

Engineering Services Report

Development Application for
Mixed Commercial / Residential Development
Epiq Lennox – Super Lot 7
Concept Approval 07_0026

Upon:

Lot 7 DP 1239938

At Epiq Estate
Lennox Head

ON BEHALF OF:

Clarence Property Corporation Pty Ltd

Our Reference: 2014/351

Date: September 2018


Newton Denny Chapelle
CONSULTING SURVEYORS & PLANNERS

Revision History				
REVISION #	DATE	DESCRIPTION	ORIGINATOR	APPROVED
A	24/08/2018	Issued for Approval	CP	DC
B	27/09/2018	Issued for Approval	CP	DC

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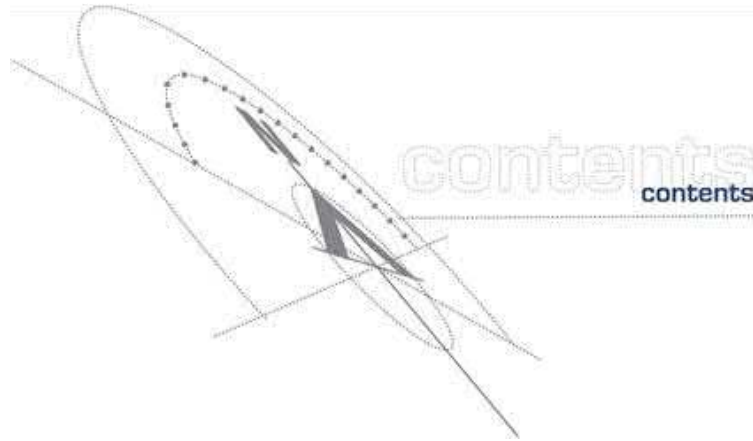


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Appendices

Appendix A

Concept Engineering Plans

Plan Number	Plan Name	Revision
14351-S7-DA-AD-01	OVERALL SITE PLAN	A
14351-S7-DA-BE-01	BULK EARTHWORKS PLAN	A
14351-S7-DA-BE-11	BULK EARTHWORKS SECTIONS - SECTION A & SECTION B	A
14351-S7-DA-BE-12	BULK EARTHWORKS SECTIONS - SECTION C & SECTION D	A
14351-S7-DA-BE-13	BULK EARTHWORKS SECTIONS - SECTION E & SECTION F	A
14351-S7-DA-CI-01	CIVIL WORKS PLAN	A
14351-S7-DA-CI-10	CIVIL WORKS LONGITUDINAL SECTION - MC00	A
14351-S7-DA-CI-11	CIVIL WORKS LONGITUDINAL SECTION - MC01	A
14351-S7-DA-CI-12	CIVIL WORKS LONGITUDINAL SECTION - MC01	A
14351-S7-DA-CI-13	CIVIL WORKS LONGITUDINAL SECTION - MC02	A
14351-S7-DA-CI-14	CIVIL WORKS LONGITUDINAL SECTION - MC03 & MC04	A
14351-S7-DA-CI-21	CIVIL SERVICES PLAN	A
14351-S7-DA-CI-22	DRAINAGE CATCHMENT PLAN	A

Appendix B

Acid Sulfate Soil Management Plan - Geolink

Appendix C

MUSIC Model

Appendix D

H2One – Hydraulic Assessment of the Dual Reticulation Network

Executive Summary

This Engineering Services Report is to accompany the Development Application seeking approval for a Mixed Use Subdivision upon Lot 7 DP 1239938 forming part of the Estate known as Epiq Lennox. The site is known as Super Lot 7 and covers an area of approximately 5.39Ha at the northern end of the greater Epiq site and west of Hutley Drive.

The Epiq development has been previously approved (Department of Planning approval 07_0026) with several stages constructed, approved or pending approval on the site. This report details the engineering design elements required for the development to comply with the relevant polices, standards and regulations required for a residential development in the Ballina Shire Council Local Government Area. Significant engineering design has previously been undertaken for the site as part of greater development approval. The following components have been assessed:

- Bulk Earthworks – A maximum fill height of 2.5m and maximum cut depth of 2.5m is expected across the site. Approximately 27,000m³ of fill is required to for the site with this material anticipated to come from the existing temporary stockpile on the eastern portion of the site and other stages of the Epiq Development.
- Traffic – Based on the previously approved and constructed stages of the Epiq Lennox development the surrounding road network has sufficient capacity for the proposed development (4,110vpd capacity vs 2,309vpd expected traffic).
- Road Layout and Pedestrian Access – Road reserve and carriageway widths are at or above the minimum widths specified in the Northern Rivers Local Government Standards, with the exception of the minor Access Streets servicing the residential component of the Live Work lots. These access lanes are in accordance with other similar rear access lanes in the Ballina Shire. A 1.35m wide footpath connection will be installed throughout the development.
- Stormwater Quality – Additional Gross Pollutant Traps have been installed throughout the greater Epiq Estate to ensure the stormwater treatment targets are achieved for the development. An additional GPT will be installed on the outlet of the northern catchment to ensure the pollution reduction targets are achieved.
- Stormwater Attenuation – Stormwater attenuation for the site will be provided via Detention Basin 2 adjacent to Hutley Drive as identified by Gilbert and Sutherland. The site is anticipated to generate additional flows to those modelled by G+S. Additional modelling in accordance with BSC current Standards for Stormwater Management has been undertaken confirming that the downstream network has sufficient capacity to convey these flows
- Potable and Recycled Water Reticulation – Water connections will be supplied to all lots with connection to the greater Lennox Head reticulation networks. Connection stubs will be extended to the western boundary for the adjacent Outlook development.
- Sewer Reticulation – All lots will be provided with a gravity sewer connection. Connection to the greater Lennox Head sewer network will be via the existing stub to the Trunk main on the eastern side of Hutley Drive

1 Introduction

Newton Denny Chapelle has been engaged by Clarence Property Corporation Ltd to prepare an Engineering Services Report to accompany the application for the Mixed Use Subdivision upon Super Lot 7 (SL7) within the Epiq Lennox Estate. The site is located in Lennox Head and has previously been known as the Pacific Pines Estate, now referred to as Epiq Lennox.

The proposed development consists of:

- 34 Residential Lots;
- 26 Live Work;
- 3 Development Lots.

The total development site is approximately 80.5ha in size with this application relating specifically to the area known as Super Lot 7 (refer Figure 1-1). The SL7 site is approximately 5.39Ha in size.



Figure 1-1 – Epiq Estate Development Site

This report relates to the bulk earthworks, traffic, stormwater and servicing requirements of the site. Several elements of the engineering design have already been completed as part of previous approvals (eg stormwater) for the estate. This report is intended to append the original designs where necessary and also demonstrate that the proposed engineering modifications meet the relevant consent conditions.

2 Report Scope

This report focuses on providing sufficient concept engineering design details to facilitate a thorough understanding of the proposed works. The works covered by this report include new infrastructure for traffic, stormwater (quality and attenuation) and servicing provisions for the proposed development.

It is recognised that a subsequent submission of detailed engineering design plans and specifications are required to be made before final approval of the development by Ballina Shire Council. At this stage any minor amendments of the design elements proposed will be addressed to meet any of the concerns raised through the approvals process. The concepts and calculations outlined in this report and associated plans shall not be used for construction without the written permission of Newton Denny Chapelle.

2.1 Reference Documents

The following documents have been used in the preparation of this report:

- Gilbert + Sutherland, *Revised Stormwater Assessment & Management Plan, Pacific Pines Estate, Montwood Drive & Hutley Drive, Lennox Head, New South Wales, July 2014*
- Ballina Shire Council, *Ballina Development Control Plan 2012 - Chapter 3 – Urban Development*
- Cardno Eppell Olsen, *Pacific Pines Estate, Traffic and Transport Statement, November 2011*
- Ballina Shire Council – *Stormwater Management Standards for Development – 2015*
- Ardill Payne and Partners, *Project Application Stage 1, Engineering Report – Pacific Pines Subdivision*
- Water Services Association of Australia, *Sewerage Code of Australia, WSA 02-2002*
- Geolink, *Water Reticulation Hydraulic Analysis – Addendum Report*
- Geolink, *Investigation of Gravity Sewer Augmentation On Hutley Drive*
- Cardno Eppell Olsen, *Pacific Pines Estate, Traffic & Transport Statement, November 2011*
- Northern Rivers Local Government – *Development Design Manual*
- Ballina Shire Council, *Development Control Plan - Chapter 13 – Stormwater Management 2006*
- SMEC Urban, *Pacific Pines Estate - Water Reticulation Hydraulic Analysis, March 2012*
- SMEC Urban, *Pacific Pines Estate – Dual Reticulation Analysis, Letter Dated 30 March 2012*
- Newton Denny Chapelle, *Engineering Services Report (Modification 5 to Concept approval 07_0026), Dated November 2016*

3 Site Description

The site consists of a vacant development lot created as part of the subdivision works. The site has been previously used for grazing cattle with the North West corner of the site designated as a revegetation area. The lower eastern portion of the site has been previously filled as part of the Stage 1B works involving the construction of Hutley Drive. The site generally grades north west to south east.

The areas surrounding the development site can be summarised as:

- Northern Boundary – Is formed with the Henderson Lane Road Reserve. There is an existing driveway access to neighbouring Lot 1 DP1070446 within this reserve. An environmental buffer is located within the development site along this boundary.

- Eastern Boundary – Is formed with the existing Hutley Drive Road Reserve and drainage swale. This land is generally lower than the development site.
- Southern Boundary – Is formed with the Sport fields constructed as part of previous stages of the development. Road 5 will be extended to the western boundary within the Super Lot 7 site as part of the subdivision works.
- Western Boundary – Is formed with existing vacant Road Reserve. This area is generally higher than the proposed development.

4 Bulk Earthworks

The lower portion of the site has been filled as part of the previous stages of the development. As far as it can be ascertained, prior to these filling activities the natural ground level along the eastern boundary of the site was approximately RL 2.5m, with a localised lower drainage channel present in the south east corner of the site. This flat eastern portion of the site has been filled to between RL3 to RL4 as part of the 1B works. It is anticipated that the finish level of each site will be greater than 3.5m AHD above the prescribed level of 2.65m AHD for flooding.

Approximately 27,000m³ of fill is required to for the site with this material anticipated to come from the existing temporary stockpile on the eastern portion of the site and other stages of the Epiq Development. A maximum fill height of 2.5m and maximum cut depth of 2.5m is expected across the site.

The site generally drains North West to South East. Fill placed on the site is not higher than the land to the west of the site so is not considered to adversely impact overland drainage on these properties. No filling within the Hutley Drive Road Reserve is not proposed.

4.1 Acid Sulfate Soils

The site is mapped as having Class 2 and Class 5 Acid Sulfate Soils (Ballina LEP 2012), refer to Figure 4-1.



Figure 4-1 - Acid Sulfate Soils

The only excavations expected to intersect potential acid sulfate soils are associated with the installation of service lines. For example, the lowest point of the sewer along the eastern boundary is expected to be a RL1.2m below the original surface level of the site of RL2.5m. Any excavation in these areas will be undertaken in accordance with the Acid Sulfate Soil Management Plan – Pacific Pines Stage 1B plan prepared by Geolink (dated 27/08/2014). This plan is attached in Appendix B.

5 Road Layout and Site Access

Road 5 will be extended to service the development and provide connection to the greater Road Network via Hutley Drive. The proposed development will involve the extension of Road 5 and the construction of four new roads. A summary of the proposed Roads is presented in Table 5-1:

Table 5-1 - Summary of Proposed Roads

Road	Approx. Length (m)	Carriageway Width (m)	Reserve Width (m)	Road Hierarchy	Maximum Grade
Road 1	590	7-9 Ex On-street Parking	Variable 15 – 21.6m	Local Street	14%
Road 2	225	5.5	6.5	Access Street	<5%
Road 3	105	7	15	Local Street	14%
Road 4	182	6	8	Access Street	8%
Road 5 (extension)	160	9.5	18	Collector Street	12%
Total:	1,262				

A 1.35m wide footpath will be provided along one side of all public Roads with connection to the surrounding footpath network in Road 5. A 2.5m wide sealed maintenance access path will be installed along the eastern side of the site adjacent to the development lots. The area surrounding this access path will be dedicated as part of the Hutley Drive Road Reserve upon completion of the subdivision.

5.1 Access Street

It is proposed that the rear access laneway (Road 2) has a 5.5m carriageway within a 6.5m wide reserve. This Street is only expected to provide access to the rear of the live/work allotments for the residential component of the lot. Access to the Commercial component of the development will be via Road 1 with parking provided on Road 1. Through traffic is not expected on this Street as the surrounding Road network is considered to provide a more efficient connection.

The most lots serviced by an Access Street (between connecting Local Streets) is 7 lots. Based on a peak hour trip rate of 0.5 trips/dwelling, the peak hourly trips are considered to be 3.5 per hour (one every 17 minutes). Access Streets of similar configuration have been previously approved in the Ballina Shire (Bourke Terrace and Woods Terrace). It is noted that these previously approved Streets service more dwellings than those proposed in this development (eg Woods Terrace services 14 houses).

6 Traffic Assessment

6.1 Background Information

Previous studies of the traffic generated by the greater Epiq development site have been undertaken by Carndo Eppell Olsen and updated by Newton Denny Chapelle as part of the Modification 5 to Concept Approval 07_0026. These studies have identified that the extension of Hutley Drive is needed to service the fully developed site. Without the extension of Hutley Drive the existing surrounding road network has an approved capacity of 7,456vpd. This daily traffic volume has been approved in the Ballina Shire Council Ordinary Council meeting on the 23rd October 2014 (refer Figure 6-1).

