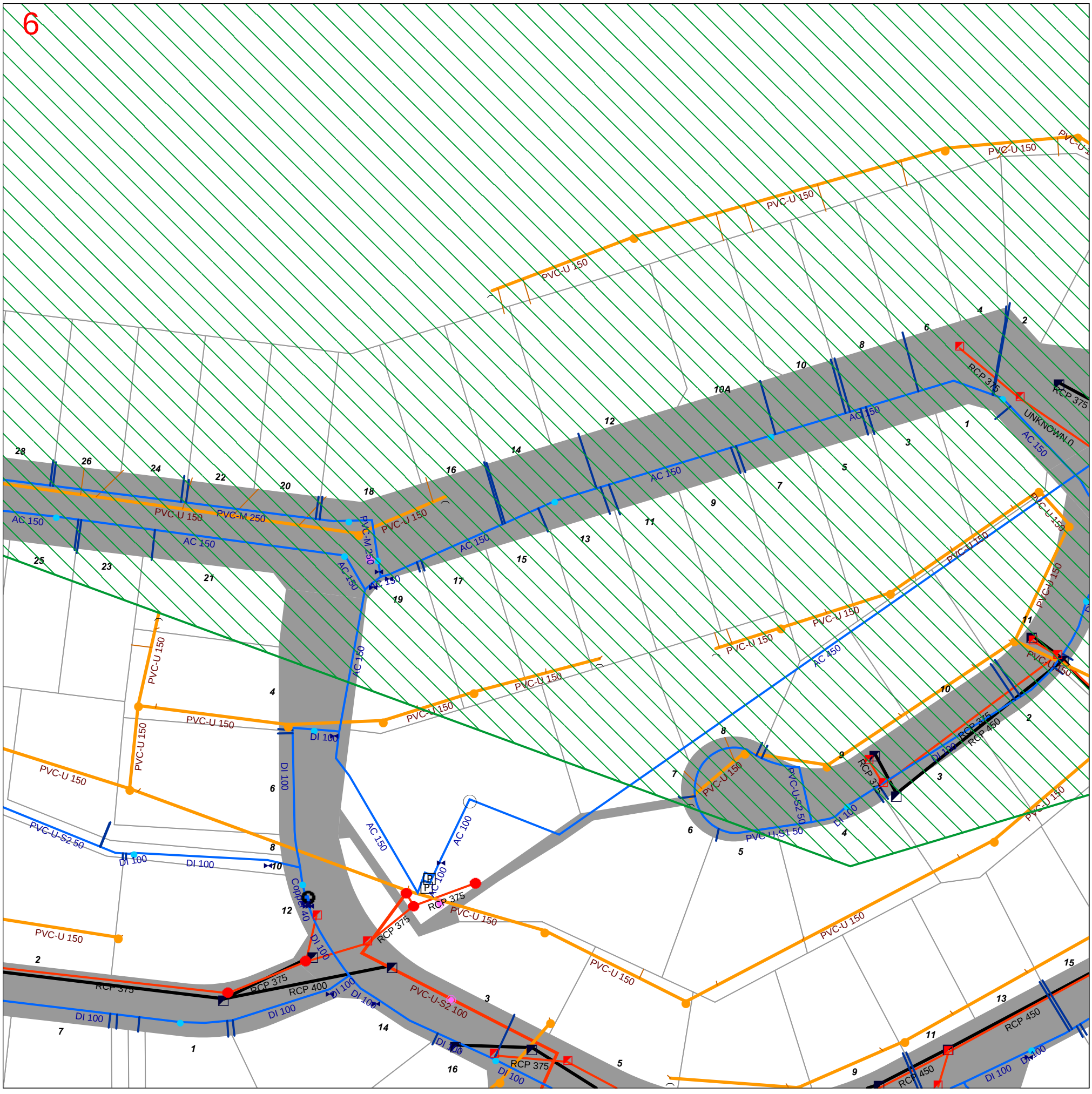
Map 6

Sequence No: 248308311

43 McAllisters Road Bilambil Heights

TWEED SHIRE COUNCIL

Date: 03/12/2024



Sewer Pipeline
- Sewer Rising Main
- Sewer Rising Main (Abandoned)
- Sewer Rising Main (Private)
- Sewer Gravity Main (Abandoned)
- Sewer Gravity Overflow
- Sewer Gravity Main (Private)
- Sewer Service Connection

