



CIVIL ENGINEERING REPORT: SITE BASED STORMWATER
MANAGEMENT PLAN

391-397 Park Ridge Road

391-397 Park Ridge Road, Park Ridge QLD 4125

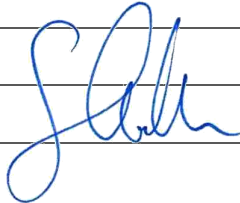
PREPARED FOR
Park Ridge Unit Trust

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Glossary

Term	Definition
ADP	Area Development Plan
AEP	Annual Exceedance Probability
ARI	Average Recurrence Interval
ESR	Engineering Services Report
EY	Exceedances per year
IECA	International Erosion Control Association
MCU	Material Change of Use
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
QUDM	Queensland Urban Drainage Manual
ROL	Reconfiguring of a Lot
SBSMP	Site Based Stormwater Management Plan
SPP	State Planning Policy
SQID	Stormwater Quality Improvement Device
WQO	Water Quality Object
WSUD	Water Sensitive Urban Design

Executive Summary

Northrop Consulting Engineers Pty Ltd (Northrop) have been engaged by Park Ridge Unit Trust to prepare a Site Based Stormwater Management Plan (SBSMP) for Development Application submission to Logan City Council. The proposed residential subdivision is located at 391-397 Park Ridge Road, Park Ridge QLD 4125 and will deliver 61 residential lots with supporting road infrastructure and green space.

This SBSMP addresses the stormwater management strategy for the proposed development and demonstrates that the proposed development can be constructed and operated in accordance with all stormwater objectives required for the development. The primary outcomes of this SBSMP are as follows:

Lawful Point of Discharge

The existing lawful point of discharge will be maintained with most of the site flows being captured for stormwater quantity and quality treatment prior to discharge from the site. The northern portion of the site will discharge to the roadside swale adjacent to Park Ridge Road and the southern portion of the site will discharge to the drainage channel running along the southern boundary of the existing lot.

Stormwater Quantity

The stormwater quantity objective was to demonstrate non-worsening in peak discharges from the subject site for all storm events up to and including the 100-year. The purpose is to ensure that the existing infrastructure and/or downstream properties are not adversely affected.

The proposed development increases the total impervious area, resulting in an increase in flow volume or rate due to development. As such, on-site detention will be required.

To achieve non-worsening, the proposed development requires a total detention volume of 200m³ and 545m³ which has been achieved via a combined bioretention/detention basin located on the northern boundary and utilising the existing dam near the southern boundary, respectively.

Stormwater Quality

Stormwater quality infrastructure has been included in the design to achieve the water quality objectives for South East Queensland specified in the State Planning Policy 2017, namely, the removal of gross pollutants, suspended solids, nitrogen and phosphorus. The proposed treatment train was modelling using MUSIC modelling software and includes the following SQID's:

- North Basin – 100 m² bioretention basin located within detention basin;
- South Basin – 100 m² bioretention basin located within detention basin;

Erosion and Sediment Control

Construction phase ESCP measures are to be implemented during construction in accordance with the relevant requirements.

1. Introduction

Northrop Consulting Engineers Pty Ltd (Northrop) have been engaged by Park Ridge Unit Trust to develop a Site Based Stormwater Management Plan (SBSMP) in support of a Development Application submission to Logan City Council and any nominated referral agency. The proposed residential subdivision is located at 391-397 Park Ridge Road, Park Ridge QLD 4125 (Lot 20 RP94215), the full site details are summarised in Table 1-1 below. The proposed development will deliver a 61 residential lots with supporting road infrastructure and green space.

Table 1-1 - Property Details

Category	Description
Site Address	391-397 Park Ridge Road, Park Ridge QLD 4125
Lot Title	Lot 20 RP94215
Total Site Area	4.5 Ha
Proposed Land Use	Residential Subdivision

This primary objectives of this SBSMP is to define the following:

- Lawful point of discharge
- Stormwater Conveyance and Flood Management
- Stormwater Quantity management strategy
- Stormwater Quality management strategy
- Erosion and Sediment Control strategy.

1.1. Related Reports and Documents

This report is to be read in conjunction with the following reference documents:

- Civil Design Drawings by Northrop. Drawings No C001 to C201 (Revision 1)
- Engineering Services Report by Northrop. Report No. BN213636_ESR001_A
- East Neighbouring Lot DA Application, COM/5/2022

2. Site Context and Existing Characteristics

The subject site is located at 391-397 Park Ridge Road, Park Ridge. The site comprises of one rural residential property lot to be subdivided into 59 residential lots and supporting service infrastructure. The site is currently bound by:

- Park Ridge Road to the North
- Residential lots to the South
- Lot 2 RP164124 to the West
- Lot 19 RP94215 to the East

In its current state the subject site is undeveloped with medium vegetated land and trees cover. A site locality is located below in Figure 2-1.



Figure 2-1 - Site Locality (SOURCE: Nearmap, 2022)

2.1. Existing Lawful Point of Discharge

The following existing stormwater infrastructure has been identified in the vicinity of the site. The information has been sourced from the DBYD site survey information (refer to Appendix D).

- External roadside swale drains on Park Ridge Road along the northern boundary
- Stormwater Main located within Park Ridge Road, to the north-east of the subject site
- Existing farm dam located in the south east corner of the site
- Natural waterway/channel running along southern boundary of site

Since the site currently has no internal stormwater infrastructure, all flows generated on the site flow overland towards the roadside swale along the Park Ridge Road and the southern waterway. The site will maintain both existing Lawful Points of Discharge, Park Ridge Road Swale in the north and the drainage channel running along the southern boundary.

3. Proposed Development

The proposed development is a residential subdivision that involves construction of 57 residential lots with supporting road infrastructure and green space. The proposed architectural layout of the development prepared by Steve Cooper & Associates is shown below in Figure 3-1. Full Subdivision Plan of Development drawings are included in Appendix E.

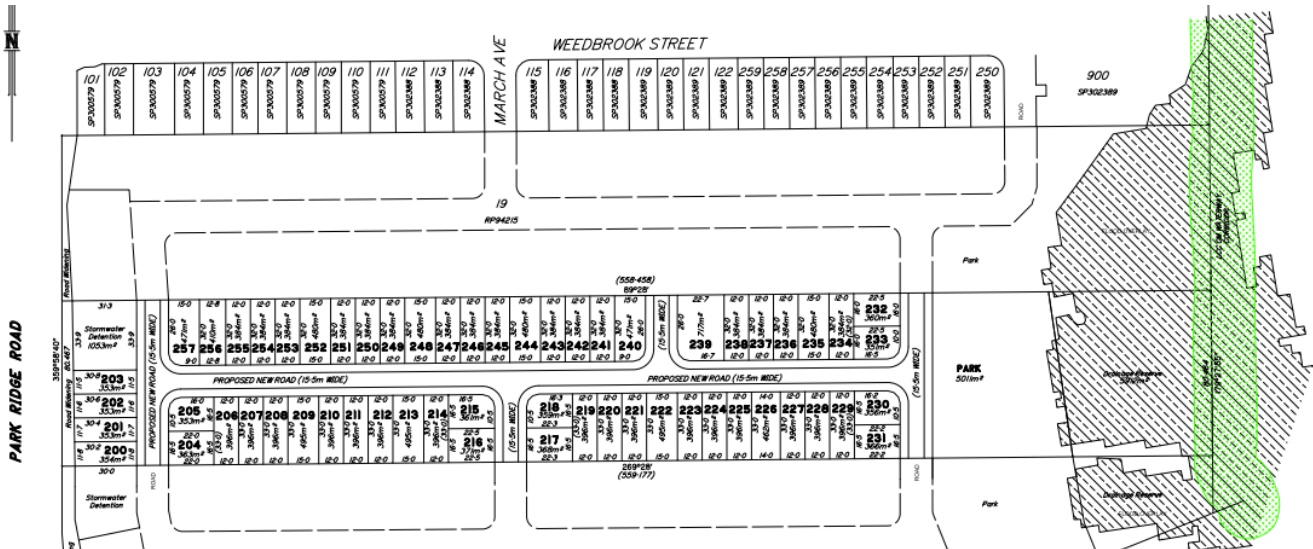


Figure 3-1 - Proposed Development (Steve Cooper & Associates, 2023)

3.1. Proposed Stormwater Management Strategy

The proposed development will introduce a new internal pit and pipe system sized to capture the minor 10% AEP event. All other events above the minor event will be conveyed overland within the road reserve. Inter-allotment drainage proposed on the eastern side of the lot will be designed to capture the major event and convey flows to the southern dam. Flows will discharge towards the bioretention basin located on the north and south boundaries of the subject site.

The flows from the northern portion of the site will be managed by a combined detention/bioretention basin on the north-east corner of the site. The proposed combined detention/bioretention basin will discharge to the external road swale drain running along Park Ridge Road. Council has proposed land resumption along Park Ridge which has been considered in the design.

Flows from the southern portion of the site will discharge to the existing dam along the southern boundary. Stormwater quantity modelling on the existing dam has been completed to ensure non-worsening at the downstream LPOD has been achieved. The proposed retrofitted dam has been assessed to restrict developed flows to pre-development flows for all events up to the 1% AEP. Discussion with Council have been completed and general support for this strategy has been given (Refer to Appendix F). Water quality management will be addressed via a bioretention basin located within the southern parkland to ensure the bioretention basin is compliant with AO/PO12 & AO/PO13 of the LCC Flood Hazard Code. A splitter structure upstream of the bioretention basin is proposed to decrease scour within the bioretention basin. Flows above a 3-month event will bypass the southern bioretention basin and be piped to the dam.

Stormwater quantity and quality modelling has been prepared for the proposed development to demonstrate compliance with the objectives defined above in Section 4.1. The stormwater infrastructure has been sized to ensure there is no actionable nuisance in the external stormwater system as a result of the proposed development. Stormwater quality is implemented in the basins by adding a bioretention component to the base of the basin to ensure the stormwater quality objectives are achieved prior to discharge from the site.

A schematic of the proposed stormwater strategy is presented below in Figure 3-2. Refer to Appendix A for Civil Engineering Drawings.

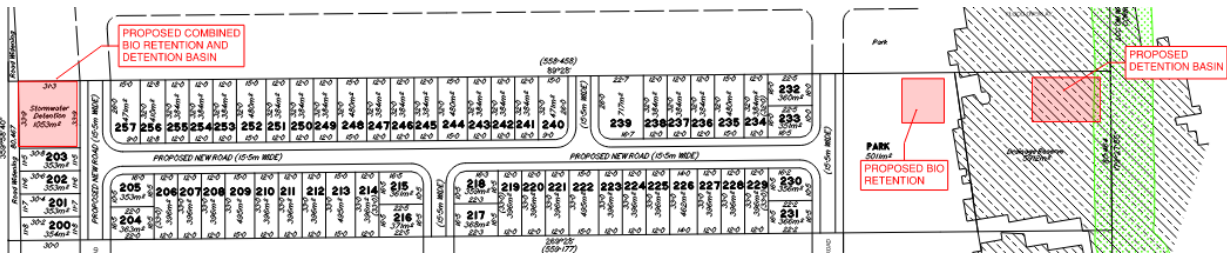


Figure 3-2 - Schematic of Proposed Stormwater Management Strategy

4. Stormwater Management Objectives

4.1. Development Control Plan Objectives

Stormwater management for the proposed development has been designed in accordance with the following documents:

- Logan City Council Planning Scheme
- State Planning Policy (SPP), 2017
- Environmental Protection (Water) Policy, 2009)
- Queensland Urban Drainage Manual (QUDM) Fourth Edition, 2016
- Water By Design MUSIC Modelling Guidelines, Version 3.0, 2018
- Water by Design - Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands V1.1, 2010
- Plumbing and Drainage Code AS3500.3
- Australian Rainfall and Runoff Guideline (ARR)
- International Erosion Control Association – Best Practise Erosion and Sediment Control, 2008

The stormwater management objectives for the development are summarised below:

- Development should not result in water being diverted onto land that is not normally subject to overland flow
- Define a lawful point of discharge that will not cause an actionable nuisance in accordance with QUDM
- Ensure that the development does not create adverse flood impacts to upstream or adjacent properties
- No increase in post development flows for all rainfall events up to and including 100-year event
- Stormwater quality to achieve the minimum design requirements of the State Planning Policy (2017) and achieve water quality objectives in accordance with Environmental Protection (Water) Policy (2009), as follows in Table 4-1 below.

Table 4-1 - Water Quality Objectives

Pollutant	Percent Reduction
Gross Pollutants (>5mm), GP	90%
Total Suspended Solids, TSS	80%
Total Phosphorous, TP	60%
Total Nitrogen, TN	45%

5. Stormwater Quantity Management

5.1. Stormwater Conveyance Management

There is an existing external upstream catchment which overland flows across the eastern boundary into the subject site. As the east neighbouring lot (Lot 2 RP164124) is likely to be developed prior to the subject site, which will result in no external upstream catchment as all neighbouring lots will grade to the proposed (refer to COM/5/2022 Civil Engineering Plans prepared by Burchills Engineering Solutions).

All minor runoff (10-yr ARI event) will be captured in a pit and pipe system and conveyed to the proposed bioretention basins. For all events above the minor, major flows will be conveyed via overland flow through the proposed road reserves to the proposed bioretention basins.

The remaining southern balance of the site will remain untouched, this area (Catchment D3) currently discharges to the existing dam and has been considered in the assessment of the dam.

5.2. Rational Method Calculations

Existing and developed rational method calculations have been prepared in accordance with QUDM for the 1, 2, 5, 10, 20, 50, and 100-year rainfall events. All of the parameters used for the rational method calculations are summarised below in Table 5-1 and Table 5-2. Refer to Appendix B for full rational method calculations.

Table 5-1 - Catchment Details

Catchment ID	E1	E2	D1	D2	D3
Catchment Description	Existing North Catchment	Existing South Catchment	Northern Developed	Southern Developed	Undeveloped South Balance
Area (ha)	2.07	2.31	1.68	1.68	1.025
Slope (%)	3%	4%	2%	2%	4%
Fraction Impervious ¹	0.018	0.005	0.75	0.75	0
Runoff Coefficient (C ₁₀) ²	0.7	0.7	0.82	0.82	0.7
Time of Concentration (min)	17.9	17.4	8.2	8.3	16.4

¹ Lot Fraction impervious taken from LCC Planning Scheme

² Runoff coefficient taken from QUDM – Table 4.5.3 and Table 4.5.4

Table 5-2 - Rational Method Peak Flow Rates

Catchment ID	Peak Flow (m ³ /s)						
	Q1	Q2	Q5	Q10	Q20	Q50	Q100
E1	0.223	0.269	0.413	0.512	0.617	0.786	0.908
E2	0.249	0.300	0.461	0.571	0.689	0.877	1.013
D1	0.285	0.345	0.529	0.658	0.797	1.023	1.185
D2	0.285	0.345	0.529	0.658	0.797	1.023	1.185
D3	0.113	0.137	0.210	0.260	0.314	0.400	0.462

Table 5-2 above indicates an increase in peak flows for the site as a result of the development. Detailed hydrological modelling using a storage routing model has been prepared to analyse flow attenuation requirements listed in the stormwater quantity objectives in Section 4.

5.3. Hydrological Modelling (DRAINS)

The DRAINS model was setup using the same parameters used in the traditional rational method listed in Table 5-1 however catchment areas were broken down further for sizing the on-site detention (OSD) system.

Hydrological modelling of the existing and developed site has been modelled using DRAINS software. The ILCL hydrological model was adopted as the hydrological model to allow for comparison against the traditional rational method in accordance with QUDM. Comparison of the DRAINS model is summarised in Table 5-4 to demonstrates general compatibility between the two hydrological models and that the DRAINS model is conservative.

The DRAINS model was setup using BOM rainfall parameters and hydrological model parameters listed in Table 5-3. The catchment breakdown adopted in the DRAINS model is the same as detail in Table 5-1.

Table 5-3 - Hydrological Model Parameters

Parameter	Value
Hydrologic routing method	ILCL
Impervious Area Initial Loss, mm	1
Impervious Area Continuing Loss, mm/hr	0
Pervious Area Initial Loss, mm	20
Pervious Area Continuing Loss, mm/hr	1.5
IFD Data	2019 IFD's as listed in ARR Data Hub
Time of Concentration	Kinematic Wave Equation using detailed catchment parameters

Table 5-4 – Rational Method Calibration Summary

ARI (years)	E1	E1 (DRAINS)	% Difference	D1	D1 (DRAINS)	% Difference
1	0.223	0.257	13.35%	0.285	0.318	10.22%
2	0.269	0.380	29.14%	0.345	0.426	19.11%
5	0.413	0.498	17.08%	0.529	0.559	5.31%
10	0.512	0.592	13.52%	0.658	0.669	1.62%
20	0.617	0.701	11.98%	0.797	0.78	-2.20%
50	0.786	0.861	8.72%	1.023	0.95	-7.65%
100	0.908	0.972	6.58%	1.185	1.07	-10.72%

5.4. On-Site Detention (OSD) System Design

An OSD system has been designed to achieve the stormwater quantity objectives listed in Section 4. Each basin parameter is summarised below in Table 5-5.

The detention basins have been sized to ensure post development flows do not exceed pre-development flows for both northern and southern catchments at each corresponding LPOD. The existing southern balance lot (Catchment D3) has been included in the southern dam design to allow for the change in catchment runoff characteristics that occur when piping a catchment.

The results in Table 5-6 summarises that the site post-development flows are restricted to the pre-development flows for all storm events up to and including the 1% AEP.

Engineering drawings in Appendix A provide more details on the tank arrangement and locality.

Table 5-5 – OSD Tank Parameters

OSD Parameters	North Basin	South Basin
Required Basin Volume	200 m ³	545 m ³
Basin Footprint	580 m ²	680 m ²
Maximum Water Depth	490 mm	1150 mm
Orifice 1	400mm x 200mm @ base of basin (to orifice centre)	500mm x 400mm @ from base of basin (to orifice centre)
Overflow Pit	900x900 Overflow Pit @ 380mm from base of basin	900x900 Overflow Pit @ 650mm from base of basin
Weir	-	2m Weir @ 1000mm from base of basin

*all depths include 300mm extended detention (extended not included in detention modelling)

Table 5-6 - Comparison of Pre and Post Development Flows – Northern Basin

ARI (years)	E1 Existing - Unmitigated	D1 Total Developed - Unmitigated	D1 Total Developed - Mitigated
1	0.257	0.318	0.254
2	0.38	0.426	0.323
5	0.498	0.559	0.463
10	0.596	0.669	0.56
20	0.701	0.78	0.663
50	0.861	0.95	0.803
100	0.972	1.07	0.928

Table 5-7 - Comparison of Pre and Post Development Flows – Southern Dam

ARI (years)	E2 Existing - Unmitigated	D2+D3 Total Developed - Unmitigated	D2+D3 Total Developed - Mitigated
1	0.295	0.4	0.287
2	0.431	0.538	0.372
5	0.564	0.711	0.553
10	0.682	0.864	0.651
20	0.79	1.02	0.749
50	0.971	1.19	0.927
100	1.1	1.37	1.09

6. Stormwater Quality Management - Construction Phase

6.1. Erosion and Sediment Control

Prior to construction commencing, it is the principal contractor's responsibility to ensure adequate erosion and sediment control measures are installed around the subject site to minimise disturbance and ensure the quality of runoff discharging from the site is of an acceptable standard.

An erosion and sediment control plan (ESCP) will be included in future operational works. The ESCP will be prepared in accordance with the Best Practice Erosion and Sediment Control Manual (ICEA 2009) based on Type 1 techniques. Erosion and sediment control techniques used for the site include:

- Sediment barriers to be installed on all entrances to stormwater inlet pits
- Construction entry and exit shakedown areas
- Sediment fences are to be installed on the downstream boundaries of the subject site
- Construction of temporary bunds at the top of all earthworks batters to ensure runoff is directed away from exposed batters
- Construction of temporary diversion drains to divert water to sediment basins and around any stockpiles
- Sediment fences to be installed on the downstream side of any stockpiles
- Stabilisation of all batters upon reaching the finished earthworks levels
- Dust control measures which includes covering stockpiles, maintain site fences and watering exposed areas
- Sediment basin in accordance with IECA Best Practice Erosion and Sediment Control.

6.2. Staged Construction and Establishment of Biobasin

To overcome challenges associated with establishing the proposed Bio-detention Basin during the initial construction phases, a staged construction and establishment method will be adopted. The basin is to be protected by measures in accordance with Surface Protection (Option 1) of the Construction and Establishment Guidelines of Water by Design.

After construction of the civil infrastructure (under-drainage and media) of the basin, the contractor is to install the protective layers on the surface of the filter media. Surface protection will include filter cloth, topsoil and turf (50mm topsoil underlain by A29 Bidim geofabric). The surface protection layer will allow the basin to operate as a shallow sediment basin during construction phase.

Protective layers may be removed and vegetation planting can begin once 80-90% of works within the upstream catchment are complete.

Civil construction step-by-step sequence and sign-off forms have been included in Appendix H. Refer to Table 3.6 of Construction and Establishment Guidelines of Water by Design for more information on proposed surface protection.

7. Stormwater Quality Management - Operational Phase

7.1. Proposed Stormwater Quality Improvement Devices (SQID's)

During the operational phase of the development, it is proposed to construct the following stormwater quality improvement devices (SQID's) to achieve the stormwater quality objectives summarised in Section 4.1:

- **North Basin** – 100 m² bioretention basin within detention basin
- **South Basin** – 100 m² bioretention basin within the southern portion of the site

Engineering drawings in Appendix A provide more details on the tank arrangement and locality.

7.1.1. Bio-Retention Basin

A bio-retention basin is a landscaped basin used to slow and treat on-site runoff. Stormwater runoff is directed to the basin and is filtered through a filter media layer (e.g. sandy loam) that treats stormwater through a combination of physical, chemical and biological processes as stormwater percolates downwards to a receiving underlying drainage. Specific vegetation is essential in the design to ensure excess nutrients are removed through evapotranspiration and nutrient cycling, which effectively reduce nutrient loads discharging from the site.

7.2. Stormwater Quality Modelling (MUSIC) Methodology

Stormwater quality modelling for the site was prepared using 'Model for Urban Stormwater Improvement Conceptualisation' (MUSIC) Version 6.3. The model has been built to assess the adequacy of the proposed SQID's and to ensure that the quality of stormwater meets the WQO's for the development. A diagrammatic layout of the MUSIC Model is presented in Figure 7-1 below.

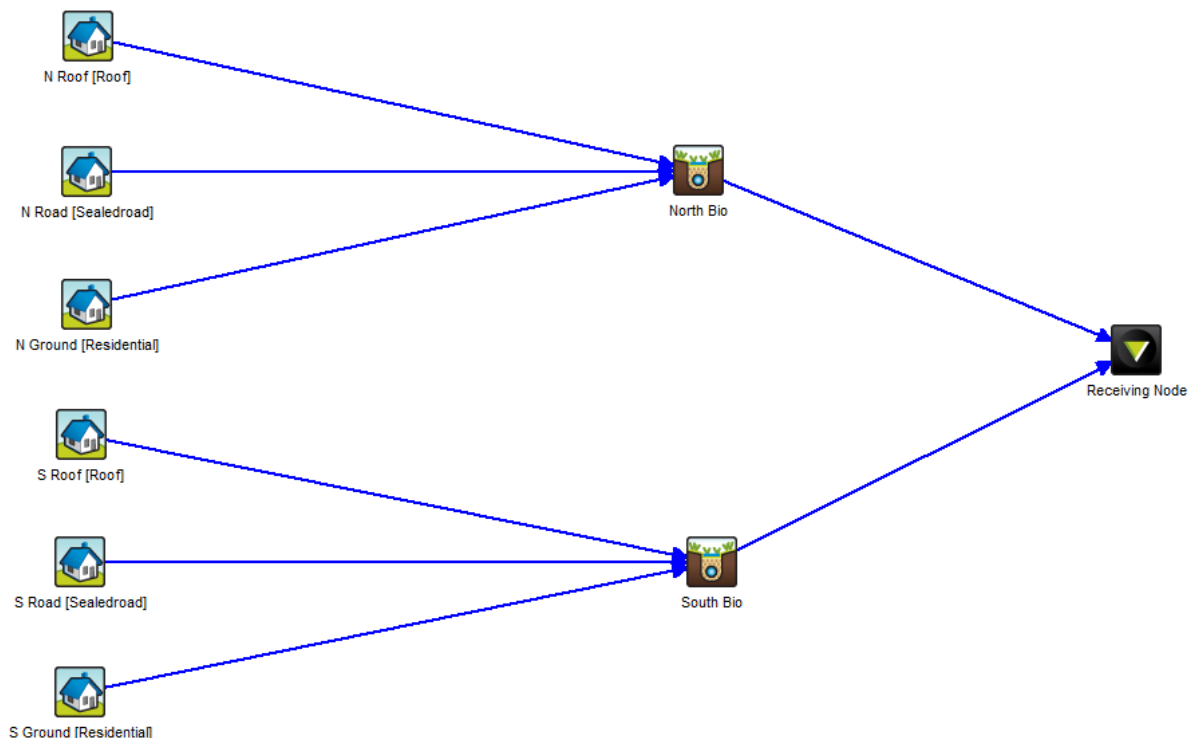


Figure 7-1 - MUSIC Link and Node Diagram

For the analysis of the MUSIC modelling, Meteorological data (average potential evapotranspiration (PET) and Rainfall Station) was based on the recommendations listed in WBD MUSIC Modelling Guidelines for SEQ, Table 3.1. The rainfall data was obtained from the Bureau of Meteorology for Station No. 40406 at Beenleigh. The analysis was undertaken using a 6 min time step for the period 01/01/1990 to 31/12/1999.

The following rainfall and runoff parameters shown in Table 7-1 have been utilised.

Table 7-1 - Rainfall Runoff Parameters

Parameter	Value*
Land Use Category	Urban Residential
Rainfall Threshold (mm/day)	1.0
Soil Storage Capacity (mm)	500
Initial Storage (% of Capacity)	10
Field Capacity (mm)	200
Infiltration Capacity Coefficient – a	211
Infiltration Capacity Exponent – b	5.0
Initial Depth (mm)	50
Daily Recharge Rate (%)	28
Daily Base flow Rate (%)	27
Daily Deep Seepage Rate (%)	0

The catchments used for MUSIC modelling were broken down into land use category to accurately model the pollutant runoff characteristics for all land-use categories. The Source node catchments are summarised below in Table 7-2.

Table 7-2 - Catchment Source Node Summary

Catchment ID	MUSIC Source Nodes	Catchment Area (Ha)	Impervious %
North Basin (D1)	Roof	0.706	100%
	Road	0.401	65%
	Ground	0.562	0%
South Basin (D2)	Roof	0.707	100%
	Road	0.504	65%
	Ground	0.471	0%

*Catchment D3 was not assessed as the catchment will remain untouched

The pollutant concentration parameters used in the model were based on information provided in Water By Design – MUSIC Modelling Guidelines for South East Queensland V3.0 (2018). The parameters are listed in Table 7-3 below:

Table 7-3 - Water Quality Parameters for MUSIC Source Nodes

Land- Use Category		Log TSS (mg/L)		Log TP (mg/L)		Log TN (mg/L)	
		Storm Flow	Base flow	Storm Flow	Base Flow	Storm Flow	Base Flow
Roof Areas (Urban Residential)	Mean	1.30	N/A	-0.89	N/A	0.26	N/A
	Std Dev	0.39	N/A	0.31	N/A	0.23	N/A
Roads (Urban Residential)	Mean	2.43	1.00	-0.30	-0.97	0.26	0.20
	Std Dev	0.39	0.34	0.31	0.31	0.23	0.20
Ground Level (Urban Residential)	Mean	2.18	1.00	-0.47	-0.97	0.26	0.20
	Std Dev	0.39	0.34	0.31	0.31	0.23	0.20

*Parameter values taken from WBD – MUSIC Modelling Guidelines for SEQ, V3.0 (2018), Table 3.9.

Table 7-4 - Bioretention Sizing Summary

Parameter	North Bio	South Bio
Extended Detention Depth (mm)	300	300
Surface Detention Area (m ²)	159	156
Minimum Filter Area (m ²)	100	100
Minimum Filter Media Depth (mm)	0.4	0.4
Saturated Hydraulic Conductivity (mm/hour)	200	200
TN Filter Media Content (mg/kg)	400	400
Orthophosphate Filter Media Content (mg/kg)	30	30

Table 7-5 - MUSIC Model Results

Pollutant	Annual Loads (kg/yr)		% Reduction		Compliance
	Source	Residual	Actual	Target	
TSS	3490	672	80.7	80	OK
TP	7.53	2.17	71.2	60	OK
TN	48.9	25.1	48.7	45	OK
GP	539	0	100	90	OK

The modelling results shown in Table 7-5 demonstrates that the treatment train will achieve the water quality targets set out in Table 4-1.

8. Maintenance

All the stormwater quantity and quality infrastructure detailed in this document are contained within the subject site and will remain an asset of the development's property owner, Body Corporate or similar internal authority.

Maintenance of the all SQIDs will be the responsibility of Logan City Council. The maintenance should be carried out in accordance with Water By Design's Maintaining Vegetated Stormwater Assets, Version 1. Both monitoring and maintenance will be required to ensure the Bioretention system functions adequately to achieve water quality and hydraulic performance objectives. Maintenance is focussed predominantly on preventing clogging of the filter media by preserving a well vegetated surface within the bioretention system.

A well-maintained bioretention systems will generally possess the following qualities:

- Free draining filter media
- Well established and dense vegetation cover
- Absence of weeds and sediment
- Unrestricted inlet and outlet measures.

In order to achieve a highly functioning bioretention system it is recommended to inspect and maintain the system in accordance with Table 8-1 and immediately after a significant rainfall event (<50mm/day) following the construction establishment period. The inspections will inform if any additional maintenance is required that will increase this inspection and maintenance frequency.

Table 8-1 - Maintenance Frequency

Location	Maintenance	Performance Indicator*	Min. Frequency (Months)
General	Damaged Structures e.g. pit lids, grates, bollards	- No damage that poses a risk to public safety or structural integrity	12
Inlet and/or Sediment Forebay	Erosion	- No evidence of erosion of subsidence/ settlement	12
	Sediment, Litter and Debris	- Coarse Sediment forebay <75% full - No blockage from litter or debris	12
Bioretention System	Erosion	- No evidence of erosion of subsidence/ settlement - Erosion that does not pose a risk to public safety or structural integrity and will not worsen if left unattended	12
	Crust of fine sediment	- No surface crusting	12
	Depression or mounds	- No surface depression or mounds >100mm	12
	Hydraulic conductivity / permeability	- Filter media is draining freely - Water does not pond for more than 12 hours after rainfall - No obvious impermeable or clay-like surface on the filter media	6
	Underdrain flush out	- Flush out underdrainage - No damage and end caps securely in place	3

	Litter	- Remove litter	3
	Vegetation	- Minimum 95% vegetation cover - Plants healthy and free from disease - Average plant height >500mm	3
	Algal bloom / moss growth	- Max 10% of surface covered in algae - No moss growth	6
Outlet Structure	Erosion	- No evidence of erosion of subsidence/ settlement, including edges of rock protection of top of weir for large systems	12
	Damaged Structures e.g. pit lids, grates	- No damage that poses a risk to public safety or structural integrity	6
	Sediment, Litter and Debris	- No blockage	3
	Outlet freely draining	- No downstream impediments to release of water - No erosion or damage to outlet structure - No evidence of malfunction	6

**As defined in the Inspection and Maintenance checklist for bioretention systems, by Water By design*

Appendix G contains a sample inspection and maintenance checklist that can be used for the Bio-retention system.

8.1. Bioretention Vegetation Establishment

The first two years of vegetation establishment are the most intensive that may require replanting and regular weeding. During the establishment phase, maintenance and inspections are required in accordance with Table 8-2.