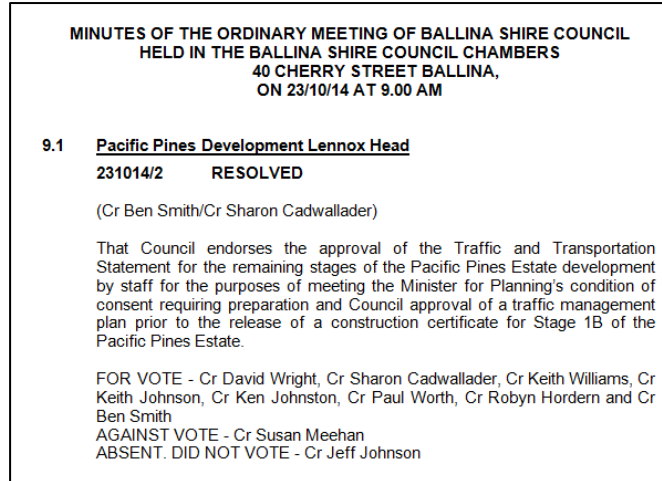


Figure 6-1 - Excerpt from Council Meeting Minutes 23/10/2014

The approved traffic capacity relates to the available capacity of the surrounding road network being Montwood Drive and Henderson Lane. The existing road network has a surveyed volume of 1,712 for Montwood Drive and 1,634vpd for Henderson Lane leaving an excess of 4,110vpd for the Epiq development to utilise.

6.2 Daily Traffic Generation

The daily traffic generation for the proposed development has been estimated based on the traffic generation rates for developments outlined in the *Ballina Shire Council, Ballina Road Contribution Plan – Version 4.1*. Where traffic generation rates are not specified by BSC those detailed by the RMS and Institute of Transport Engineers have been adopted. The total daily vehicle trips estimated for the development are outlined in Table 6-1:

Table 6-1 - Traffic Generation Rates

Land Use	Qty	Units	Trip Rate	Total Daily Vehicle Trips
Residential Lots	34	Dwellings	6.45	219.3
Live/Work Lots				
- Residential (2 bdrm)	26	Lots	3.9	101.4
- Commercial (BSC Office)*	52m ² / 26 units	m ²	10 / 100m ²	135.2
Development Lots				
- Tavern/Hotel (BSC)*	1,000	m ²	40 / 100m ²	400.0
- Storage Facility (ITE – Mini Warehouse)*	0.657	Acre	35.43 / Acre	23.3
Live/Work Lot*				
- Residential (2 bdrm)	26	Lots	3.9	101.4
- Commercial (BSC Office)*	52m ² / 26 units	m ²	10 / 100m ²	135.2
Existing Entitlement				-1
			Total:	1114.8

*Areas assumed

Local trip generation rates for the residential component of the development are considered appropriate for the estimation of traffic generated and have been previously accepted as part of Modification 5 to the Concept Plan. Averaging the data for all regional sites (Coffs Harbour, Lismore, Orange, Wagga Wagga and Wollongong) investigated in the RMS Technical Direction 2013/04a results in an average daily trip rate of 6.33. The adopted local rate of 6.45 vpd is considered appropriate when applying the aggregate survey data as suggested by the RMS.

6.3 Local Road Network

As detailed in Modification 5 to the Concept Approval 07_0026 the surrounding Road network has insufficient capacity to service the entire Epiq Lennox development until the northern connection of Hutley Drive is constructed. The surrounding Road network has an approved capacity of 7,456vpd. The existing Road network has a surveyed volume of 3,346vpd leaving and excess of 4,110vpd for the Epiq Estate to utilise.

The previously approved and constructed stages of Epiq are expected to generate 2,309vpd (including this development, refer Table 6-2). These volumes have been determined from the traffic generation rates outlined in the Ballina Shire Roads Contributions Plan (eg 6.45/dwelling). In accordance with the RMS recommendations, 25% of the trips are internal with 75% of the total trips generated utilising the surrounding external Road network.

Table 6-2 - Daily Vehicle Trips Generated by the Development

Approved Epiq Releases	Residential (vpd)			Medium Density (vpd)*			Commercial / Retail (vpd)		
	I ¹	E ²	T ³	I ¹	E ²	T ³	I ¹	E ²	T ³
1A ⁺	82	247	329	0	0	0	0	0	0
1B ⁺	-	-	-	-	-	-	0	0	0
2 (SL8+ST3) ⁺	132	397	529	0	0	0	0	0	0
3 (ST2+ST6) ⁺	194	581	774	0	0	0	0	0	0
4 ⁺	56	169	226	26	79	105	0	0	0
Super Lot 7 (this application)	106	317	422	0	0	0	174	521	694
Totals:	570	1710	2280	26	79	105	174	521	694
External Traffic Total:	2309								

*The number of dwellings has been based on the maximum density allowed for the zoning (1 dwelling/250m² - total area 6,906m²)

⁺ Previously approved or constructed stage

¹ Internal Trips

² External Trips

³ Total Trips

Based on the previously approved and constructed stages of the Epiq Lennox development the surrounding road network has sufficient capacity for the proposed development (4,110vpd capacity vs 2,309vpd expected traffic). In accordance with the concept approval an assessment of the surrounding road network to confirm there is sufficient capacity for the development will be undertaken prior to the issue of a subdivision certificate.

6.4 Road Contributions

Estimated traffic contributions for the site have been calculated in accordance with the Ballina Shire Road Contribution Plan Version 4.1 and the Ballina Shire Council Fees and Charges 2018/2019. The estimated trip generation and contributions are outlined in Table 6-3 and Table 6-4 below:

Table 6-3 - Ballina Shire Trip End Calculations

Land Use	Qty	Units	Trip Rate	Commercial Reduction	Total Daily Vehicle Trips
Residential Lots	34	Dwellings	6.45		219.3
Live/Work Lots					
- Residential (2 bdrm)	26	Lots	3.9		101.4
- Commercial (BSC Office) *	52m ² / 26 units	m ²	10 / 100m ²	0.2	27.0
Development Lots					
- Tavern/Hotel (BSC) *	1,000	m ²	40 / 100m ²	0.2	80.0
- Storage Facility (ITE – Mini Warehouse) *	0.657	Acre	35.43 / Acre	0.2	4.7
Live/Work Lot*					
- Residential (2 bdrm)	26	Lots	3.9		101.4
- Commercial (BSC Office) *	52m ² / 26 units	m ²	10 / 100m ²	0.2	27.0
Existing Entitlement					-1
Total:					559.8

*Areas assumed

Table 6-4 - Ballina Shire Contributions FY18/FY19

Contribution	FY18/FY19 Per Equivalent Residential Lot	FY18/FY19 Per Trip
Road Contribution	\$12,061	\$1,869.92
Road Administration Contribution	\$181	\$28.06
	Total:	\$1,897.98

The total expected Road Contributions are approximately \$1.063 million.

7 Stormwater Management

The site has been previously modelled by Gilbert and Sutherland ('Revised Stormwater Assessment & Management Plan' dated July 2014) to determine the quality treatment and attenuation requirements for the site. The stormwater objectives for the site are defined in Condition B6 of the Pacific Pines – Concept Approval (MP 07_0026), see Figure 7-1 below:

<p>B6 Stormwater Management Plan</p> <p>The proponent is to prepare a stormwater management plan for the entire site, prepared by a suitable qualified person(s) that includes detailed modelling for both water quality and quantity. The plan shall demonstrate:</p> <ol style="list-style-type: none"> 1) That the project does not concentrate or lead to an increase in the volume or rate of flow of stormwater discharged from the site over and above pre-development flow conditions; and 2) That the project does not increase the average annual load of key stormwater pollutants in stormwater discharged from the site over and above pre-development conditions. 3) <u>that</u> all stormwater infrastructure is located outside the conservation zone area. <p>The plan is to be prepared in accordance with the Water Sensitive Urban Design requirements of <i>Ballina Shire Combined Development Control Plan Chapter 13 – Stormwater Management</i>.</p> <p>The stormwater plan is to be submitted to and approved by Council prior to the issue of a Construction Certificate for Stage 1A.</p>
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Figure 7-1 - Excerpt from Concept Approval (MP 07_0026) - Stormwater Management Plan

The previously approved SWMP has been used as a first preference for the basis of this assessment. Where the proposed development differs from the original assumptions contemporary stormwater management standards have been applied.

7.1 Stormwater Quality

The stormwater from the site will be discharged to the WQCP (via the CMZ) in accordance with the Gilbert and Sutherland Stormwater Management Plan. Super Lot 5 forms part of Catchment 16 (refer Figure 7-2).

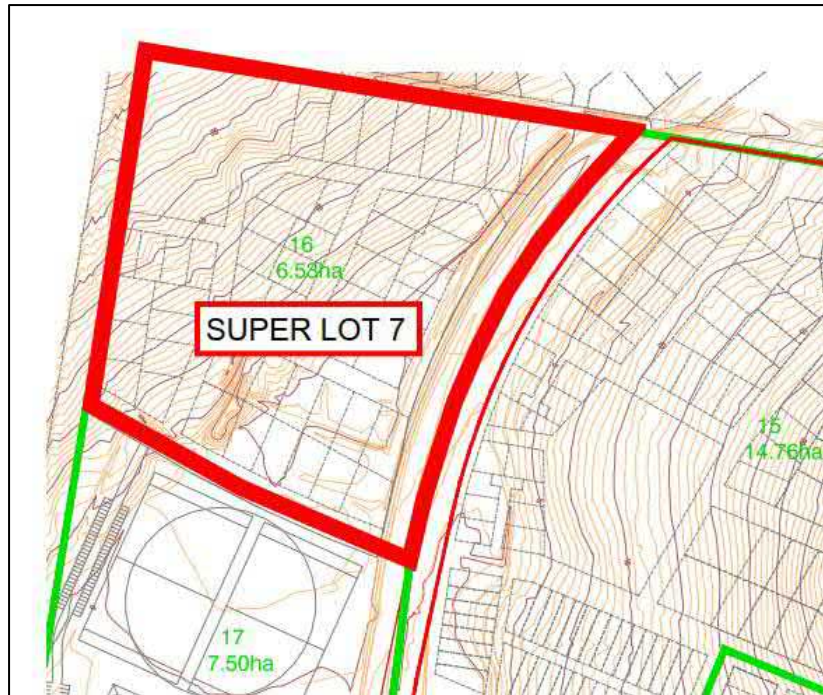


Figure 7-2 - Excerpt from G+S MUSIC Model Catchment Plan - DWG 10734-1.3-D

The stormwater quality modelling has been previously undertaken by Gilbert and Sutherland. This modelling shows that the overall development can achieve the required stormwater quality targets, refer Figure 7-3.

Table 4.3.2 Comparison of average annual pollutant loads

	Load reduction (%)		
	Suspended Solids	Total Nitrogen	Total Phosphorus
Existing	370,000	2,700	355
Developed	189,000	2,500	338
Change%	-48.9%	-7.4%	-5.0%

Figure 7-3 - G+S Modelling Results

The Gilbert and Sutherland MUSIC Model has been previously modified to reflect the changes to the greater Development. These include:

- Increase in Neighbourhood Shopping Centre as Part of MOD 5
- Actual impervious areas modelled in Super Lot 5

The model has been further modified to reflect the current configuration of Super Lot 7. Since the original G+S modelling additional precincts (eg Live/Work, Tavern) have been incorporated in the site. These precincts will increase the impervious areas above those modelled by Gilbert and Sutherland.

As a single lumped catchment, the catchment parameters in the MUSIC model can be summarised as shown in Table 7-1 and Table 7-2. The greater lumped catchment (16) has been further broken into smaller sub catchments as detailed in Table 7-4 and Table 7-5.

Table 7-1 - Gilbert and Sutherland MUSIC Catchment (Extract from Appendix 3 of SWMP)

Catchment	Area	Forest	Rural	Urban	Commercial	Townhouse
16	6.53	0.00	1.56	4.97	0.00	0.00

Table 7-2 - Revised MUSIC Catchments

Catchment	Area*	Forest	Rural	Urban	Commercial	Townhouse
16	6.53	0.936	0.00	4.10	0.625	0.870

*Note actual area of SL7 is 5.39 but the urban area has been increased to kept total area consistent with G+S

An extract from the MUSIC model showing Catchment 16 (Super Lot 7) is shown in Table 7-4 Figure 7-4 below. The greater Epiq Estate revised MUSIC model is attached in Appendix C.

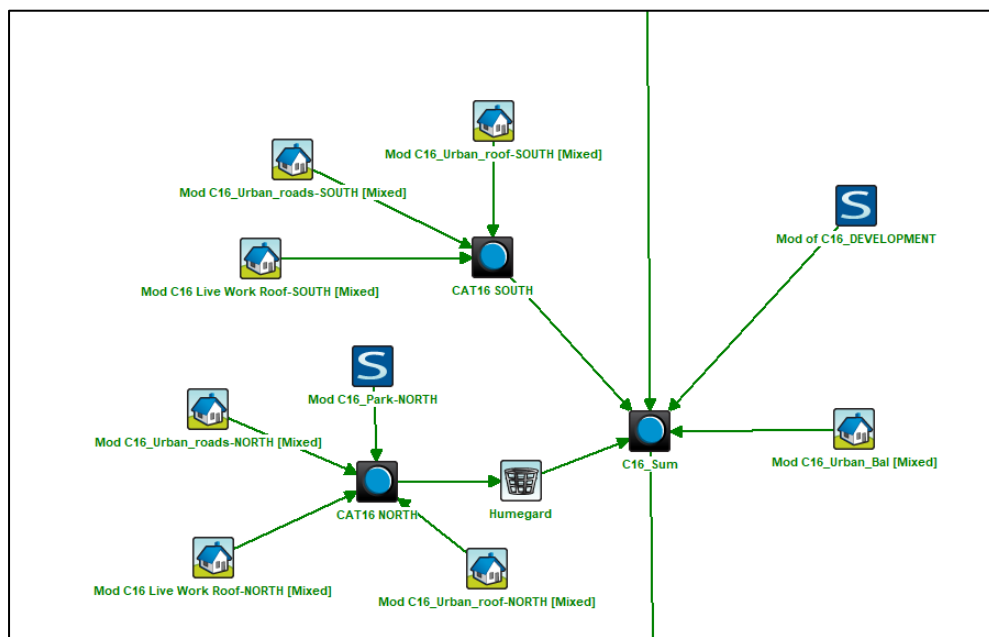


Figure 7-4 - SL7 Extract from the greater Epiq Estate MUSIC Model

The MUSIC model also considers the additional treatment devices (to those originally proposed by G+S) installed throughout the Epiq Estate. These devices include:

- 3x Humegard Units installed as part of Release 2 (G+S Catchment 15);
- 1x Humegard Unit designed in Release 3 (G+S Catchment 11);
- 1x Humegard designed in the Neighbourhood Shopping Centre (G+S Catchment 15);

The MUSIC model has been run with the revised information (shown in Appendix C). The results of the model are summarised in Table 7-3:

Table 7-3 - MUSIC Model Results

	Suspended Solids	Total Nitrogen	Total Phosphorus
Developed	186,000	2480	332

As shown above the revised treatment train for the greater Epiq Development results in less total annual pollutant loads than previously modelled by Gilbert and Sutherland. The proposed treatment levels are considered to satisfy the pollutant reduction targets approved in the greater Epiq Stormwater Management Plan.