Sewer Gravity Mains
- 0- 200
- 225 - 600
- 700- 900

Sewer Node
- End Cap
- Public Manhole
- Public Property Pump
- Public Pump Station
- Vacuum Chamber
- Vent Stack

Communication
- Communication Node
- Communication Cables

Stormwater Pipe (Survey)
- Stormwater Pipe (Survey)
- Stormwater Culvert (Survey)

Stormwater Pipe
- Stormwater Pipe
- Stormwater Pipe (Abandoned)
- Stormwater Pipe (Private)
- Stormwater Culvert
- Stormwater Culvert (Abandoned)
- Stormwater Channel
- Stormwater Channel (Abandoned)

Stormwater Node (Survey)
- Manhole
- Drop Inlet
- Kerb Inlet
- Wingwall

Stormwater Node
- Manhole
- Drop Inlet
- Kerb Inlet
- Wingwall
- Private Stormwater Point

Water Pipe Location
- Water Main
- Water Main (Abandoned)
- Water Main (Private)
- Water Main (Recycled)
- Water Service Connections

Water Node
- Gate Valve
- Hydrant
- Pressure Reducing Valve
- Pressure Sustaining Valve
- Pump
- Reservoir
- Scour Valve

SCIMS Survey Marks
- CP
- CR
- GB
- MM
- PM
- SS
- TS

General
- Property Boundary
- BYDA Work Area
- Flood Levee

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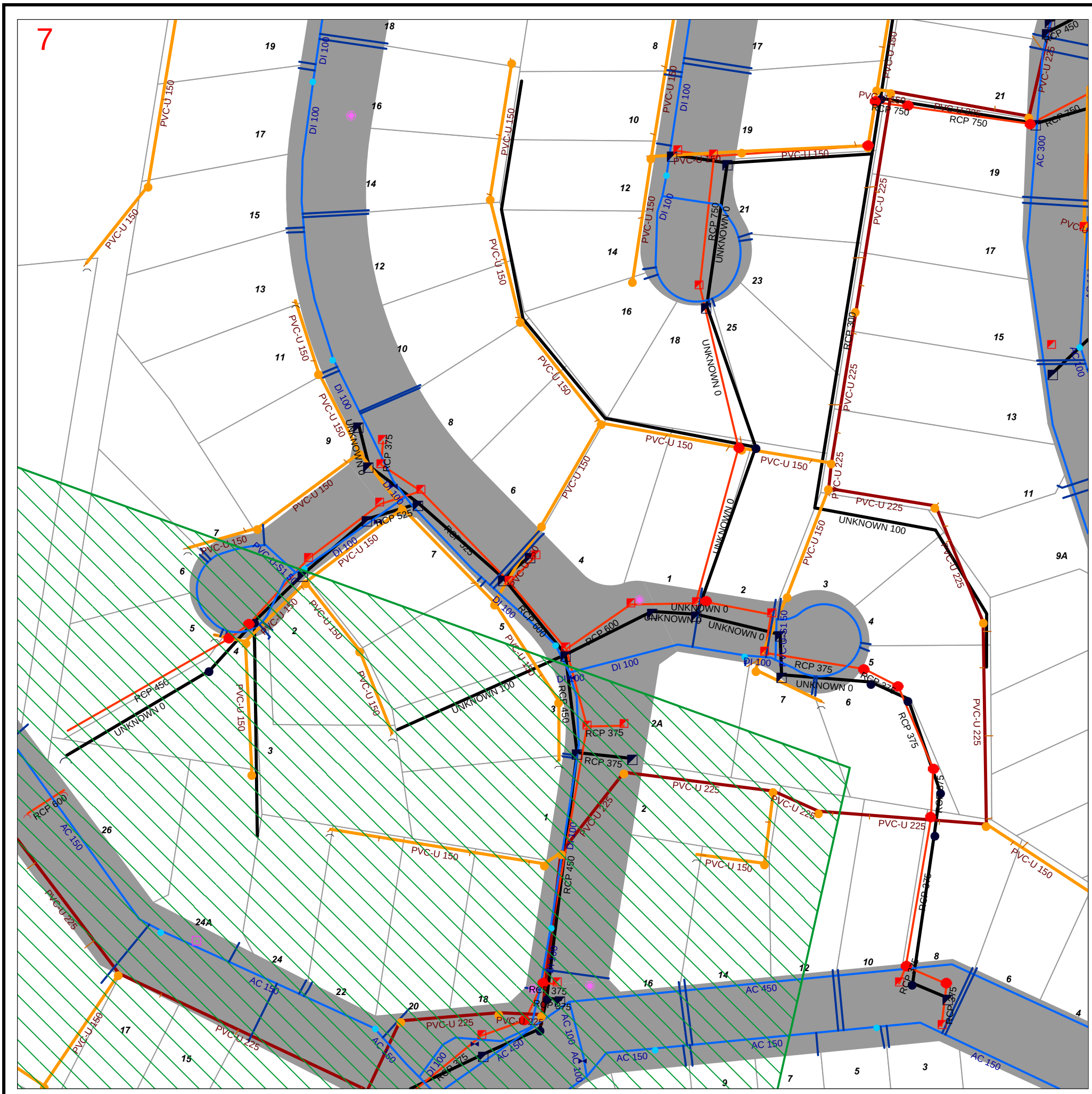
Map 7