Table 8-2 - Establish Phase Maintenance Frequency

Time After Construction	Min. Frequency (Weeks)
1-6 Months	4
6-12 Months	8
12-24 Months	8

9. Conclusion

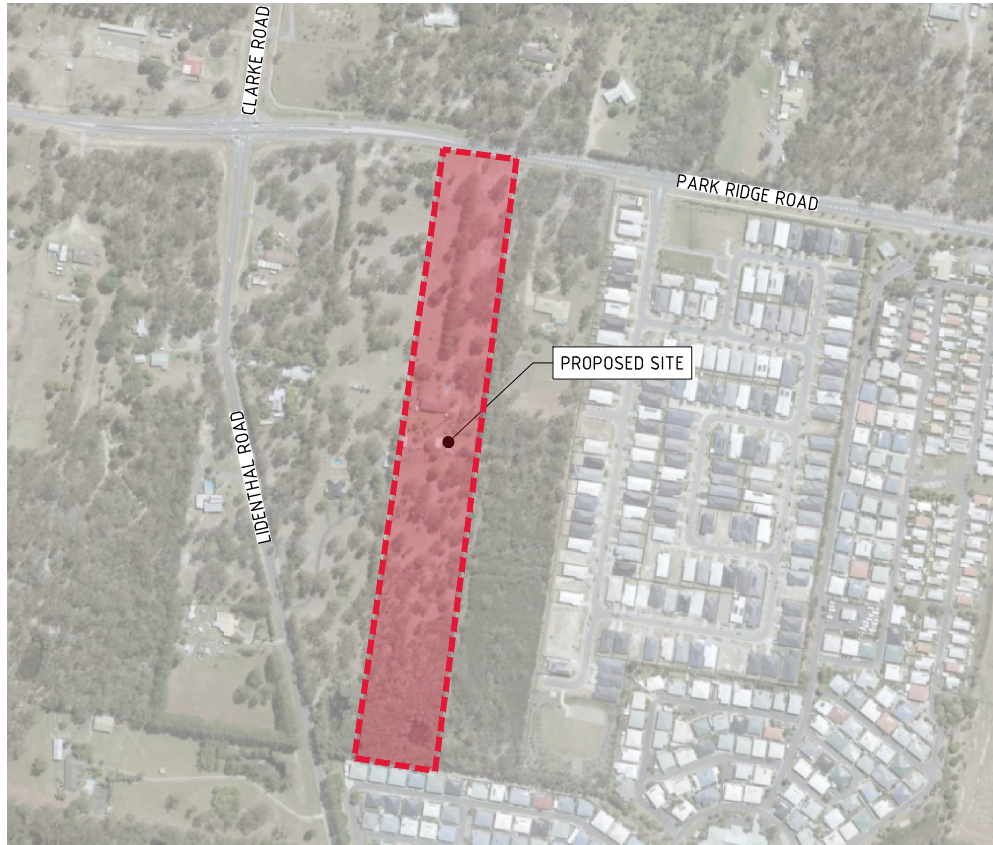
Northrop Consulting Engineers has prepared this SBSMP for the proposed residential subdivision at 391-397 Park Ridge Road, Park Ridge QLD 4125 . Based on investigations, analyses and designs, it has been demonstrated that the proposed development can be constructed and operated in accordance with all stormwater objectives listed in Section 4. The primary outcomes of this SBSMP are as follows:

- **Lawful Point of Discharge** - The existing lawful point of discharge will be maintained with most of the site flows being captured for stormwater quantity and quality treatment prior to discharge from the site. The northern portion of the site will discharge to the stormwater infrastructure within Park Ridge Road and the southern portion of the site will discharge to the drainage channel running along the southern boundary of the existing lot.
- **Stormwater Quantity** - The proposed development increases the total impervious area, resulting in an increase in flow volume or rate due to development. As such, on-site detention will be required. To achieve non-worsening, the proposed development requires a total detention volume of 200m³ and 545m³ which has been achieved via a combined bioretention/detention basin located on the northern boundary and utilising the existing dam along the southern boundary, respectively.
- **Stormwater Quality** - Stormwater quality infrastructure has been included in the design to achieve the water quality objectives for South East Queensland specified in the State Planning Policy 2017, namely, the removal of gross pollutants, suspended solids, nitrogen and phosphorus. The proposed treatment train was modelling using MUSIC modelling software and includes the following SQID's:
 - North Basin – 100 m² bioretention basin located within detention basin;
 - South Basin – 100 m² bioretention basin located within detention basin;
- **Erosion and Sediment Control** - Construction phase ESCP measures are to be implemented during construction in accordance with the relevant requirements.

Appendix A – Civil Engineering Plans

57 LOT RESIDENTIAL SUBDIVISION

391-397 PARK RIDGE RD, PARK RIDGE QLD 4125



SOURCE : NOMETROMAP.COM.AU (©2021)

DRAWING SCHEDULE

DWG NUMBER	DWG TITLE
GENERAL	
C001	COVER SHEET, LOCALITY PLAN AND DRAWING SCHEDULE
C005	EXISTING SURVEY
EARTHWORKS	
C101	PRELIMINARY BULK EARTHWORKS LAYOUT PLAN SHEET 1 OF 4
C102	PRELIMINARY BULK EARTHWORKS LAYOUT PLAN SHEET 2 OF 4
C103	PRELIMINARY BULK EARTHWORKS LAYOUT PLAN SHEET 3 OF 4
C104	PRELIMINARY BULK EARTHWORKS LAYOUT PLAN SHEET 4 OF 4
C111	PRELIMINARY BULK EARTHWORKS SECTION SHEET 1 OF 3
C112	PRELIMINARY BULK EARTHWORKS SECTION SHEET 2 OF 3
C113	PRELIMINARY BULK EARTHWORKS SECTION SHEET 3 OF 3
ROADWORKS AND DRAINAGE	
C211	ROADWORKS AND DRAINAGE LAYOUT PLAN SHEET 1 OF 4
C212	ROADWORKS AND DRAINAGE LAYOUT PLAN SHEET 2 OF 4
C213	ROADWORKS AND DRAINAGE LAYOUT PLAN SHEET 3 OF 4
C214	ROADWORKS AND DRAINAGE LAYOUT PLAN SHEET 4 OF 4
C221	PRELIMINARY ROAD LONG SECTION SHEET 1 OF 2
C222	PRELIMINARY ROAD LONG SECTION SHEET 2 OF 2
C291	VEHICLE TURN PATH LAYOUT PLAN
C310	STORMWATER CATCHMENT KEY PLAN
C381	PRELIMINARY BIO-BASIN LAYOUT PLAN SHEET 1 OF 3
C382	PRELIMINARY BIO-BASIN LAYOUT PLAN SHEET 2 OF 3
C383	PRELIMINARY BIO-BASIN LAYOUT PLAN SHEET 3 OF 3
SEWER AND WATER	
C401	SEWER AND WATER RETICULATION LAYOUT PLAN SHEET 1 OF 2
C402	SEWER AND WATER RETICULATION LAYOUT PLAN SHEET 2 OF 2

DRAWN: CLOPEZ
DESIGNED: MITCHELL
JOB MANAGER: RUIJANG
VERIFIER:

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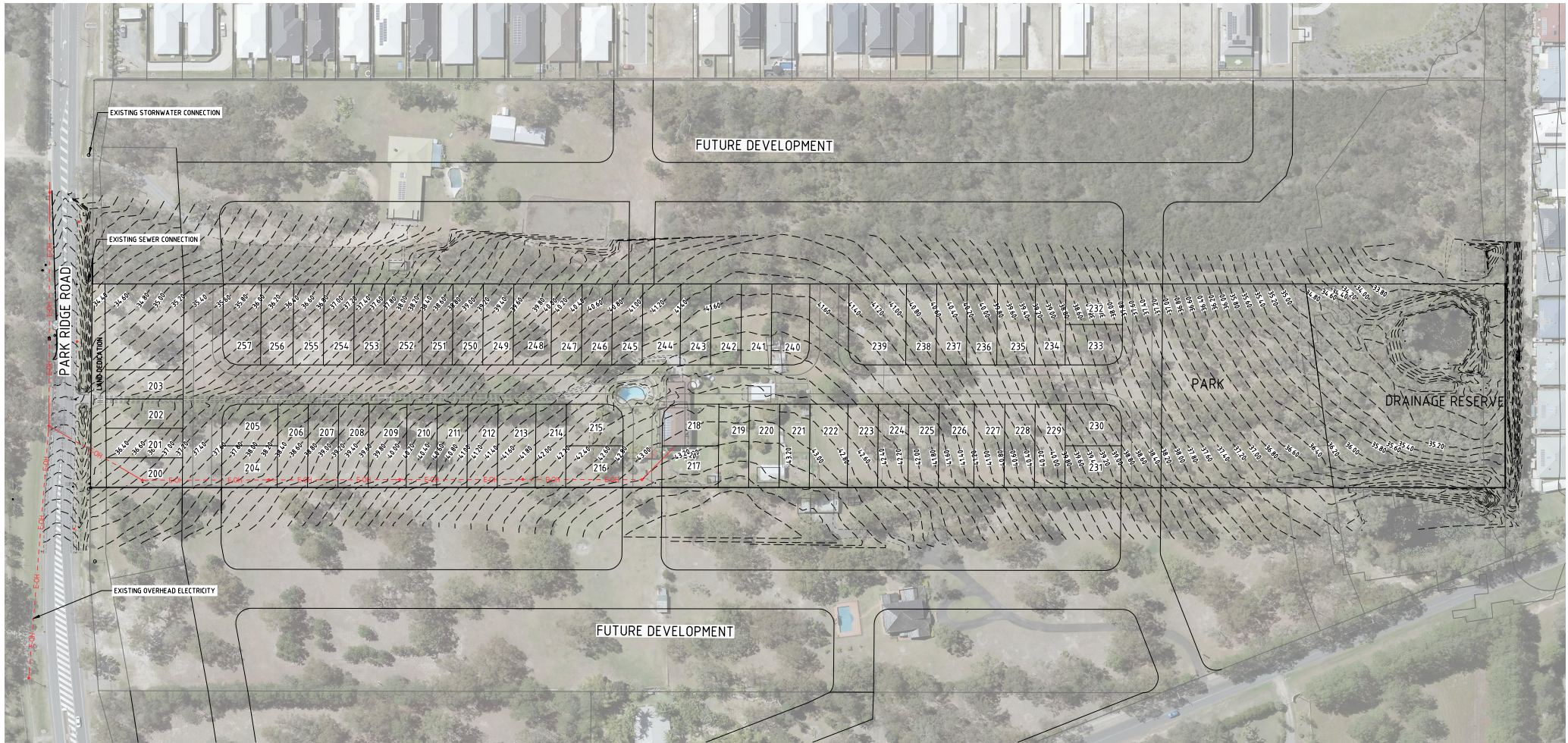
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GPO BOX 423 Brisbane QLD 4001
(07) 3368 0400 Brisbane@northrop.com.au
ABN 81 084 433 100

PROJECT	57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT 391-397 PARK RIDGE ROAD, PARK RIDGE QLD 4125
---------	--

DRAWING TITLE	CIVIL ENGINEERING PACKAGE COVER SHEET, LOCALITY PLAN AND DRAWING SCHEDULE
---------------	---

JOB NUMBER	BN213636
DRAWING NUMBER	C001
REVISION	2
DRAWING SHEET SIZE = A1	

FOR APPROVAL



- NOTES**
1. THE EXISTING UTILITY SERVICES INFORMATION SHOWN HAS BEEN COMPILED FROM SURVEY INFORMATION SUPPLIED BY **STEVE COOPER & ASSOCIATES PTY LTD**.
 2. THE INFORMATION IS NOT INTENDED TO PROVIDE THE CONTRACTOR WITH COMPLETE OR ACCURATE INFORMATION CONCERNING THE LOCATION & EXTENT OF UTILITY SERVICES.
 3. THE CONTRACTOR WILL BE SOLELY RESPONSIBLE FOR ANY DAMAGE INCURRED TO EXISTING UTILITY SERVICES AS A RESULT OF THE EXECUTION OF WORK UNDER THE CONTRACT.
 4. NO WORK SHALL BE CARRIED OUT WITHIN 3 METRES OF ANY EXISTING SERVICES WITHOUT PRIOR RECORDED CONSULTATION WITH THE RELEVANT AUTHORITY.
 5. THE CONTRACTOR SHALL VERIFY THE LOCATION, DEPTH & EXTENT OF ALL EXISTING SERVICES PRIOR TO THE COMMENCEMENT OF WORK.
 6. THE CONTRACTOR SHALL VERIFY THE LOCATION, DEPTH & EXTENT OF ALL EXISTING SERVICES PRIOR TO THE COMMENCEMENT OF WORK.
 7. ALL EXISTING SERVICES & STRUCTURES ARE TO BE MAINTAINED IN GOOD ORDER FOR THE DURATION OF THE CONTRACT & WHERE RELOCATION IS REQUIRED, REFER SPECIFICATION.

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PROJECT

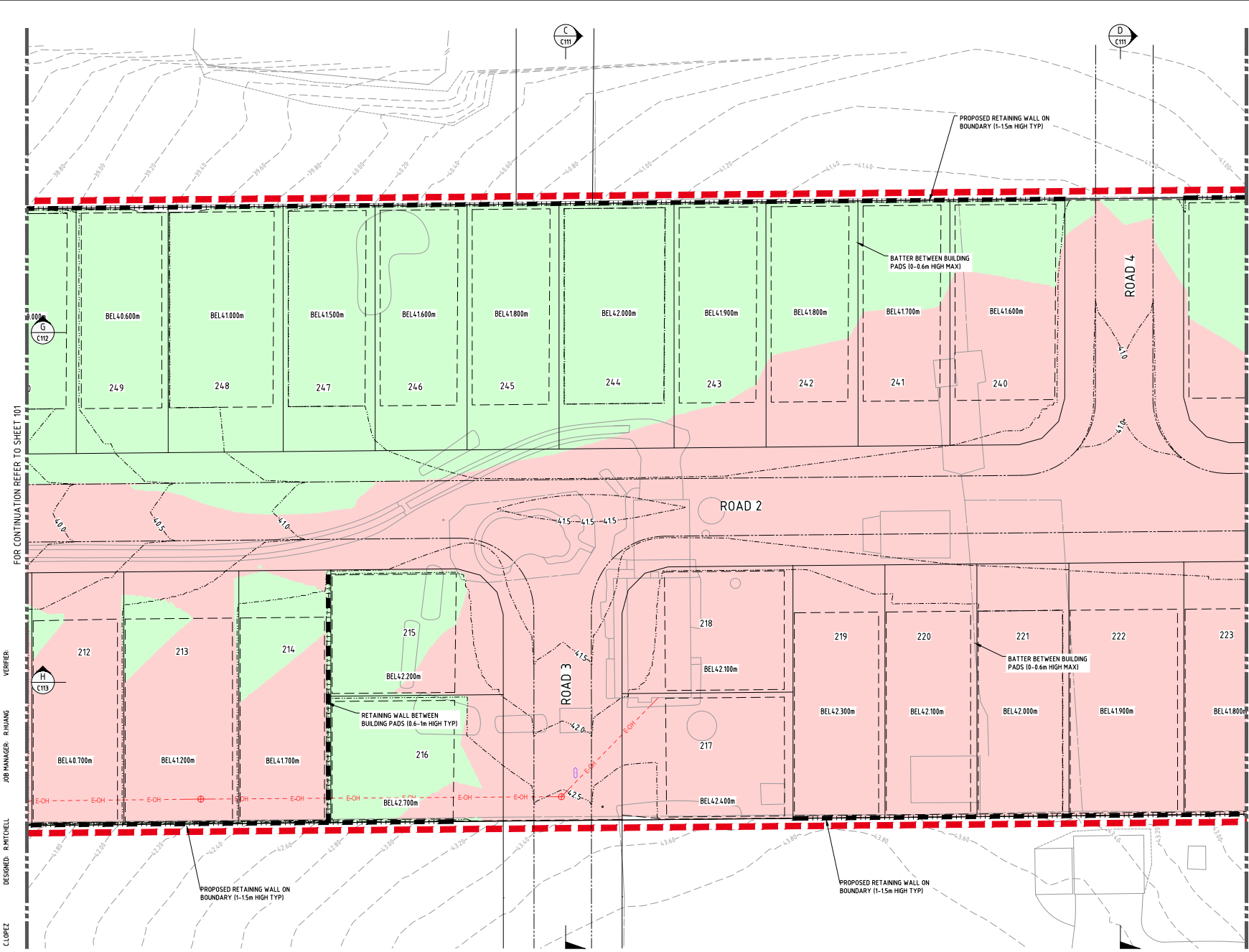
**57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT
391-397 PARK RIDGE ROAD,
PARK RIDGE QLD 4125**

DRAWING TITLE

**CIVIL ENGINEERING PACKAGE
EXISTING SURVEY**

JOB NUMBER	REVISION
BN213636	2
C005	2
DRAWING SHEET SIZE = A1	

DRAWN: CLOPEZ
DESIGNED: RUTICHELL
JOB MANAGER: RUIJIANG
MEMBER:



LEGEND

- XX.XX--- PROPOSED BULK EARTHWORKS CONTOURS (0.2m)
- XX.XX--- EXISTING SURFACE CONTOURS
- ▬▬▬▬▬▬▬▬ PROPOSED RETAINING WALL CONCRETE SLEEPER
- ▬▬▬▬▬▬▬▬ STAGE BOUNDARY
- Earthworks Cut Area (Pink)
- Earthworks Fill Area (Green)

FOR CONTINUATION REFER TO SHEET 001

FOR CONTINUATION REFER TO SHEET 103

VERIFIER: RUMING

DESIGNED: RUTICHELL

DRAWN: CLOPEZ

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PROJECT

57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT
 391-397 PARK RIDGE ROAD, PARK RIDGE QLD 4125

DRAWING TITLE

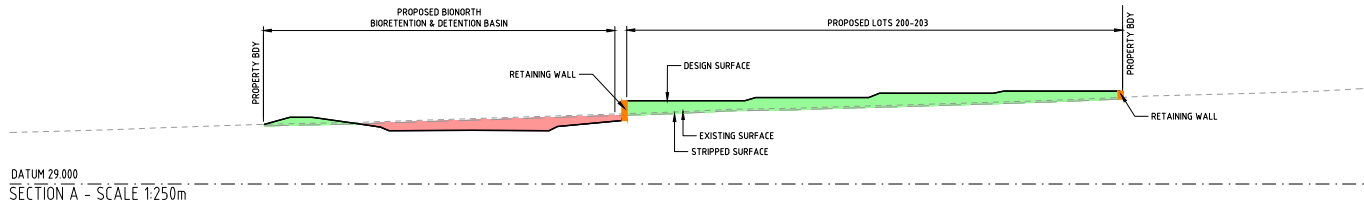
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 PLAN SHEET 2 OF 4

JOB NUMBER	REVISION
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DRAWING NUMBER	DRAWING SHEET SIZE = A1
C102	

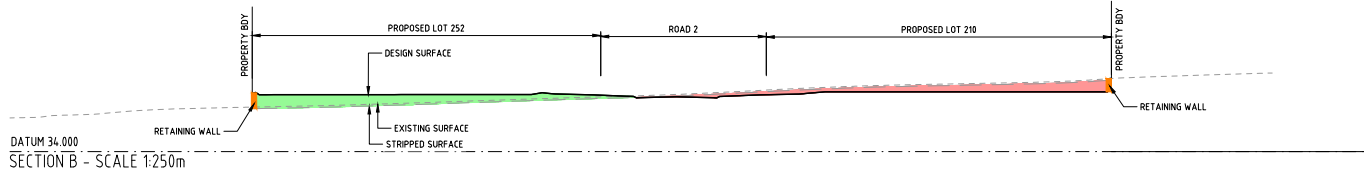
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EXISTING SURFACE	- - - - -
STRIPPED SURFACE
EARTHWORK AREA OF CUT	
EARTHWORK AREA OF FILL	
PROPOSED RETAINING WALL (TYPE TBC) - BY OTHERS	

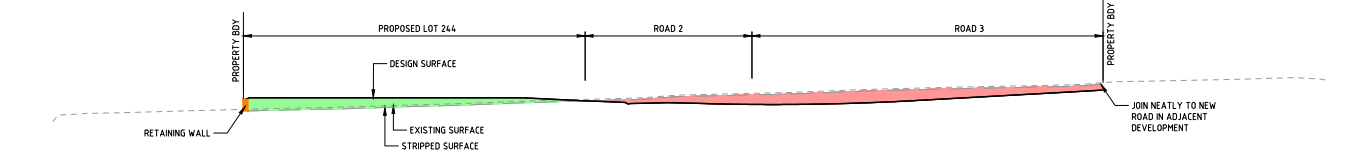
LAYOUT & NOTES REFERENCE
 FOR EARTHWORKS LAYOUT PLAN & REFERENCE NOTES
 REFER DWG No C-101



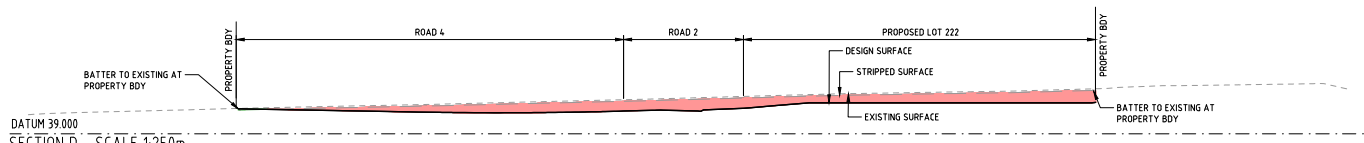
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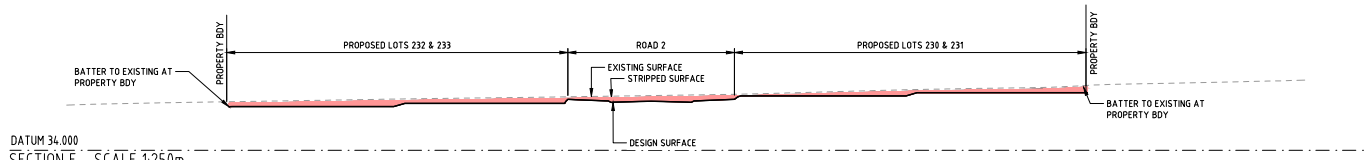
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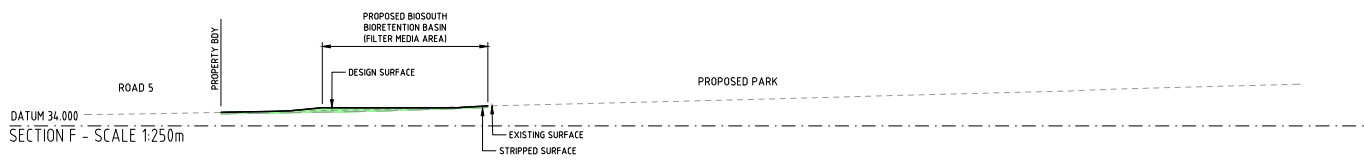
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SECTION D - SCALE 1:250m



DATUM 34.000
SECTION E - SCALE 1:250m



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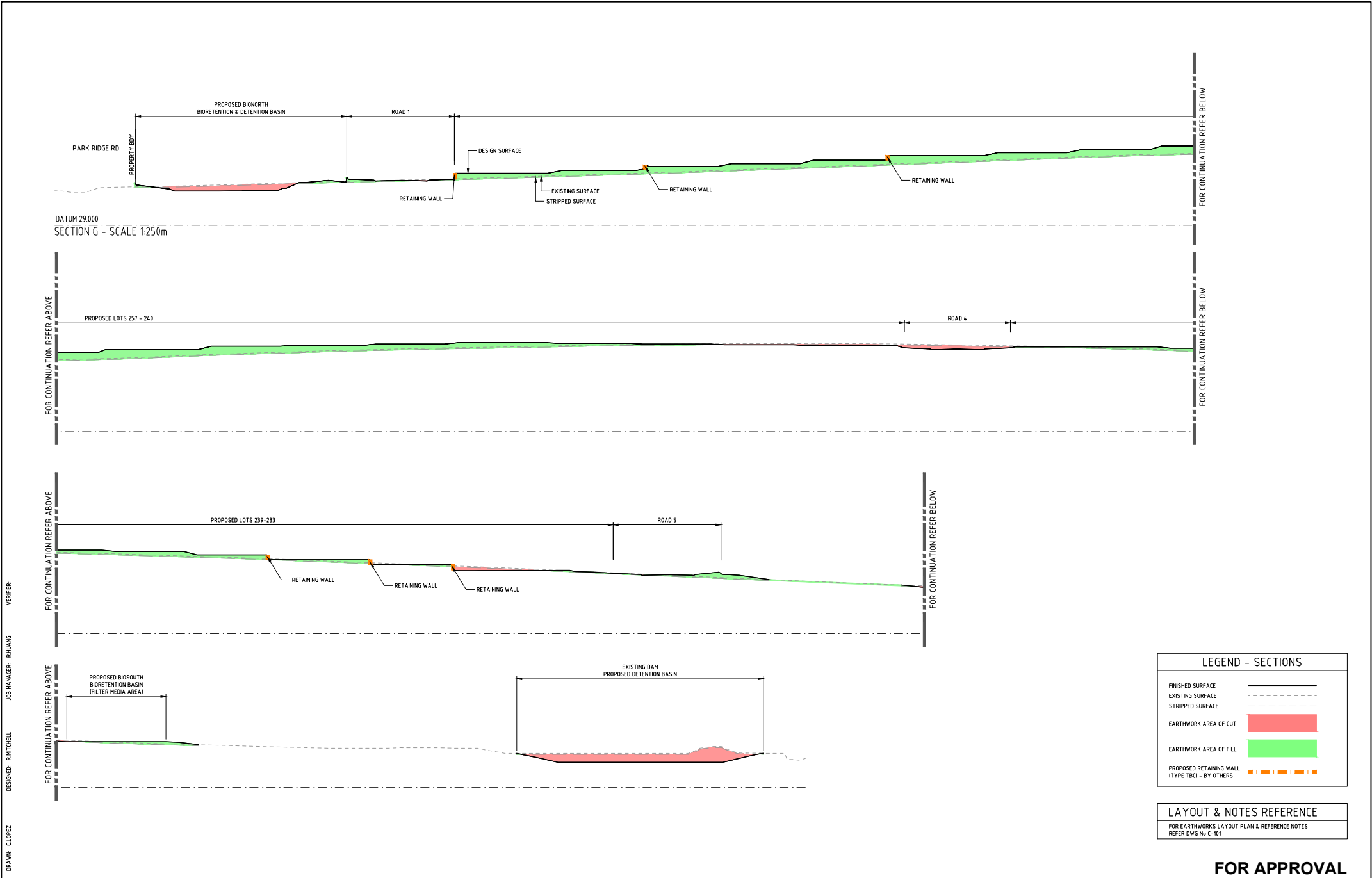
DRAWN: CLOPEZ, DESIGNED: MITCHELL, JOB MANAGER: RUIJANG, VERIFIER:

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SECTION G - SCALE 1:250m

LEGEND - SECTIONS	
FINISHED SURFACE	———
EXISTING SURFACE	- - - - -
STRIPPED SURFACE	— · — · —
EARTHWORK AREA OF CUT	
EARTHWORK AREA OF FILL	
PROPOSED RETAINING WALL (TYPE TBC) - BY OTHERS	

LAYOUT & NOTES REFERENCE
FOR EARTHWORKS LAYOUT PLAN & REFERENCE NOTES REFER DWG No C-101

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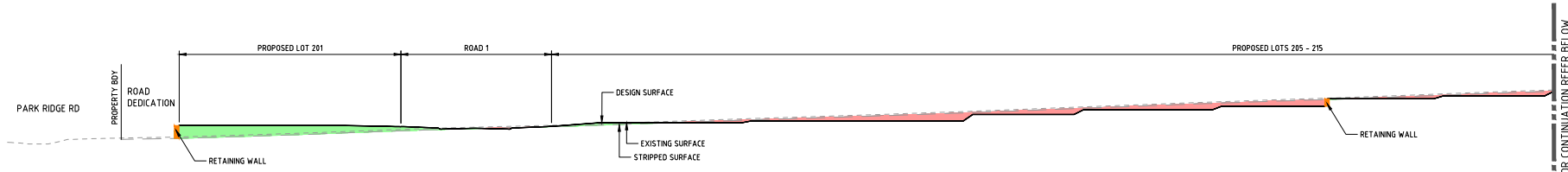
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PROJECT	57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT 391-397 PARK RIDGE ROAD, PARK RIDGE QLD 4125
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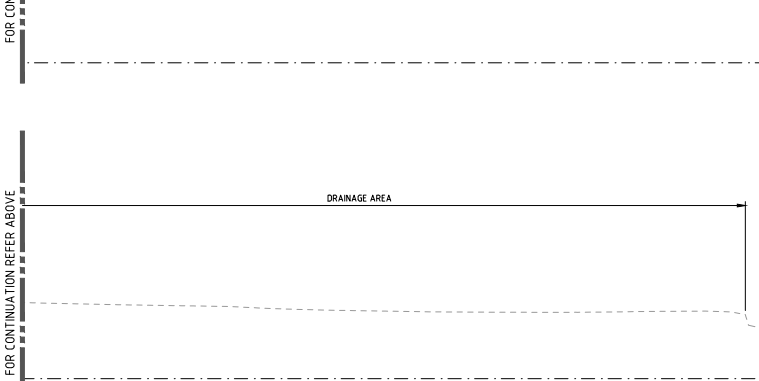
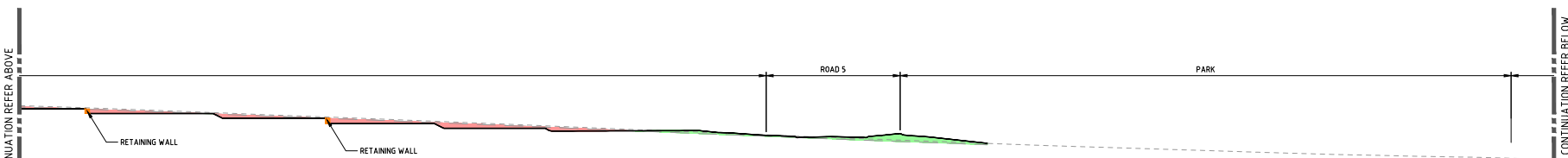
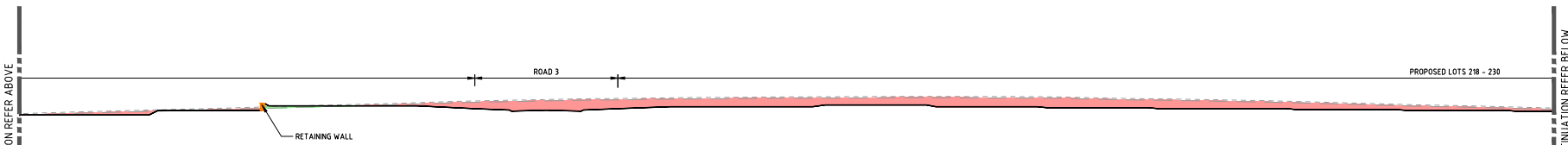
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JOB NUMBER	BN213636
DRAWING NUMBER	C112
REVISION	2
DRAWING SHEET SIZE = A1	

DRAWN: CLOPEZ
DESIGNED: MITCHELL
JOB MANAGER: RUMANG
VERIFIER:



DATUM 29.000
SECTION H - SCALE 1:250m



FOR CONTINUATION REFER BELOW

FOR CONTINUATION REFER BELOW

FOR CONTINUATION REFER BELOW

LEGEND - SECTIONS	
FINISHED SURFACE	———
EXISTING SURFACE	- - - - -
STRIPPED SURFACE	— · — · —
EARTHWORK AREA OF CUT	
EARTHWORK AREA OF FILL	
PROPOSED RETAINING WALL (TYPE TBC) - BY OTHERS	

LAYOUT & NOTES REFERENCE
FOR EARTHWORKS LAYOUT PLAN & REFERENCE NOTES
REFER DWG No C-101

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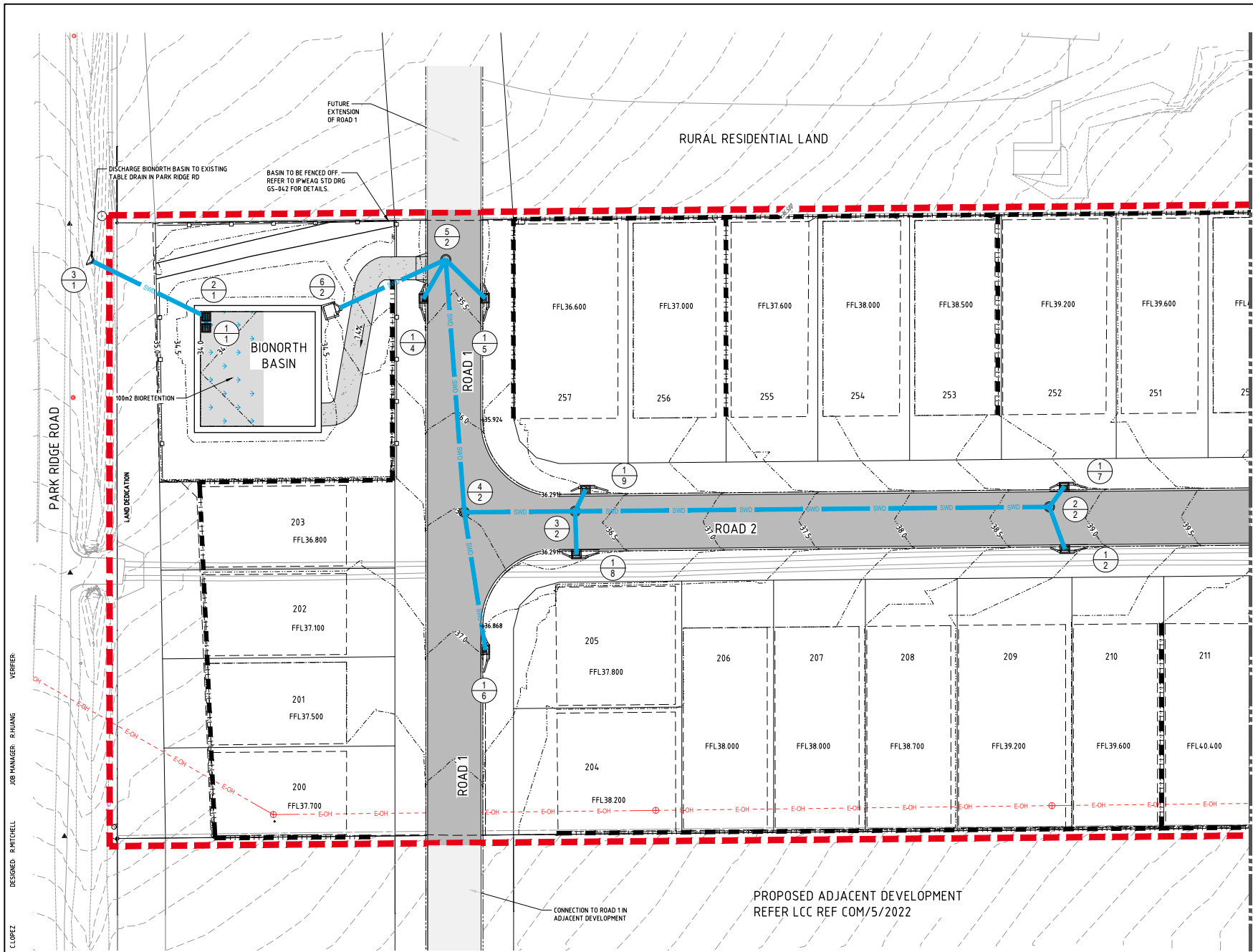
PROJECT
57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT
 391-397 PARK RIDGE ROAD,
 PARK RIDGE QLD 4125

DRAWING TITLE
CIVIL ENGINEERING PACKAGE
 PRELIMINARY BULK EARTHWORKS SECTION
 SHEET 3 OF 3

JOB NUMBER	REVISION
BN213636	2
C113	2

DRAWING SHEET SIZE = A1

DRAWN: CLOPEZ
 DESIGNED: MITCHELL
 JOB MANAGER: RUIJANG
 CHECKED: FOR CONTINUATION REFER ABOVE



LEGEND	
	PROPOSED SURFACE CONTOURS
	EXISTING SURFACE CONTOURS
	PROPOSED MOUNTABLE KERB & CHANNEL
	EXISTING ELECTRICITY (OVERHEAD)
	PROPOSED RETAINING WALL CONCRETE SLEEP
	STAGE BOUNDARY
	PROPOSED NEW ASPHALT PAVEMENT REFER LONGITUDINAL & CROSS SECTIONS FOR PAVEMENT DETAILS
	PROPOSED STORMWATER BASIN
	PROPOSED ACCESS TRACK
	PROPOSED STORMWATER GULLY PIT
	PROPOSED STORMWATER MANHOLE
	PROPOSED FIELD INLET
	PROPOSED STORMWATER DRAINAGE

- NOTES**
- ALL DIMENSIONS ON THE DRAWINGS ARE IN METRES UNLESS SHOWN OTHERWISE.
 - ALL WORK SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE RELEVANT LOGAN CITY COUNCIL SPECIFICATIONS & STANDARD DRAWINGS & NORTHROP SPECIFICATIONS & PROJECT DRAWINGS.
 - THE CONTRACTOR SHALL VERIFY THE LOCATION & RELATIVE LEVELS OF EXISTING SERVICES PRIOR TO CONSTRUCTION. THE CONTRACTOR IS TO TAKE ALL NECESSARY PRECAUTIONS REGARDING CONSTRUCTION ADJACENT TO EXISTING SERVICES. CONTRACTOR TO PROTECT IN PLACE EXISTING SERVICES. ANY DAMAGE TO EXISTING SERVICES TO BE REPAIRED AT CONTRACTORS EXPENSE.
 - THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH OTHER CONSULTANTS PLANS, SPECIFICATIONS & OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED BY THE SUPERINTENDENT DURING THE COURSE OF THE CONTRACT.
 - THE CONTRACTOR SHALL ERECT TRAFFIC CONTROL DEVICES IN ACCORDANCE WITH THE APPROVED TRAFFIC MANAGEMENT PLAN.
 - THE CONTRACTOR SHALL VERIFY OFFSET PEG LOCATIONS & BENCH MARK LEVELS & ADVISE THE SUPERINTENDENT OF ANY DISCREPANCY BEFORE COMMENCEMENT OF CONSTRUCTION.
 - THE ROAD PAVEMENT ADOPTED WILL BE DETERMINED BY THE ENGINEER & APPROVED BY LOGAN CITY COUNCIL. THIS PAVEMENT SHALL BE BASED ON SOIL TEST TAKEN AT SUBGRADE LEVEL. ANY VARIATIONS TO THE NORMAL PAVEMENT THICKNESS WILL BE PAID AT THE RATES SHOWN IN THE PRICED SCHEDULE OF RATES.
 - SIDE DRAINS SHALL BE PROVIDED UNDER ALL KERBS AS PER LOGAN CITY COUNCIL STANDARDS.
 - MITRE DRAIN LOCATION & EXTENTS SHALL BE DETERMINED ON SITE BY THE SUPERINTENDENT.