7.2 Stormwater Attenuation

Stormwater attenuation for the site has been remodelled based on the design areas of the Super Lot 7 site. The Gilbert and Sutherland assumptions in relation to the impervious areas within Catchment 16 and 17 are considered to underestimate the actual stormwater runoff based on the current development layout. In remodelling the site, the new Ballina Shire Council Stormwater Management Standards for Development (SMSD) have been applied.

The catchment areas within Super Lot 7 have been determined from the design plans and are summarised in Table 7-4:

Table 7-4 - Super Lot 7 Catchments

Catchment	Area (m ²)	Townhouse (m ²)	Residential Lots (m ²)	Road Reserve (m ²)	Commercial (m ²)	Reveg
NORTHERN	27,185	3303	2830	11695		9,357
SOUTHERN	17,415	2345	9255	5,815		
DEVELOPMENT	9,300	3051			6,249	

The impervious fractions for each catchment have been adopted in accordance with those outlined in the *Northern Rivers Handbook of Stormwater Drainage Design* and are outlined in Table 7-5 below. The impervious percentages for the Townhouse and Road Reserve have been assumed.

Table 7-5 - Catchment Impervious Fractions

Catchment	Area (m ²)	Townhouse (m ²)	Residential Lots (m ²)	Road Reserve (m ²)	Commercial (m ²)	Reveg
NORTHERN		1	0.9	0.75	0.95	
SOUTHERN		1	0.9	0.75	0.95	
DEVELOPMENT		1	0.9	0.75	0.95	0

The Greenfield Development Method 1 from the BSC SMSD has been applied to ensure there are no adverse impacts on downstream users. Attenuation of the stormwater generated by the site is not proposed, with investigation of the capacity of the downstream flow paths investigated. The immediate downstream infrastructure includes the five culverts (1.8Wx0.9H) and an existing Ø1050 pipe under Road 5. These structures have been installed as part of the Stage 1B works and are shown in Figure 7-5:

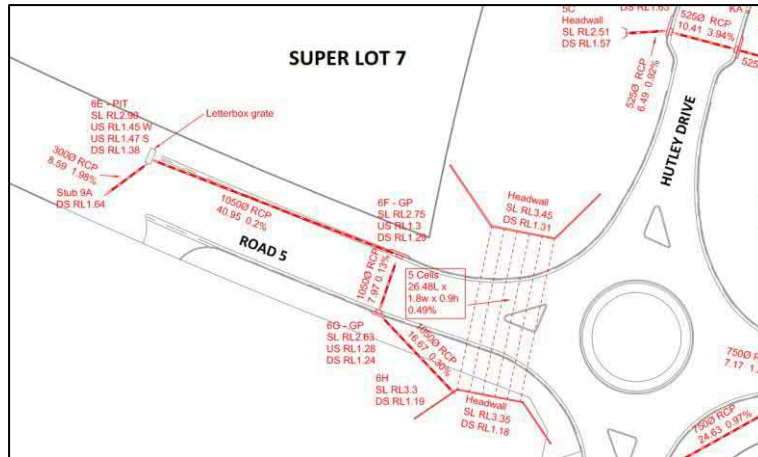


Figure 7-5 - Excerpt from NDC 1B Drainage Summary 3 - WAX Plan

Super Lot 7 ultimately drains to Stormwater Detention Basin 2 and the Hutley Drive swale, refer Table 7-4.

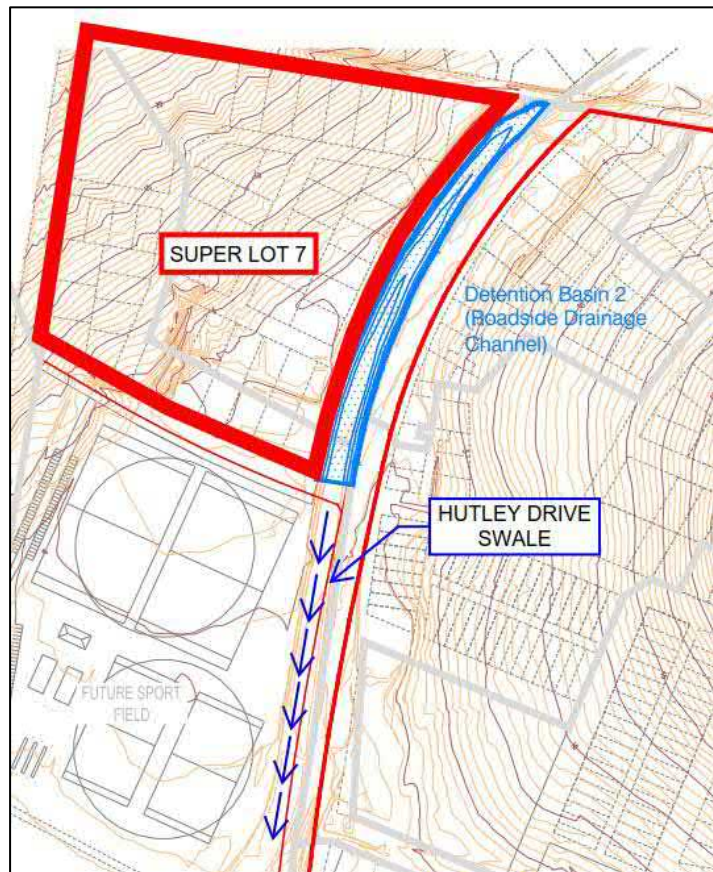


Figure 7-6 - Extract from G+S Plan 10734-1.9-D

The Hutley Drive swale drains into the Ballina Nature Reserve and North Creek just to the south of the sports fields. Detention Basin 2 has been sized by Gilbert and Sutherland to attenuate the anticipated 100 year flows, refer Figure 7-7.

Basin 2 (roadside drainage channel)	
Stage-storage characteristics	
RL (mAHD)	Volume (x10 ³ m ³)
1.40	0.00
2.00	0.37
2.50	1.48
3.00	3.38
3.40	5.34
Outlet 1 (Pipe) Details	
Width x height (m)	1.8 x 0.9
No. of boxes	5
IL (mAHD)	1.37
Estimated basin performance	
Maximum water surface elevation (mAHD)	2.8
Maximum volume stored (x10 ³ m ³)	2.8

Figure 7-7 – Excerpt from G+S Revised Stormwater Assessment July 2014

The outlet of Stormwater Detention Basin 2 is controlled by 5 box culverts installed as part of Stage 1B. The flows entering these culverts and the basin have previously been determined by G+S and shown on Geolink’s approved stamped plans, refer Figure 7-8. These upstream flows have been adopted for this assessment.

Culvert Design Details provided by Gilbert & Sutherland (also refer to Stormwater Assessment & Management Plan by Gilbert & Sutherland July 2014)		
Parameters	Q5	Q100
Catchment Area (ha)	91.28	91.28
surrounding channel characteristics	meandering roadside basin upstream	
proposed culvert detail	5 x 1.8m (w) x 0.9m(h) box	
Results		
approach flow (m ³ /s)	10.5	20.5
pipe / road flow (m ³ /s)	10.4 / 0.0	20.4 / 0.0
upstream / downstream WSL (m AHD)	2.3 / 2.1	3.2 / 2.5
pipe velocity (m/s)	1.3	2.5

Figure 7-8 - Hydraulic Calculations (Excerpt from Geolink Plan 1675/1B 117)

7.2.1 Drains Model

The stormwater drainage concept is to drain the majority of the SL7 site into Stormwater Detention Basin 2 immediately adjacent to the east of the site. The southern portion of the site and the extension of Road 5 will be directed into the existing Ø1050 pipe beneath Road 5. This pipe has been previously installed as part of the Stage 1B works.

The capacity of Stormwater Detention Basin 2 and the existing Ø1050 pipe under Road 5 have been modelled in Drains to confirm there are no adverse impacts on this downstream infrastructure. As the exact configuration of the upstream flows are not known, a node with a baseflow equal to the 100 year flows (20.5m³/s) has been adopted in the modelling. This ensures that the worst-case storm modelled by G+S is adopted across all storm events.

The following Drains model has been developed for the site:

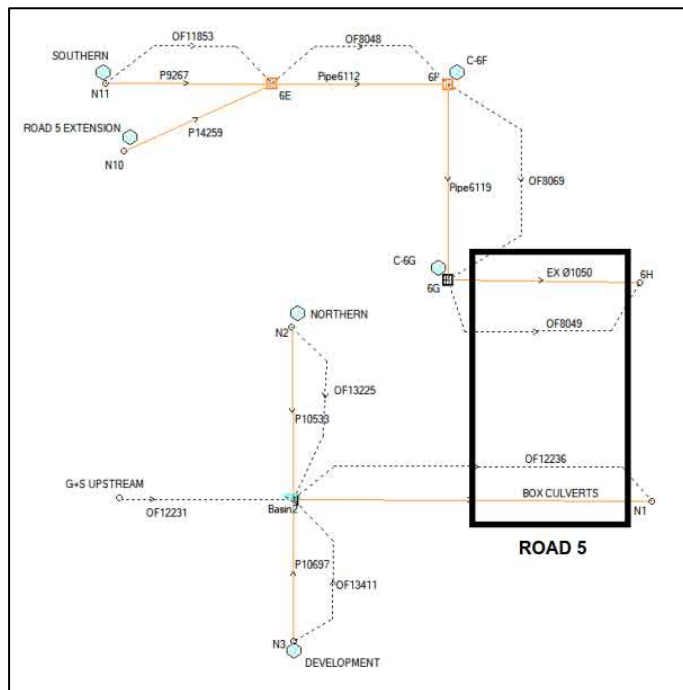


Figure 7-9 - Drains Model

The model has been run over the 5, 20 and 100 year ARI events with the results presented in Figure 7-10 to Figure 7-12:

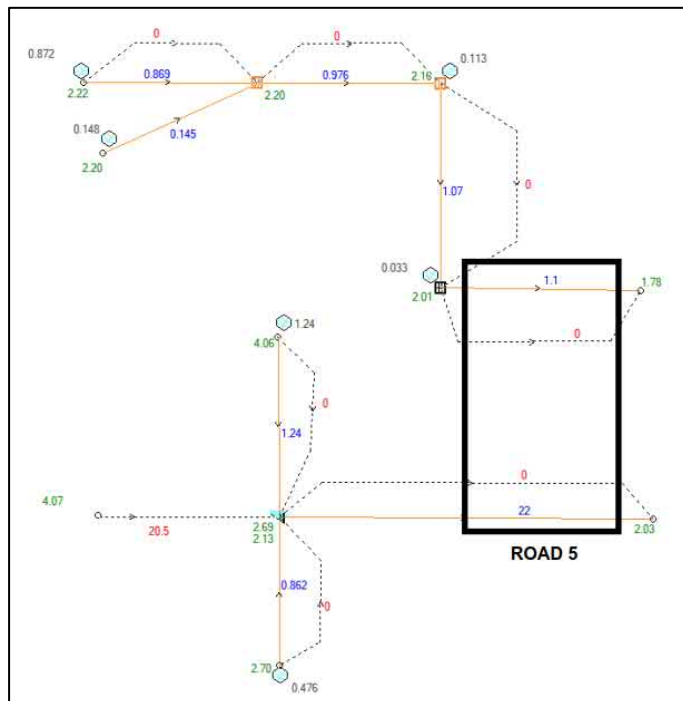


Figure 7-10 - Drains Results 5 Year ARI

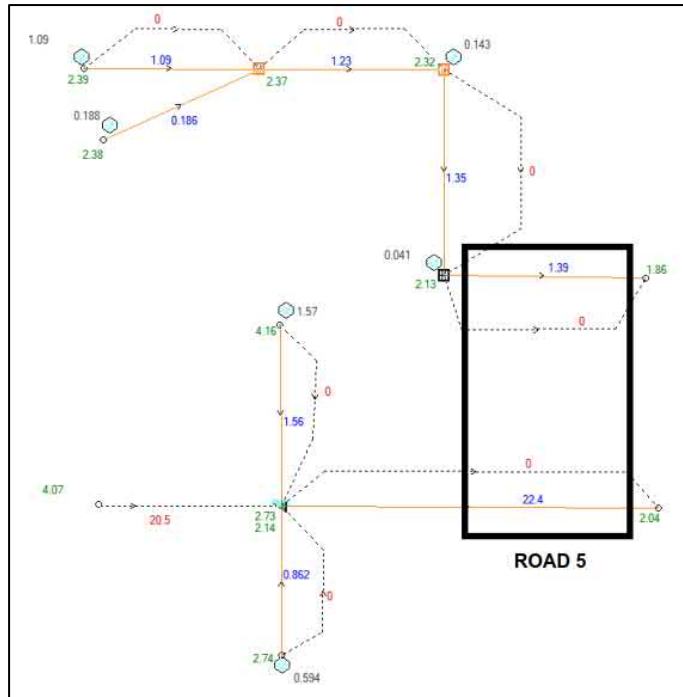


Figure 7-11 - Drains Results 20 Year ARI

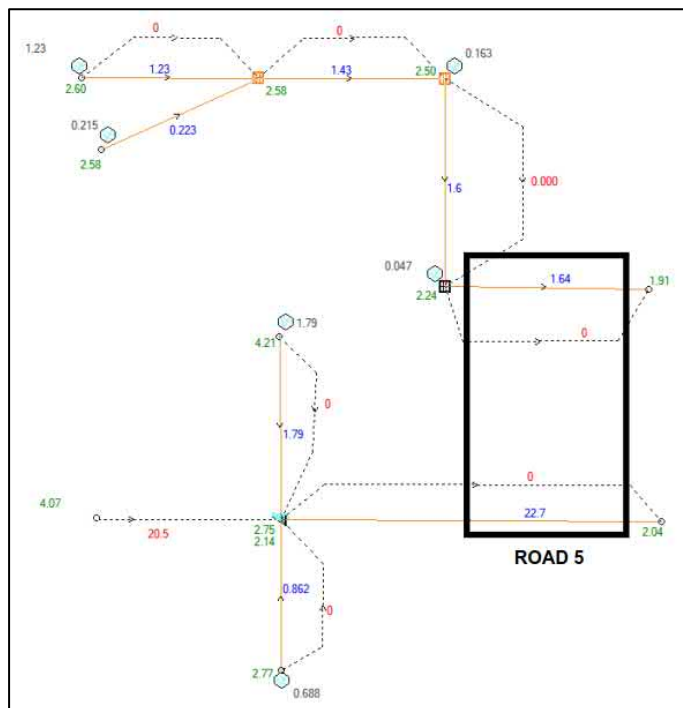


Figure 7-12 - Drains Results 100 Year ARI

As shown above the existing attenuation basin/culverts and Ø1050mm pipe beneath Road 5 have sufficient capacity to convey the upstream flows and those generated by Super Lot 7 for the 100 year ARI event. All flows observed are below the major event limits specified in QUDM Section 7.4 for Road flows.

7.3 Summary of Stormwater Devices

The stormwater devices required for the site are outlined in Table 7-6:

Table 7-6 - Stormwater Management Devices

Location	Quality	Attenuation
Public Devices		
Super Lot 7 – Northern Catchment	1x Humegard GPT	-
Detention Basin 2	-	Existing
Outlet Pipe 6F-6H	-	Existing
Private Devices		
None Proposed	-	-

8 Sewer Services

All lots will be provided with a gravity sewer connection. An existing Ø225mm sewer stub has been provided for the site as part of the Stage 1B works. This stub is located midway along the eastern boundary and connects to the existing sewer trunk main within Hutley Drive. The Ø225mm trunk main will be extended along Road 5 to the western boundary (for future connection of the adjacent Outlook Development).

The expected sewer equivalent demand for the SL7 development is outlined in Table 8-1:

Table 8-1 - Expected Sewer Demand

Type of Development	Quantity	Units	Rate	Equivalent Tenements
Residential Lots	34	Lot	1	34
Live Work Lots				
- Multi-Residential Units (2 bdrm)	26	Unit	0.75	19.5
- Commercial (52m ² /unit) ¹	1,352	m ²	0.01	13.52
Development Lots ²				
- Tavern (Pub / Bar)	1,000	m ²	0.05	50
- Self Storage ³	50	m ²	0.006	0.3
- Live Work (rate from above)	9	Unit	1.27	11.43
Total ET:				128.75
¹ General retail shop / office assumed				
² All Commercial areas assumed				
³ Office area only				

The adjacent Outlook development is expected to generate approximately 168ET of additional demand. Based on the preliminary design the proposed Ø225mm Trunk Main between Road 5 and the connection stub will not have sufficient capacity (due to grade) to service the Outlook Estate and the Development Lots. To ensure this trunk line has sufficient capacity a secondary service line will be run adjacent to the Trunk Main to service the development lots. The existing downstream sewer stub along the eastern side of the site (from the Hutley Drive main) has sufficient capacity for the proposed

development. This Ø225mm main has a grade of approximately 1% and an estimated 367ET capacity based on the WSAA Guidelines. The SP3001 rising main within Hutley Drive has been extended as part of the Stage 1B works to increase the capacity of the existing gravity sewer system.

As the exact future configuration of the development lots are unknown at this stage it is proposed to create these lots with a 1 ET entitlement. Future development upon each site will necessitate the payment of additional contributions.

9 Water Reticulation

Each lot will be provided with a potable and recycled water connection. This will be via the extension of the existing Ø200mm potable water and Ø250mm recycled water within Road 5.

The expected potable water demand for the development is outlined in Table 9-1:

Table 9-1 - Expected Water Demand

Type of Development	Quantity	Units	Rate	Equivalent Tenements
Residential Lots	34	Lot	1	34
Live Work Lots				
- Multi- Residential Units (2 bdrm)	26	Unit	0.60	15.6
- Commercial (52m ² /unit) ¹	1,352	m ²	0.01	13.52
Development Lots ²				
- Tavern (Pub / Bar)	1,000	m ²	0.03	30
- Self Storage ³	50	m ²	0.004	0.2
- Live Work (rate from above)	9	Unit	1.12	10.08
Total ET:				103.4
¹ General retail shop / office assumed				
² All Commercial areas assumed				
³ Office area only				

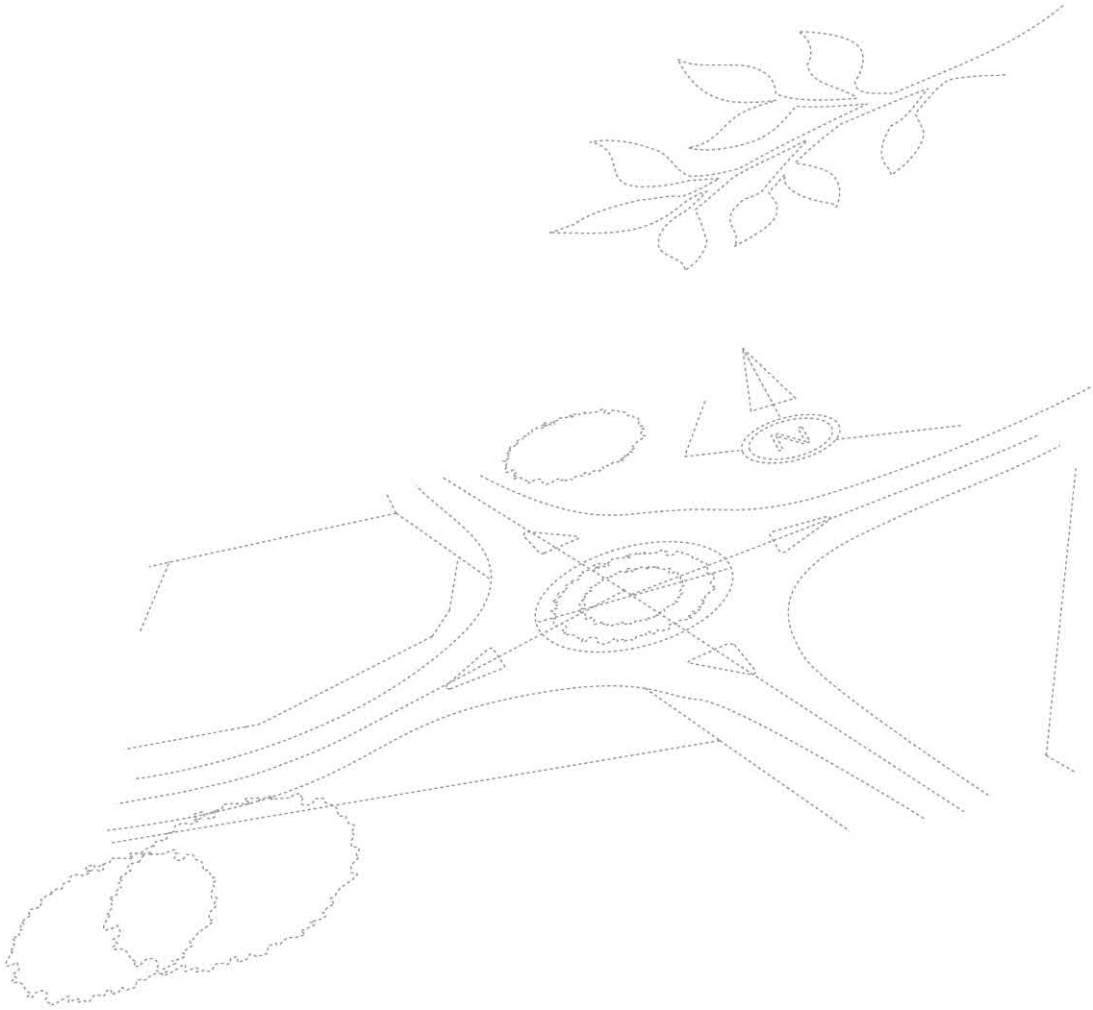
As the exact future configuration of the development lots are unknown at this stage it is proposed to create these lots with a 1 ET entitlement. Future development upon each site will necessitate the payment of additional contributions.

Modelling of the capacity of the surrounding potable and recycled water networks has been undertaken by H2One (assessment attached to this report). This report has made an allowance for the site and can be updated during subsequent design phases as required by Ballina Shire Council.

10 Sediment and Erosion Control

During construction sediment and erosion control measures will be installed to ensure the loss of soil from the site is minimised. All control measures will be installed prior to the commencement of construction and be in accordance with Managing Urban Stormwater-Soils & Construction Volume 1 (2004) by Landcom.

Appendix A Concept Engineering Plans





LEGEND:

	PROPERTY BOUNDARY
	PROPOSED PROPERTY BOUNDARY
	PROPOSED DRAINAGE NETWORK
	PROPOSED ROAD SURFACE

SITE PLAN
SCALE 1:500

FOR APPROVAL

Plot Date: 24 Aug, 2018 CAD File Name: K:\Jobs\2014\14351 - Clarence Property\Super Lot 7\Engineering\Drawings\14351-S7-DA-AD-01.dwg

REV	DESCRIPTION	BY	CP	DATE
A	FOR APPROVAL	DY	CP	24.08.18

SCALES SHOWN ARE FOR AN A1 SIZE ORIGINAL DRAWING

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Full Size 1:500 ; Half Reduction 1:1000
SCALE (m)

SCALES	APPROVALS

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VERT. DATUM	AHD
SURVEY	NDC
DRAWN	DY
DESIGN	DY
APPROVED	CP
DATE	24.08.2018

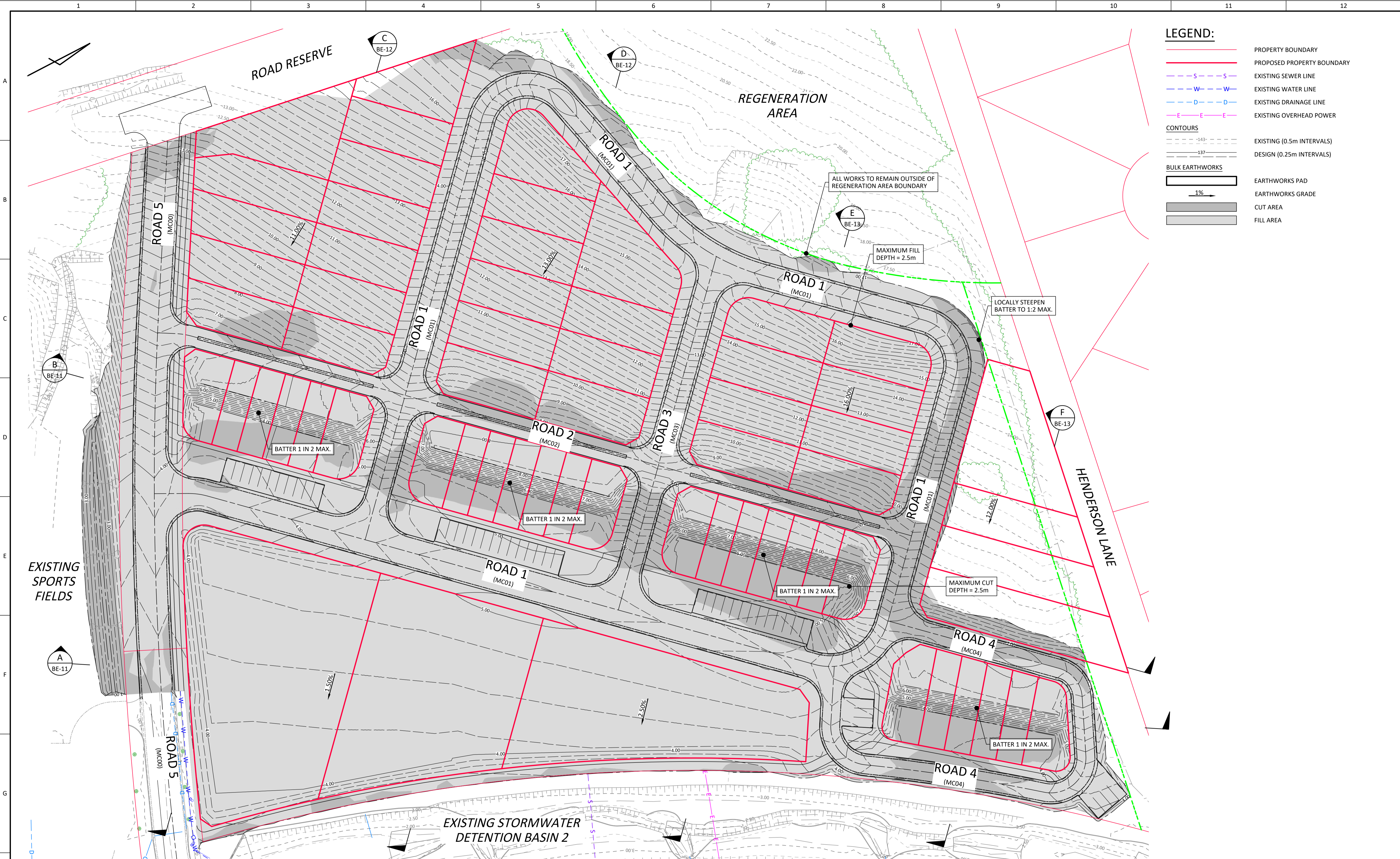
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EPIQ ESTATE - LENNOX HEAD, NSW, 2478
SUPER LOT 7
OVERALL SITE PLAN