Sequence No: 248308311

43 McAllisters Road Bilambil Heights

TWEED SHIRE COUNCIL

Date: 03/12/2024



Sewer Pipeline
- Sewer Rising Main
- Sewer Rising Main (Abandoned)
- Sewer Rising Main (Private)
- Sewer Gravity Main (Abandoned)
- Sewer Gravity Overflow
- Sewer Gravity Main (Private)
- Sewer Service Connection

Sewer Gravity Mains
- 0- 200
- 225 - 600
- 700- 900

Sewer Node
- End Cap
- Public Manhole
- Public Property Pump
- Public Pump Station
- Vacuum Chamber
- Vent Stack

Communication
- Communication Node
- Communication Cables

Stormwater Pipe (Survey)
- Stormwater Pipe (Survey)
- Stormwater Culvert (Survey)

Stormwater Pipe
- Stormwater Pipe
- Stormwater Pipe (Abandoned)
- Stormwater Pipe (Private)
- Stormwater Culvert
- Stormwater Culvert (Abandoned)
- Stormwater Channel
- Stormwater Channel (Abandoned)

Stormwater Node (Survey)
- Manhole
- Drop Inlet
- Kerb Inlet
- Wingwall

Stormwater Node
- Manhole
- Drop Inlet
- Kerb Inlet
- Wingwall
- Private Stormwater Point

Water Pipe Location
- Water Main
- Water Main (Abandoned)
- Water Main (Private)
- Water Main (Recycled)
- Water Service Connections

Water Node
- Gate Valve
- Hydrant
- Pressure Reducing Valve
- Pressure Sustaining Valve
- Pump
- Reservoir
- Scour Valve