DRAWN: CLOPEZ
DESIGNED: BUTCHHELL
JOB MANAGER: RUIJANG
VERIFIER:

FOR CONTINUATION REFER TO SHEET C212

PROPOSED ADJACENT DEVELOPMENT
REFER LCC REF COM/5/2022

FOR APPROVAL

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE	CLIENT
1	ISSUED FOR APPROVAL	KAE	SK	SK	15.03.23	PARK RIDGE UNIT TRUST
2	ISSUED FOR APPROVAL	CL	GC	RH	01.08.23	

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PLANNER

Steve Cooper & Associates Pty Ltd

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(07) 3368 0400 brian@northrop.com.au
ABN 91 084 433 100

PROJECT

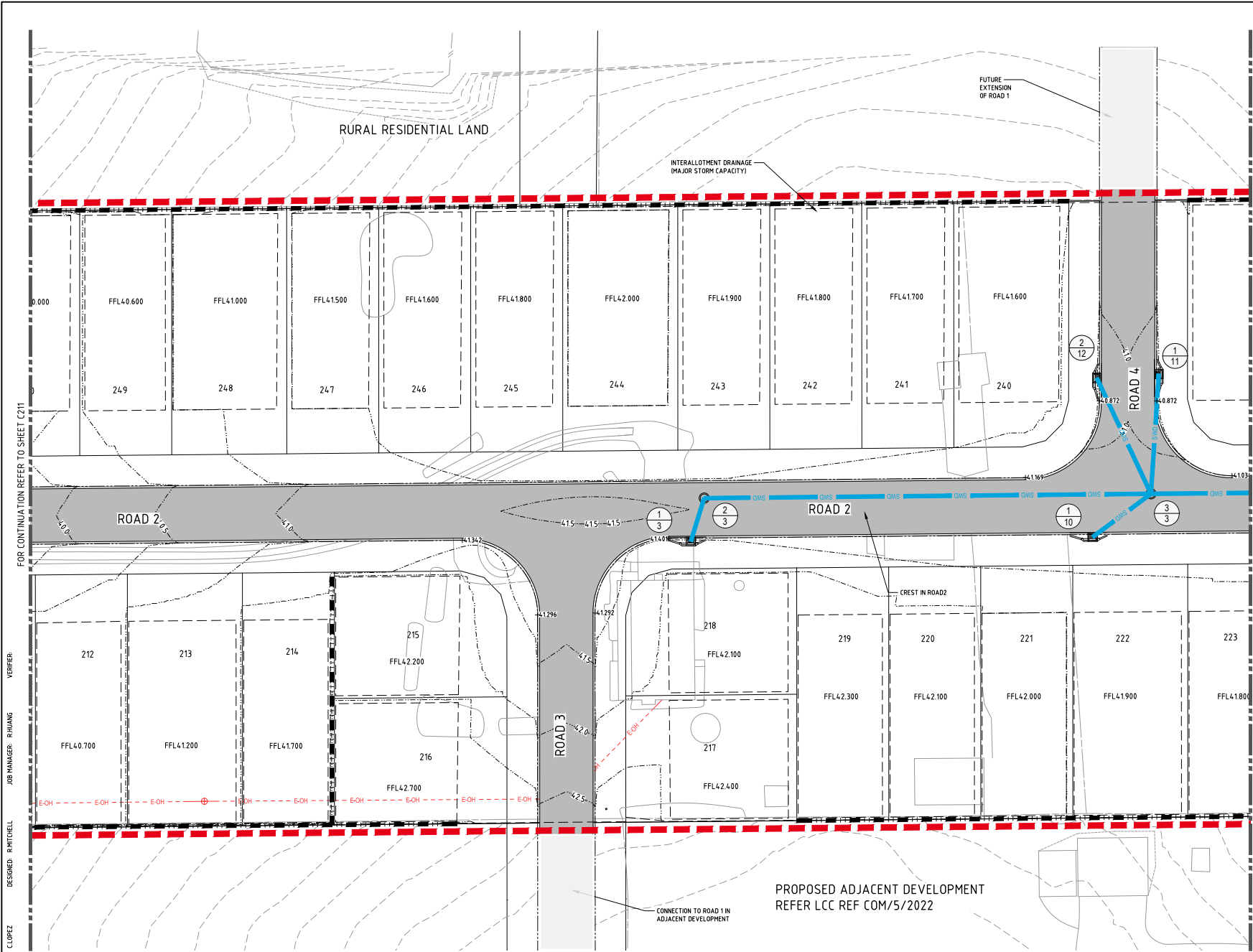
57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT
391-397 PARK RIDGE ROAD,
PARK RIDGE QLD 4125

DRAWING TITLE

CIVIL ENGINEERING PACKAGE
ROADWORKS AND
DRAINAGE LAYOUT PLAN
SHEET 1 OF 4

JOB NUMBER	DRAWING NUMBER	REVISION
BN213636	C211	2

DRAWING SHEET SIZE = A1



LEGEND

- XX.XX--- PROPOSED SURFACE CONTOURS
- XX.XX--- EXISTING SURFACE CONTOURS
- PROPOSED MOUNTABLE KERB & CHANNEL
- E-OH --- EXISTING ELECTRICITY (OVERHEAD)
- PROPOSED RETAINING WALL CONCRETE SLEEP
- STAGE BOUNDARY
- PROPOSED NEW ASPHALT PAVEMENT REFER LONGITUDINAL & CROSS SECTIONS FOR PAVEMENT DETAILS
- PROPOSED STORMWATER BASIN
- PROPOSED ACCESS TRACK
- PROPOSED STORMWATER GULLY PIT
- PROPOSED STORMWATER MANHOLE
- PROPOSED FIELD INLET
- SWD --- PROPOSED STORMWATER DRAINAGE

- ### NOTES
- ALL DIMENSIONS ON THE DRAWINGS ARE IN METRES UNLESS SHOWN OTHERWISE.
 - ALL WORK SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE RELEVANT LOGAN CITY COUNCIL SPECIFICATIONS & STANDARD DRAWINGS & NORTHROP SPECIFICATIONS & PROJECT DRAWINGS.
 - THE CONTRACTOR SHALL VERIFY THE LOCATION & RELATIVE LEVELS OF EXISTING SERVICES PRIOR TO CONSTRUCTION. THE CONTRACTOR IS TO TAKE ALL NECESSARY PRECAUTIONS REGARDING CONSTRUCTION ADJACENT TO EXISTING SERVICES. CONTRACTOR TO PROTECT IN PLACE EXISTING SERVICES. ANY DAMAGE TO EXISTING SERVICES TO BE REPAIRED AT CONTRACTORS EXPENSE.
 - THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH OTHER CONSULTANTS PLANS, SPECIFICATIONS & OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED BY THE SUPERINTENDENT DURING THE COURSE OF THE CONTRACT.
 - THE CONTRACTOR SHALL ERECT TRAFFIC CONTROL DEVICES IN ACCORDANCE WITH THE APPROVED TRAFFIC MANAGEMENT PLAN.
 - THE CONTRACTOR SHALL VERIFY OFFSET PEG LOCATIONS & BENCH MARK LEVELS & ADVISE THE SUPERINTENDENT OF ANY DISCREPANCY BEFORE COMMENCEMENT OF CONSTRUCTION.
 - THE ROAD PAVEMENT ADOPTED WILL BE DETERMINED BY THE ENGINEER & APPROVED BY LOGAN CITY COUNCIL. THIS PAVEMENT SHALL BE BASED ON SOIL TEST TAKEN AT SUBGRADE LEVEL. ANY VARIATIONS TO THE NORMAL PAVEMENT THICKNESS WILL BE PAID AT THE RATES SHOWN IN THE PRICED SCHEDULE OF RATES.
 - SIDE DRAINS SHALL BE PROVIDED UNDER ALL KERBS AS PER LOGAN CITY COUNCIL STANDARDS.
 - MITRE DRAIN LOCATION & EXTENTS SHALL BE DETERMINED ON SITE BY THE SUPERINTENDENT.

FOR CONTINUATION REFER TO SHEET C211

FOR CONTINUATION REFER TO SHEET C213

DESIGNED: BARTHEL

DRAWN: CLOPEZ

JOB MANAGER: RUIHANG

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE	CLIENT
1	ISSUED FOR APPROVAL	KAE	SK	SK	15.03.23	PARK RIDGE UNIT TRUST
2	ISSUED FOR APPROVAL	CL	GC	RH	01.08.23	

PARK RIDGE UNIT TRUST

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PLANNER

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SCALE 1:250@A1

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(07) 3368 0400 nrothrop@northrop.com.au
ABN 61 084 433 100

PROJECT

57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT
391-397 PARK RIDGE ROAD,
PARK RIDGE QLD 4125

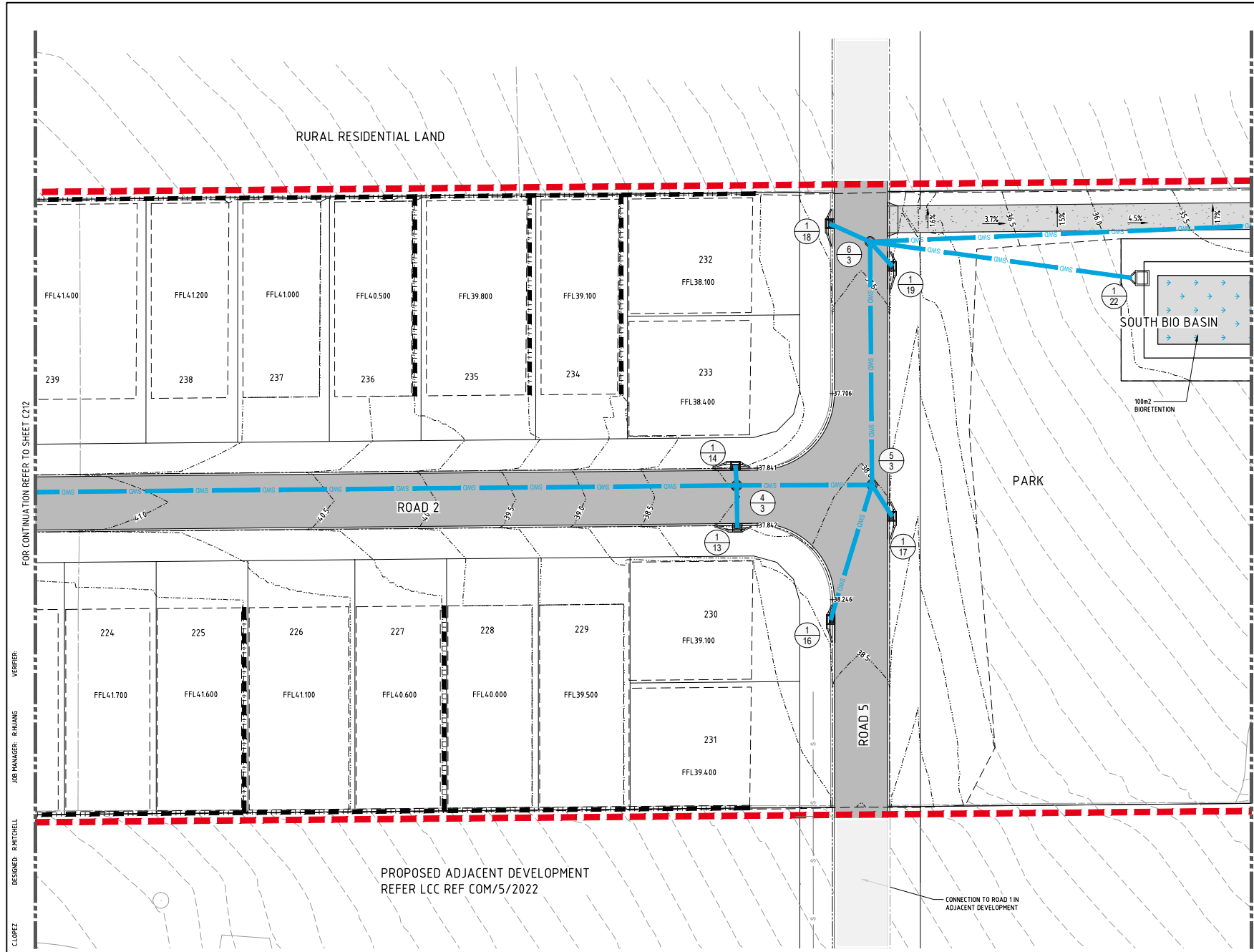
DRAWING TITLE

CIVIL ENGINEERING PACKAGE
ROADWORKS AND DRAINAGE LAYOUT PLAN
SHEET 2 OF 4

JOB NUMBER	DRAWING NUMBER	REVISION
BN213636	C212	2

DRAWING SHEET SIZE = A1

FOR APPROVAL



LEGEND

- XX.XX --- PROPOSED SURFACE CONTOURS
- XX.XX ... EXISTING SURFACE CONTOURS
- PROPOSED MOUNTABLE KERB & CHANNEL
- - - E-OH - - - EXISTING ELECTRICITY (OVERHEAD)
- PROPOSED RETAINING WALL (CONCRETE SLEEP)
- STAGE BOUNDARY
- PROPOSED NEW ASPHALT PAVEMENT
REFER LONGITUDINAL & CROSS SECTIONS FOR PAVEMENT DETAILS
- PROPOSED STORMWATER BASIN
- PROPOSED ACCESS TRACK
- PROPOSED STORMWATER GULLY PIT
- PROPOSED STORMWATER MANHOLE
- PROPOSED FIELD INLET
- SWD PROPOSED STORMWATER DRAINAGE

NOTES

1. ALL DIMENSIONS ON THE DRAWINGS ARE IN METRES UNLESS SHOWN OTHERWISE.
2. ALL WORK SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE RELEVANT LOGAN CITY COUNCIL SPECIFICATIONS & STANDARD DRAWINGS & NORTHROP SPECIFICATIONS & PROJECT DRAWINGS.
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4. THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH OTHER CONSULTANTS PLANS, SPECIFICATIONS & OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED BY THE SUPERINTENDENT DURING THE COURSE OF THE CONTRACT.
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8. SIDE DRAINS SHALL BE PROVIDED UNDER ALL KERBS AS PER LOGAN CITY COUNCIL STANDARDS.
9. MITRE DRAIN LOCATION & EXTENTS SHALL BE DETERMINED ON SITE BY THE SUPERINTENDENT.

FOR CONTINUATION REFER TO SHEET C212

FOR CONTINUATION REFER TO SHEET C214

DESIGNED: RUTICHELL
JOB MANAGER: RUMJANG
VERIFIER:

DRAWN: CLOPEZ

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE	CLIENT
1	ISSUED FOR APPROVAL	KAE	SK	SK	15.03.23	PARK RIDGE UNIT TRUST
2	ISSUED FOR APPROVAL	CL	GC	RH	01.08.23	

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PLANNER

Steve Cooper & Associates Pty Ltd

NORTHROP

Brisbane
Level 9, 200 Mary Street, Brisbane QLD 4000
GPO BOX 423 Brisbane QLD 4001
(07) 3368 0400. brisbane@northrop.com.au
ABN 61 084 433 100

PROJECT

57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT
391-397 PARK RIDGE ROAD,
PARK RIDGE QLD 4125

DRAWING TITLE

CIVIL ENGINEERING PACKAGE
ROADWORKS AND
DRAINAGE LAYOUT PLAN
SHEET 3 OF 4

JOB NUMBER
BN213636

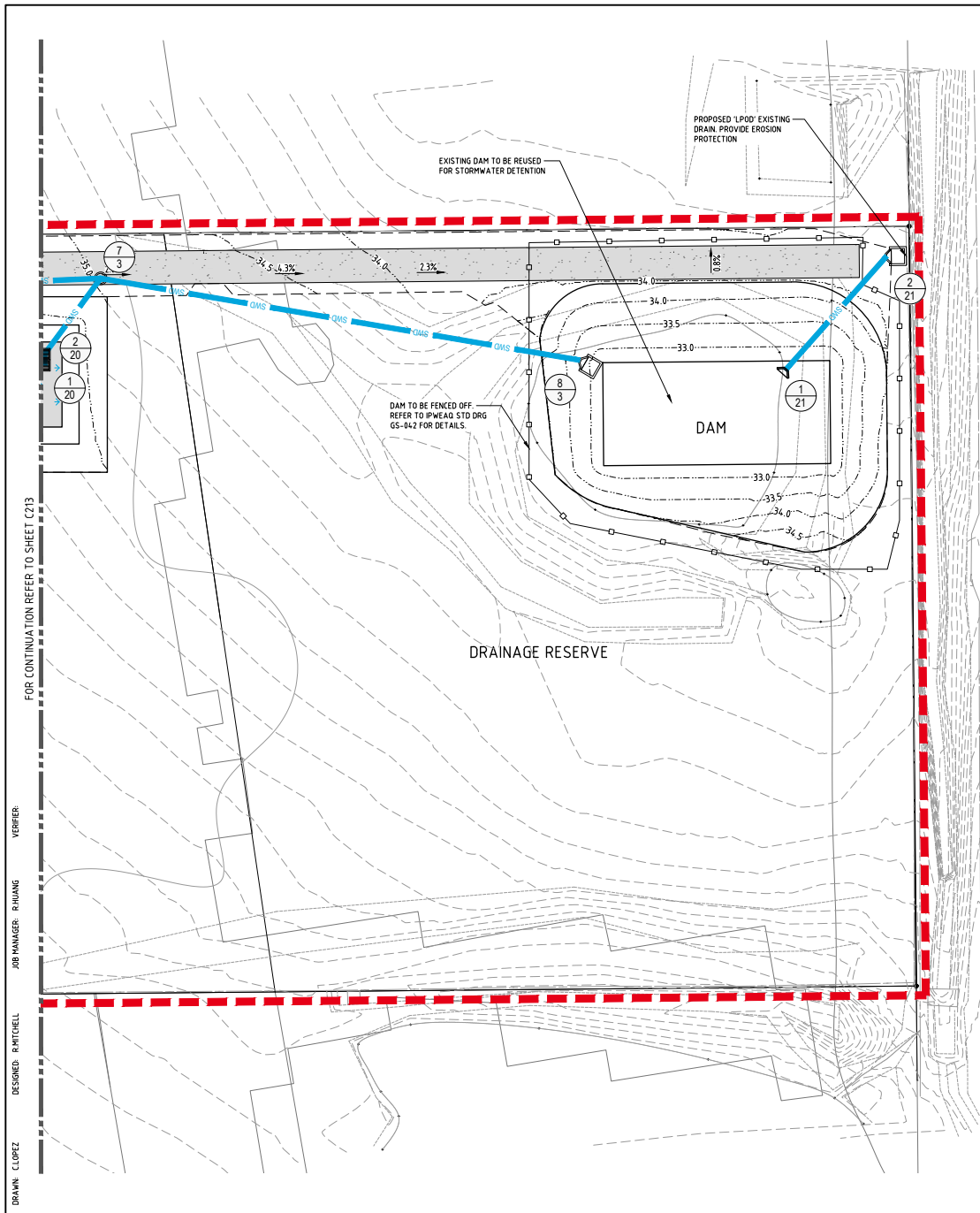
DRAWING NUMBER
C213

REVISION
2

DRAWING SHEET SIZE = A1

FOR APPROVAL

SCALE 1:250@A1



LEGEND	
---XX.XX---	PROPOSED SURFACE CONTOURS
- - - - -	EXISTING SURFACE CONTOURS
====	PROPOSED MOUNTABLE KERB & CHANNEL
---	EXISTING ELECTRICITY (OVERHEAD)
---	PROPOSED RETAINING WALL CONCRETE SLEEP
---	STAGE BOUNDARY
---	PROPOSED NEW ASPHALT PAVEMENT REFER LONGITUDINAL & CROSS SECTIONS FOR PAVEMENT DETAILS
---	PROPOSED STORMWATER BASIN
---	PROPOSED ACCESS TRACK
---	PROPOSED STORMWATER GULLY PIT
---	PROPOSED STORMWATER MANHOLE
---	PROPOSED FIELD INLET
---	PROPOSED STORMWATER DRAINAGE

- NOTES**
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DRAWN: CLOPEZ
 DESIGNED: MITCHELL
 JOB MANAGER: RUIHANG
 VERIFIER:
 FOR CONTINUATION REFER TO SHEET C213

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
1	ISSUED FOR APPROVAL	KAE	SK	SK	15.03.23
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PARK RIDGE UNIT TRUST

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PLANNER

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SCALE 1:250@A1

NORTHROP

Brisbane

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 GPO BOX 423 Brisbane QLD 4001
 (07) 3368 0400 Brisbane@northrop.com.au
 ABN 81 084 433 100

PROJECT

57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT
391-397 PARK RIDGE ROAD, PARK RIDGE QLD 4125

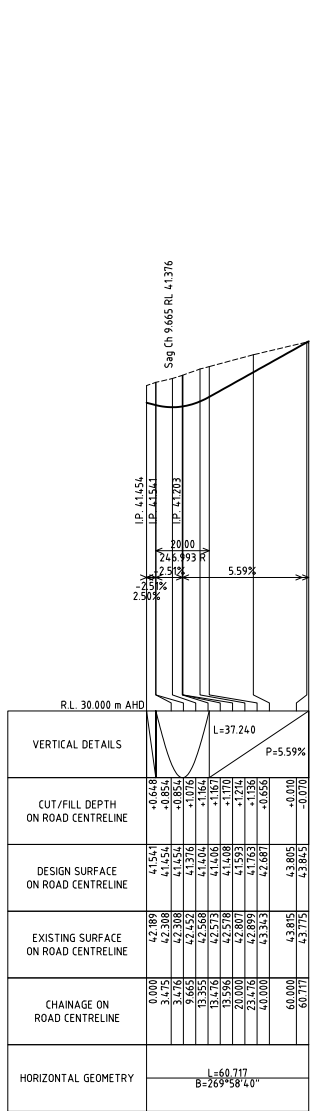
DRAWING TITLE

CIVIL ENGINEERING PACKAGE
ROADWORKS AND DRAINAGE LAYOUT PLAN
SHEET 4 OF 4

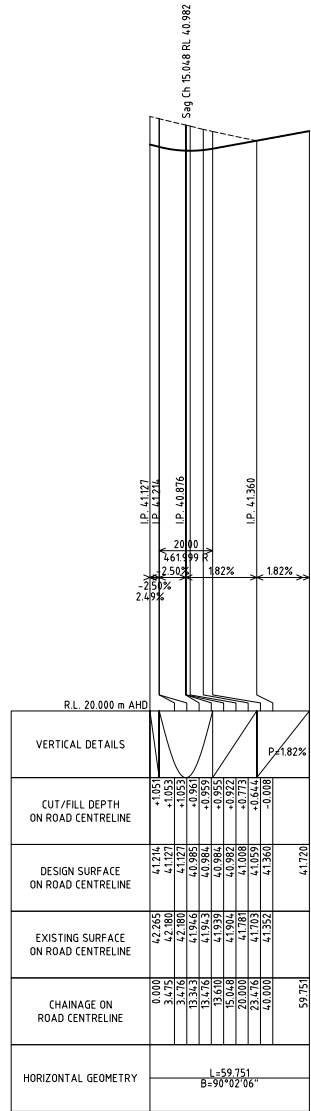
JOB NUMBER	REVISION
BN213636	2
DRAWING NUMBER	REVISION
C214	2
DRAWING SHEET SIZE = A1	

FOR APPROVAL

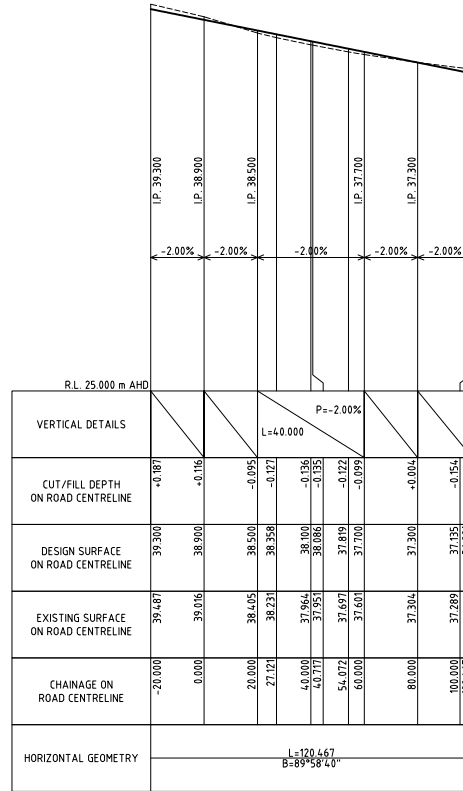
DESIGNED: MITCHELL
 DRAWN: CLOPEZ
 JOB MANAGER: RUIJANG
 VERIFIER:



LONGITUDINAL SECTION ROAD 33 Scale: H 1 in 1000 V 1 in 100



LONGITUDINAL SECTION ROAD 45 Scale: H 1 in 1000 V 1 in 100



LONGITUDINAL SECTION ROAD 55 Scale: H 1 in 1000 V 1 in 100

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
1	ISSUED FOR APPROVAL	KAE	SK	SK	15.03.23
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CLIENT
PARK RIDGE UNIT TRUST

PLANNER
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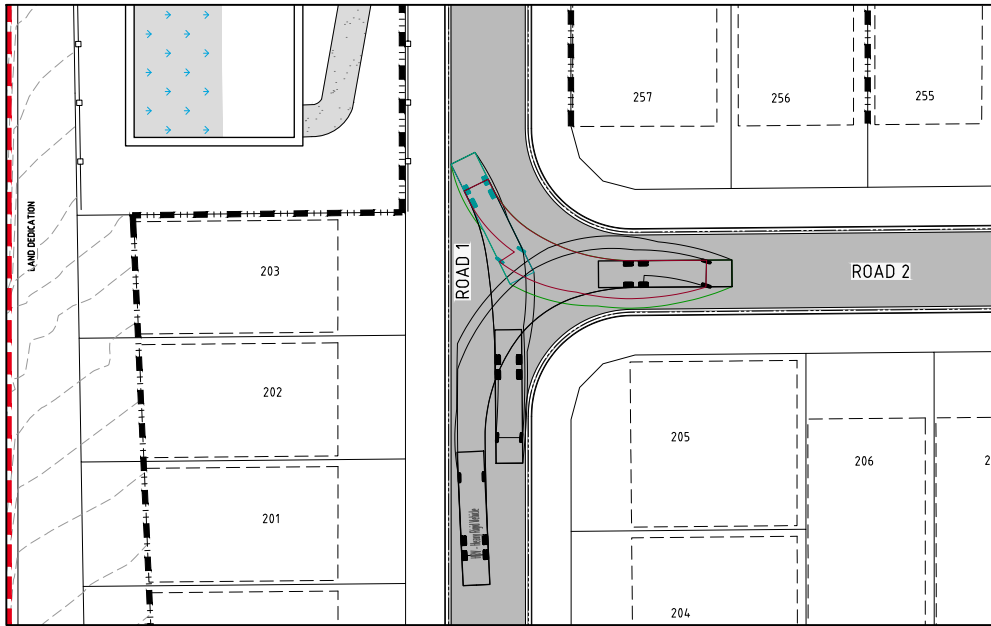
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 ABN 81 084 433 100

PROJECT
57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT
 391-397 PARK RIDGE ROAD,
 PARK RIDGE QLD 4125

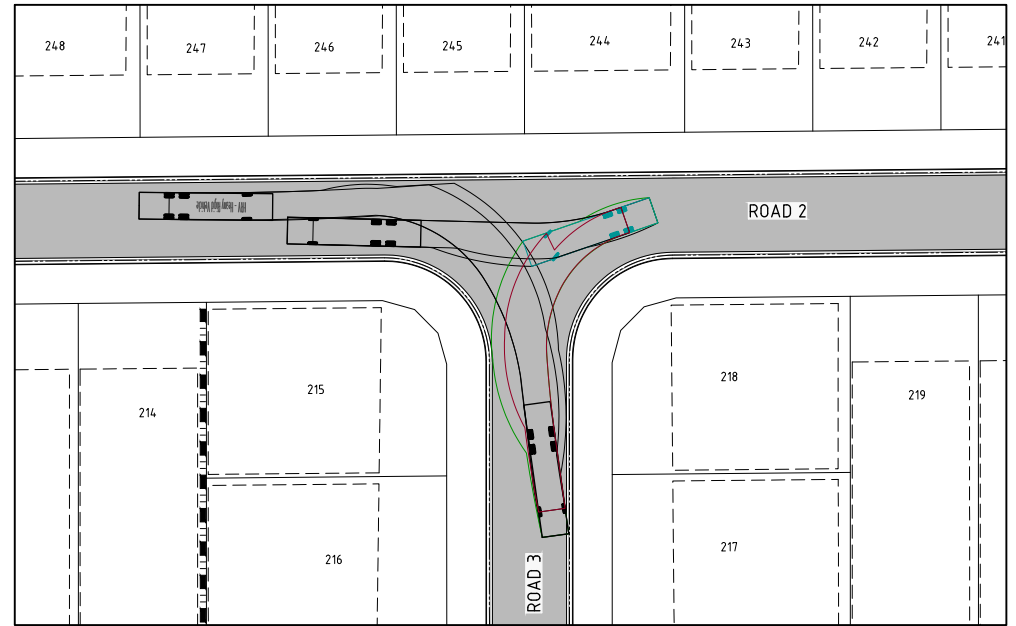
DRAWING TITLE
CIVIL ENGINEERING PACKAGE
 PRELIMINARY ROAD LONG SECTION SHEET 2 OF 2