Reference No. 2014/351	DRAWING No. 14351-S7-DA-AD-01	REVISION A
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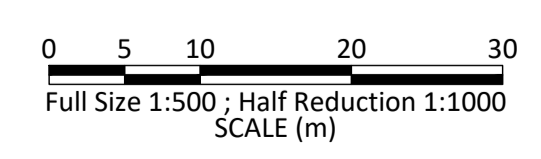
LEGEND:

	PROPERTY BOUNDARY
	PROPOSED PROPERTY BOUNDARY
	EXISTING SEWER LINE
	EXISTING WATER LINE
	EXISTING DRAINAGE LINE
	EXISTING OVERHEAD POWER
CONTOURS	
	EXISTING (0.5m INTERVALS)
	DESIGN (0.25m INTERVALS)
BULK EARTHWORKS	
	EARTHWORKS PAD
	EARTHWORKS GRADE
	CUT AREA
	FILL AREA

PLAN
SCALE 1:500

FOR APPROVAL

SCALES SHOWN ARE FOR AN A1 SIZE ORIGINAL DRAWING



HORIZ. DATUM	MGA
VERT. DATUM	AHD
SURVEY	NDC
DRAWN	DY
DESIGN	DY
APPROVED	CP
DATE	24.08.2018

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EPIQ ESTATE - LENNOX HEAD, NSW, 2478
SUPER LOT 7
BULK EARTHWORKS
PLAN

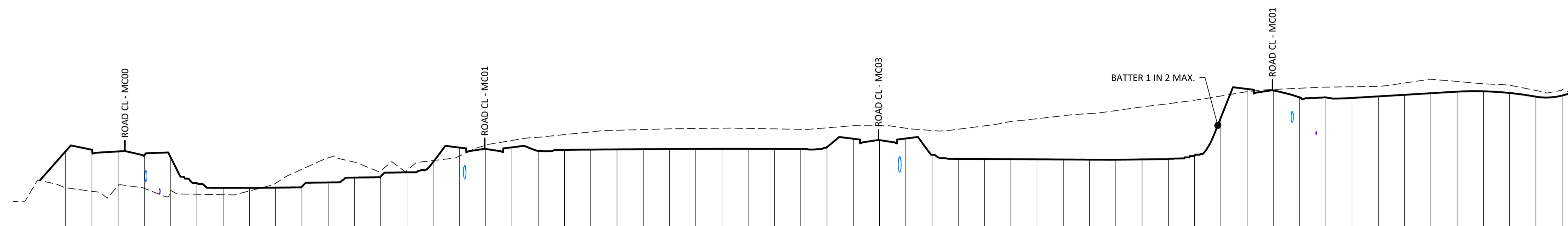
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RETAINING WALLS TO BE INCORPORATED WITH THE PROPOSED BUILDING STRUCTURES 3.0m MAX. HEIGHT

UNLESS STAMPED BY THE PRINCIPAL CERTIFYING AUTHORITY AND ISSUED WITH A NUMERICAL REVISION

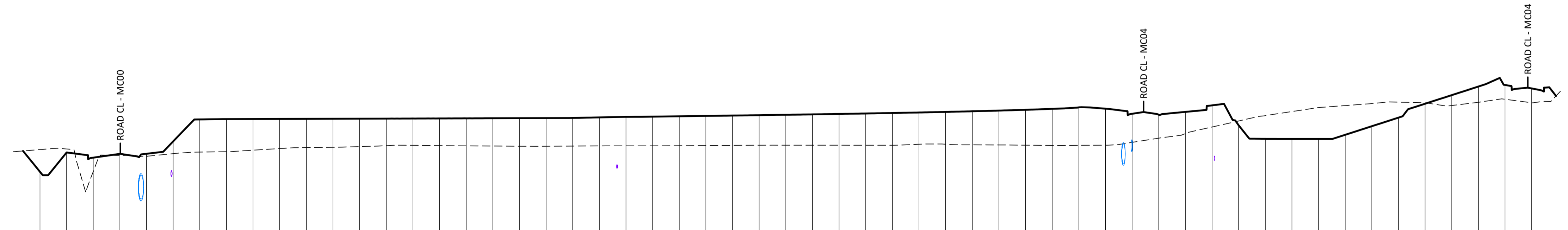
© NEWTON DENNY CHAPPELLE



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40	3.543
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65	4.785
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75	4.463
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205	6.632
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215	6.888
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BULK EARTHWORKS SECTION - SECTION B

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VERTICAL SCALE 1:100

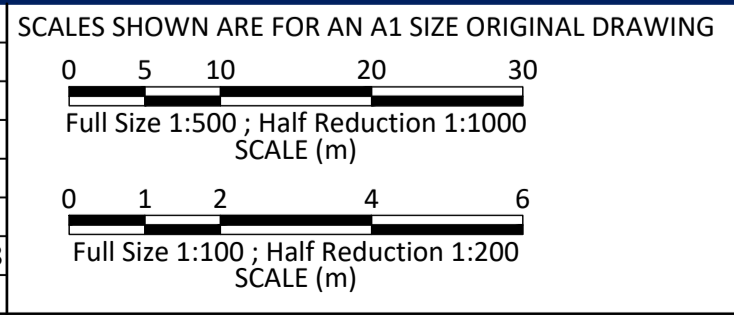


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85	3.443
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150	3.467
155	3.465
160	3.464
165	3.463
170	3.502
175	3.503
180	3.480
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190	3.467
195	3.457
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205	3.467
210	3.573
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230	4.378
235	4.579
240	4.732
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250	4.957
255	5.033
260	5.086
265	5.063
270	4.958
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280	5.194
285	5.065
290	5.410
295	
300	
302.135	

BULK EARTHWORKS SECTION - SECTION A

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

FOR APPROVAL



HORIZ. DATUM	MGA
VERT. DATUM	AHD
SURVEY	NDC
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DESIGN	DY
APPROVED	CP
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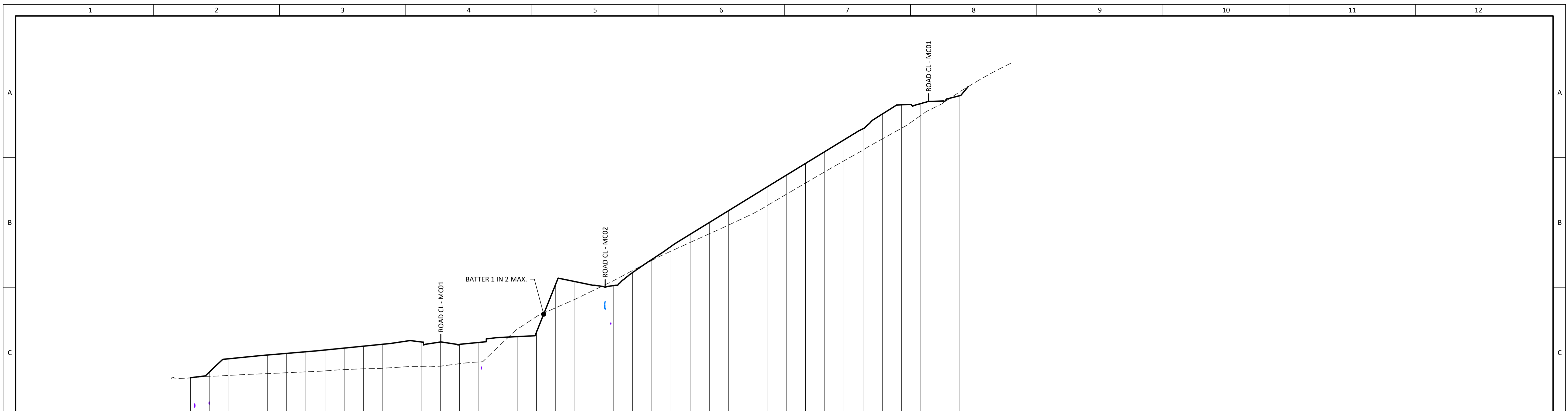
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EPIQ ESTATE - LENNOX HEAD, NSW, 2478
SUPER LOT 7
BULK EARTHWORKS
SECTIONS - SECTION A & SECTION B

REV	DESCRIPTION	DY	CP	DATE
A	FOR APPROVAL			24.08.18

Reference No.	DRAWING No.	REVISION
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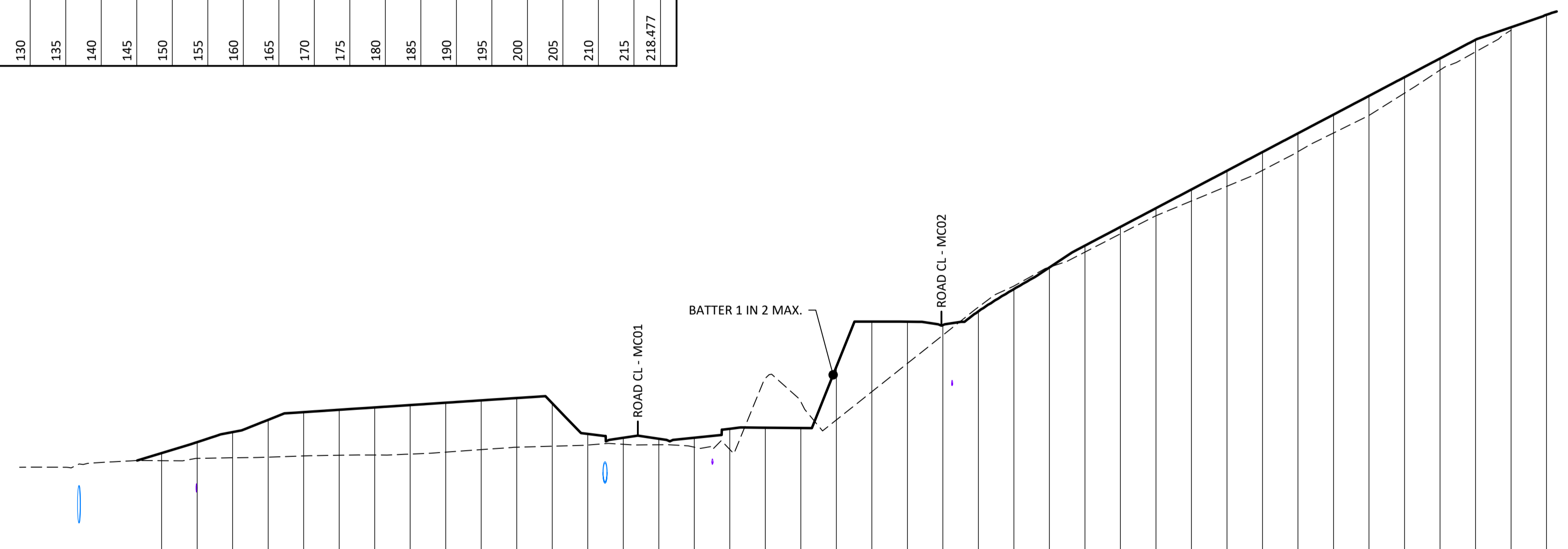


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35	3.421	4.466
40	3.471	4.557
45	3.539	4.657
50	3.579	4.757
55	3.608	4.857
60	3.672	4.987
65	3.691	4.977
70	3.716	4.974
75	3.845	4.849
80	3.934	4.951
85	4.715	5.205
90	5.639	5.255
95	6.295	5.484
100	6.755	7.984
105	7.194	8.121
110	7.679	7.929
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120	8.694	8.590
125	9.215	9.271
130	9.703	9.949
135	10.159	10.582
140	10.611	11.197
145	11.066	11.813
150	11.531	12.429
155	12.074	13.045
160	12.663	13.658
165	13.250	14.270
170	13.833	14.883
175	14.405	15.495
180	14.972	16.081
185	15.550	16.845
190	16.107	17.323
195	16.771	17.388
200	17.328	17.516
205	17.982	17.792
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BULK EARTHWORKS SECTION - SECTION D

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100



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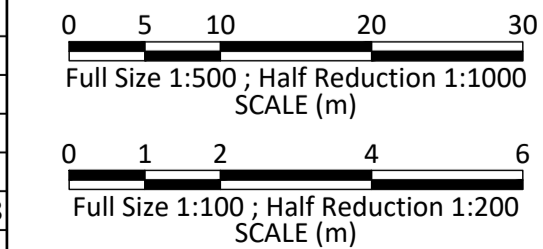
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35	3.181	4.232
40	3.216	4.450
45	3.236	4.516
50	3.241	4.582
55	3.268	4.648
60	3.323	4.714
65	3.394	4.780
70	3.462	4.846
75	3.490	4.700
80	3.524	3.836
85	3.543	3.727
90	3.532	3.700
95	3.464	3.728
100	3.399	3.981
105	5.405	4.010
110	4.742	4.002
115	4.230	5.726
120	5.025	7.000
125	5.821	6.997
130	6.616	6.902
135	7.408	7.287
140	8.000	7.914
145	8.532	8.524
150	8.956	9.139
155	9.471	9.666
160	9.981	10.193
165	10.396	10.721
170	10.810	11.248
175	11.259	11.775
180	11.785	12.302
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190	12.806	13.356
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200	14.081	14.410
205	14.596	14.938
210	15.205	15.287
215	15.640	
220		
221.421		