SCIMS Survey Marks
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General
- Property Boundary
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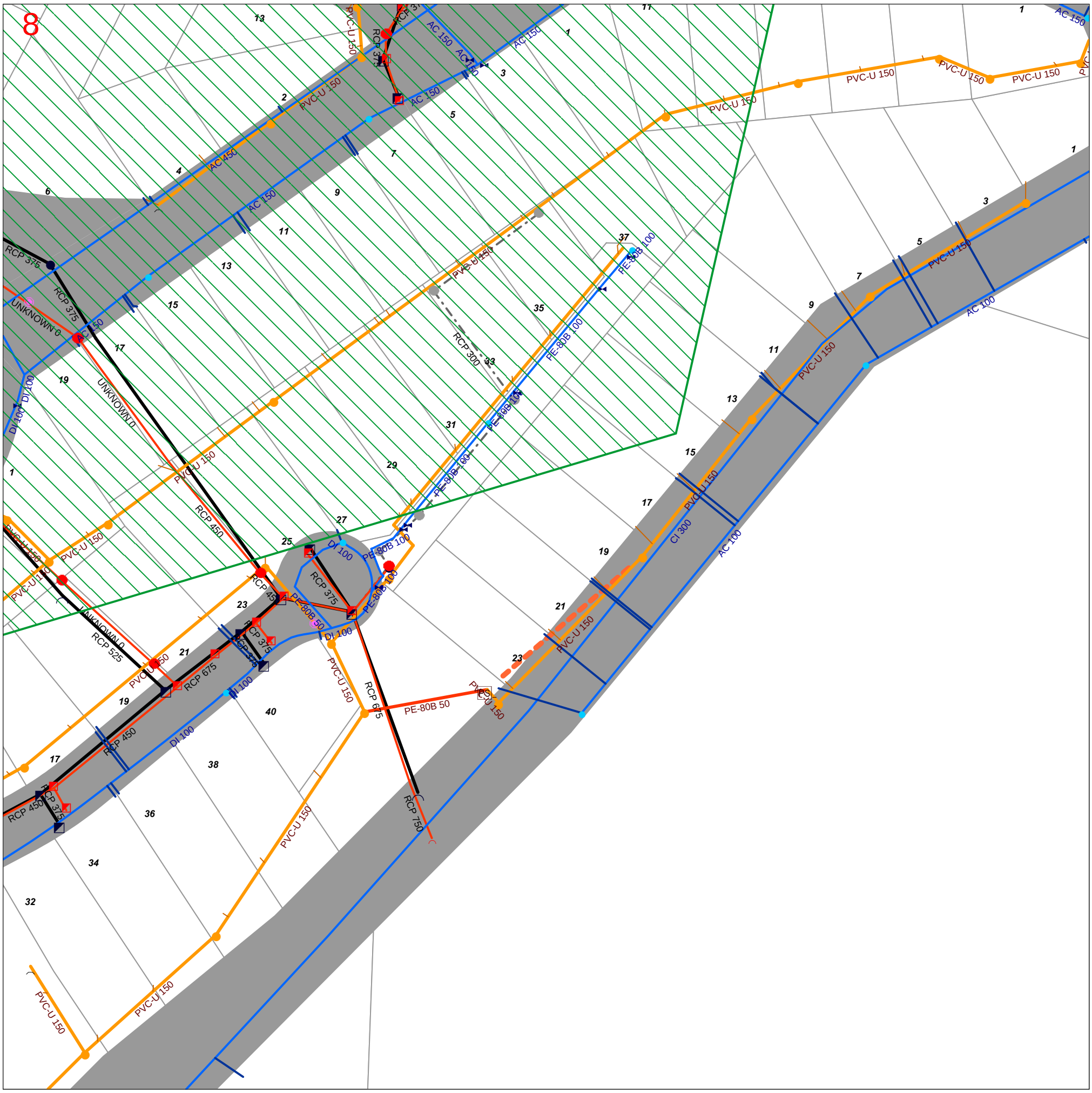
Map 8

Sequence No: 248308311

43 McAllisters Road Bilambil Heights

Date: 03/12/2024



Sewer Pipeline
- Sewer Rising Main
- Sewer Rising Main (Abandoned)
- Sewer Rising Main (Private)
- Sewer Gravity Main (Abandoned)
- Sewer Gravity Overflow
- Sewer Gravity Main (Private)
- Sewer Service Connection

Sewer Gravity Mains
- 0- 200
- 225 - 600
- 700- 900

Sewer Node
- End Cap
- Public Manhole
- Public Property Pump
- Public Pump Station
- Vacuum Chamber
- Vent Stack

Communication
- Communication Node
- Communication Cables

Stormwater Pipe (Survey)
- Stormwater Pipe (Survey)
- Stormwater Culvert (Survey)

Stormwater Pipe
- Stormwater Pipe
- Stormwater Pipe (Abandoned)
- Stormwater Pipe (Private)
- Stormwater Culvert
- Stormwater Culvert (Abandoned)
- Stormwater Channel
- Stormwater Channel (Abandoned)

Stormwater Node (Survey)
- Manhole
- Drop Inlet
- Kerb Inlet
- Wingwall

Stormwater Node
- Manhole
- Drop Inlet
- Kerb Inlet
- Wingwall
- Private Stormwater Point

Water Pipe Location
- Water Main
- Water Main (Abandoned)
- Water Main (Private)
- Water Main (Recycled)
- Water Service Connections

Water Node
- Gate Valve
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- Pressure Reducing Valve
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- Pump
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SCIMS Survey Marks
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General
- Property Boundary
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- Flood Levee

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