JOB NUMBER	BN213636
DRAWING NUMBER	C222
REVISION	2
DRAWING SHEET SIZE	A1

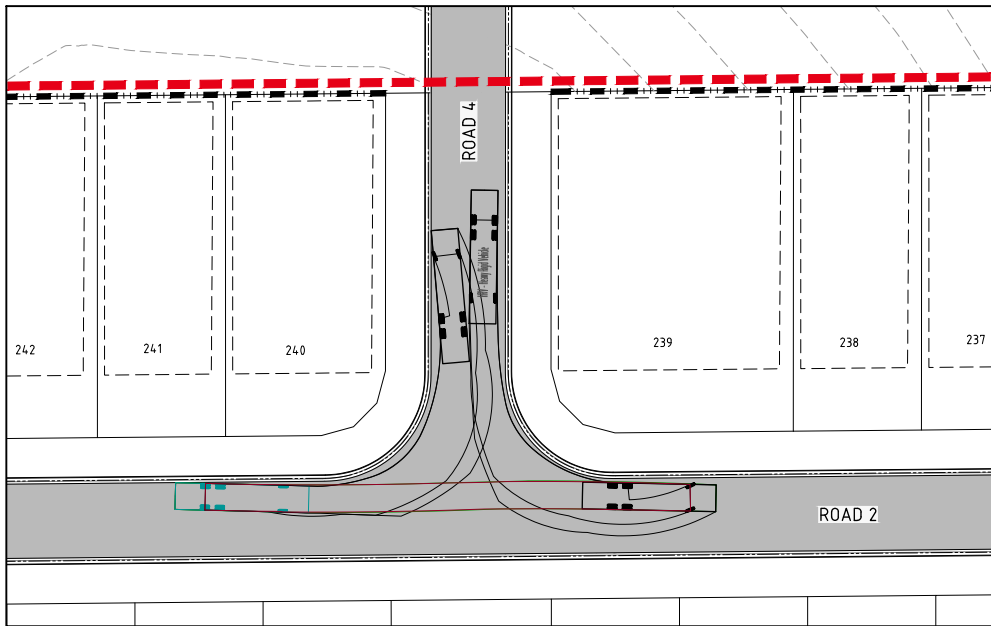
FOR APPROVAL



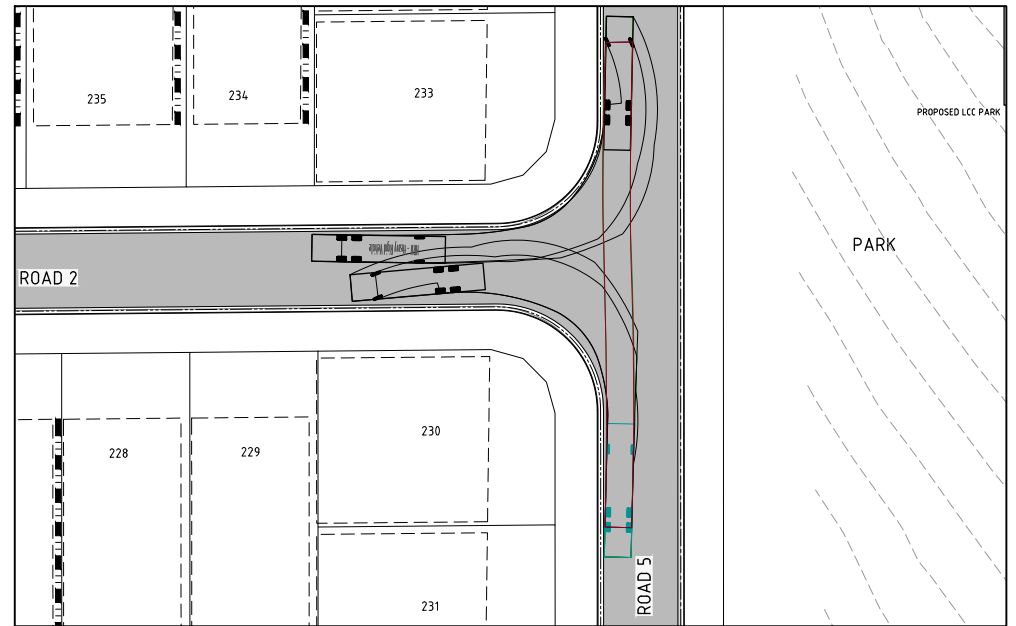
ROAD 1 & ROAD 2 TURNPATH FOR 12.5m HEAVY RIGID VEHICLE
SCALE 1:250



ROAD 2 & ROAD 3 TURNPATH FOR 12.5m HEAVY RIGID VEHICLE
SCALE 1:250



ROAD 2 & ROAD 4 TURNPATH FOR 12.5m HEAVY RIGID VEHICLE
SCALE 1:250



ROAD 2 & ROAD 3 TURNPATH FOR 12.5m HEAVY RIGID VEHICLE
SCALE 1:250

FOR APPROVAL

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE	CLIENT
1	ISSUED FOR APPROVAL	KAE	SK	SK	15.03.23	PARK RIDGE UNIT TRUST
2	ISSUED FOR APPROVAL	CL	GC	RH	01.08.23	

PARK RIDGE UNIT TRUST

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PLANNER

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SCALE 1:250@A1

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(07) 3368 0400 Brisbane@northrop.com.au
ABN 81 084 433 100

PROJECT

57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT
391-397 PARK RIDGE ROAD,
PARK RIDGE QLD 4125

DRAWING TITLE

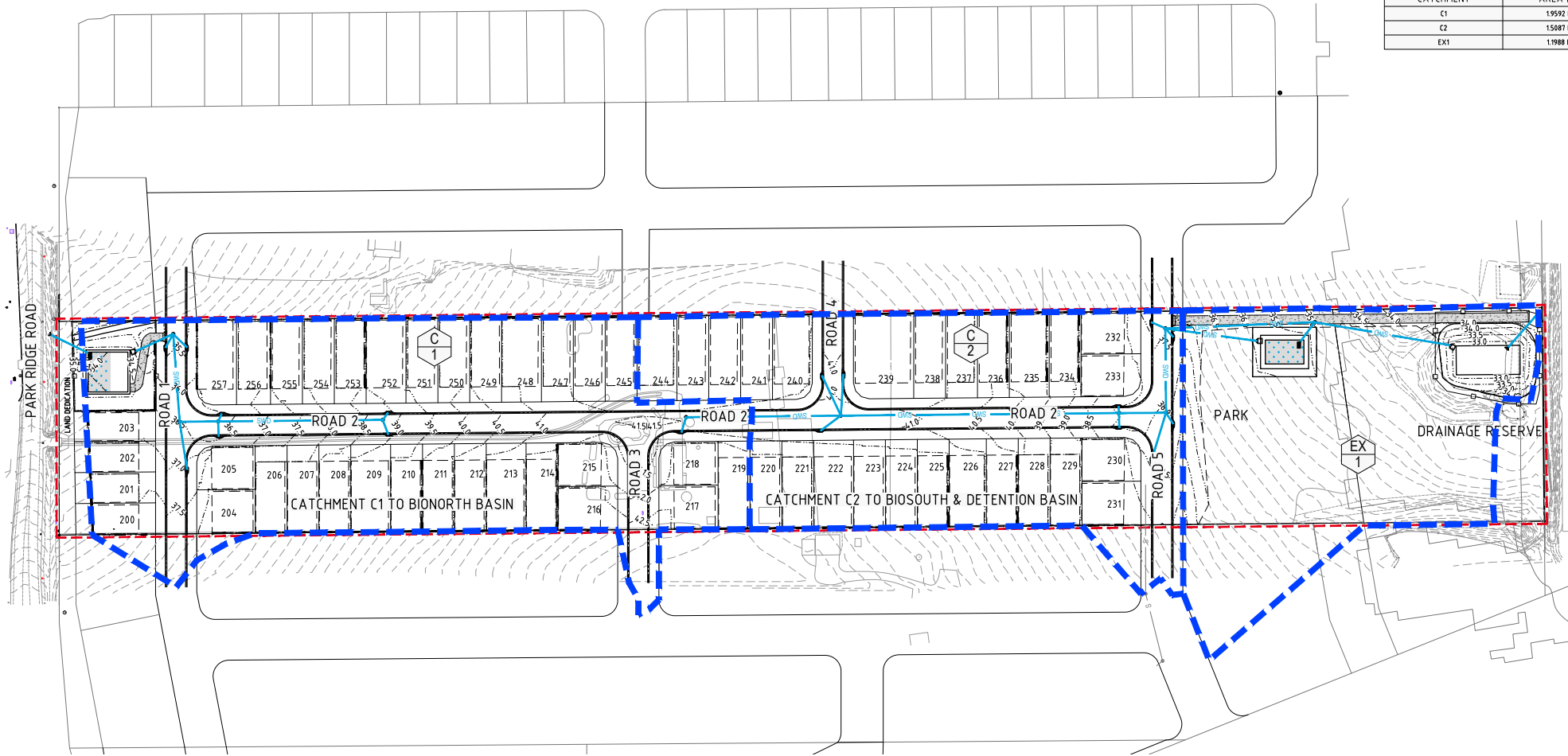
CIVIL ENGINEERING PACKAGE
VEHICLE TURN PATH LAYOUT PLAN

JOB NUMBER	REVISION
BN213636	2
DRAWING NUMBER	
C291	
DRAWING SHEET SIZE = A1	

DRAWN: CLOPEZ
DESIGNED: MITCHELL
JOB MANAGER: RUIJANG
VERIFIER:

LEGEND	
---XX.XX---	PROPOSED SURFACE CONTOURS
- - - - -XX.XX-	EXISTING SURFACE CONTOURS
	PROPOSED STORMWATER DRAINAGE
	PROPOSED ROOFWATER DRAINAGE
	PROPOSED CATCHMENT BOUNDARY
	STAGE BOUNDARY
	PROPOSED CATCHMENT NUMBER
	PROPOSED STRUCTURE NUMBER

DEVELOPED CATCHMENT TABLE	
CATCHMENT	AREA (ha)
C1	19592 ha
C2	15087 ha
EX1	1.1988 ha



DRAWN: CLOPEZ
DESIGNED: MITCHELL
JOB MANAGER: RUIJANG
VERIFIER:

FOR APPROVAL

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE	CLIENT
1	ISSUED FOR APPROVAL	KAE	SK	SK	15.03.23	PARK RIDGE UNIT TRUST
2	ISSUED FOR APPROVAL	CL	GC	RH	01.08.23	

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SCALE 1:800@A1

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(07) 3368 0400 Brisbane@northrop.com.au
ABN 91 084 433 100

PROJECT

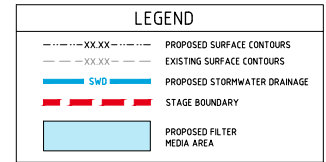
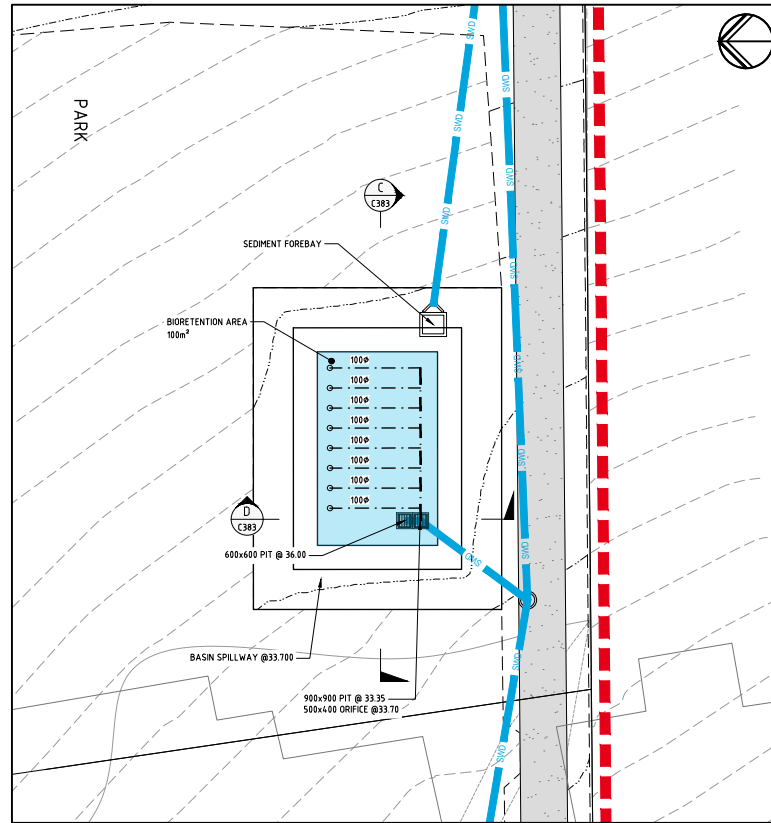
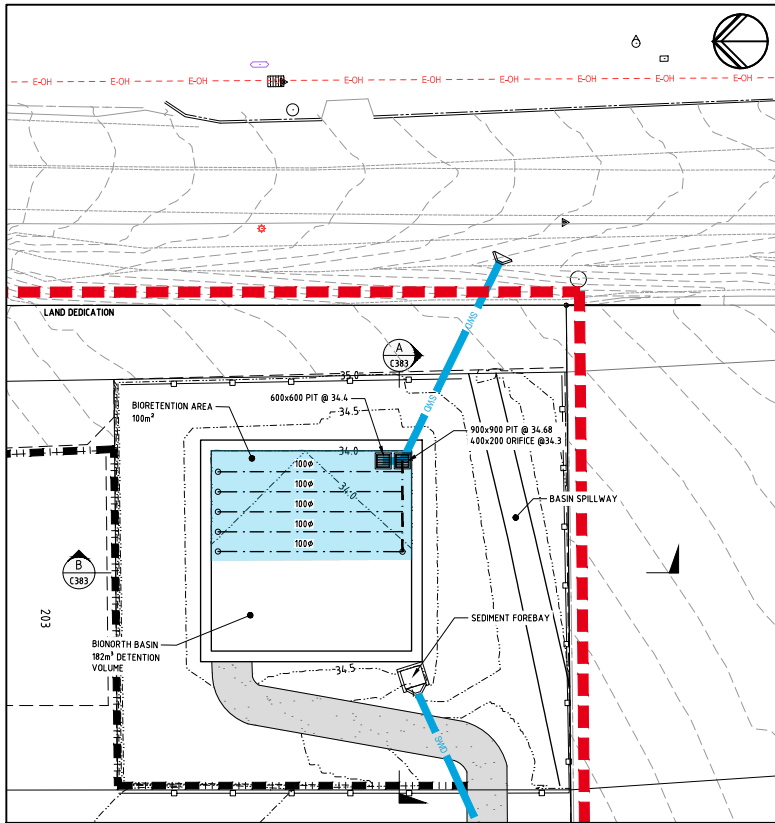
57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT
391-397 PARK RIDGE ROAD,
PARK RIDGE QLD 4125

DRAWING TITLE

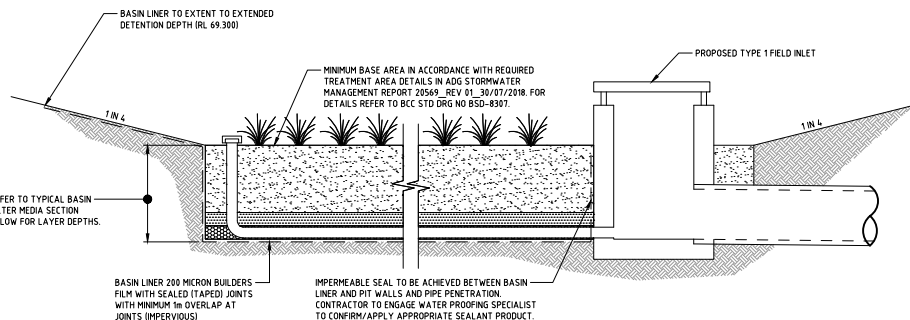
CIVIL ENGINEERING PACKAGE
STORMWATER CATCHMENT
KEY PLAN

JOB NUMBER	REVISION
BN213636	2
C310	2

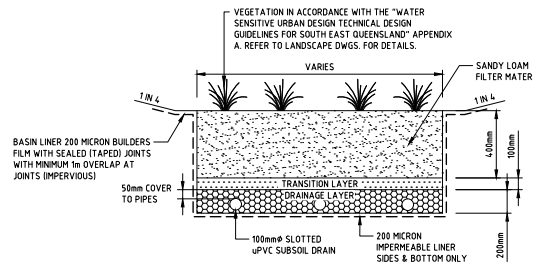
DRAWING SHEET SIZE = A1



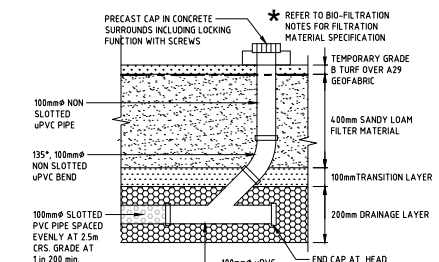
- NOTES**
1. ALL STORMWATER DRAINAGE PIPES ARE TO BE S.R.C. CLASS "D" OR F.R.C. CLASS "1" UNLESS NOTED OTHERWISE.
 2. FILTER MEDIA LAYER SHALL CONFORM WITH THE SPECIFICATIONS OF FAWB GUIDELINES FOR BIOFILTRATION MEDIA (VERSION 3.0) & WATER BY DESIGN SPECIFICATIONS "BIO RETENTION TECHNICAL DESIGN GUIDELINES VERSION 1". THE MINIMUM ORGANIC CONTENT OF THE FILTER MEDIA SHALL BE 3%.
 3. TRANSITION & DRAINAGE MEDIA LAYER SHALL CONFORM WITH THE SPECIFICATIONS OF FAWB GUIDELINES FOR BIOFILTRATION MEDIA (VERSION 3.0) & WATER BY DESIGN SPECIFICATIONS "BIO RETENTION TECHNICAL DESIGN GUIDELINES VERSION 1".
 4. THE CONTRACTOR IS RESPONSIBLE FOR UNDERTAKING DETAILED SURVEY OF EACH LAYER OF THE MEDIA INSTALLED INCLUDING THE SUBGRADE & FINISHED LEVEL SURVEYS. THE TOLERANCES FOR CONSTRUCTION OF THE MEDIA LAYERS IS INCLUDED IN THE WATER BY DESIGN CONSTRUCTION & ESTABLISHMENT SIGN OFF FORMS - BIORETENTION SYSTEMS (VERSION 1.1). ALL COSTS ASSOCIATED WITH THE DETAILED SURVEY OF THE BIORETENTION SYSTEMS, THE STAGED CONSTRUCTION APPROACH DUE TO THE SURVEY REVIEW PROCESS, & ANY REWORKS REQUIRED AS A RESULT OF THE SURVEY REVIEWS ARE DEEMED INCLUDED IN THE LUMP SUM CONTRACT PRICE FOR THE PROJECT.
 5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CO-SIGNING THE WATER BY DESIGN CONSTRUCTION & ESTABLISHMENT SIGN OFF FORMS - BIORETENTION SYSTEMS (VERSION 1.1) AT THE TIME OF CONSTRUCTION OF THE BIORETENTION SYSTEMS AS WELL AS MANAGING & COMPLYING WITH THE RELEVANT HOLD & WITNESS POINTS SPECIFIED IN THESE FORMS.
 6. THE MINIMUM HYDRAULIC CONDUCTIVITY OF ANY LAYER OF BIO BASIN MEDIA SHALL BE 200MH/K.



TYPICAL BIO-RETENTION/DETENTION BASIN SECTION
NTS



TYPICAL BASIN FILTER MEDIA SECTION
NTS



TYPICAL FLUSHING END DETAIL
NTS

VERIFIER: BUNTING
 JOB MANAGER: BUNTING
 DESIGNED: MITCHELL
 DRAWN: CLOPEZ

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE	CLIENT
1	ISSUED FOR APPROVAL	KAE	SK	SK	15.03.23	PARK RIDGE UNIT TRUST
2	ISSUED FOR APPROVAL	CL	GC	RH	01.08.23	

PARK RIDGE UNIT TRUST

PLANNER

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SCALE 1:200 @ A1

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 (07) 3368 0400 Brisbane QLD 4001
 (07) 3368 0400 Brisbane QLD 4001
 (07) 3368 0400 Brisbane QLD 4001

PROJECT

57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT
 391-397 PARK RIDGE ROAD,
 PARK RIDGE QLD 4125

JOB NUMBER

BN213636

DRAWING NUMBER

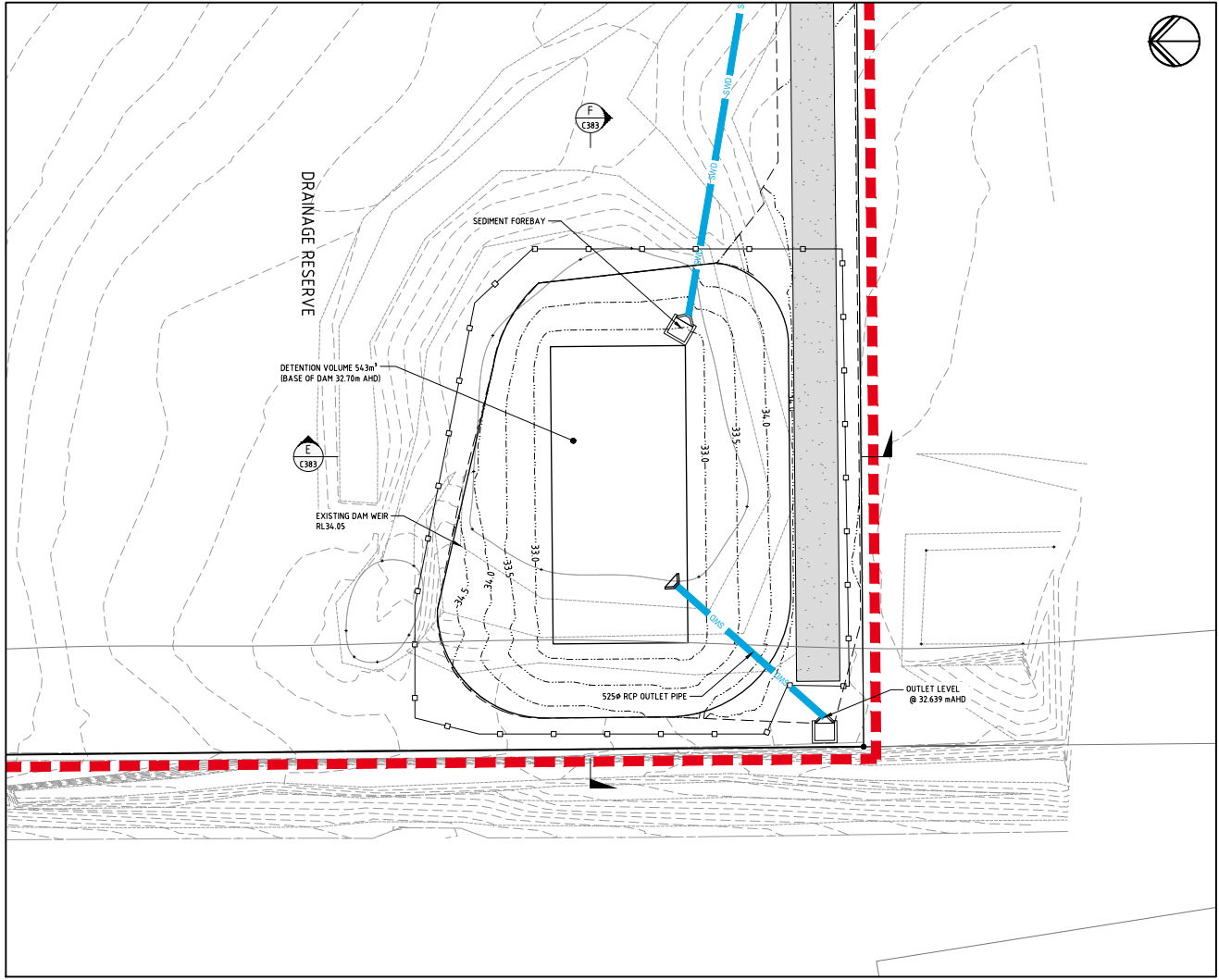
C381

REVISION

2

DRAWING SHEET SIZE = A1

FOR APPROVAL



LEGEND	
---XX.XX---	PROPOSED SURFACE CONTOURS
- - - - -	EXISTING SURFACE CONTOURS
	PROPOSED STORMWATER DRAINAGE
	STAGE BOUNDARY

- NOTES**
1. ALL STORMWATER DRAINAGE PIPES ARE TO BE S.R.C. CLASS "2" OR F.R.C. CLASS "1" UNLESS NOTED OTHERWISE.
 2. FILTER MEDIA LAYER SHALL CONFORM WITH THE SPECIFICATIONS OF FAWB GUIDELINES FOR BIOFILTRATION MEDIA (VERSION 3.01) & WATER BY DESIGN SPECIFICATIONS "BIO RETENTION TECHNICAL DESIGN GUIDELINES VERSION 1". THE MINIMUM ORGANIC CONTENT OF THE FILTER MEDIA SHALL BE 3%.
 3. TRANSITION & DRAINAGE MEDIA LAYER SHALL CONFORM WITH THE SPECIFICATIONS OF FAWB GUIDELINES FOR BIOFILTRATION MEDIA (VERSION 3.01) & WATER BY DESIGN SPECIFICATIONS "BIO RETENTION TECHNICAL DESIGN GUIDELINES VERSION 1".
 4. THE CONTRACTOR IS RESPONSIBLE FOR UNDERTAKING DETAILED SURVEY OF EACH LAYER OF THE MEDIA INSTALLED INCLUDING THE SUBGRADE & FINISHED LEVEL SURVEYS. THE DIGITAL SURVEY DATA FOR EACH LAYER IS TO BE ISSUED TO THE SUPERINTENDENT FOR REVIEW PRIOR TO THE SUBSEQUENT LAYER BEING INSTALLED. THE REQUIRED TOLERANCES FOR CONSTRUCTION OF THE MEDIA LAYERS IS INCLUDED IN THE WATER BY DESIGN CONSTRUCTION & ESTABLISHMENT SIGN OFF FORMS - BIORETENTION SYSTEMS (VERSION 1.1). ALL COSTS ASSOCIATED WITH THE DETAILED SURVEY OF THE BIORETENTION SYSTEMS, THE STAGED CONSTRUCTION APPROACH DUE TO THE SURVEY REVIEW PROCESS, & ANY REWORKS REQUIRED AS A RESULT OF THE SURVEY REVIEWS ARE DEEMED INCLUDED IN THE LUMP SUM CONTRACT PRICE FOR THE PROJECT.
 5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CO-SIGNING THE WATER BY DESIGN CONSTRUCTION & ESTABLISHMENT SIGN OFF FORMS - BIORETENTION SYSTEMS (VERSION 1.1) AT THE TIME OF CONSTRUCTION OF THE BIORETENTION SYSTEMS AS WELL AS MANAGING & COMPLYING WITH THE RELEVANT HOLD & WITNESS POINTS SPECIFIED IN THESE FORMS.
 6. THE MINIMUM HYDRAULIC CONDUCTIVITY OF ANY LAYER OF BIO BASIN MEDIA SHALL BE 200MH/H.

DRAWN: CLOPEZ
 DESIGNED: MITCHELL
 JOB MANAGER: RUIJANG
 VERIFIER:

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
1	ISSUED FOR APPROVAL	KAE	SK	SK	15.03.23
2	ISSUED FOR APPROVAL	CL	GC	RH	01.08.23

CLIENT
PARK RIDGE UNIT TRUST

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PLANNER

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PROJECT

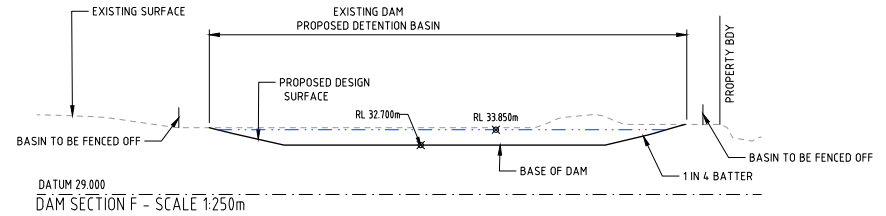
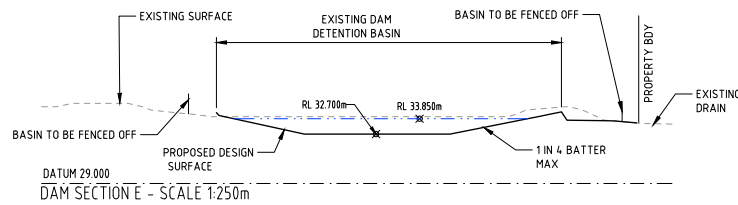
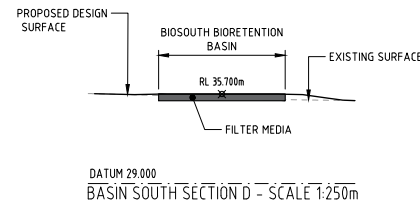
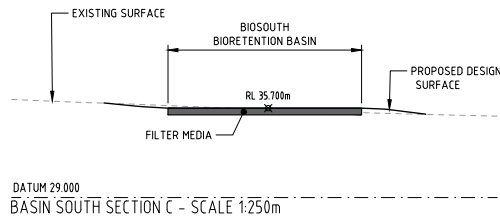
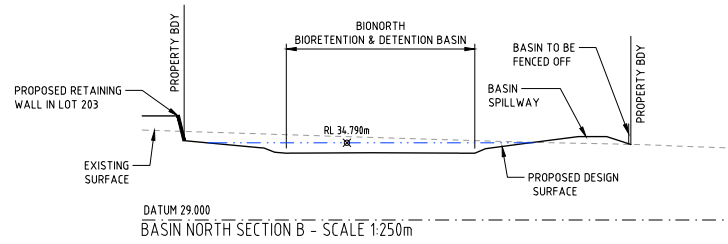
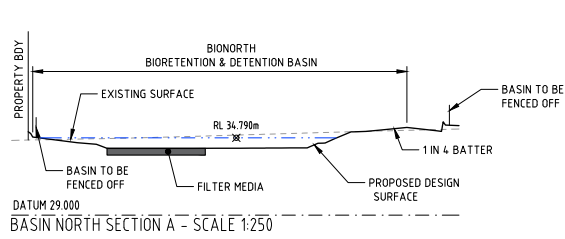
57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT
 391-397 PARK RIDGE ROAD,
 PARK RIDGE QLD 4125

DRAWING TITLE

CIVIL ENGINEERING PACKAGE
 PRELIMINARY BIO-BASIN
 LAYOUT PLAN SHEET 2 OF 3

JOB NUMBER	BN213636
DRAWING NUMBER	C382
REVISION	2
DRAWING SHEET SIZE = A1	

FOR APPROVAL




VERIFIER: RUMANG
 JOB MANAGER: RUMANG
 DESIGNED: MITCHELL
 DRAWN: CLOPEZ

FOR APPROVAL


REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
1	ISSUED FOR APPROVAL	KAE	SK	SK	15.03.23
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CLIENT
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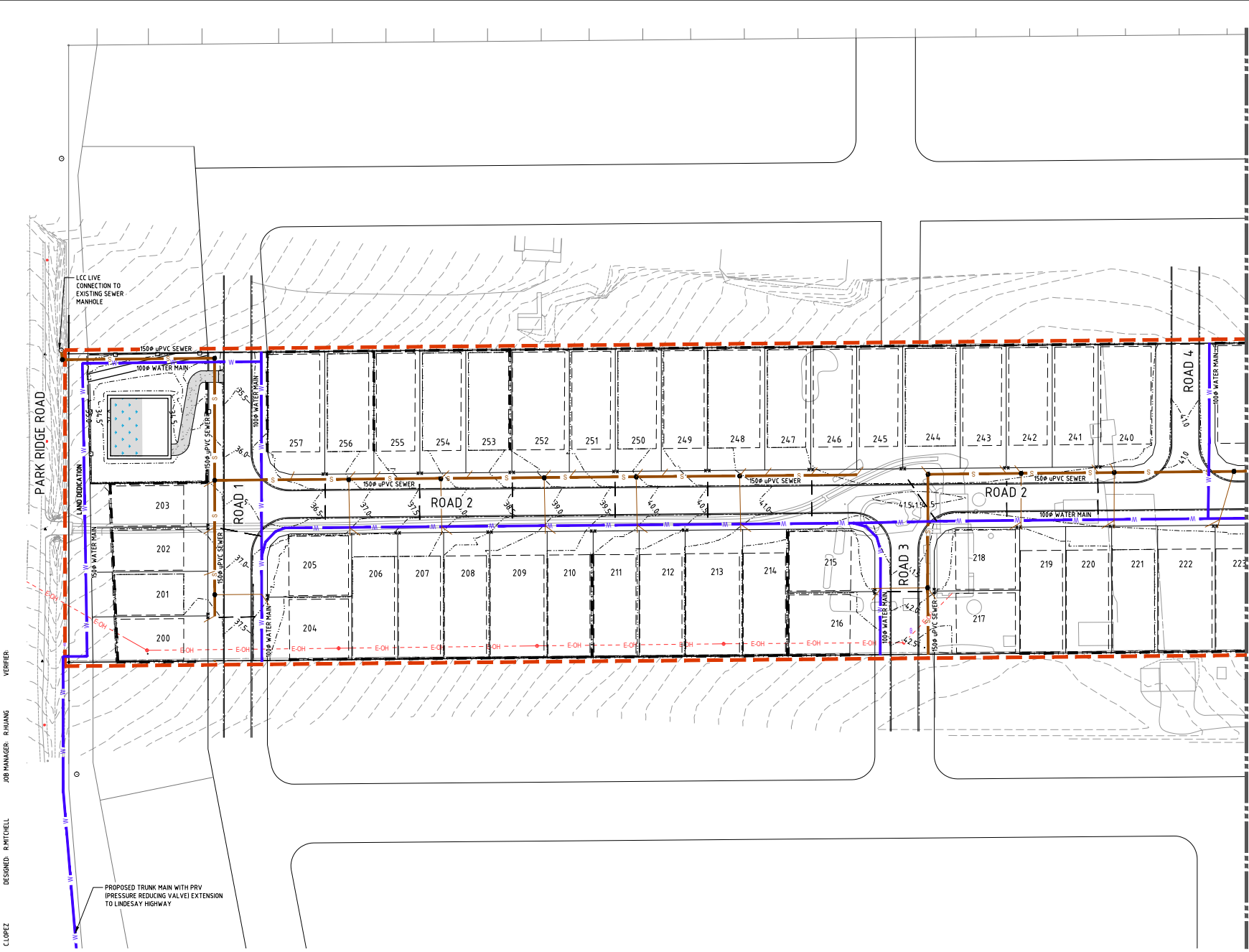
PROJECT
57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT
 391-397 PARK RIDGE ROAD,
 PARK RIDGE QLD 4125

DRAWING TITLE
CIVIL ENGINEERING PACKAGE
 PRELIMINARY BIO-BASIN
 LAYOUT PLAN SHEET 3 OF 3

JOB NUMBER	REVISION
BN213636	2
C383	

DRAWING SHEET SIZE = A1

LEGEND	
	PROPOSED SEWER RETICULATION
	PROPOSED WATER RETICULATION
	PROPOSED SURFACE CONTOURS
	EXISTING SURFACE CONTOURS
	EXISTING ELECTRICITY (OVERHEAD)
	PROPOSED RETAINING WALL CONCRETE SLEEPER
	STAGE BOUNDARY
	WATER METER
	WATER CONDUIT
	SEWER CONNECTION