BULK EARTHWORKS SECTION - SECTION C

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

FOR APPROVAL

SCALES SHOWN ARE FOR AN A1 SIZE ORIGINAL DRAWING



HORIZ. DATUM	MGA
VERT. DATUM	AHD
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DESIGN	DY
APPROVED	CP
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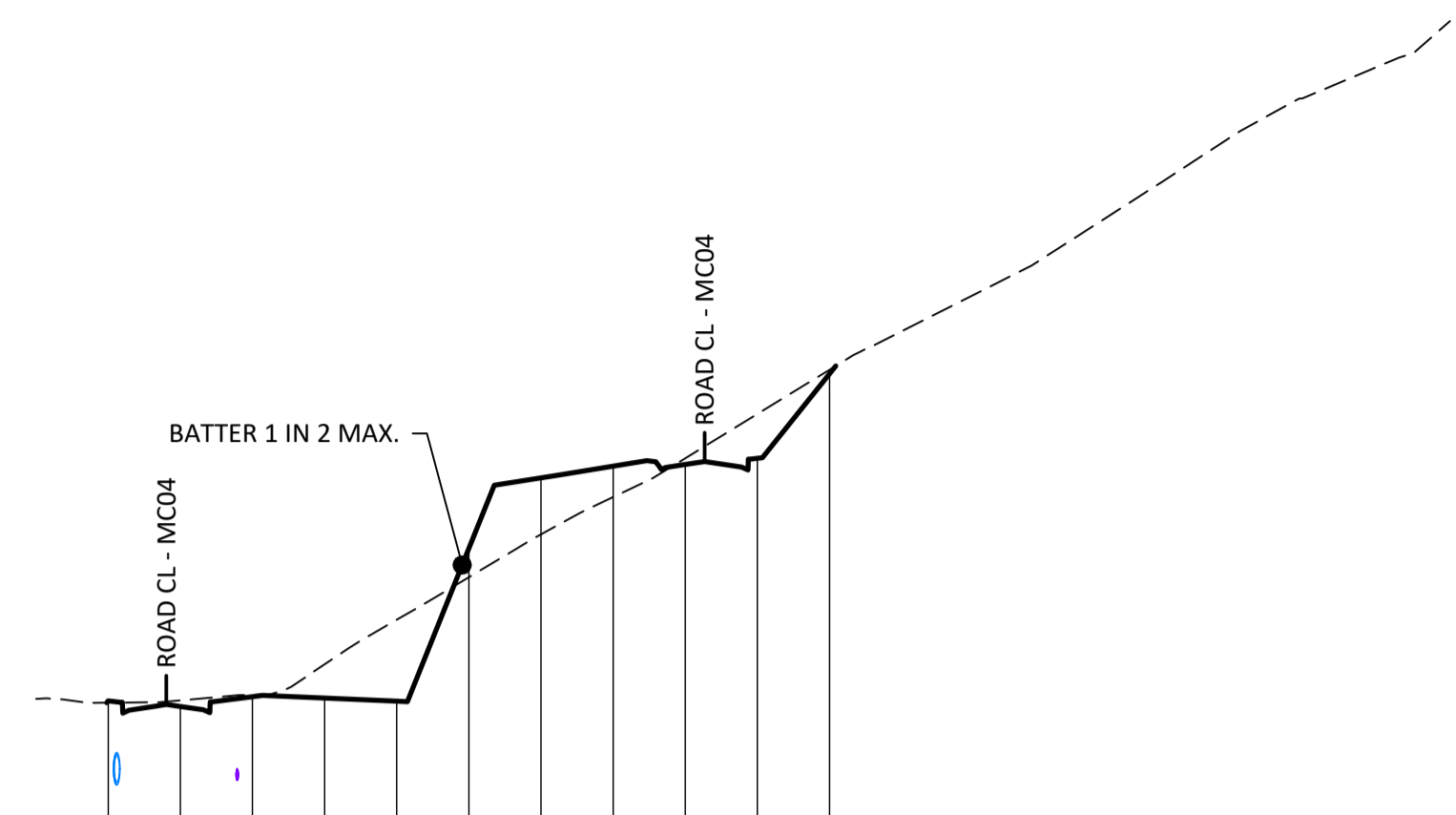
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SUPER LOT 7
BULK EARTHWORKS
SECTIONS - SECTION C & SECTION D

Reference No. 2014/351	DRAWING No. 14351-S7-DA-BE-12	REVISION A
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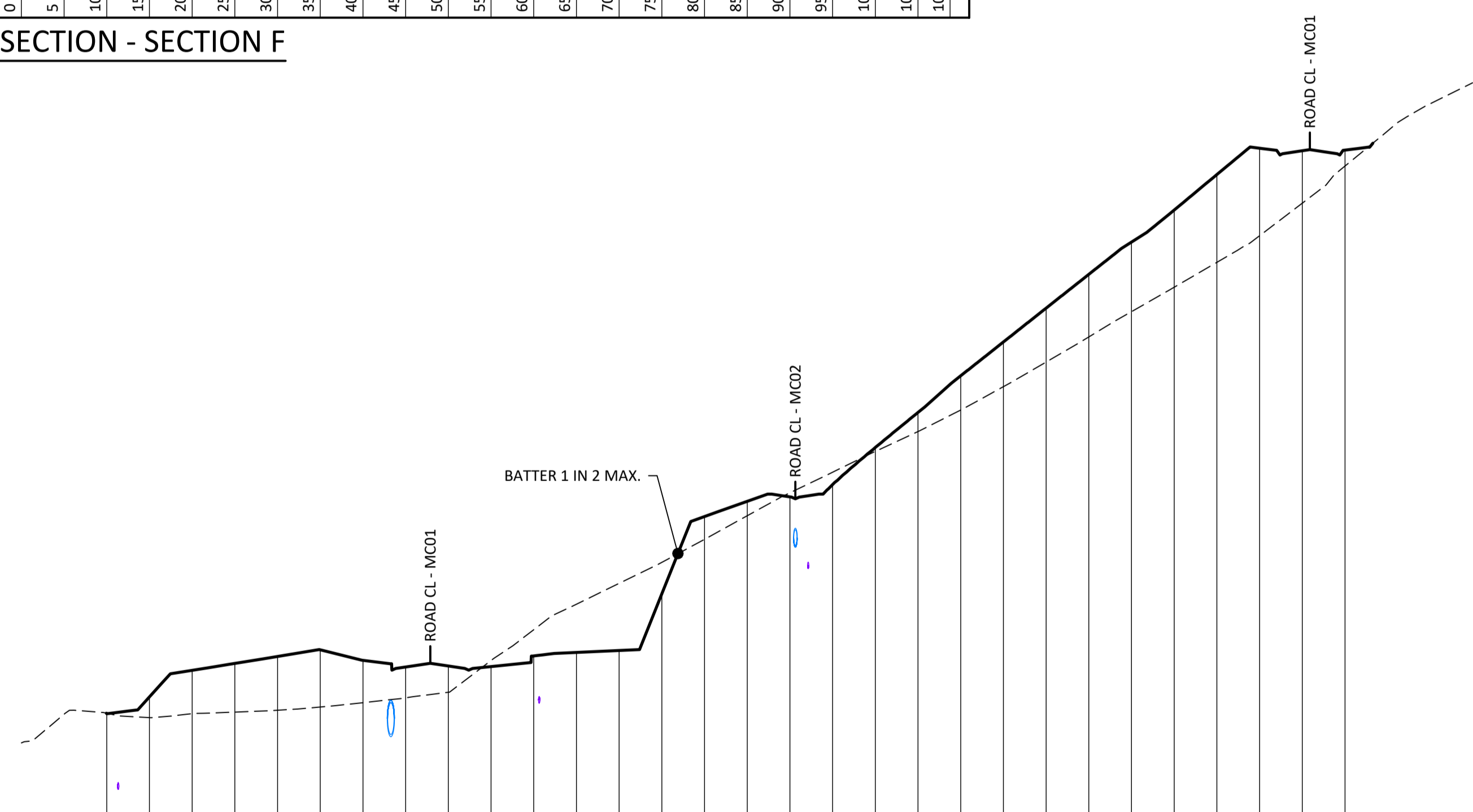


DATUM R.L. 1.50

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20	4.217	3.750
25	4.836	3.707
30	5.425	5.825
35	6.020	6.802
40	6.535	6.963
45	7.074	6.987
50	7.687	7.072
55	8.300	8.245
60	8.833	
65	9.339	
70	9.871	
75	10.513	
80	11.158	
85	11.777	
90	12.248	
95	12.659	
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105		
106.977		

BULK EARTHWORKS SECTION - SECTION F

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100



DATUM R.L. 0.50

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30	3.479	4.737
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40	3.655	4.647
45	3.768	4.492
50	3.899	4.515
55	4.643	4.501
60	5.365	4.750
65	5.963	4.832
70	6.450	4.877
75	6.942	6.206
80	7.482	8.016
85	8.034	8.371
90	8.571	8.476
95	9.054	8.764
100	9.540	9.633
105	10.005	10.454
110	10.510	11.311
115	11.058	12.103
120	11.634	12.895
125	12.222	13.687
130	12.815	14.444
135	13.387	15.194
140	13.969	16.026
145	14.593	16.642
150	15.356	16.583
155	16.225	16.598
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165	17.686	
169.94	18.173	

BULK EARTHWORKS SECTION - SECTION E

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

FOR APPROVAL

REV	DESCRIPTION	BY	CP	DATE
A	FOR APPROVAL	DY	CP	24.08.18

SCALES SHOWN ARE FOR AN A1 SIZE ORIGINAL DRAWING

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Full Size 1:500; Half Reduction 1:1000
SCALE (m)

0 1 2 4 6
Full Size 1:100; Half Reduction 1:200
SCALE (m)

HORIZ. DATUM	MGA
VERT. DATUM	AHD
SURVEY	NDC
DRAWN	DY
DESIGN	DY
APPROVED	CP
DATE	24.08.2018

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PROPERTY

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Plot Date: 24 Aug. 2018 CAD File Name: K:\Jobs\2014\14351 - Clarence Property\Super Lot 7\Engineering\Drawings\14351-S7-DA-BE-13.dwg



LEGEND:

- PROPERTY BOUNDARY
- PROPOSED PROPERTY BOUNDARY
- - - S - - - EXISTING SEWER LINE
- - - W - - - EXISTING WATER LINE
- - - D - - - EXISTING DRAINAGE LINE
- - - E - - - EXISTING OVERHEAD POWER

PROPOSED

- +—+—+— ROAD CONTROL LINE
- +—+—+— DRAINAGE
- (S) - SEWER
- PROPOSED ROAD SURFACE

PLAN
SCALE 1:500

FOR APPROVAL

REV	DESCRIPTION	DY	CP	DATE
A	FOR APPROVAL	DY	CP	24.08.18
REVISIONS				

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Full Size 1:500 ; Half Reduction 1:1000
SCALE (m)

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VERT. DATUM	AHD
SURVEY	NDC
DRAWN	DY
DESIGN	DY
APPROVED	CP
DATE	24.08.2018