FOR CONTINUATION REFER TO SHEET C402

DRAWN: CLOPEZ
DESIGNED: MITCHELL
JOB MANAGER: RUIJANG
VERIFIER:

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE	CLIENT
1	ISSUED FOR APPROVAL	KAE	SK	SK	15.03.23	PARK RIDGE UNIT TRUST
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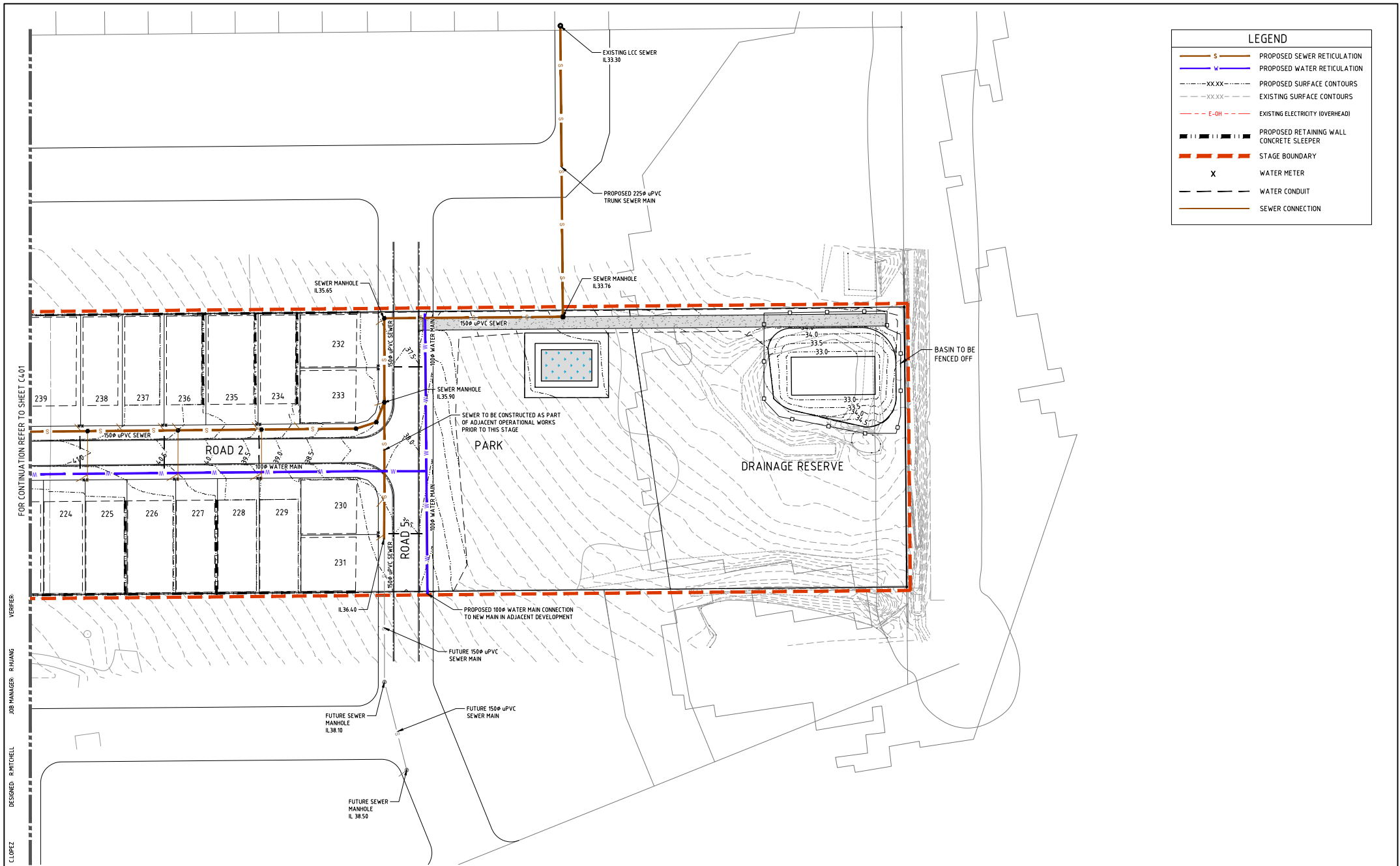
PROJECT
57 LOT RESIDENTIAL SUBDIVISION DEVELOPMENT
391-397 PARK RIDGE ROAD,
PARK RIDGE QLD 4125

DRAWING TITLE
CIVIL ENGINEERING PACKAGE
SEWER AND WATER
RETICULATION LAYOUT
PLAN SHEET 1 OF 2

JOB NUMBER	REVISION
BN213636	2
C401	2

DRAWING SHEET SIZE = A1

FOR APPROVAL



LEGEND	
	PROPOSED SEWER RETICULATION
	PROPOSED WATER RETICULATION
	PROPOSED SURFACE CONTOURS
	EXISTING SURFACE CONTOURS
	EXISTING ELECTRICITY (OVERHEAD)
	PROPOSED RETAINING WALL CONCRETE SLEEPER
	STAGE BOUNDARY
	WATER METER
	WATER CONDUIT
	SEWER CONNECTION

DRAWN: CLOPEZ
 DESIGNED: MITCHELL
 JOB MANAGER: RUIJANG
 VERIFIER:

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE	CLIENT
1	ISSUED FOR APPROVAL	KAE	SK	SK	15.03.23	PARK RIDGE UNIT TRUST
2	ISSUED FOR APPROVAL	CL	GC	RH	01.08.23	

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 ABN 61 084 433 100

PROJECT
**57 LOT RESIDENTIAL
 SUBDIVISION DEVELOPMENT
 391-397 PARK RIDGE ROAD,
 PARK RIDGE QLD 4125**

DRAWING TITLE
**CIVIL ENGINEERING PACKAGE
 SEWER AND WATER
 RETICULATION LAYOUT
 PLAN SHEET 2 OF 2**

FOR APPROVAL

JOB NUMBER	REVISION
BN213636	2
C402	2

DRAWING SHEET SIZE = A1

Appendix B – Rational Method Calculations



DESIGNED BY:	AT
DATE:	4/03/2022
PROJECT NAME:	Park Ridge Road
JOB No:	BN213636

RATIONAL METHOD SUMMARY CALCULATIONS

Catchment ID:	D1	
Description:	Northern Developed	
Catchment Area, A :	1.68	Ha
Standard Inlet Time	5	mins
Kerb Flow	0.5	mins
Pipe Flow	2.7	mins
Time of Concentration, t :	8.2	minutes
Impervious Fraction, f_i :	0.75	
Land Description (Only use if f_i < 0.2)		
10year Discharge Coefficient, C₁₀ :	0.82	

BOM IFD's:	2019
-------------------	-------------

Surface Type	n
Pavement	0.015
Soil	0.0275
Poor Grass	0.035
Average Grass	0.045
Dense Grass	0.06

Event	Rainfall Intensity <i>mm/h</i>	Runoff Coefficient <i>C</i>	Discharge <i>m³/s</i>
1 EY	93.26	0.66	0.285
0.5 EY	105.94	0.70	0.345
0.2 EY	145.60	0.78	0.529
10%	172.00	0.82	0.658
5%	198.40	0.86	0.797
2%	232.40	0.94	1.023
1%	258.00	0.98	1.185

QUDM, Table 4.5.2

Frequency Factor, F_y	
1 year ARI:	0.8
2 years ARI:	0.85
5 years ARI:	0.95
10 years ARI:	1
20 years ARI:	1.05
50 years ARI:	1.15
100 years ARI:	1.2

QUDM, Table 4.5.3 - Table of **C₁₀** values

Intensity (mm/hr)	Fraction Impervious, f_i						
	0.00	0.20	0.40	0.60	0.80	0.90	1.00
39-44	Refer to Table 4.5.4	0.44	0.55	0.67	0.78	0.84	0.90
45-49		0.49	0.60	0.70	0.80	0.85	0.90
50-54		0.55	0.64	0.72	0.81	0.86	0.90
55-59		0.60	0.68	0.75	0.83	0.86	0.90
60-64		0.65	0.72	0.78	0.84	0.87	0.90
65-69		0.71	0.76	0.80	0.85	0.88	0.90
70-90		0.74	0.78	0.82	0.86	0.88	0.90

QUDM, Table 4.5.4 - **C₁₀** value for zero fraction impervious

Land Description	High Density Bush			Medium density bush: good grass cover, high density pasture, zero tillage cropping			Low density bush: poor grass cover, low density pasture, low cover bare fallows		
	Soil Permeability			Soil Permeability			Soil Permeability		
	High	Med	Low	High	Med	Low	High	Med	Low
39-44	0.08	0.24	0.32	0.16	0.32	0.40	0.24	0.40	0.48
45-49	0.10	0.29	0.39	0.20	0.39	0.49	0.29	0.49	0.59
50-54	0.12	0.35	0.46	0.23	0.46	0.58	0.35	0.58	0.69
55-59	0.13	0.40	0.53	0.27	0.53	0.66	0.40	0.66	0.70
60-64	0.15	0.44	0.59	0.30	0.59	0.70	0.44	0.70	0.70
65-69	0.17	0.50	0.66	0.33	0.66	0.70	0.50	0.70	0.70
70-90	0.18	0.53	0.70	0.35	0.70	0.70	0.53	0.70	0.70



DESIGNED BY:	AT
DATE:	4/03/2022
PROJECT NAME:	Park Ridge Road
JOB No:	BN213636

RATIONAL METHOD SUMMARY CALCULATIONS

Catchment ID:	D2	
Description:	Southern Developed	
Catchment Area, A :	1.68	Ha
Standard Inlet Time	5	mins
Kerb Flow	0.5	mins
Pipe Flow	2.8	mins
Time of Concentration, t :	8.3	minutes
Impervious Fraction, f_i :	0.75	
Land Description (Only use if $f_i < 0.2$)		
10year Discharge Coefficient, C₁₀ :	0.82	

BOM IFD's:	2019
-------------------	-------------

Surface Type	n
Pavement	0.015
Soil	0.0275
Poor Grass	0.035
Average Grass	0.045
Dense Grass	0.06

Event	Rainfall Intensity <i>mm/h</i>	Runoff Coefficient <i>C</i>	Discharge <i>m³/s</i>
1 EY	93.26	0.66	0.285
0.5 EY	105.94	0.70	0.345
0.2 EY	145.60	0.78	0.529
10%	172.00	0.82	0.658
5%	198.40	0.86	0.797
2%	232.40	0.94	1.023
1%	258.00	0.98	1.185

QUDM, Table 4.5.2

Frequency Factor, <i>F_y</i>	
1 year ARI:	0.8
2 years ARI:	0.85
5 years ARI:	0.95
10 years ARI:	1
20 years ARI:	1.05
50 years ARI:	1.15
100 years ARI:	1.2

QUDM, Table 4.5.3 - Table of *C₁₀* values

Intensity (mm/hr)	Fraction Impervious, <i>f_i</i>						
	0.00	0.20	0.40	0.60	0.80	0.90	1.00
39-44	Refer to Table 4.5.4	0.44	0.55	0.67	0.78	0.84	0.90
45-49		0.49	0.60	0.70	0.80	0.85	0.90
50-54		0.55	0.64	0.72	0.81	0.86	0.90
55-59		0.60	0.68	0.75	0.83	0.86	0.90
60-64		0.65	0.72	0.78	0.84	0.87	0.90
65-69		0.71	0.76	0.80	0.85	0.88	0.90
70-90		0.74	0.78	0.82	0.86	0.88	0.90

QUDM, Table 4.5.4 - *C₁₀* value for zero fraction impervious

Land Description	High Density Bush			Medium density bush: good grass cover, high density pasture, zero tillage cropping			Low density bush: poor grass cover, low density pasture, low cover bare fallows		
	Soil Permeability			Soil Permeability			Soil Permeability		
	High	Med	Low	High	Med	Low	High	Med	Low
39-44	0.08	0.24	0.32	0.16	0.32	0.40	0.24	0.40	0.48
45-49	0.10	0.29	0.39	0.20	0.39	0.49	0.29	0.49	0.59
50-54	0.12	0.35	0.46	0.23	0.46	0.58	0.35	0.58	0.69
55-59	0.13	0.40	0.53	0.27	0.53	0.66	0.40	0.66	0.70
60-64	0.15	0.44	0.59	0.30	0.59	0.70	0.44	0.70	0.70
65-69	0.17	0.50	0.66	0.33	0.66	0.70	0.50	0.70	0.70
70-90	0.18	0.53	0.70	0.35	0.70	0.70	0.53	0.70	0.70



DESIGNED BY:	AT
DATE:	4/03/2022
PROJECT NAME:	Park Ridge Road
JOB No:	BN213636

RATIONAL METHOD SUMMARY CALCULATIONS

Catchment ID:	D3	
Description:	Southern Green Space	
Catchment Area, A :	1.025	Ha
Overland Sheet Flow Path Length, L :	120	m
Hortons Surface Roughness Factor, n :	0.04	
Slope of surface, S :	3.5	%
Time of Concentration, t :	16.4	minutes
Impervious Fraction, f _i :	0	
Land Description (Only use if f _i < 0.2)	Med Density Bushland - LOW Soil Permeability	
10year Discharge Coefficient, C ₁₀ :	0.7	

BOM IFD's:	2019
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Surface Type	n
Pavement	0.015
Soil	0.0275
Poor Grass	0.035
Average Grass	0.045
Dense Grass	0.06

Event	Rainfall Intensity <i>mm/h</i>	Runoff Coefficient <i>C</i>	Discharge <i>m³/s</i>
1 EY	71.08	0.56	0.113
0.5 EY	80.90	0.60	0.137
0.2 EY	111.00	0.67	0.210
10%	130.60	0.70	0.260
5%	150.00	0.74	0.314
2%	174.40	0.81	0.400
1%	193.00	0.84	0.462

QUDM, Table 4.5.2

Frequency Factor, F _y	
1 year ARI:	0.8
2 years ARI:	0.85
5 years ARI:	0.95
10 years ARI:	1
20 years ARI:	1.05
50 years ARI:	1.15
100 years ARI:	1.2

QUDM, Table 4.5.3 - Table of C₁₀ values

Intensity (mm/hr)	Fraction Impervious, f _i						
	0.00	0.20	0.40	0.60	0.80	0.90	1.00
39-44	Refer to Table 4.5.4	0.44	0.55	0.67	0.78	0.84	0.90
45-49		0.49	0.60	0.70	0.80	0.85	0.90
50-54		0.55	0.64	0.72	0.81	0.86	0.90
55-59		0.60	0.68	0.75	0.83	0.86	0.90
60-64		0.65	0.72	0.78	0.84	0.87	0.90
65-69		0.71	0.76	0.80	0.85	0.88	0.90
70-90		0.74	0.78	0.82	0.86	0.88	0.90

QUDM, Table 4.5.4 - C₁₀ value for zero fraction impervious

Land Description	High Density Bush			Medium density bush: good grass cover, high density pasture, zero tillage cropping			Low density bush: poor grass cover, low density pasture, low cover bare fallows		
	Soil Permeability			Soil Permeability			Soil Permeability		
	High	Med	Low	High	Med	Low	High	Med	Low
39-44	0.08	0.24	0.32	0.16	0.32	0.40	0.24	0.40	0.48
45-49	0.10	0.29	0.39	0.20	0.39	0.49	0.29	0.49	0.59
50-54	0.12	0.35	0.46	0.23	0.46	0.58	0.35	0.58	0.69
55-59	0.13	0.40	0.53	0.27	0.53	0.66	0.40	0.66	0.70
60-64	0.15	0.44	0.59	0.30	0.59	0.70	0.44	0.70	0.70
65-69	0.17	0.50	0.66	0.33	0.66	0.70	0.50	0.70	0.70
70-90	0.18	0.53	0.70	0.35	0.70	0.70	0.53	0.70	0.70



DESIGNED BY:	AT
DATE:	27/06/2022
PROJECT NAME:	Park Ridge Road
JOB No:	BN213636

RATIONAL METHOD SUMMARY CALCULATIONS

Catchment ID:	E1	
Description:	Existing North Catchment	
Catchment Area, A :	2.07	Ha
Overland Sheet Flow Path Length, L :	218	m
Hortons Surface Roughness Factor, n :	0.04	
Slope of surface, S :	3.4	%
Time of Concentration, t :	20.1	minutes
Impervious Fraction, f_i :	0.02	
Land Description (Only use if f_i < 0.2)	Low Density Bushland - LOW Soil Permeability	
10year Discharge Coefficient, C₁₀ :	0.7	

BOM IFD's:	2019
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Surface Type	n
Pavement	0.015
Soil	0.0275
Poor Grass	0.035
Average Grass	0.045
Dense Grass	0.06

Event	Rainfall Intensity <i>mm/h</i>	Runoff Coefficient <i>C</i>	Discharge <i>m³/s</i>
1 EY	63.40	0.56	0.204
0.5 EY	72.10	0.60	0.247
0.2 EY	99.00	0.67	0.379
10%	117.00	0.70	0.471
5%	134.00	0.74	0.566
2%	156.00	0.81	0.722
1%	173.00	0.84	0.836

QUDM, Table 4.5.2

Frequency Factor, F_y	
1 year ARI:	0.8
2 years ARI:	0.85
5 years ARI:	0.95
10 years ARI:	1
20 years ARI:	1.05
50 years ARI:	1.15
100 years ARI:	1.2

QUDM, Table 4.5.3 - Table of **C₁₀** values

Intensity (mm/hr)	Fraction Impervious, f_i						
	0.00	0.20	0.40	0.60	0.80	0.90	1.00
39-44	Refer to Table 4.5.4	0.44	0.55	0.67	0.78	0.84	0.90
45-49		0.49	0.60	0.70	0.80	0.85	0.90
50-54		0.55	0.64	0.72	0.81	0.86	0.90
55-59		0.60	0.68	0.75	0.83	0.86	0.90
60-64		0.65	0.72	0.78	0.84	0.87	0.90
65-69		0.71	0.76	0.80	0.85	0.88	0.90
70-90		0.74	0.78	0.82	0.86	0.88	0.90

QUDM, Table 4.5.4 - **C₁₀** value for zero fraction impervious

Land Description	High Density Bush			Medium density bush: good grass cover, high density pasture, zero tillage cropping			Low density bush: poor grass cover, low density pasture, low cover bare fallows		
	Soil Permeability			Soil Permeability			Soil Permeability		
	High	Med	Low	High	Med	Low	High	Med	Low
39-44	0.08	0.24	0.32	0.16	0.32	0.40	0.24	0.40	0.48
45-49	0.10	0.29	0.39	0.20	0.39	0.49	0.29	0.49	0.59
50-54	0.12	0.35	0.46	0.23	0.46	0.58	0.35	0.58	0.69
55-59	0.13	0.40	0.53	0.27	0.53	0.66	0.40	0.66	0.70
60-64	0.15	0.44	0.59	0.30	0.59	0.70	0.44	0.70	0.70
65-69	0.17	0.50	0.66	0.33	0.66	0.70	0.50	0.70	0.70
70-90	0.18	0.53	0.70	0.35	0.70	0.70	0.53	0.70	0.70



DESIGNED BY:	AT
DATE:	27/06/2022
PROJECT NAME:	Park Ridge Road
JOB No:	BN213636

RATIONAL METHOD SUMMARY CALCULATIONS

Catchment ID:	E2	
Description:	Existing South Catchment	
Catchment Area, A :	2.31	Ha
Overland Sheet Flow Path Length, L :	180	m
Hortons Surface Roughness Factor, n :	0.04	
Slope of surface, S :	3.9	%
Time of Concentration, t :	18.4	minutes
Impervious Fraction, f _i :	0.01	
Land Description (Only use if f _i < 0.2)	Med Density Bushland - LOW Soil Permeability	
10year Discharge Coefficient, C ₁₀ :	0.7	

BOM IFD's:	2019
------------	------

Surface Type	n
Pavement	0.015
Soil	0.0275
Poor Grass	0.035
Average Grass	0.045
Dense Grass	0.06

Event	Rainfall Intensity mm/h	Runoff Coefficient C	Discharge m ³ /s
1 EY	67.24	0.56	0.242
0.5 EY	76.50	0.60	0.292
0.2 EY	105.00	0.67	0.448
10%	123.80	0.70	0.556
5%	142.00	0.74	0.670
2%	165.20	0.81	0.853
1%	183.00	0.84	0.986

QUDM, Table 4.5.2

Frequency Factor, F _y	
1 year ARI:	0.8
2 years ARI:	0.85
5 years ARI:	0.95
10 years ARI:	1
20 years ARI:	1.05
50 years ARI:	1.15
100 years ARI:	1.2

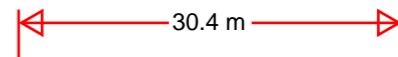
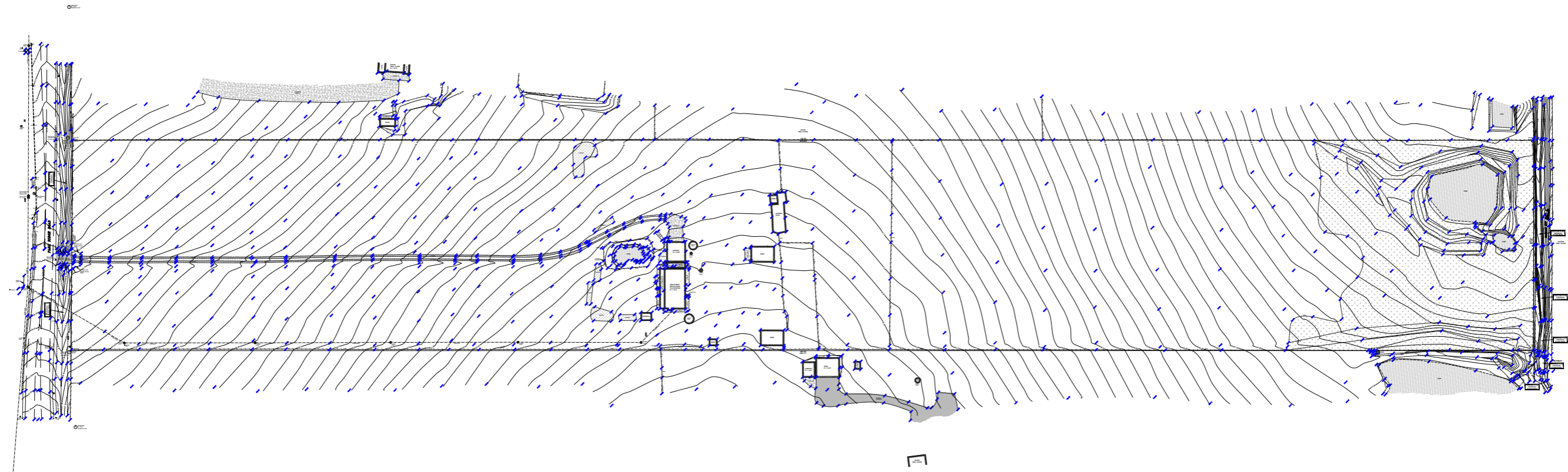
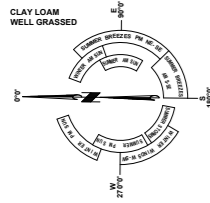
QUDM, Table 4.5.3 - Table of C₁₀ values

Intensity (mm/hr)	Fraction Impervious, f _i						
	0.00	0.20	0.40	0.60	0.80	0.90	1.00
39-44	Refer to Table 4.5.4	0.44	0.55	0.67	0.78	0.84	0.90
45-49		0.49	0.60	0.70	0.80	0.85	0.90
50-54		0.55	0.64	0.72	0.81	0.86	0.90
55-59		0.60	0.68	0.75	0.83	0.86	0.90
60-64		0.65	0.72	0.78	0.84	0.87	0.90
65-69		0.71	0.76	0.80	0.85	0.88	0.90
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QUDM, Table 4.5.4 - C₁₀ value for zero fraction impervious

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45-49	0.10	0.29	0.39	0.20	0.39	0.49	0.29	0.49	0.59
50-54	0.12	0.35	0.46	0.23	0.46	0.58	0.35	0.58	0.69
55-59	0.13	0.40	0.53	0.27	0.53	0.66	0.40	0.66	0.70
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65-69	0.17	0.50	0.66	0.33	0.66	0.70	0.50	0.70	0.70
70-90	0.18	0.53	0.70	0.35	0.70	0.70	0.53	0.70	0.70

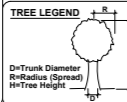
Appendix C – Site Survey Plan



OVERLAND FLOW POTENTIAL:
(PER QSO'S SUBSIDIENCE POLICY)
We have inspected the subject site during survey and consider **THERE IS STORMWATER OVERLAND FLOW POTENTIAL** affecting this site, as indicated on the plan. The aim is to identify potential concentrated stormwater overland flow (such as a drain, gully or low point). No specific Local Council searches have been conducted and engineering analysis may be required.

NOTE: NO CORNER PEGS WERE FOUND TO DETERMINE BOUNDARY POSITIONS. BOUNDARIES SHOWN ARE APPROX. ONLY & RELATE TO EXISTING FENCE LINE.

Services shown hereon have been located where possible by field survey. If not able to be located, services have been plotted from the records of relevant authorities where available. Prior to any excavation or construction on the site, the relevant authority should be contacted for possible location of further underground services.



G.L.
CUT
FILL
F.L.

NOTE: PHOTOS AVAILABLE FOR FURTHER REFERENCE
Levels & Contours shown hereon are related to AHD. Prior to any construction the relevant authority should be contacted for possible minimum floor level requirements and flood information.

NOTE: AN IDENTIFICATION SURVEY IS REQUIRED PRIOR TO CONSTRUCTION. PLEASE CONTACT admin@stevecooper.com.au FOR A FEE PROPOSAL. TYPICAL TIMEFRAME VARIES FROM 5-10 BUSINESS DAYS.

DWG No	DATE	AMENDMENTS	INITIAL
21-2306	11.02.2022	ORIGINAL CONTOUR	AJS
21-2306A	26.04.2022	EXTRA SURVEY ADDED	AJS

STEVE COOPER & ASSOCIATES PTY LTD
ABN 57 010 839 022
LICENSED LAND SURVEYORS,
LAND PLANNING CONSULTANTS,
PH: (07) 3846 6477
27 NORFOLK ROAD, SOUTH BRISBANE 4101
EMAIL: admin@stevecooper.com.au

BUILDER -
BUILDERS JOB NO: -
CLIENT MURRAY BELL
DESIGNER -

SITE:
#391-397 PARK RIDGE ROAD
PARK RIDGE
LOT 20 ON RP94215

LOCAL AUTH: LOGAN C.C.
LBD REF: 100 P1
AREA: 4.496 ha

SERVICES
U/G POWER YES
WATER NO
TELECOM YES
GAS NO
SEWER SEPTIC
ROOFWATER ROAD/REAR
STORMWATER ROAD/REAR

LEGEND
OH LIGHT
SWATER PIT
FIRE HYDRANT
WATER VALVE
MOUNTABLE KERB
NON-MOUNT KERB
REF RL: 33.62
DATUM: AHD (VIA PSM #157827)

DATE: 26.04.2022
CCAD: 21-2306A.mxd
DRAWN BY: AJS
SURVEYOR: CC
CHECKED: KT

CONTOUR AND DETAIL SURVEY

THIS SURVEY MAPS THE SITE FEATURES AND LEVELS. IT DOES NOT GUARANTEE THE POSITION OF PEGS, ALLOTMENT BOUNDARIES OR FENCES. CHECK TITLE FOR ANY EASEMENTS.

SCALE: 1:600 - Or 1:600 AD
JOB NO: 21-2306A

Appendix D – DBYD

Dial Before You Dig (DBYD)

Asset Location Response



PO Box 3226 Logan City DC QLD 4114 • 150 Wembley Road, Logan Central
p (07) 3412 3412 • e council@logan.qld.gov.au • www.logan.qld.gov.au • ABN 21-627-796 435



Robin Huang
Level 9,200 Mary Street
Brisbane City QLD 4000
rhuang@northrop.com.au

Logan City Council has been advised that you have placed an enquiry through the Dial Before You Dig service. Our records indicate the enquiry with the following details are affecting Logan City Council asset(s).

Enquiry Details	
Sequence Number	208585576
Enquiry Date	25/02/2022 14:23
Response	AFFECTED
Address	391-397 Park Ridge Road Park Ridge
Location in Road	Road, Footpath, Nature Strip
Activity	Planning and Design

Please review plans attached and contact Logan City Council prior to commencing works:

Logan City Council now provides a limited amount of As-Constructed and Drainage Plans on-line, click on the [Logan City As-Constructed Plans](#) link and type in the property address you are seeking.

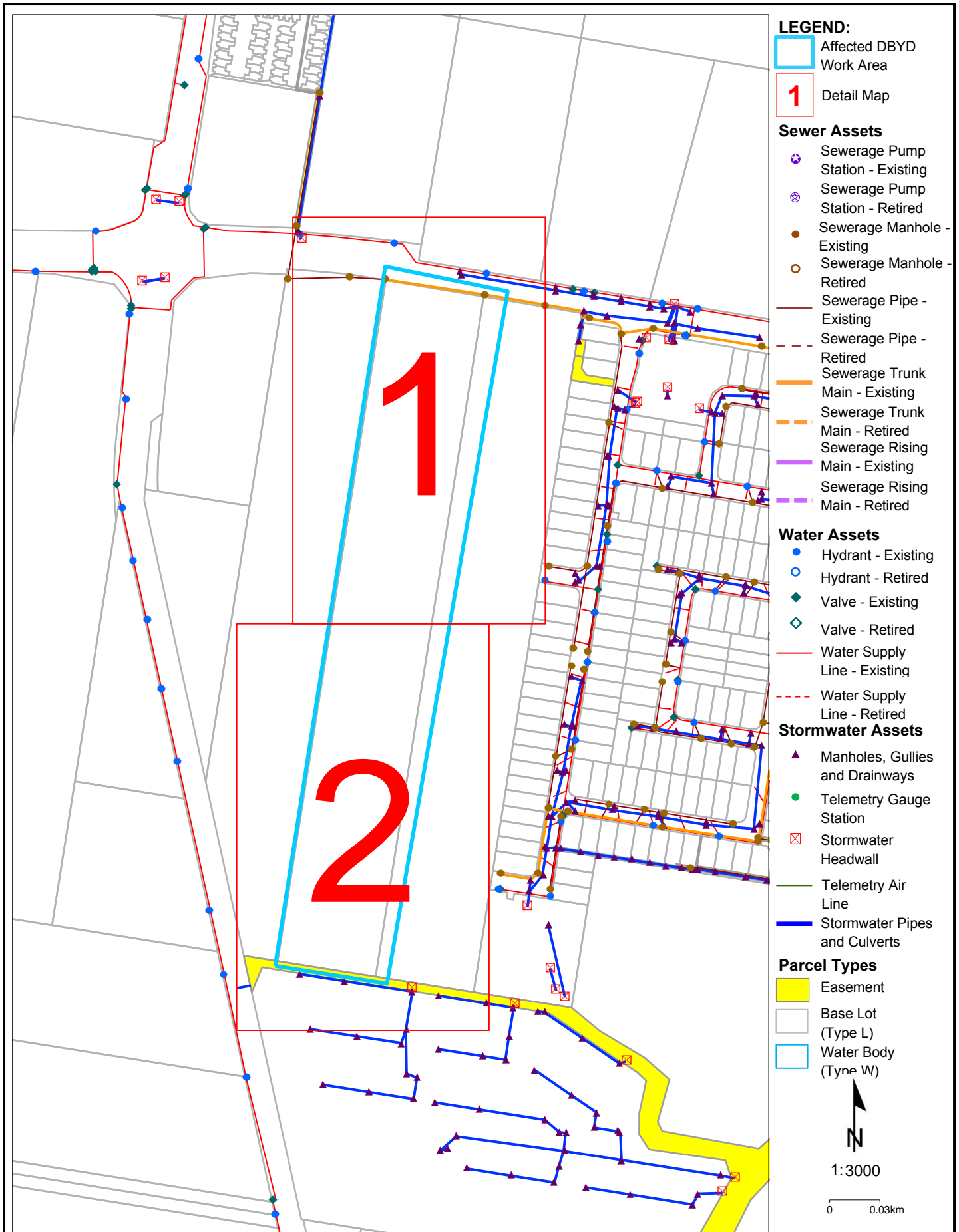
Unfortunately, not all properties will have plan records accessible on-line. The following options are available to customers should a record not be available:

- For **As Constructed Private Sewer/Roofwater (Inside Properties)**
Contact *Development Assessment, Building & Plumbing*
p: (07) 3412 5269
Alternatively visit our Website [Link to the relevant PS1 or PS2 forms:](#)
[Logan City As-Constructed Plans](#)
- For **As Constructed Private Sewer/Water/Stormwater (Outside Properties)**
Contact *Road Infrastructure Planning*
p: (07) 3412 5282
Alternatively visit our Website [Link for PS3 forms:](#)
[Logan City As-Constructed Plans](#)

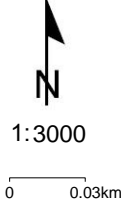
If you need more assistance please call us on 07 3412 3412 or email us at council@logan.qld.gov.au.

Disclaimer: This document is confidential to the addressee and may also be privileged, and neither confidentiality nor privilege is waived, lost or destroyed by virtue of it being transmitted to an incorrect addressee. Unauthorised use of the contents is therefore strictly prohibited. Any information contained in this document that has been extracted from Council's records is believed to be accurate, but no responsibility is assumed for any error or omission. Council will only accept responsibility for information contained under official letterhead and duly signed by, or on behalf of, Chief Executive Officer.

Logan City Council's infrastructure dates back over many years and may include manufactured materials containing asbestos. You are solely responsible for ensuring that appropriate care is taken at all times and that you comply with all mandatory requirements relating to such matters, including but not limited to "workplace health and safety".

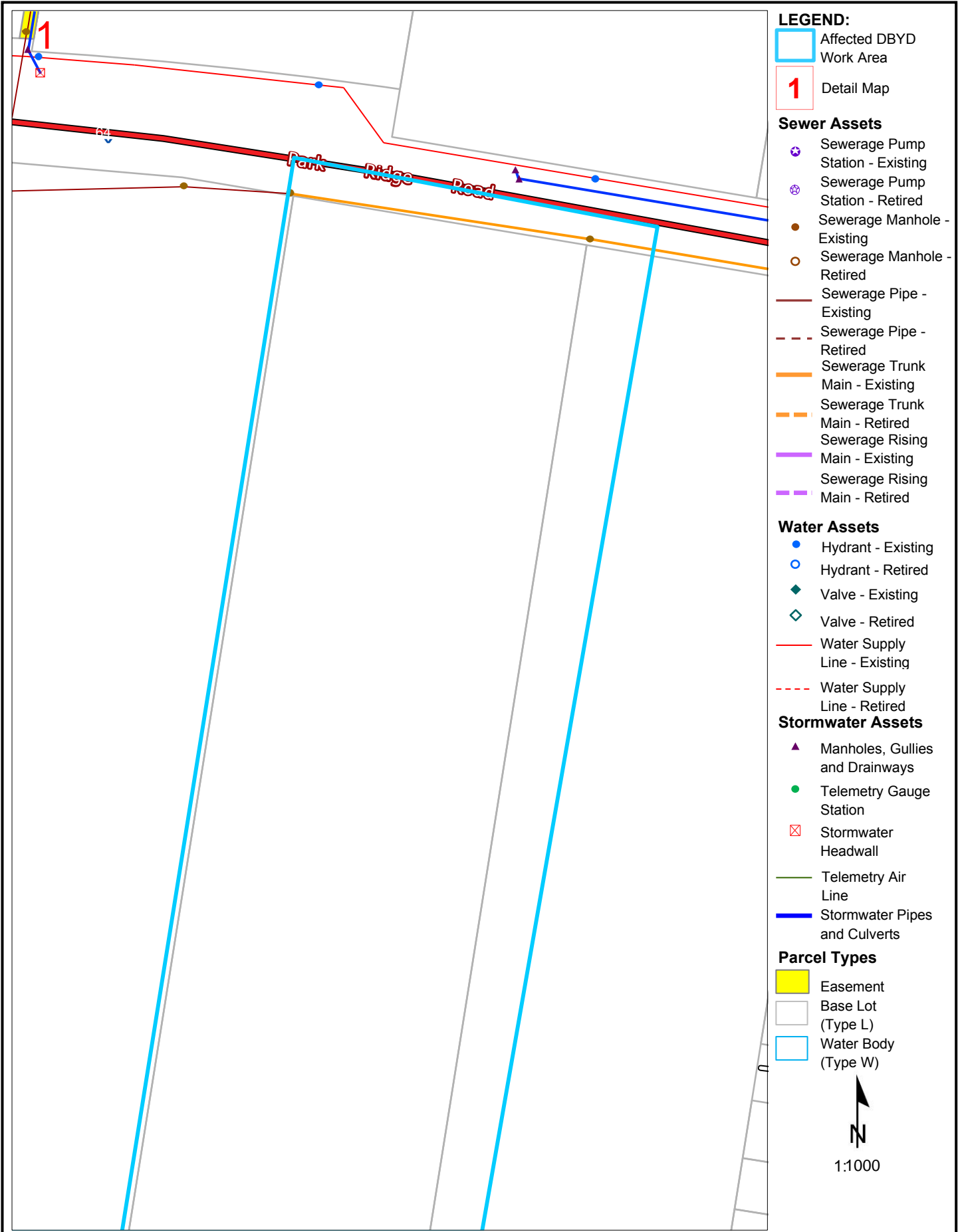


- LEGEND:**
- Affected DBYD Work Area
 - 1 Detail Map
- Sewer Assets**
- ✱ Sewerage Pump Station - Existing
 - ✱ Sewerage Pump Station - Retired
 - Sewerage Manhole - Existing
 - Sewerage Manhole - Retired
 - Sewerage Pipe - Existing
 - - - Sewerage Pipe - Retired
 - Sewerage Trunk Main - Existing
 - - - Sewerage Trunk Main - Retired
 - Sewerage Rising Main - Existing
 - - - Sewerage Rising Main - Retired
- Water Assets**
- Hydrant - Existing
 - Hydrant - Retired
 - ◆ Valve - Existing
 - ◇ Valve - Retired
 - Water Supply Line - Existing
 - - - Water Supply Line - Retired
- Stormwater Assets**
- ▲ Manholes, Gullies and Drainways
 - Telemetry Gauge Station
 - ⊠ Stormwater Headwall
 - Telemetry Air Line
 - Stormwater Pipes and Culverts
- Parcel Types**
- Easement
 - Base Lot (Type L)
 - Water Body (Type W)




Disclaimer: The plans are indicative only and while all reasonable care has been taken in producing this information, Logan City Council does not warrant the accuracy, completeness or currency of this information and accepts no responsibility for, or in connection with any loss or damage suffered as a result of any inaccuracies, errors or omissions or your reliance on this information. Base material reproduced with permission of the Director-General, Department of Natural Resources and Mines. The State of Queensland (Department of Natural Resources and Mines).

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LEGEND:







 Affected DBYD Work Area

 Detail Map






Sewer Assets

-  Sewerage Pump Station - Existing
-  Sewerage Pump Station - Retired
-  Sewerage Manhole - Existing
-  Sewerage Manhole - Retired
-  Sewerage Pipe - Existing
-  Sewerage Pipe - Retired
-  Sewerage Trunk Main - Existing
-  Sewerage Trunk Main - Retired
-  Sewerage Rising Main - Existing
-  Sewerage Rising Main - Retired




Water Assets

-  Hydrant - Existing
-  Hydrant - Retired
-  Valve - Existing
-  Valve - Retired
-  Water Supply Line - Existing
-  Water Supply Line - Retired

Stormwater Assets

-  Manholes, Gullies and Drainways
-  Telemetry Gauge Station
-  Stormwater Headwall
-  Telemetry Air Line
-  Stormwater Pipes and Culverts

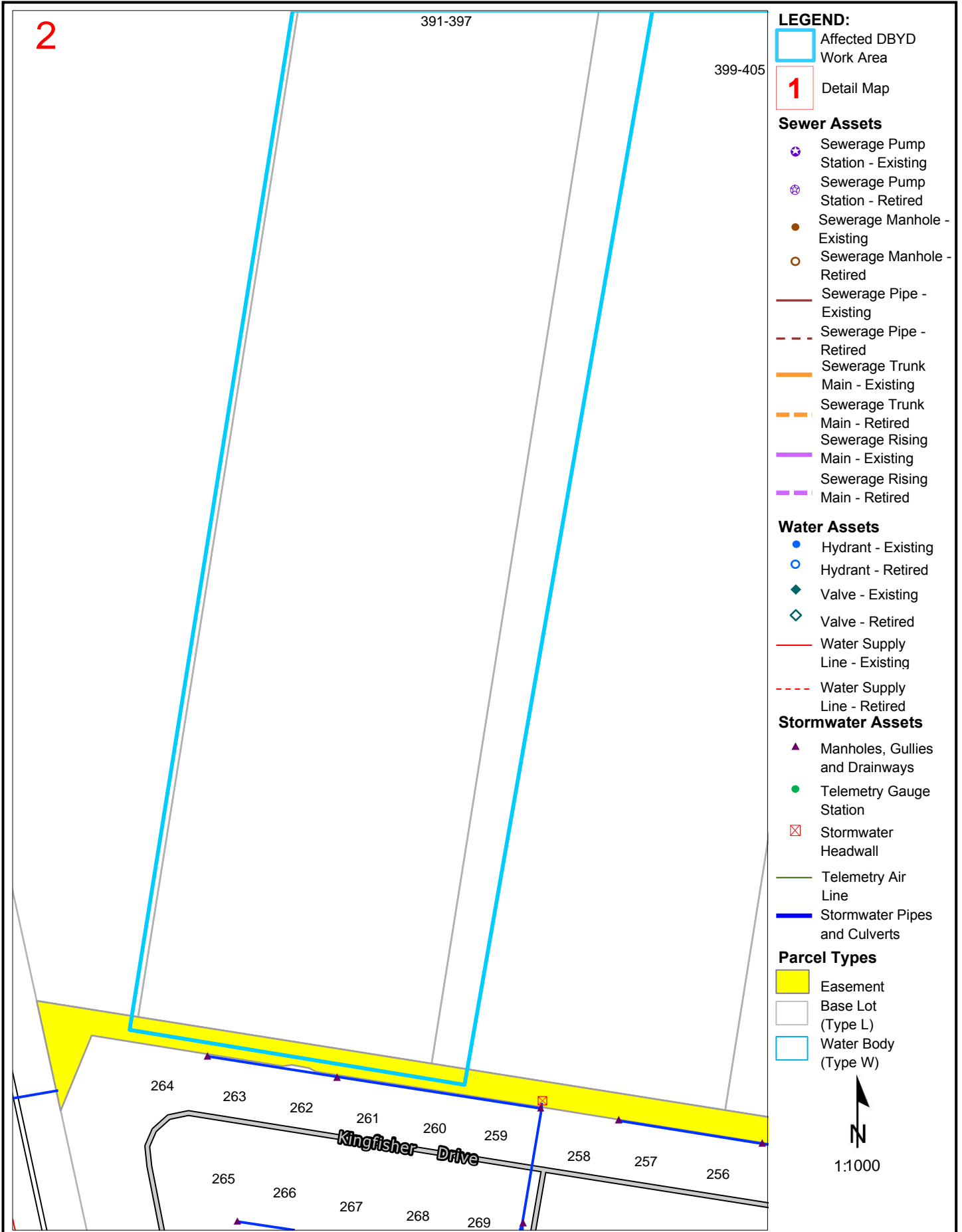
Parcel Types

-  Easement
-  Base Lot (Type L)
-  Water Body (Type W)



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LEGEND:

Affected DBYD Work Area

Detail Map

Sewer Assets

- Sewerage Pump Station - Existing
- Sewerage Pump Station - Retired
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- Sewerage Manhole - Retired
- Sewerage Pipe - Existing
- Sewerage Pipe - Retired
- Sewerage Trunk Main - Existing
- Sewerage Trunk Main - Retired
- Sewerage Rising Main - Existing
- Sewerage Rising Main - Retired

Water Assets

- Hydrant - Existing
- Hydrant - Retired
- Valve - Existing
- Valve - Retired
- Water Supply Line - Existing
- Water Supply Line - Retired

Stormwater Assets

- Manholes, Gullies and Drainways
- Telemetry Gauge Station
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For Emergency Situations
please call 13 19 62



DBYD

Sequence: 208585577

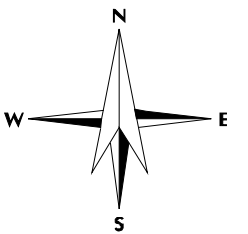
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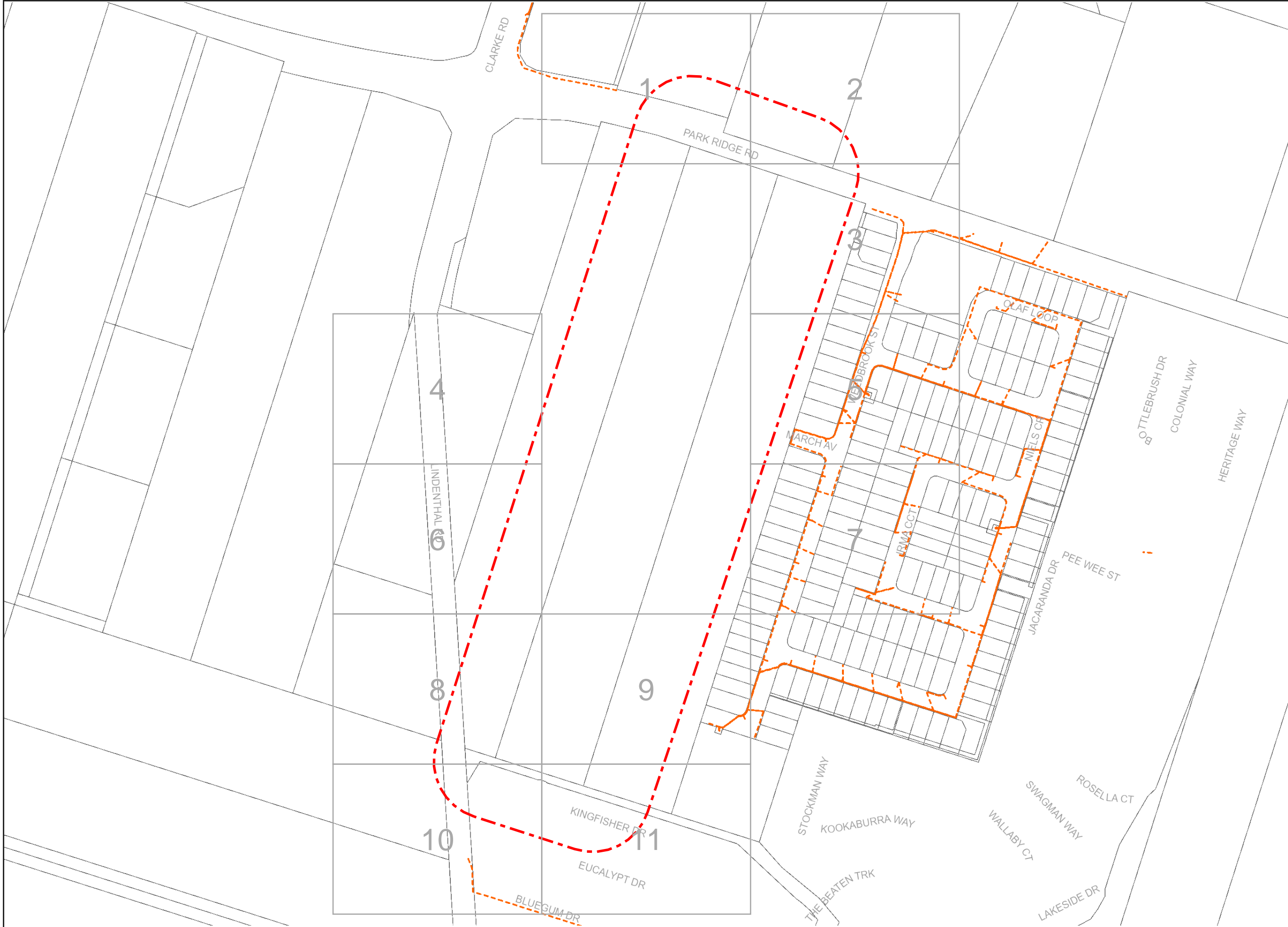
OVERVIEW

For a full list of Map Symbols, please refer to the supplied DBYD Symbology Legend page

AS5488 Category "D" Plan



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This output provides details of the ENERGEX electrical network. As variations map exist no responsibility is incurred by ENERGEX for the accuracy or completeness of the information provided. Exact positions of cables and electrical connectivity should be confirmed on site.



DBYD

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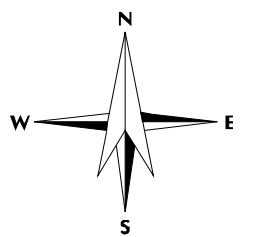
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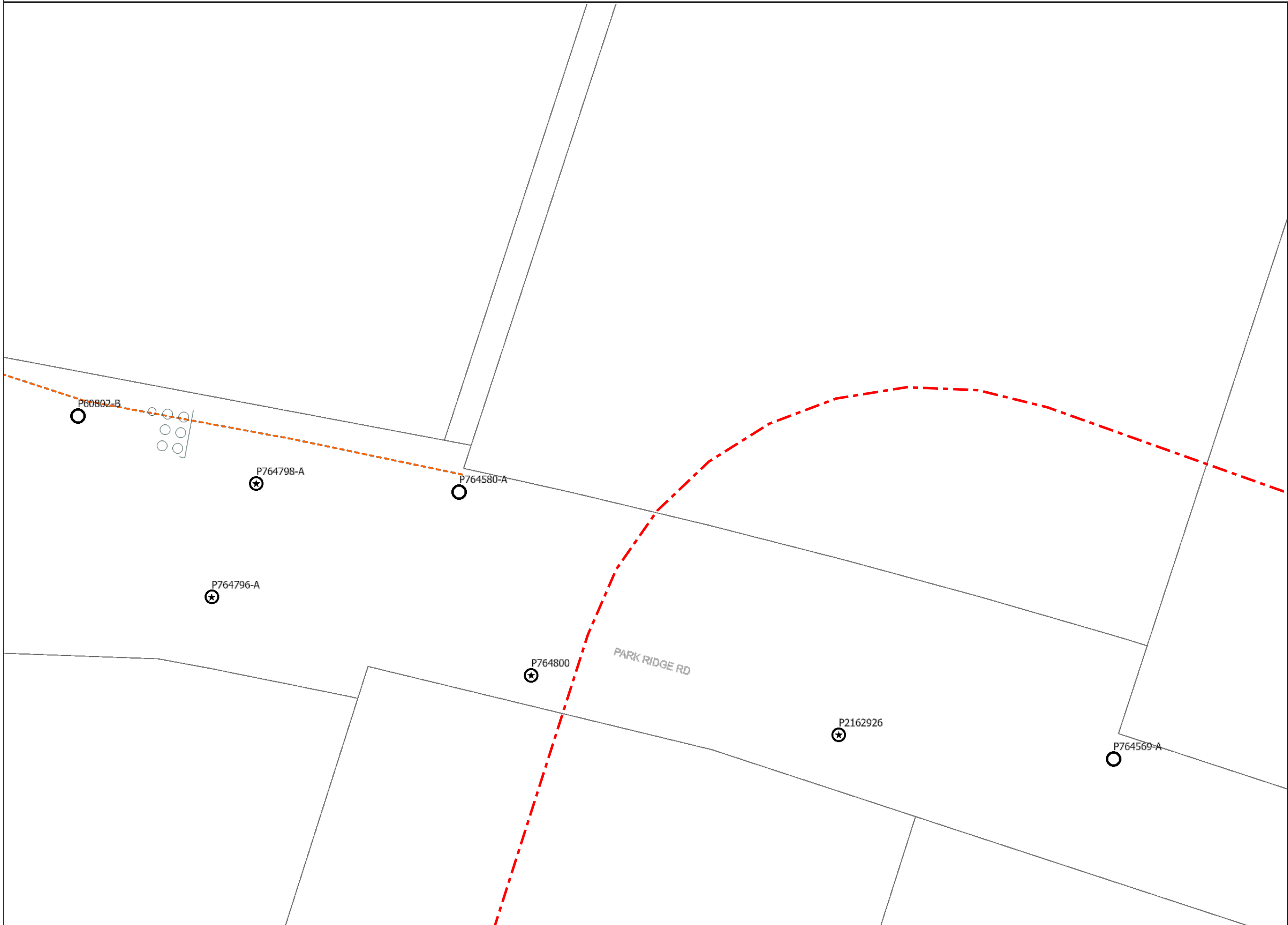
For a full list of Map
Symbols, please
refer to the supplied
DBYD Symbology
Legend page

AS5488 Category "D" Plan



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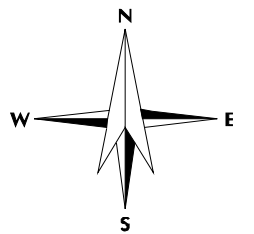
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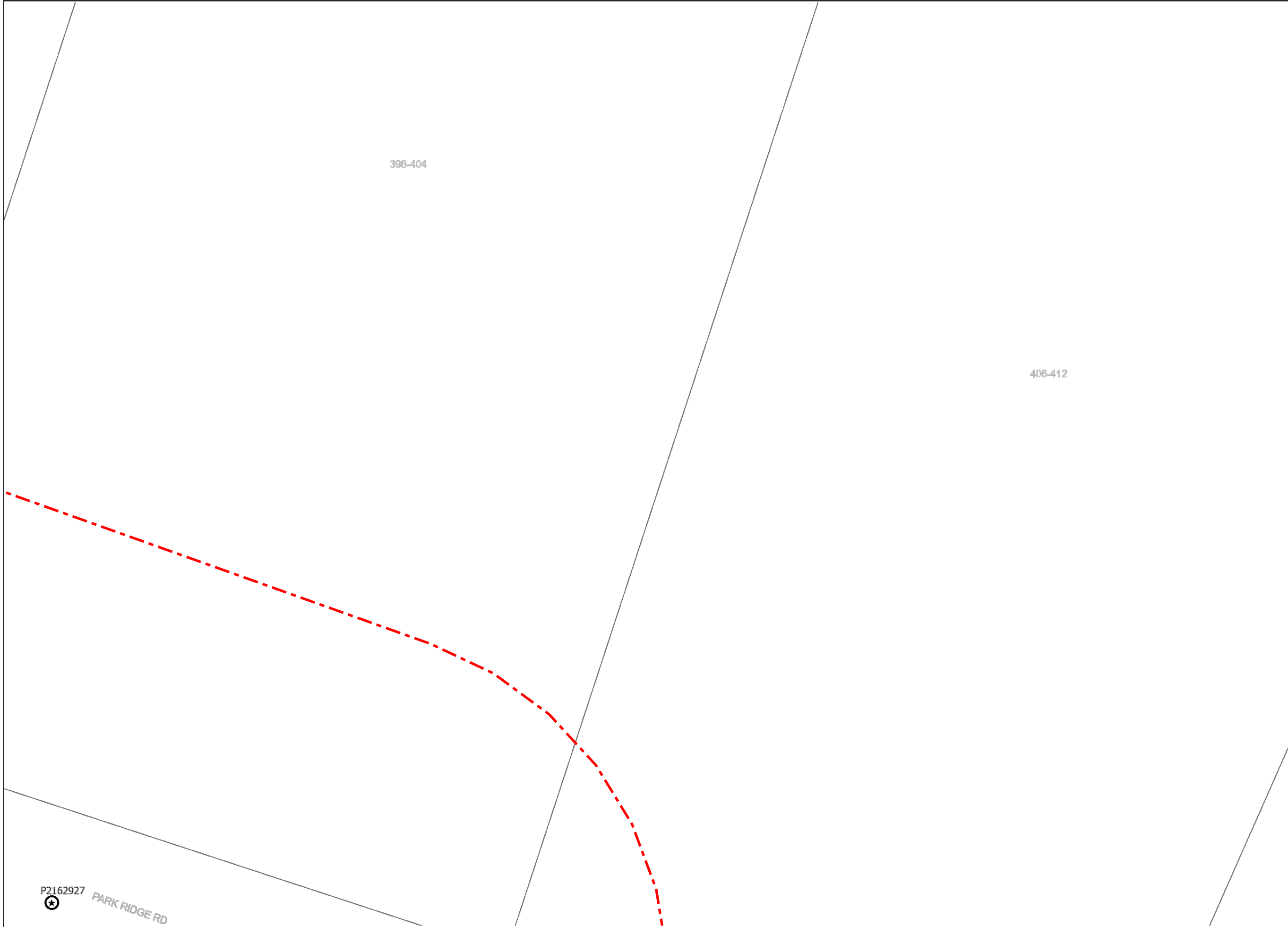
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AS5488 Category "D" Plan



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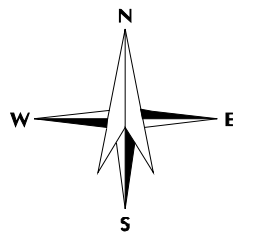


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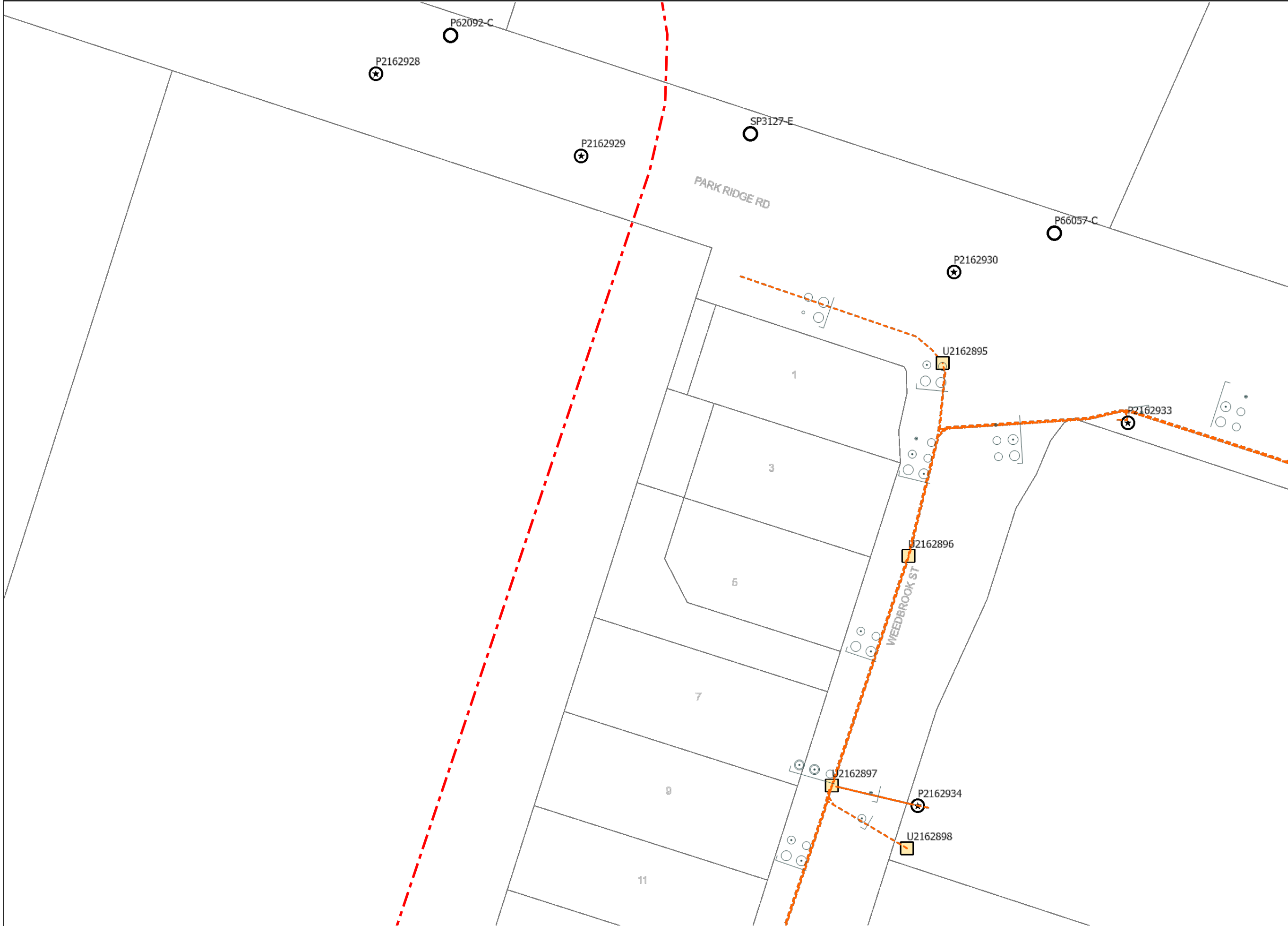
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Scale: 1:500
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For a full list of Map Symbols, please refer to the supplied DBYD Symbolology Legend page

AS5488 Category "D" Plan



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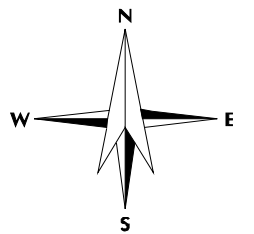


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Date: 25/02/2022
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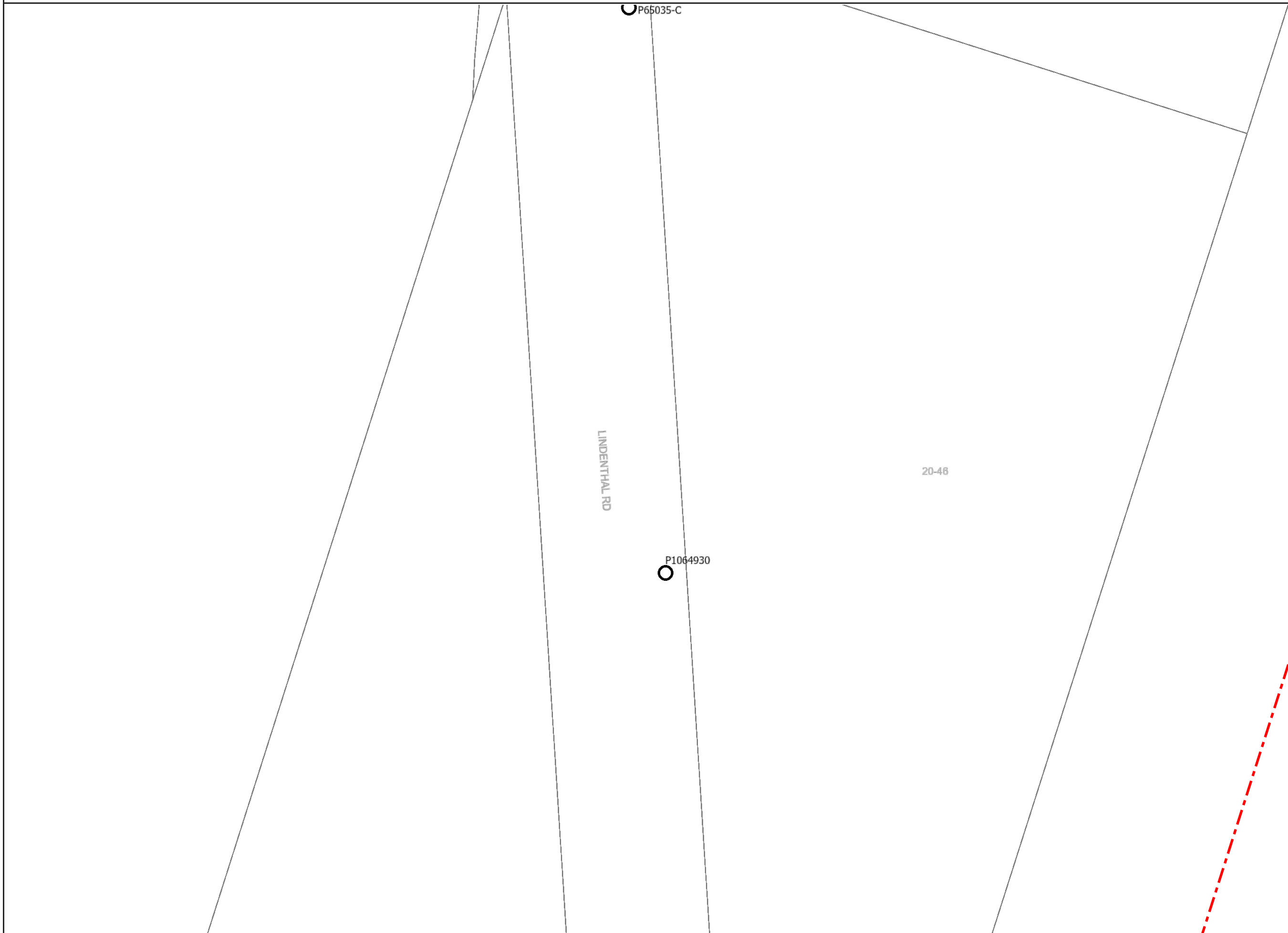
For a full list of Map Symbols, please refer to the supplied DBYD Symbolology Legend page

AS5488 Category "D" Plan



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DBYD

Sequence: 208585577

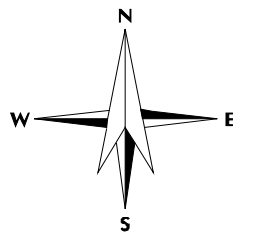
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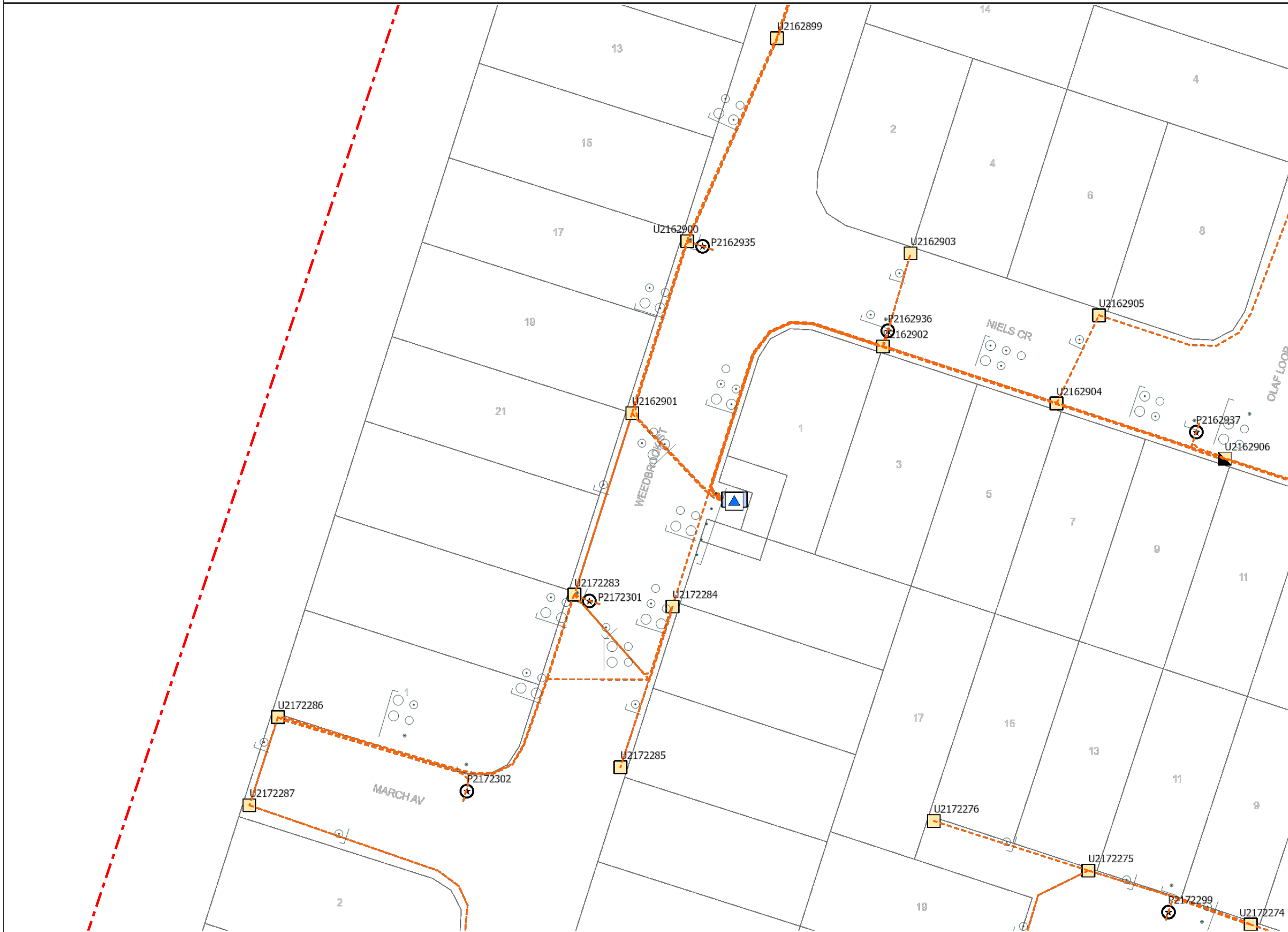
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For a full list of Map Symbols, please refer to the supplied DBYD Symbolology Legend page