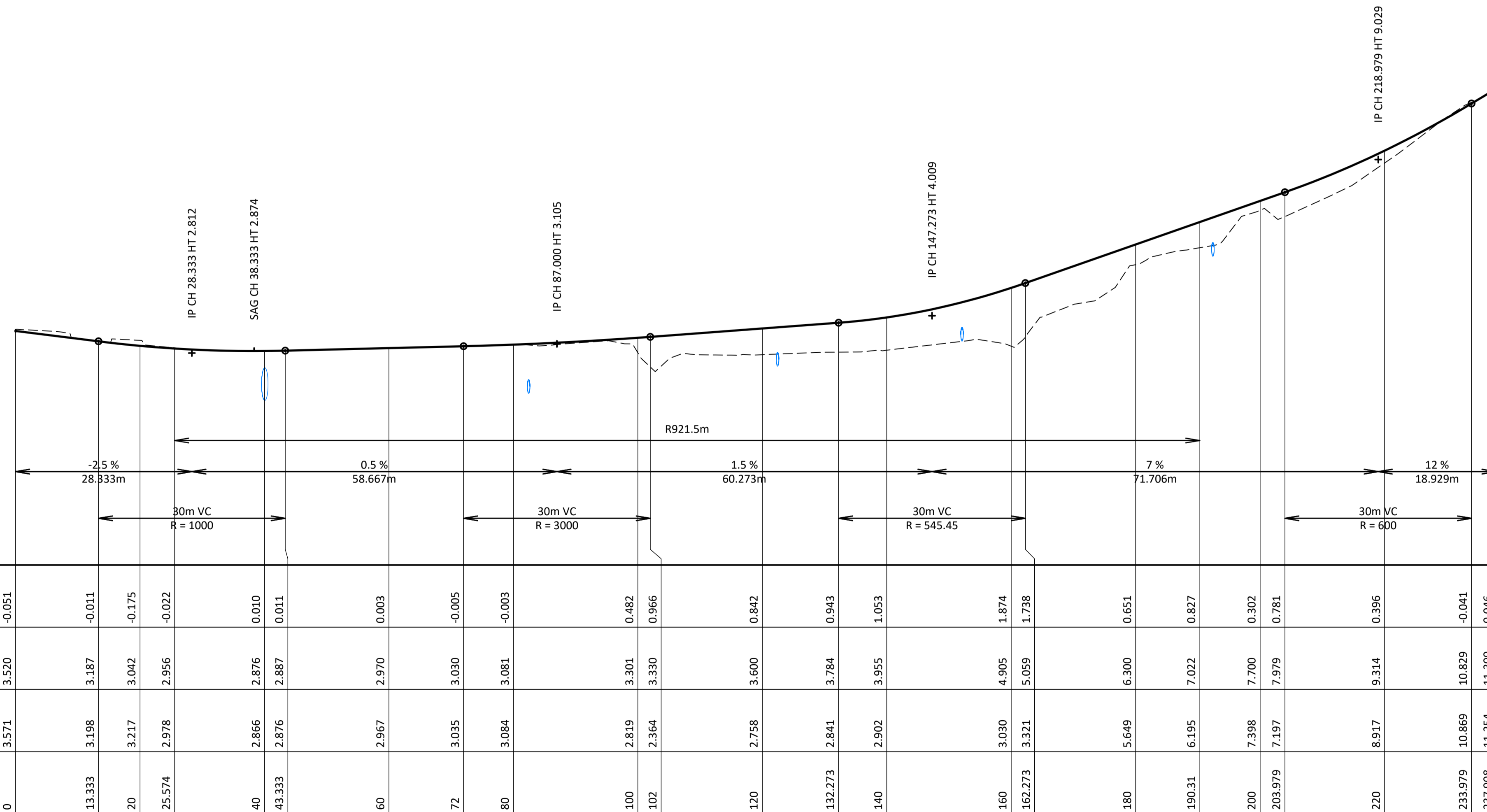
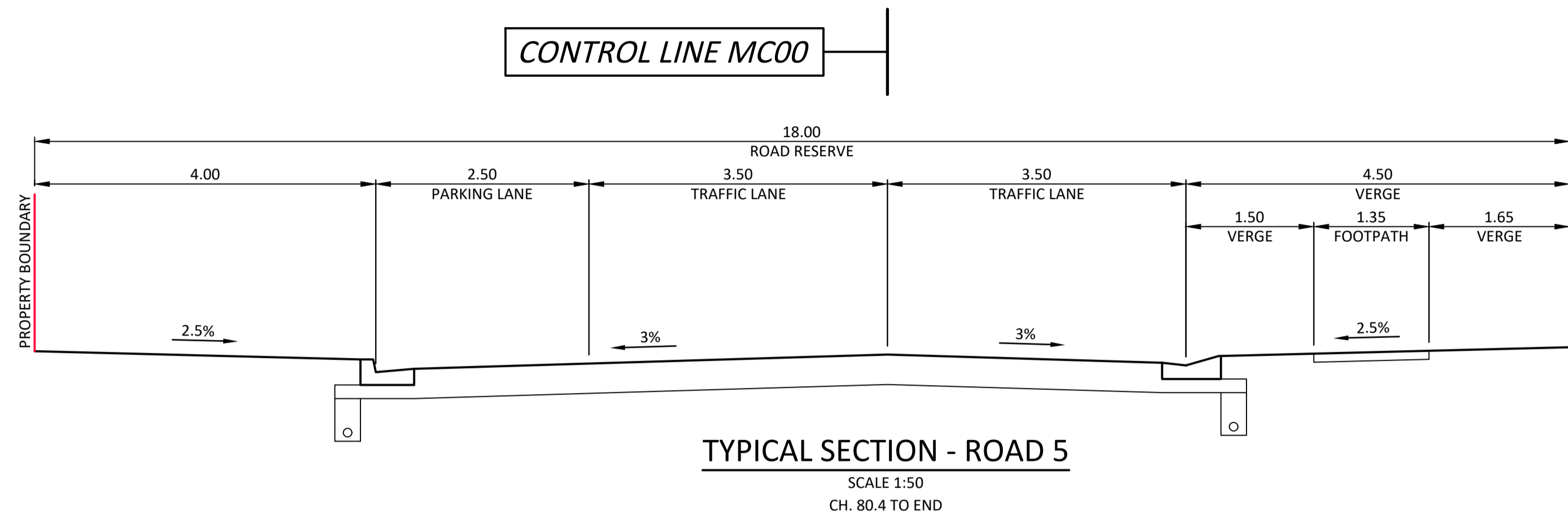
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Casino
100 Barker St. Casino 2470
T & F: 66 625000

**CLARENCE
PROPERTY**

EPIQ ESTATE - LENNOX HEAD, NSW, 2478
SUPER LOT 7
CIVIL WORKS
PLAN

Reference No. 2014/351	DRAWING No. 14351-S7-DA-CI-01
REVISION A	



Horiz Curve Data

Vertical Geometry Grade (%)

Vertical Grade Length

Vertical Curve Length (m)

Vertical Curve Radius (m)

DATUM R.L. -4.00

DEPTH TO EXISTING SURFACE	DESIGN HEIGHT	EXISTING SURFACE	CHAINAGE
-0.051	3.520	3.571	0
-0.011	3.187	3.198	13.333
-0.175	3.042	3.217	20
-0.022	2.956	2.978	25.574
0.010	2.876	2.866	40
0.011	2.887	2.876	43.333
0.003	2.970	2.967	60
-0.005	3.030	3.035	72
-0.003	3.081	3.084	80
0.482	3.301	2.819	100
0.966	3.330	2.364	102
0.842	3.600	2.758	120
0.943	3.784	2.841	132.273
1.053	3.955	2.902	140
1.874	4.905	3.030	160
1.738	5.059	3.321	162.273
0.651	6.300	5.649	180
0.827	7.022	6.195	190.31
0.302	7.700	7.398	200
0.781	7.979	7.197	203.979
0.396	9.314	8.917	220
-0.041	10.829	10.869	233.979
0.046	11.300	11.254	237.908

LONGITUDINAL SECTION MC00

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

FOR APPROVAL

REVISIONS	DESCRIPTION	DY	CP	DATE
A	FOR APPROVAL			24.08.18

SCALES SHOWN ARE FOR AN A1 SIZE ORIGINAL DRAWING

SCALE (m)	Full Size	Half Reduction
0 5 10 20 30	1:500	1:1000
0 1 2 4 6	1:100	1:200
0 0.5 1 2 3	1:50	1:100

HORIZ. DATUM	MGA
VERT. DATUM	AHD
SURVEY	NDC
DRAWN	DY
DESIGN	DY
APPROVED	CP
DATE	24.08.2018

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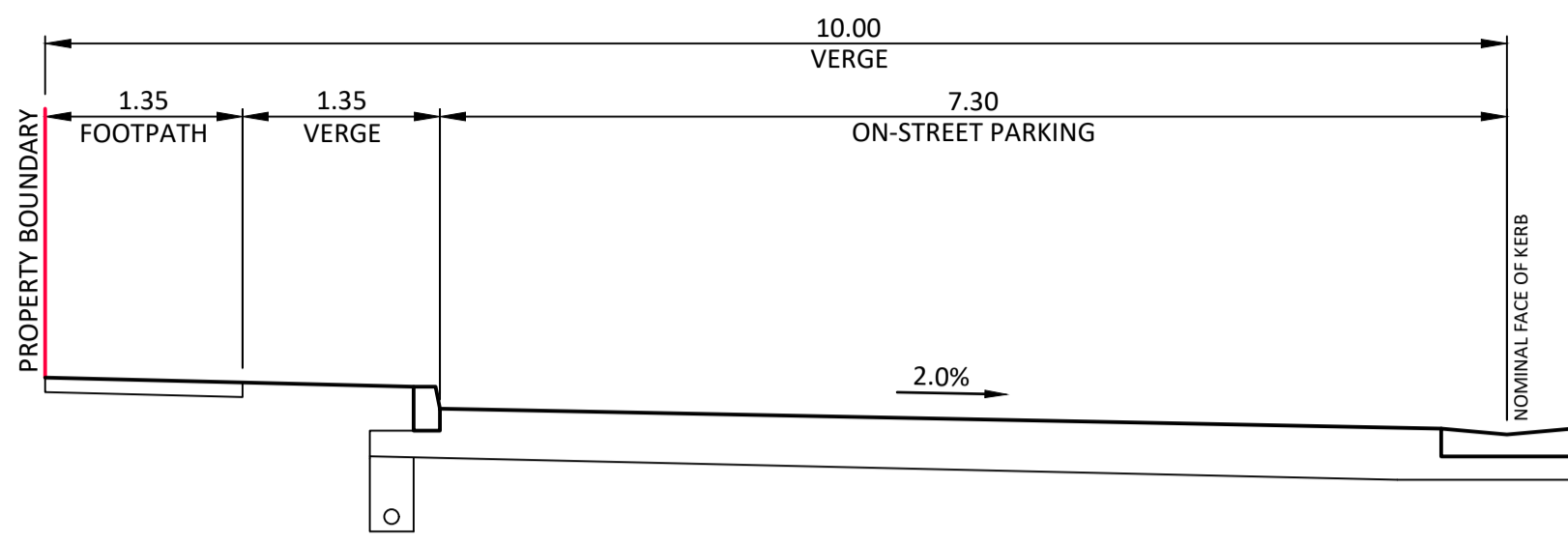
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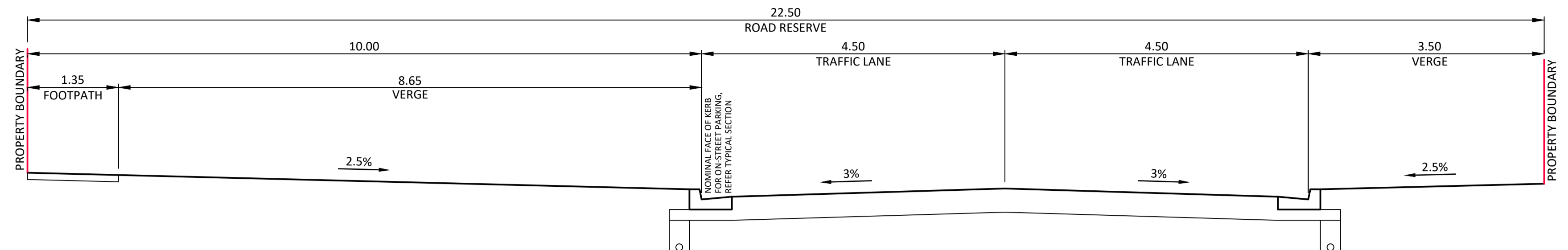
EPIQ ESTATE - LENNOX HEAD, NSW, 2478
SUPER LOT 7
CIVIL WORKS
LONGITUDINAL SECTION - MC00

Reference No. 2014/351	DRAWING No. 14351-S7-DA-CI-10	REVISION A
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Plot Date: 24 Aug. 2018 CAD File Name: K:\Jobs\2014\14351 - Clarence Property\Super Lot 7\Engineering\Drawings\14351-S7-DA-CI-10.dwg

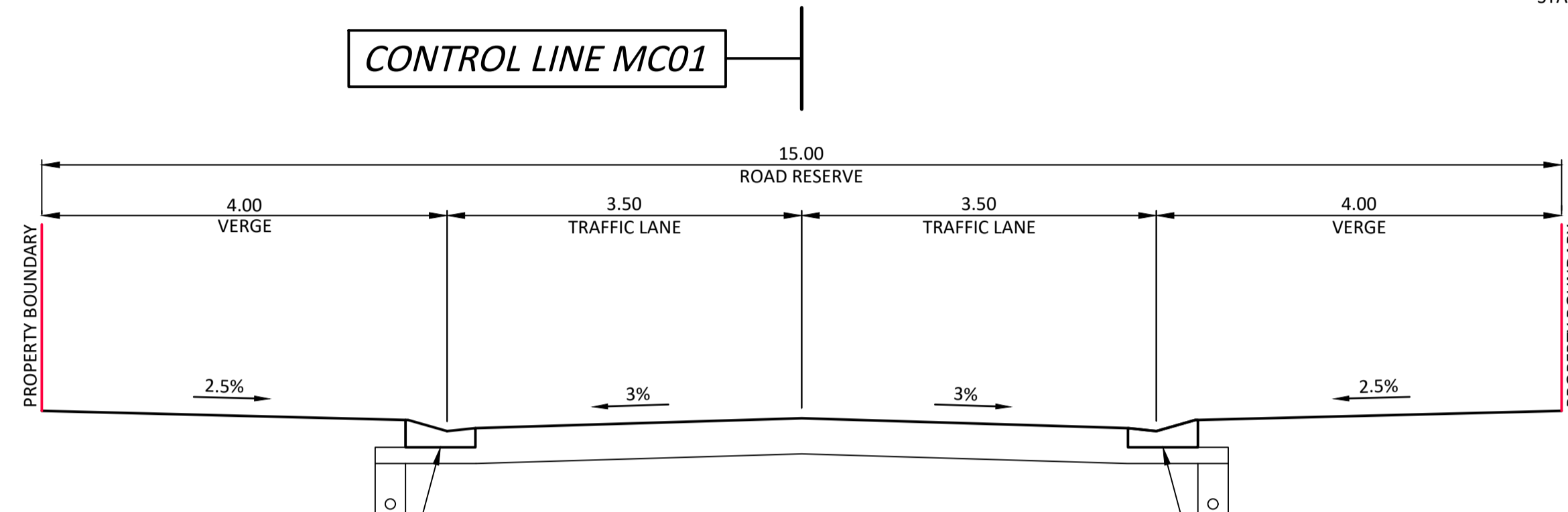


TYPICAL SECTION ON-STREET PARKING



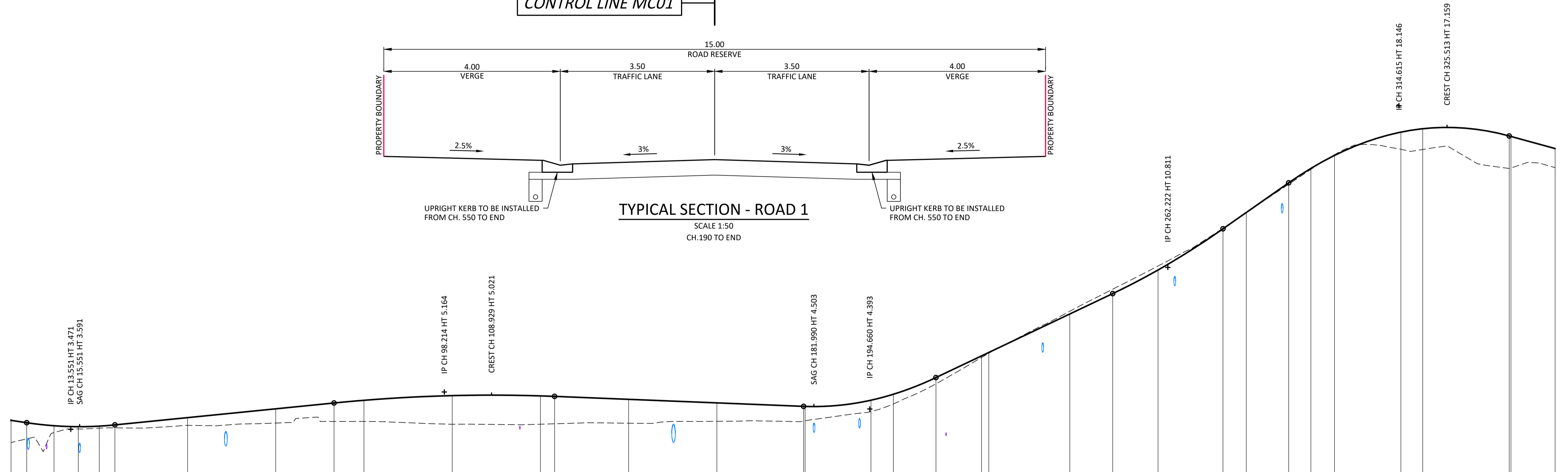
TYPICAL SECTION - ROAD 1

SCALE 1:50
START TO CH. 190



TYPICAL SECTION - ROAD 1

SCALE 1:50
CH. 190 TO END



Horiz Curve Data

Vertical Geometry Grade (%)