AS5488 Category "D" Plan



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DBYD

Sequence: 208585577

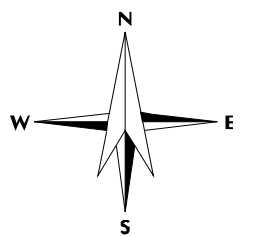
Date: 25/02/2022

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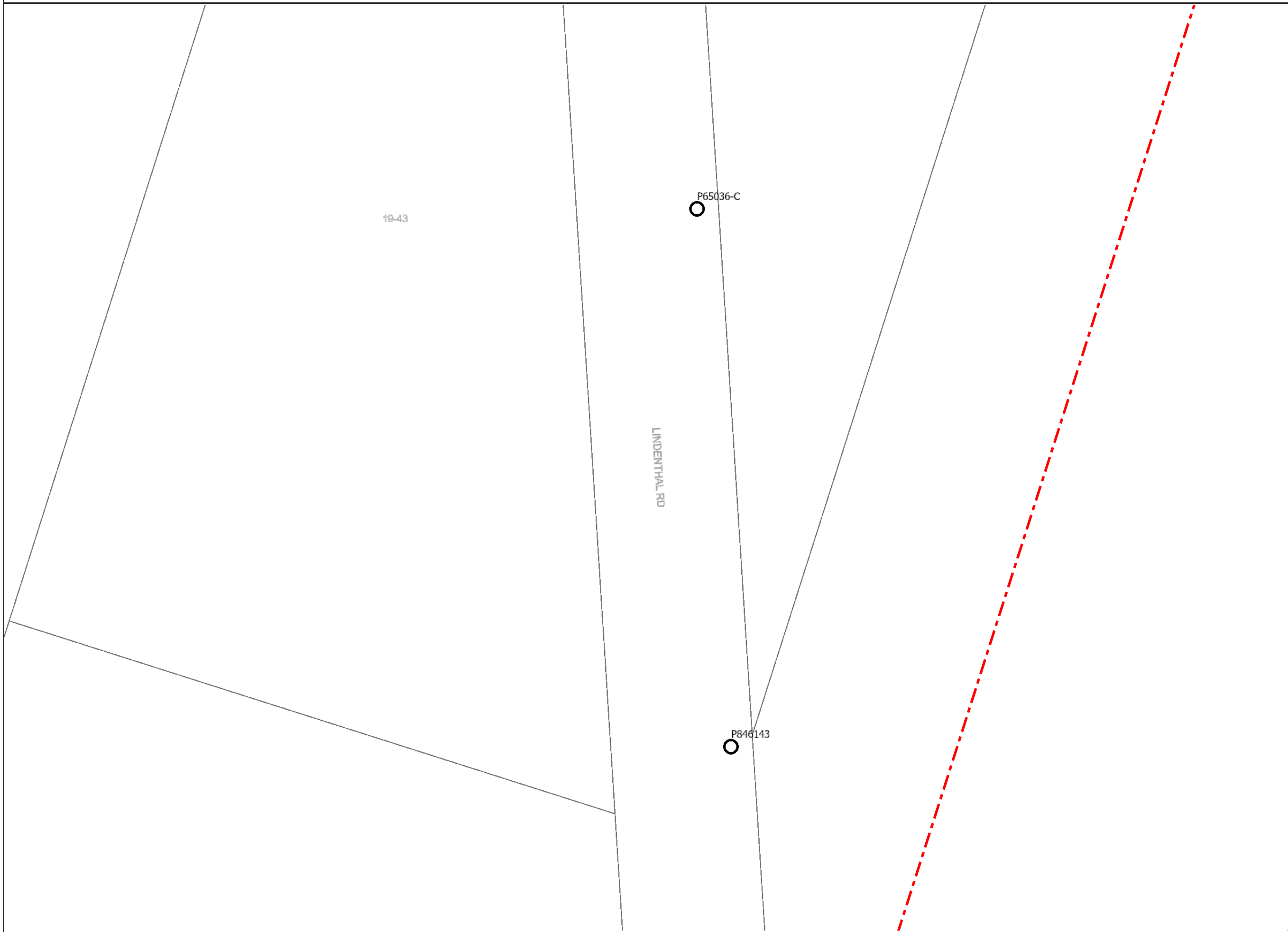
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For a full list of Map Symbols, please refer to the supplied DBYD Symbolology Legend page

AS5488 Category "D" Plan



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This output provides details of the ENERGEX electrical network. As variations map exist no responsibility is incurred by ENERGEX for the accuracy or completeness of the information provided. Exact positions of cables and electrical connectivity should be confirmed on site.

All underground cables shall be treated as being energised. Where a cable is located that is not represented on the ENERGEX DBYD map, then ENERGEX shall be contacted immediately.

For Emergency Situations please call 13 19 62

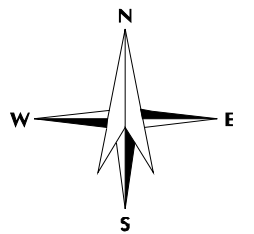


DBYD

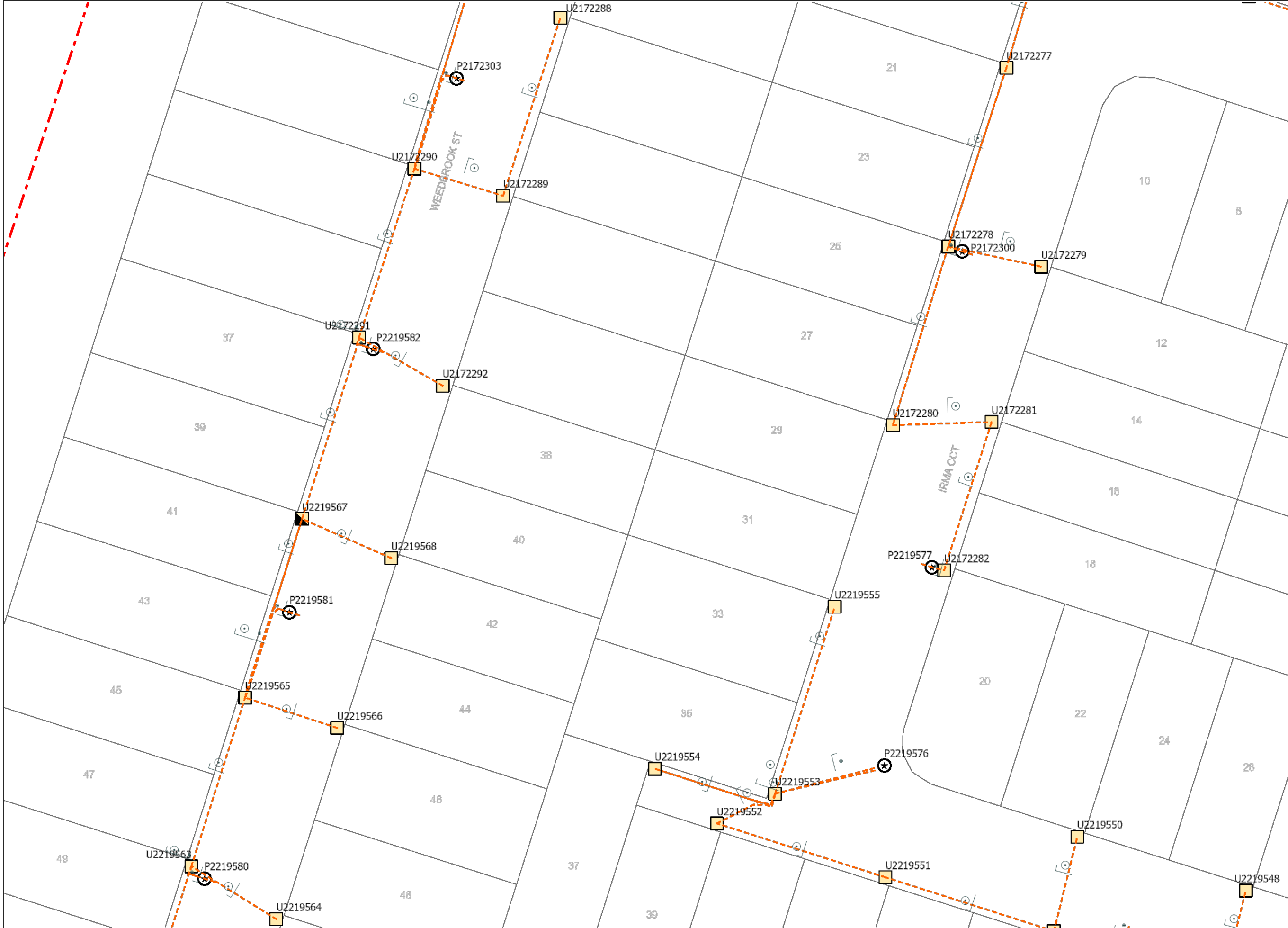
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Date: 25/02/2022
Scale: 1:500
Tile No: 7

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DBYD

Sequence: 208585577

Date: 25/02/2022

Scale: 1:500

Tile No: 8

All underground cables shall be treated as being energised. Where a cable is located that is not represented on the ENERGEX DBYD map, then ENERGEX shall be contacted immediately.

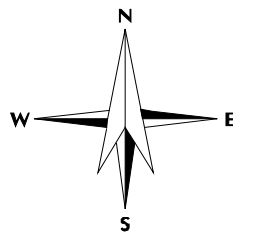
45-57

LINDENTHAL RD

P65037-C

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AS5488 Category "D" Plan



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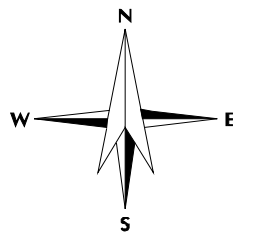


DBYD

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Date: 25/02/2022
Scale: 1:500
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For a full list of Map Symbols, please refer to the supplied DBYD Symbolology Legend page

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For Emergency Situations
please call 13 19 62



DBYD

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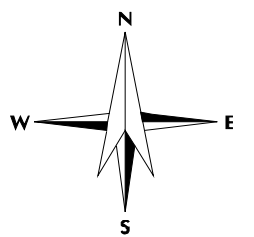
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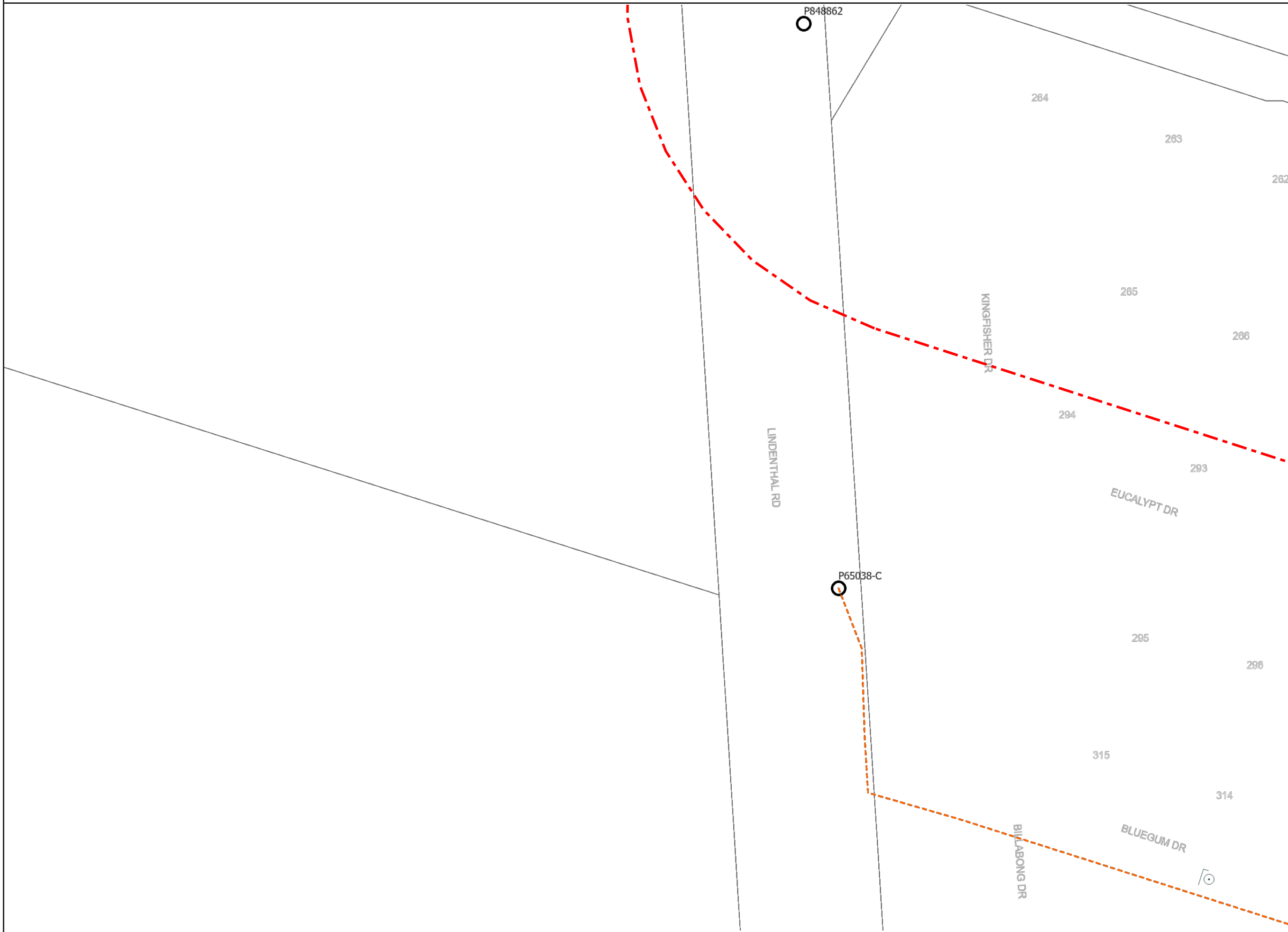
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For Emergency Situations
please call 13 19 62



DBYD

Sequence: 208585577

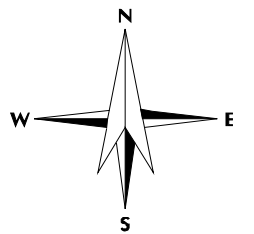
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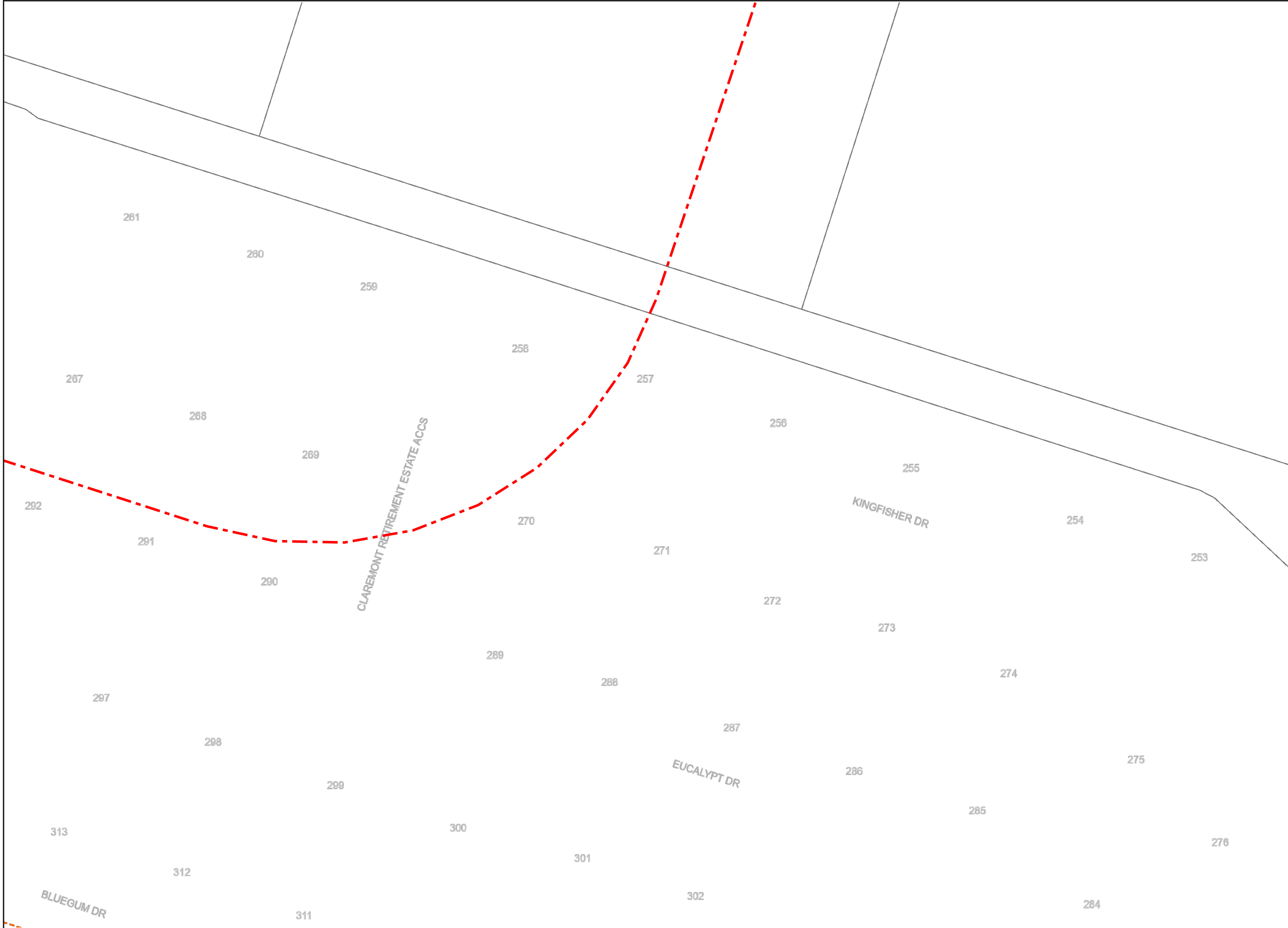
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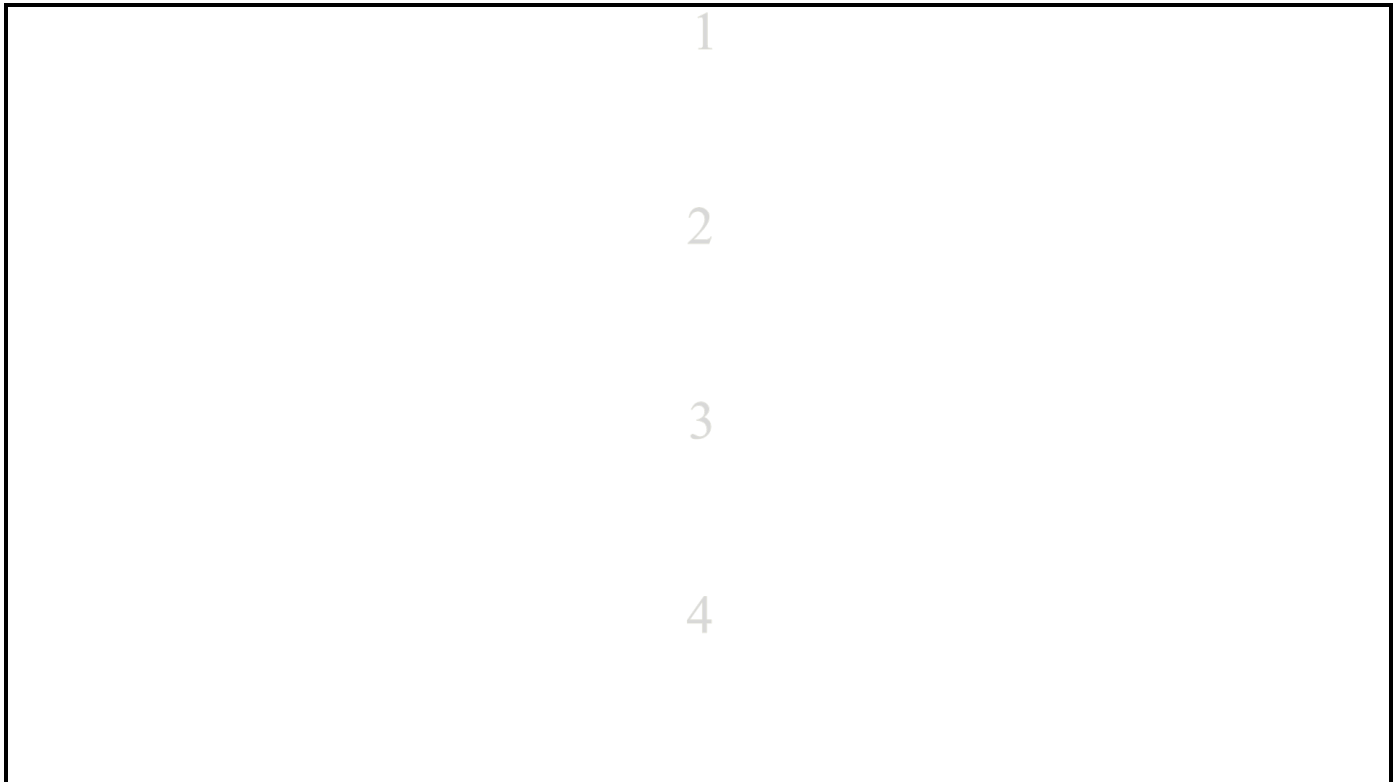


This output provides details of the ENERGEX electrical network. As variations map exist no responsibility is incurred by ENERGEX for the accuracy or completeness of the information provided. Exact positions of cables and electrical connectivity should be confirmed on site.

To: Robin Huang
Phone: Not Supplied
Fax: Not Supplied
Email: rhuang@northrop.com.au

Dial before you dig Job #:	31471102	
Sequence #	208585578	
Issue Date:	25/02/2022	
Location:	391-397 Park Ridge Road , Park Ridge , QLD , 4125	

Indicative Plans

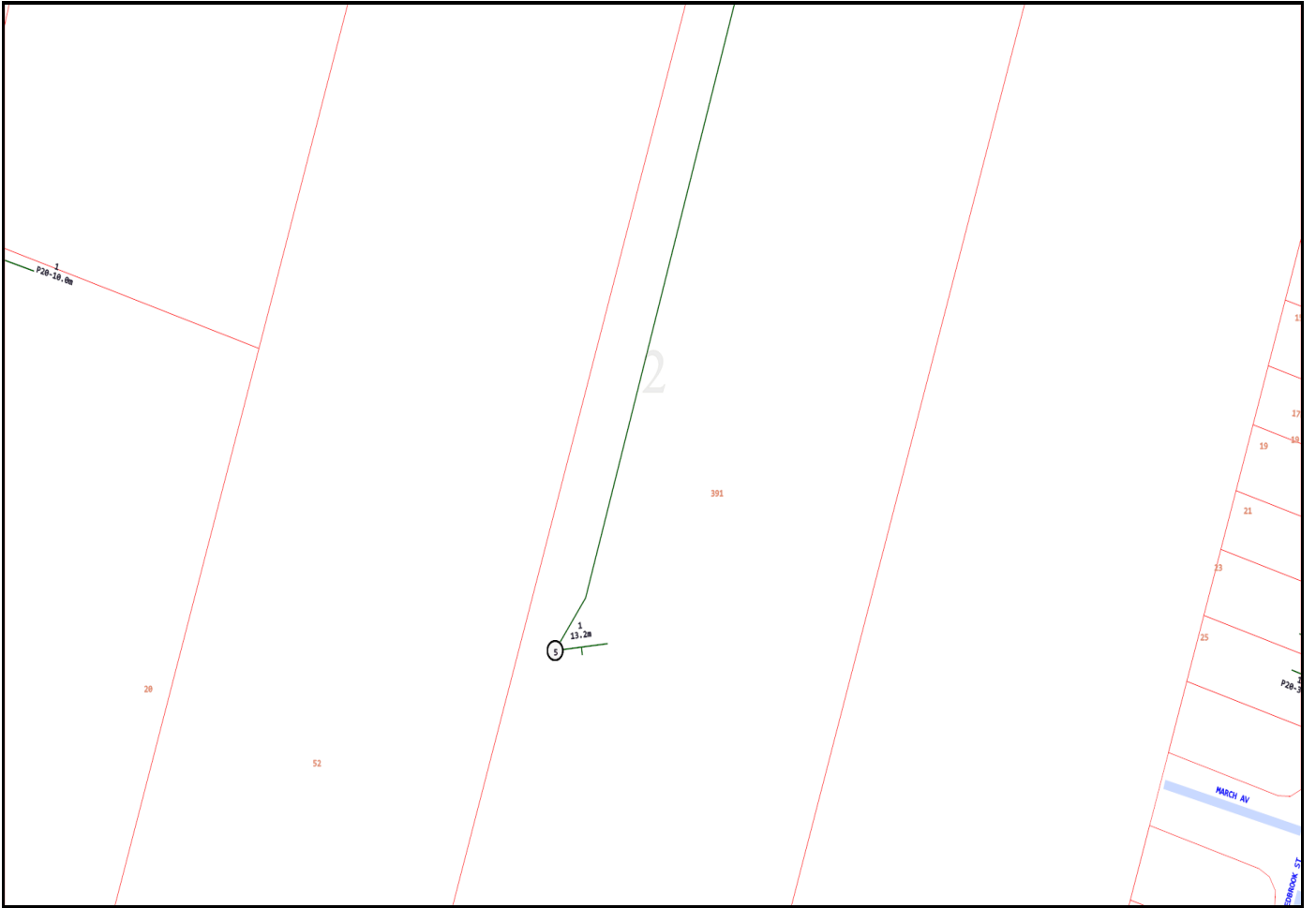


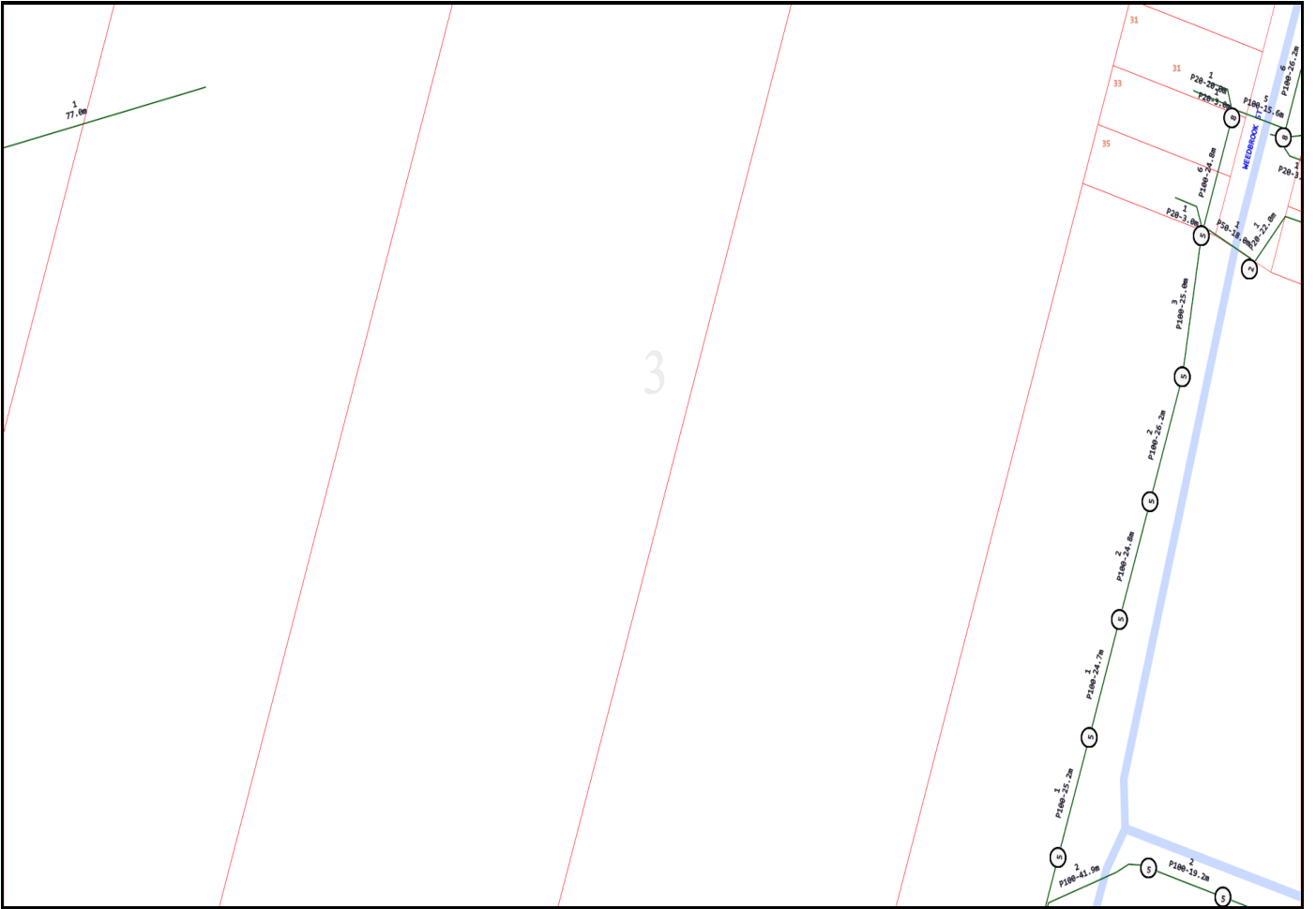


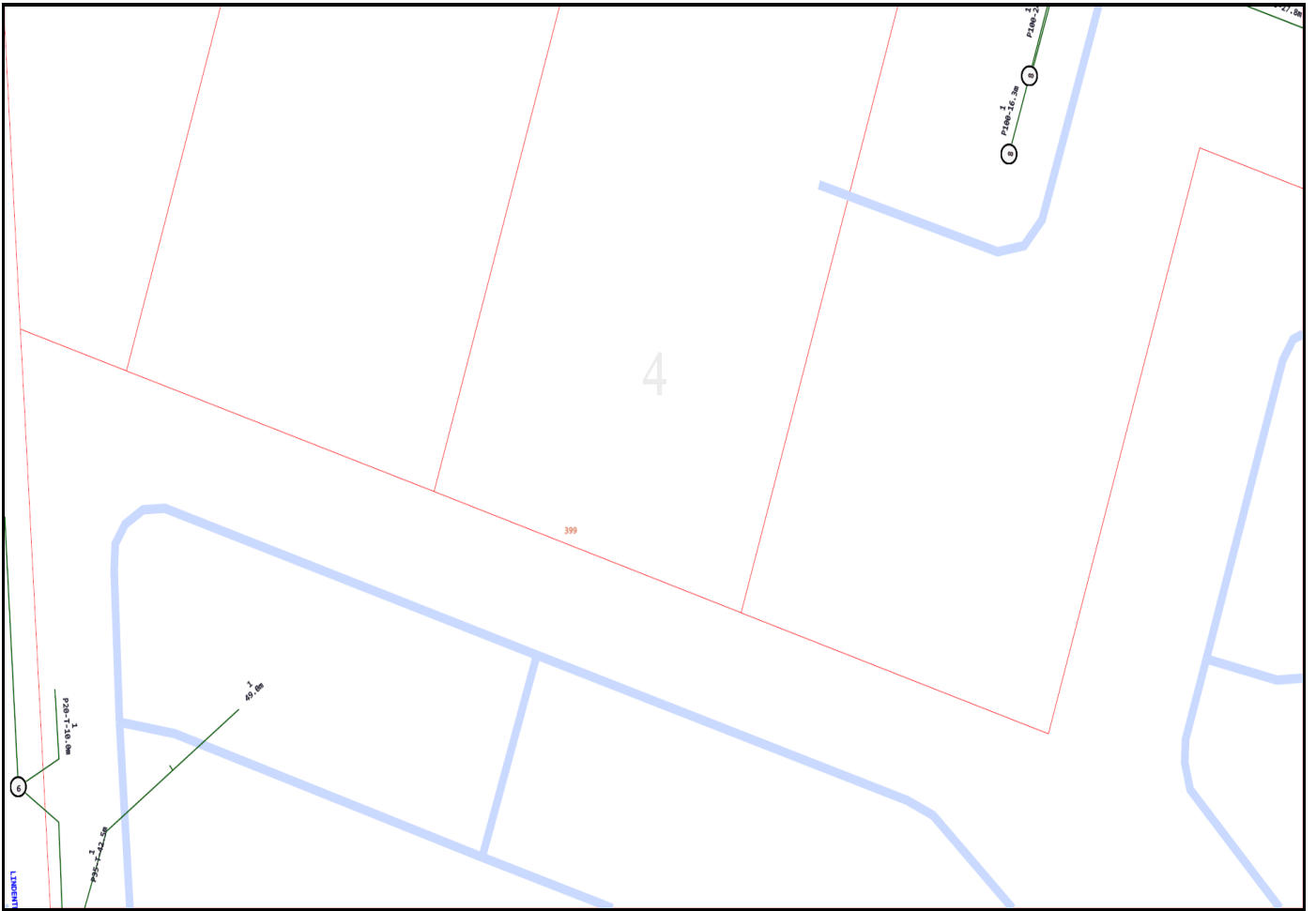
LEGEND



	Parcel and the location
	Pit with size "5"
	Power Pit with size "2E". Valid PIT Size: e.g. 2E, 5E, 6E, 8E, 9E, E, null.
	Manhole
	Pillar
	Cable count of trench is 2. One "Other size" PVC conduit (PO) owned by Telstra (-T-), between pits of sizes, "5" and "9" are 25.0m apart. One 40mm PVC conduit (P40) owned by NBN, between pits of sizes, "5" and "9" are 20.0m apart.
	2 Direct buried cables between pits of sizes, "5" and "9" are 10.0m apart.
	Trench containing any INSERVICE/CONSTRUCTED (Copper/RF/Fibre) cables.
	Trench containing only DESIGNED/PLANNED (Copper/RF/Fibre/Power) cables.
	Trench containing any INSERVICE/CONSTRUCTED (Power) cables.
	Road and the street name "Broadway ST"
Scale	0 20 40 60 Meters 1:2000 1 cm equals 20 m







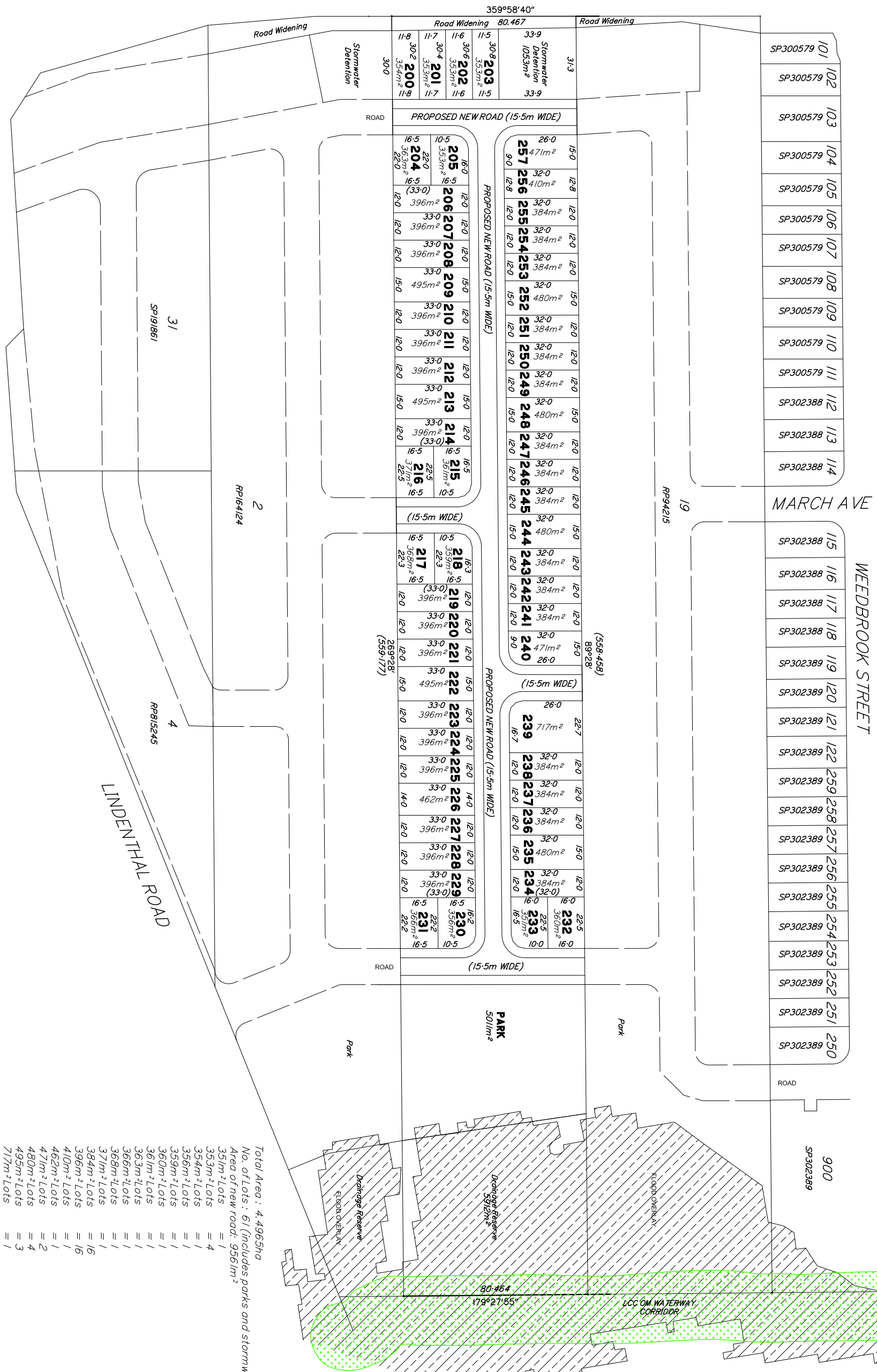
Emergency Contacts

You must immediately report any damage to the **nbn**TM network that you are/become aware of. Notification may be by telephone - 1800 626 329.

Appendix E – Subdivision Plan Of Development



PARK RIDGE ROAD



PROPOSAL PLAN


PROPOSED LOTS 200-259

CANCELLING LOT 20 ON RP94215
#391-397 PARK RIDGE ROAD, PARK RIDGE

SP300579	101
SP300579	102
SP300579	103
SP300579	104
SP300579	105
SP300579	106
SP300579	107
SP300579	108
SP300579	109
SP300579	110
SP300579	111
SP302388	112
SP302388	113
SP302388	114
SP302388	115
SP302388	116
SP302388	117
SP302388	118
SP302389	119
SP302389	120
SP302389	121
SP302389	122
SP302389	259
SP302389	258
SP302389	257
SP302389	256
SP302389	255
SP302389	254
SP302389	253
SP302389	252
SP302389	251
SP302389	250

Total Area : 4.4965ha
No. of Lots : 61 (includes parks and stormwater detention)
Area of new road: 956lm²

33lm ² Lots	= 1
353m ² Lots	= 4
354m ² Lots	= 1
356m ² Lots	= 1
359m ² Lots	= 1
360m ² Lots	= 1
361m ² Lots	= 1
363m ² Lots	= 1
366m ² Lots	= 1
368m ² Lots	= 1
371m ² Lots	= 1
384m ² Lots	= 16
396m ² Lots	= 16
410m ² Lots	= 1
462m ² Lots	= 1
471m ² Lots	= 2
480m ² Lots	= 4
495m ² Lots	= 3
717m ² Lots	= 1



STEVE COOPER & ASSOCIATES PTY LTD
ABN 67 010 839 022
LICENSED LAND SURVEYORS,
LAND PLANNING CONSULTANTS,
PH: 3846 6477
27 NORFOLK ROAD, SOUTH BRISBANE 4101
EMAIL: admin@stevecooper.com.au

SITE:
#391-397 PARK RIDGE ROAD
PARK RIDGE
LOT 20 ON RP94215

LOCAL AUTH: LOGAN C.C.
4.496ha
UBD REF: 100 P1

SUBDIVISION PROPOSAL PLAN

DATE: 14/02/2023 SURVEYOR: JP
DRAWN BY: GBF
CCAD: 21-2306proposal.mxd CHECKED:
SCALE: 1:1250 - 01ig A2
JOB NO: 21-2306p3

This design is preliminary only and is subject to review to accommodate Local Authority, Engineering and Marketing requirements. Areas and distances are approximate only and subject to survey.

Appendix F – Council Correspondence on Southern Dam

Amelia Tatham

From: Robertson, Scott <ScottRobertson@logan.qld.gov.au>
Sent: Monday, 9 January 2023 4:53 PM
To: Sam Underwood
Subject: COM/57/2022 - 391-397 Park Ridge Road, PARK RIDGE QLD 4125

Follow Up Flag: Follow up
Flag Status: Flagged

Good afternoon Sam,

The following comments have been provided following the meeting held on Monday 19 December.

Regarding parks, any clearing of koala habitat must consider SARA requirements. Increasing the usable area of Park is required.

Regarding Stormwater Management, Council is accepting of an alternative stormwater management solution, as long as this is in accordance with the standards of Planning Scheme Policy 5 – Infrastructure. A solution in combination with the adjoining property is encouraged. The use of the existing dams as a combined stormwater quality/quantity configuration can be accepted if the external flows can be isolated using bypass infrastructure. The design of the water quality concept is to be detailed to allow review of surface elevations, inlet and outlet structures relative to the external flood conditions. I.e. ensure compliance with AO/PO12 & AO/PO13 of the FHO code. One way to demonstrate this is if it can be confirmed that overland flow paths can or can be designed to circumnavigate the dams (future bio and detention) without causing worsening.

Please advise if further information is required.

Thank you for your time Sam. I hope you have a great day and enjoyed your Christmas and New Years break!

Please do not hesitate to contact the undersigned should you have any further queries.

Kind regards,



Scott Robertson
Planning Officer | Development Assessment Branch

ScottRobertson@logan.qld.gov.au | 07 3412 5982 | Teams [Call](#) / [Chat](#)
Connect with us: [Website](#) | [Facebook](#) | [Twitter](#) | [LinkedIn](#)

*Logan City Council acknowledges the Traditional Custodians of the lands and waterways across the City of Logan.
We pay our respects to Elders past, present and emerging.*

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Appendix G – Bio-retention Maintenance Checklist

4.3 Inspection and maintenance checklist for bioretention systems

ASSET TYPE	Bioretention	ASSET ID
Location		
Date		
Date of last rainfall		Weather
Officer's name		

Bioretention plan

Insert diagram or plan of the asset showing key features e.g. locations of inlet, outlet, and overflow

Additional information

Time taken to complete inspection or maintenance

- Photos of site (explanatory notes)
- 1.
 - 2.
 - 3.
 - 4.
 - 5.
 - 6.

General comments and sketches

Officer's signature

What to look for	Performance Indicator (PI)	Condition rating*	Maintenance undertaken**	Additional work needed
SURROUNDS				
Damaged or removed structures e.g. traffic bollards	No damage that poses a risk to public safety or structural integrity			
INLET				
Erosion	Inlet is structurally sound and there is no evidence of erosion or subsidence/settlement			
Damaged or removed structures e.g. pit lids or grates	No damage that poses a risk to public safety or structural integrity			
Sediment, litter, or debris	No blockage			
COARSE SEDIMENT FOREBAY (IF PRESENT)				
Erosion	Minor erosion only that does not pose a risk to public safety or structural integrity and would not worsen if left unattended			
Sediment	Coarse sediment forebay <75% full and no litter			

* 1 – PI met; 2 – PI met after maintenance activity undertaken; 3 – Additional maintenance needed; 4 – Rectification may be needed; NI – not inspected; NA – not applicable

** Quantify where possible e.g. amount of sediment or litter removed

What to look for	Performance Indicator (PI)	Condition rating*	Maintenance undertaken**	Additional work needed
BATTER SLOPES AND BASE INVERT				
Erosion	Minor erosion only that does not pose a risk to public safety or structural integrity and would not worsen if left unattended			
Crust of fine sediment	No surface crusting			
Depressions or mounds	No surface depressions or mounds > 100 mm			
Hydraulic conductivity or permeability	Filter media is draining freely, whereby water is not ponded on the surface for more than 12 hours after rainfall and there is no obvious impermeable or clay-like surface on the filter media**			
Underdrains/clean out points	Clean out points not damaged and end caps securely in place			
Litter	Maximum 1 piece litter per 4 m ²			
Unusual odours, colours, or substances (e.g. oil and grease)	None detected			
Vegetation	Minimum 95% vegetation cover (minimal bare batches)			
	Plants healthy and free from disease			
	Average plant height > 500 mm			

* 1 – PI met; 2–PI met after maintenance activity undertaken; 3 – Additional maintenance needed; 4 – Rectification may be needed; NI – not inspected; NA – not applicable

** Quantify where possible e.g. amount of sediment or litter removed

What to look for	Performance Indicator (PI)	Condition rating*	Maintenance undertaken**	Additional work needed
Algal or moss growth	Maximum 10% of surface covered in algae			
	No moss growth			
OUTLET (OVERFLOW WEIR, PIPE, OR OUTFALL)				
Erosion	Outlet is structurally sound and there is no evidence of erosion or subsidence/settlement, including around edges of rock protection or toe of weir for large systems			
Damaged or removed structures e.g. pit lids or grates	No damage that poses a risk to public safety or structural integrity			
Sediment, litter or debris	No blockage			
Outlet freely draining to receiving drainage or waterway	No downstream impediments to the release of water, no erosion or damage to the outfall structure, and no evidence of malfunction (e.g. excessive sediment accumulated)			

* 1 – PI met; 2 – PI met after maintenance activity undertaken; 3 – Additional maintenance needed; 4 – Rectification may be needed; NI – not inspected; NA – not applicable

** Quantify where possible e.g. amount of sediment or litter removed

*** Presence of *Typha* is an indicator of poorly draining filter media

Appendix H – Bio-retention Construction Sequence

FORM F — Protective Measures

Purpose: To ensure protective measures are correctly installed to protect the bioretention system while building is occurring in the catchment.

Protection option adopted (Option 1, 2 or 3)				
Option 1 — Surface protection during building phase	Checked	Satisfactory	Action (if unsatisfactory)	Initial
Continuous sediment fences installed around perimeter of filter media and top of batter.				
Where landscape works are not to commence immediately then cover batters with filter cloth.				
Protective covering (filter cloth + 25 mm topsoil + turf) installed across entire filter media area of system.				
Option 2 — Bypass and early establishment	Checked	Satisfactory	Action (if unsatisfactory)	Initial
Continuous sediment fences installed around perimeter of filter media and top of batter.				
Where landscape works are not to commence immediately then cover batters with filter cloth.				
Temporary bund installed (where required) to prevent stormwater runoff from entering bulk of system. Bund keyed into batters of bioretention and crest level higher than pits and weirs.				
Temporary protective covering (filter cloth + 25 mm topsoil + turf) installed within banded area.				
Option 3 – Sediment Basin and Bioretention Function	Checked	Satisfactory	Action (if unsatisfactory)	Initial
Continuous sediment fences installed around perimeter of filter media and top of batter.				
Sediment basin installed upstream of bioretention in accordance with either (hydraulic structure): <ul style="list-style-type: none"> • WSUD Technical Design Guidelines for SEQ (SEQHWP, 2006) • Local erosion and sediment control guidelines or Best Practice Erosion and Sediment Control (IECA, 2008). 				
Suitable access provided to sediment basin for clean out.				
Bioretention system installed downstream of sediment basin.				
Protective covering (filter cloth, 25mm top soil and turf) installed across entire filter media area of basin.				

HOLD POINT: Superintendent and bioretention designer inspection and sign-off before proceeding.

Comments (attach and refer to additional pages if necessary)

NB: Photos attached.

Signed by superintendent: _____

Print name: _____

Date: _____

AND

Signed by bioretention designer: _____

Print name: _____

Date: _____

3.9 Step-by-step sequence — Options 1, 2 and 3




The following sections provide a step-by-step sequence for civil construction, building phase protection and landscape establishment for the Staged Construction and Establishment Options 1, 2 and 3. Detailed descriptions and, where available, photos are provided for each step in tabular format. It is envisaged the tables will be laminated and used as an on-site reference during construction and establishment.

3.9.1 Stage 1 – Civil construction

The recommended civil construction sequence for bioretention systems is summarised in Table 3.7. The construction sequence should be read in combination with the Bioretention Construction and Establishment Sign-Off Forms.

Table 3.7: Civil construction (Stage 1) step-by-step sequence — Options 1, 2 and 3


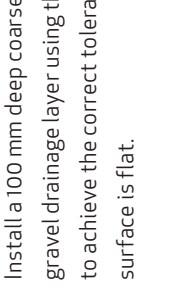

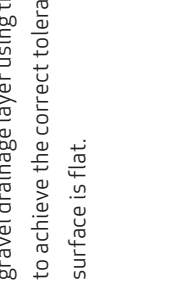

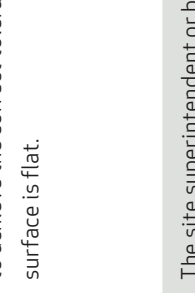

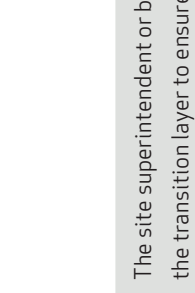
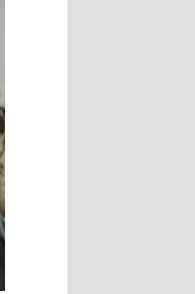
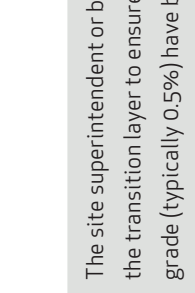
CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 1: Pre-start meeting	<p>Hold a pre-start meeting with the bioretention designer, civil engineer, landscape architect, site superintendent, civil contractor, landscape contractor and, where required, the Council compliance officer to:</p> <ul style="list-style-type: none"> - explain the function of the bioretention system - highlight issues and risks associated with construction and establishment - talk through a preferred construction and establishment approach for the site - explain the as-constructed survey or drawing, inspection and sign-off requirements - confirm sources of bioretention media and certification requirements. 		
STEP 2: Preparation	<p>Prepare for construction at least 10 days before starting on site. Preparation includes organising the correct equipment to achieve required tolerances (Section 3.4.2), sourcing the bioretention media, ensuring the supplier of the filter media is completing the correct testing (Section 3.5), ordering materials and identifying construction timing and rain contingency plans (Section 3.3).</p>		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 3: Install overflow pit and outlet pipe	<p>Install the overflow pit and ensure the crest of the pit is at design level. The crest of the pit can be used as a datum from which other levels within the system are measured. The pit requires holes for under-drainage pipe connections. These holes should be drilled at this stage or plastic stubs should be installed at the time of casting the pit.</p> <p>Construct outflow headwalls and install sections of stormwater outlet pipe. If the outlet pipe is below the receiving environment levels (Section 3.3.4) consult the superintendent and designers to resolve a change in the design.</p> <p>Design levels and tolerances (+25 mm) must be achieved (Section 3.4.2).</p>		
STEP 4: Bulking out	<p>Undertake bulk earthworks, including construction of bunds surrounding system. The bunds and batters surrounding the system should have 200 mm of topsoil applied following earthworks. Design levels for the top of the bund are inclusive of this 200 mm layer of topsoil, so that bulk earthworks should leave the top of bund 200 mm below the design level.</p> <p>Excavate the surrounding landform to design subsoil levels. This will reduce the need for earthworks adjacent to the systems after they have been constructed. If adopting Construction and Establishment Method Option 3, the upstream sediment basin should be constructed and commissioned prior to bulking out the bioretention system.</p>		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 5: Trimming and profiling	<p>Undertake detailed excavation, trimming and profiling of bunds, embankments, batters, sides and base of system, ensuring the base has a minimum 0.5% grade towards pit, unless the design specifies a flat base and design levels achieve (+ 50 mm).</p> <p>If the design has a flat base and does not contain the 0.5% grade, confirm with the designer and refer to these guidelines or the <i>WSUD Technical Design Guidelines for SEQ</i> (SEQHWP, 2006).</p> <p>Ensure base of system is free from debris and meets the tolerances (Section 3.4.2).</p>		
STEP 6: Construct overflow weir if required	<p>Where an overflow weir is part of the system design, it should be constructed at this stage and appropriately 'keyed' into the bunds to avoid potential scour at the edges of the weir. Design levels and tolerances must be achieved (+25 mm).</p>		
STEP 7: As-constructed survey	<p>Undertake an as-constructed survey of the system at this stage to confirm design and tolerances (Section 3.4.2) are achieved, including:</p> <ul style="list-style-type: none"> - overflow pit crest level, invert level and under-drainage connections invert and diameter - outlet pipe upstream and downstream invert levels - overflow weir - base of bioretention system to illustrate the level and the 0.5% grade. 		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 8: HOLD POINT Inspection and sign-off (Form A)	Following collection of the as-constructed survey, the site superintendent and bioretention designer will inspect the system with the contractor, review the as-constructed survey and take photos. If the construction meets the tolerances outlined Section 3.4.2 and conforms with the design, complete Sign-Off Form A attaching the as-constructed survey and photos.		
STEP 9: Filter cloth Lining	Line system with filter cloth, ensuring the filter cloth extends a minimum of 500 mm beyond the top of the bioretention system side walls.		
STEP 10: Install under-drainage	Install slotted rigid under-drainage pipes and ag-pipes and rigid collector pipes in the specified layout outlined in Section 3.3.6. Ensure all pipes are laid at a minimum 0.5% slope with no localised depressions verified using levels or string lines. Ensure levels are achieved (+25 mm). Seal junctions and connections using sufficient sealant to prevent sand, gravel or soil passing into drainage network. The same drainage layer material (aggregate) may be required to raise pipe in section to adhere to design grade (0.5%).		
STEP 11: Install cleanouts	Connect clean-out points ensuring top of clean-out points will ultimately sit at least 50 mm (preferably 150 mm) above the bioretention surface. The caps on the clean-out points should be screwed in place to secure against vandalism.		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 12: HOLD POINT Inspection and sign-off (Form B)	Following installation of the liner and under-drainage, either the site superintendent or bioretention designer will inspect the system with the contractor and take photos. If the lining and under-drainage meets the design and construction requirements, they will complete Sign-Off Form B and attach photos.		
STEP 13: Source drainage layer, transition layer and filter media material	Testing and sourcing the drainage, transition and filter media layers should have commenced as part of Step 2. By Step 13, the material can be delivered and stockpiled on site ready for installation.		
STEP 14: Install drainage layer	Install 200–250 mm deep gravel drainage layer to cover the slotted under-drainage pipe network. The preferred approach is to use an excavator (long-arm if required) or conveyor belt (see Section 3.4.7) positioned on the edge of the system to place gravel into the system. Contractors can then spread and flatten the gravel to the specified depth using spreader bars. The exact procedure for constructing the drainage layer is determined through consultation with the contractor. It may differ from the procedure described in Section 3.4.7.		
STEP 15: HOLD POINT Inspection of drainage layer	The site superintendent or bioretention designer should inspect the drainage layer to ensure the correct depth (200–250 mm) and tolerances (+25 mm) have been achieved and that the surface is flat.		The site superintendent or bioretention designer should inspect the drainage layer to ensure the correct depths (200–250 mm) and grades (typically 0.5%) have been achieved and the surface is flat. The relevant sections of Sign-Off Form C must be completed and photos taken. There is no need to stop construction for this inspection unless specifically required. The site superintendent or designer should undertake the inspection as construction occurs.






CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 16: Install transition layer	Install a 100 mm deep coarse sand transition layer on top of the gravel drainage layer using the same approach outlined in Step 14 to achieve the correct tolerances (+25 mm) and to ensure the surface is flat.	 2	 4
STEP 17: Inspection of transition layer	The site superintendent or bioretention designer should inspect the transition layer to ensure the correct depths (100 mm) and grade (typically 0.5%) have been achieved and that the surface is flat. The relevant sections of Sign-Off Form C should be completed and photos taken. The site superintendent or designer can undertake the inspection as construction occurs.	 2	 4
STEP 18: Install filter media	Place the bioretention filter media to the designed the surface level of the bioretention system in two separate lifts, where required, with each lift lightly compacted as outlined in Section 3.4.6. At the completion of the section lift and compaction, use a spreader bar to flatten the surface of the filter media. Ultimately, the surface of the filter media must be at the design level (+25 mm) and free from local depressions.	 2	 4
STEP 19: Install sediment fences	Immediately after installing the filter media, install sediment fences around the filter media and at the top of the batter to prevent sediment from entering the batters and to keep construction vehicles off the system.	 2	 4
STEP 20: Lay protective filter cloth, where required	If there is a delay between Step 18 and Steps 25 and 29, the surface and batters of the bioretention system should be covered with a temporary layer of filter cloth to protect against sediment-laden runoff. Some or all of this filter cloth will be left in place as part of Steps 25 to 28.	 2	 4




CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 21: As constructed survey	Undertake an as-constructed survey of the system surface and surrounding bunds, picking at least four spots on the surface of the small bioretention systems (<100 m ²), one spot level per 100 m ² on the surface of large bioretention systems and at least one spot level every 10 m along the top of the bunds as well as any low points.		
STEP 22: HOLD POINT Inspection and sign-off (Forms C and D)	Following collection of the as-constructed survey, the site superintendent and bioretention designer will inspect the system, review the as-constructed survey and take photos. If the construction meets the tolerances outlined in Section 3.4.2 and conforms to the design, Sign-Off Forms C and D will be completed and signed and the as-constructed survey and photos attached.		
STEP 23: Install coarse sediment forebay	Construct the coarse sediment forebay in accordance with the design and advice provided in Section 3.4.9. Concrete is preferred with surface treatment as directed by the design.		
STEP 24: Inspection and sign-off (Form E) PRACTICAL COMPLETION	The site superintendent or bioretention designer should inspect the coarse sediment forebay to ensure consistency with design. The relevant sections of Sign-Off Form E should be completed and photos are taken before either Building Phase Protection works or Landscape Works start.		
CONTINUE TO STEP 25 (Building Phase Protection)	if there is building or works in the catchment that will cause damage to the bioretention system or the accumulation of sediment in the system.		
CONTINUE TO STEP 29 (Landscape Works)	if there is no building or works proposed in the catchment that are likely to cause damage to the bioretention system or the accumulation of sediment in the system.		

3.9.2 Stage 2 — Building phase protection

Steps 25–28 provide the construction and establishment sequence for the Building Phase Protection (Stage 2) for Option 1, 2 and 3.

Table 3-8: Building phase protection (Stage 2) step-by-step sequence — Options 1 and 3

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 25: Install sediment fences	If not installed as part of Step 19, sediment fences should be installed around the filter media and at the top of the batter to prevent sediment entering from the batters and to keep construction vehicles off the system.		
STEP 26: Install protective layers on surface of filter media (filter cloth and turf)	Cover the surface of filter media with filter cloth or 25–50 mm of coarse sand and place 25 mm topsoil and turf over the filter cloth or coarse sand. Filter cloth has been known to block in some situations. Coarse sand (25–50 mm) can be used if there is concern with the filter cloth.		
STEP 27: HOLD POINT Inspection and sign-off (Form F)	Following installation of protective layers, the site superintendent and bioretention designer will inspect the system with the contractor. If approved, Sign-Off Form F can be completed and signed and photos attached.		
STEP 28: Building phase operation	During the building phase, which may be as long as 2–4 years, the bioretention system will operate as a shallow sediment basin, and protect the filter media from sediment and clogging. When 80–90% of the building in the catchment is complete, Stage 3: Landscape Works can start (Step 29).		





CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 25: Install sediment fences	<p>If not already installed as part of STEP 19, sediment fences should be installed around the filter media and at the top of the batter to prevent sediment entering from the batters and to keep construction vehicles off the system.</p>		
STEP 26A: Install bypass system (temporary protective bunds)	<p>The majority of the bioretention system should be isolated from sediment-laden inflows. This can be achieved by:</p> <ul style="list-style-type: none"> - completely bypassing pipe flows during the building phase and connecting the pipe system to the bioretention system following the building phase - partitioning (bunding) the majority of the bioretention system to isolate flows to the outlet and inlet of the system. <p>Where partitioning (bunding) is used:</p> <ul style="list-style-type: none"> - it should be designed so that flows are directed into either the overflow pit or overflow weir rather than entering the bioretention system preventing sediment-laden runoff from spreading across the bioretention surface - in small bioretention systems, the protective bund can be created using form ply with all joints overlaid and sealed - in larger bioretention system, the protective bunds can be created using the filter media wrapped in filter cloth - the crest of the bund should be higher than both the overflow pit and the surrounding embankments to ensure no sediment-laden flow enters the bioretention system and the bund should be keyed into the batters to avoid scouring around the edges causing water to enter the system. 		









CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 26B: Install protective layers on surface of filter media (filter cloth and turf)	Install temporary protective covering over the bioretention surface located within banded area adjacent to the coarse sediment forebay. Cover the surface of filtration media with filter cloth (or coarse sand) and place 25 mm topsoil and turf over the filter cloth.		
STEP 27: HOLDPOINT Inspection and sign-off (Form F)	Following collection of the as-constructed survey, the site superintendent and bioretention designer will inspect the system, review the as-constructed survey and take photos. If the construction meets the tolerances outlined in Section 3.4.2 and conforms to the design, Sign-Off Forms C and D will be completed and signed and the as-constructed survey and photos attached.		
STEP 28: Building phase operation	During the building phase, which may be up to 2–4 years, landscape can be established on the majority of the bioretention system surfaces in accordance with Stage 3: Landscape Works (Step 29 onwards). The small, protected part of the bioretention system will operate as a sediment basin, while protecting the filter media from sediment and clogging. When 80–90% of the building in the catchment is complete, the bund and protective layers can be removed and appropriate landscaping applied.		


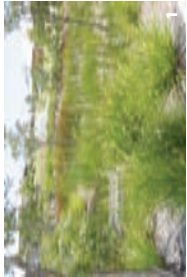
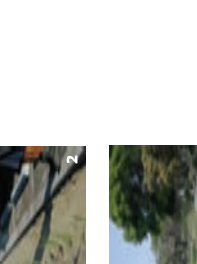
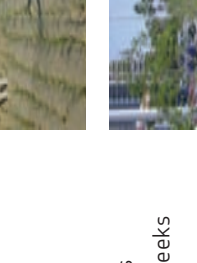
3.9.3 Stage 3 — Landscape establishment



Once the building phase is finished, the protected portions of the bioretention system are cleaned and any accumulated is removed in readiness for establishing the landscape. The recommended landscape establishment sequence for the bioretention systems is shown in Table 3.10. The construction sequence should be read in combination with the Bioretention Construction and Establishment Sign-Off Forms.

Table 3.9: Landscape establishment (Stage 3) step-by-step sequence — Options 1, 2 and 3

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 29: Pre-start and plant set-out meeting	Before starting landscape preparation, hold a pre-start and plant set-out meeting with the bioretention designers, including an ecologist, site superintendent and landscape contractors. The meeting should confirm design and planting establishment and set out the planting to ensure the correct plants are installed in the correct locations.		
STEP 30: Preparation	Prepare for the landscape establishment up to six months before starting, including ordering and inspecting plants at the nursery, ordering and receiving organic mulch and matting and organising a source of irrigation water.		
STEP 31: Remove building phase protection and flushing of under-drainage (where required)	Remove the building phase protective measures such as bunds, filter cloth, coarse sand, turf and accumulated sediment. Care should be taken to avoid damaging the clean-out points for the under-drainage. The under-drainage should be flushed out with potable water to remove any accumulated sediment. If adopting Option 1, the protective measures will remain in place while landscape is being establishment. Protective measures are removed when building is 80–90% complete.		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 32: Flatten surface	After the protective layers are removed, flatten the surface of the filter media using a spreader bar. Additional filter media may be required to fill in any over-excavated zones. Care should be taken to not over-compact the filter media (refer Sections 3.4.6 and 3.4.7).		
STEP 33: Mulching	Mulch the filter media surface in accordance with Section 3.6.4. Create holes in the mulch for planting. Ensure the holes have 50 mm separation from stem of the plant to the mulch.		
STEP 34: Soil preparation	Dig planting holes by hand and apply the prescribed amount of slow-release native fertiliser detailed in Section 3.6.3. Pre-soaked wetting agents are recommended in this step.		
STEP 35: Planting	Plant tubestock ensuring the root ball is covered with filter media and the stem is sitting above the filter media. Clear away any mulch from the step to 50 mm (refer Section 3.6.5).		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 36: Inspection and sign-off (Form G) PRACTICAL COMPLETION	After installing the mulch and plants, the site superintendent and bioretention designer will inspect the system and Sign-Off Form G is completed and photos attached.		
STEP 37: Watering	Water the plants according to Section 3.6.6: Week 1-6 5 waterings per week Week 6-10 3 waterings per week Week 11-15 2 waterings per week If there is no rain, each plant should receive 2.5-5.0 litres of water per week during establishment in the first six weeks (40 mm per week).		
STEP 38: Weeding	Inspect bioretention plants for nightly during establishment, removing any weeds by hand.		

CONSTRUCTION STEP	ACTIVITY	PHOTOS (SMALL BIORETENTION SYSTEM)	PHOTOS (LARGE BIORETENTION SYSTEM)
STEP 39: On-going inspections and final landscape establishment	<p>Monitor the establishment of plants until they are robust and self-sustaining.</p> <p>An established bioretention is measured by (Section 3.6.7):</p> <ol style="list-style-type: none"> 1. survival of more than 90% of plants 2. 80% coverage of bioretention surface 3. more than one species per macrophyte zone 4. at least 5 plants per m2 and preferably 6–10 plants/m2 5. an increase in plant height of at least 50% measured through markers or stakes 6. propagation of more than 2–3 stems and there is seeding 7. no weeds. <p>Record growth and maturity through three-monthly photo logs every 500m2.</p>		
STEP 40: Inspection and sign-off (Form H)	<p>After plants are established, the site superintendent and bioretention designer will inspect the system and complete Sign-Off Form H with attached photos.</p>	