Vertical Grade Length

Vertical Curve Length (m)

Vertical Curve Radius (m)

DATUM R.L. -3.00

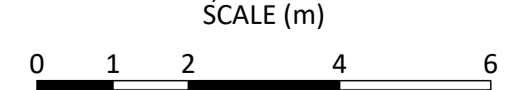
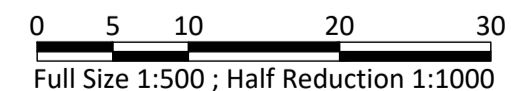
DEPTH TO EXISTING SURFACE	1.005	0.734	0.310	0.104	0.093	0.133	0.349	0.645	0.835	0.959	1.298	1.284	1.242	1.082	0.836	0.668	0.653	0.517	0.440	0.284	0.072	0.037	-0.125	-0.200	-0.180	-0.025	0.024	0.063	0.046	-0.031	0.778	0.942	1.475	1.432	0.864
DESIGN HEIGHT	3.878	3.771	3.633	3.591	3.616	3.671	4.000	4.400	4.664	4.787	4.999	4.987	4.964	4.830	4.670	4.513	4.510	4.791	5.060	5.818	6.800	6.956	8.700	9.624	10.695	12.561	13.300	14.646	15.300	15.890	16.946	17.100	16.771	16.750	16.200
EXISTING SURFACE	2.872	3.037	3.323	3.487	3.523	3.538	3.651	3.755	3.829	3.828	3.701	3.703	3.722	3.748	3.834	3.845	3.857	4.274	4.621	5.534	6.728	6.919	8.825	9.823	10.875	12.586	13.276	14.583	15.254	15.921	16.168	16.157	15.296	15.318	15.336
CHAINAGE	0	3.551	9.75	15.252	20	23.551	40	60	73.214	80	100	120	123.214	140	160	179.66	180	194.934	200	209.66	220	221.638	240	249.722	260	274.722	280	289.615	294.638	300	315.058	320	339.615	340	350

LONGITUDINAL SECTION MC01

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

FOR APPROVAL

SCALES SHOWN ARE FOR AN A1 SIZE ORIGINAL DRAWING



HORIZ. DATUM	MGA
VERT. DATUM	AHD
SURVEY	NDC
DRAWN	DY
DESIGN	DY
APPROVED	CP
DATE	24.08.2018

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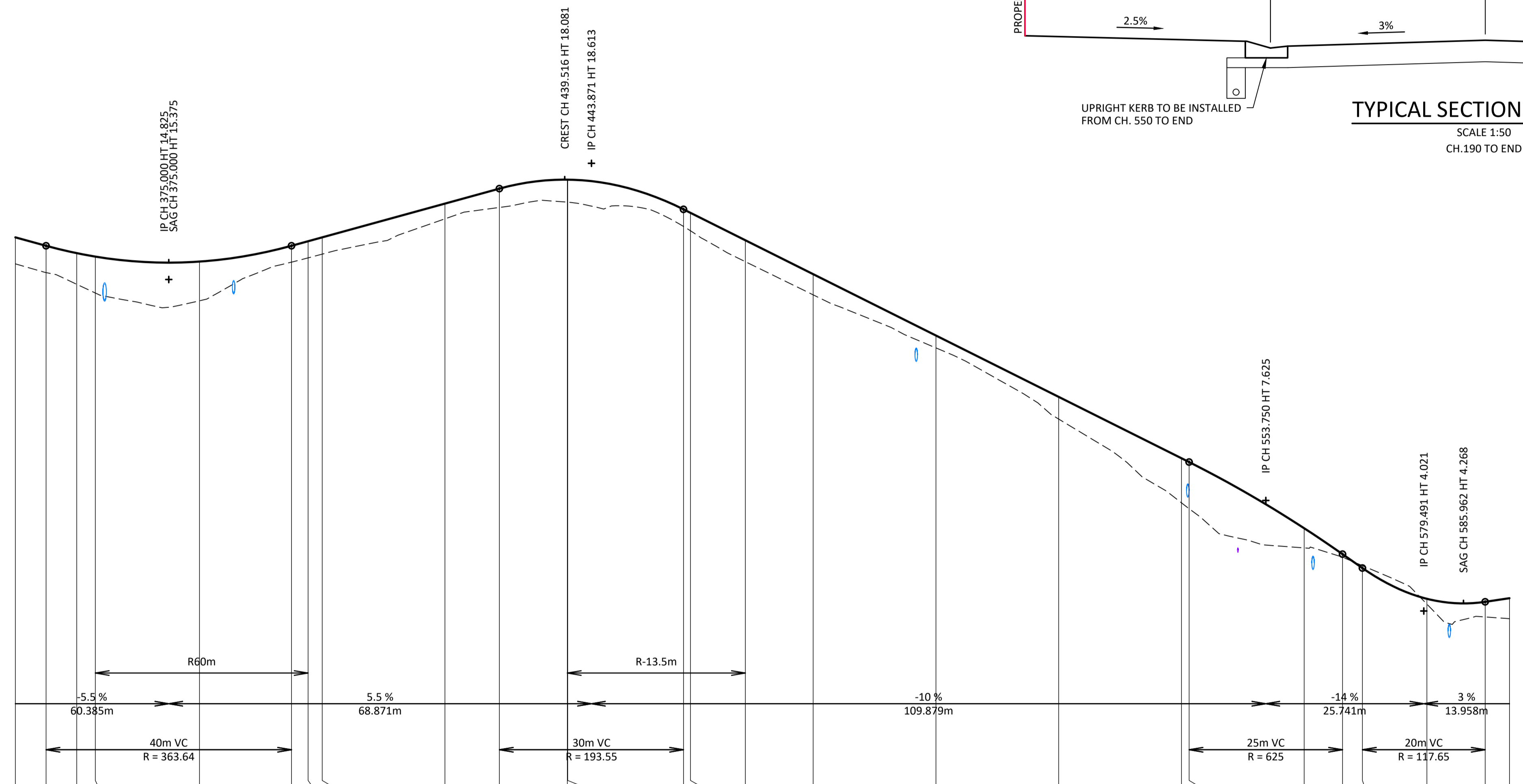
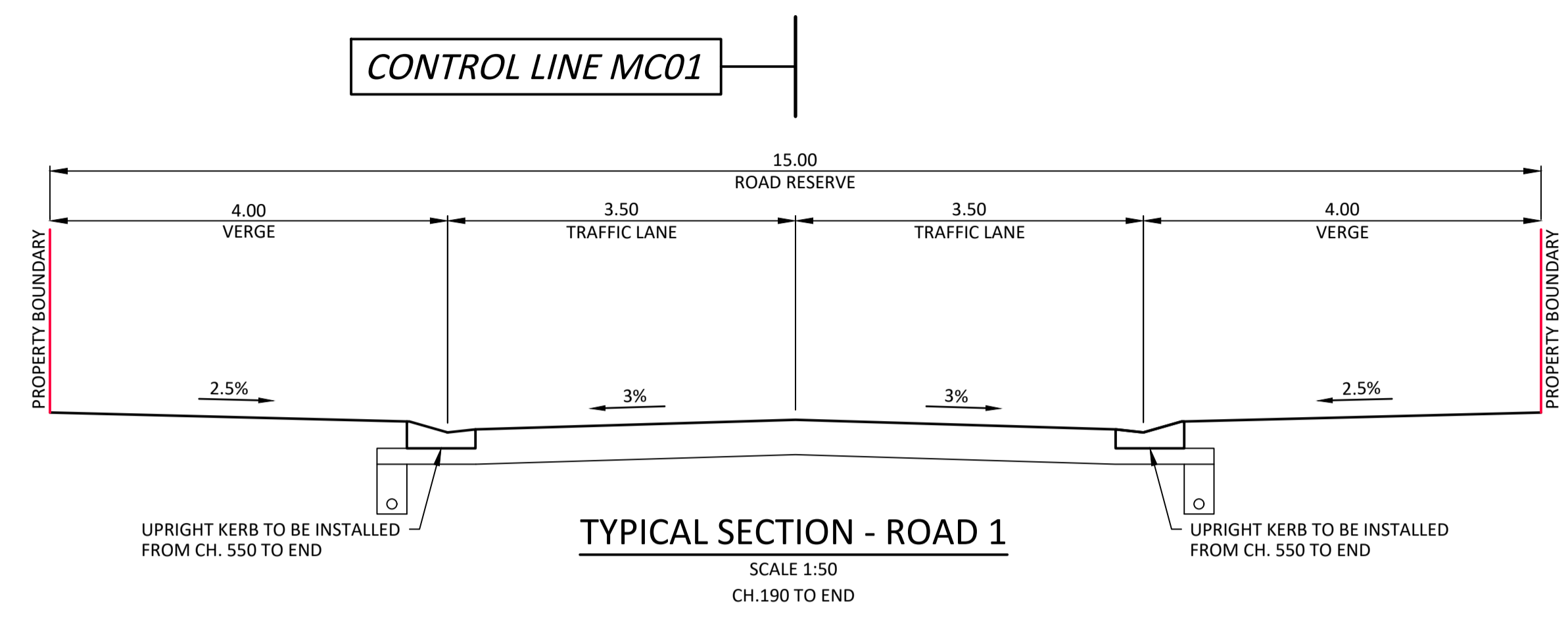
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EPIQ ESTATE - LENNOX HEAD, NSW, 2478
SUPER LOT 7
CIVIL WORKS
LONGITUDINAL SECTION - MC01

Reference No.	DRAWING No.	REVISION
2014/351	14351-S7-DA-CI-11	A

Plot Date: 24 Aug, 2018 CAD File Name: K:\Jobs\2014\14351 - Clarence Property\Super Lot 7\Engineering\Drawings\14351-S7-DA-CI-11.dwg



Horiz Curve Data
Vertical Geometry Grade (%)
Vertical Curve Length (m)
Vertical Curve Radius (m)

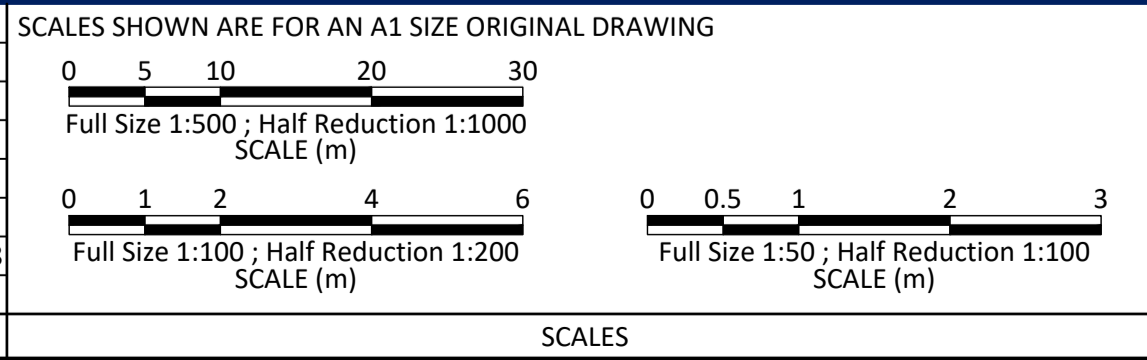
DEPTH TO EXISTING SURFACE	DESIGN HEIGHT	EXISTING SURFACE	CHAINAGE
0.864	16.200	15.336	350
0.873	15.925	15.052	355
1.014	15.684	14.670	360
1.186	15.572	14.386	363.029
1.278	15.409	14.131	380
0.533	15.925	15.392	395
0.543	16.073	15.530	397.697
0.547	16.200	15.653	400
0.496	17.300	16.804	420
0.615	17.788	17.173	428.871
0.733	18.080	17.347	439.939
0.734	18.080	17.346	440
0.558	17.113	16.555	458.871
0.586	17.000	16.414	460
0.698	16.105	15.407	468.945
0.674	15.000	14.326	480
0.404	13.000	12.596	500
0.724	11.000	10.276	520
1.452	9.000	7.548	540
1.519	8.875	7.356	541.25
0.641	6.719	6.078	560
0.100	5.875	5.775	566.25
-0.079	5.421	5.500	569.491
0.176	4.419	4.244	580
0.494	4.321	3.828	589.491
0.670	4.440	3.770	593.449

LONGITUDINAL SECTION - MC01

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

FOR APPROVAL

REV	DESCRIPTION	BY	CP APP.	DATE
A	FOR APPROVAL	DY	CP	24.08.18



HORIZ. DATUM	MGA
VERT. DATUM	AHD
SURVEY	NDC
DRAWN	DY
DESIGN	DY
APPROVED	CP
DATE	24.08.2018

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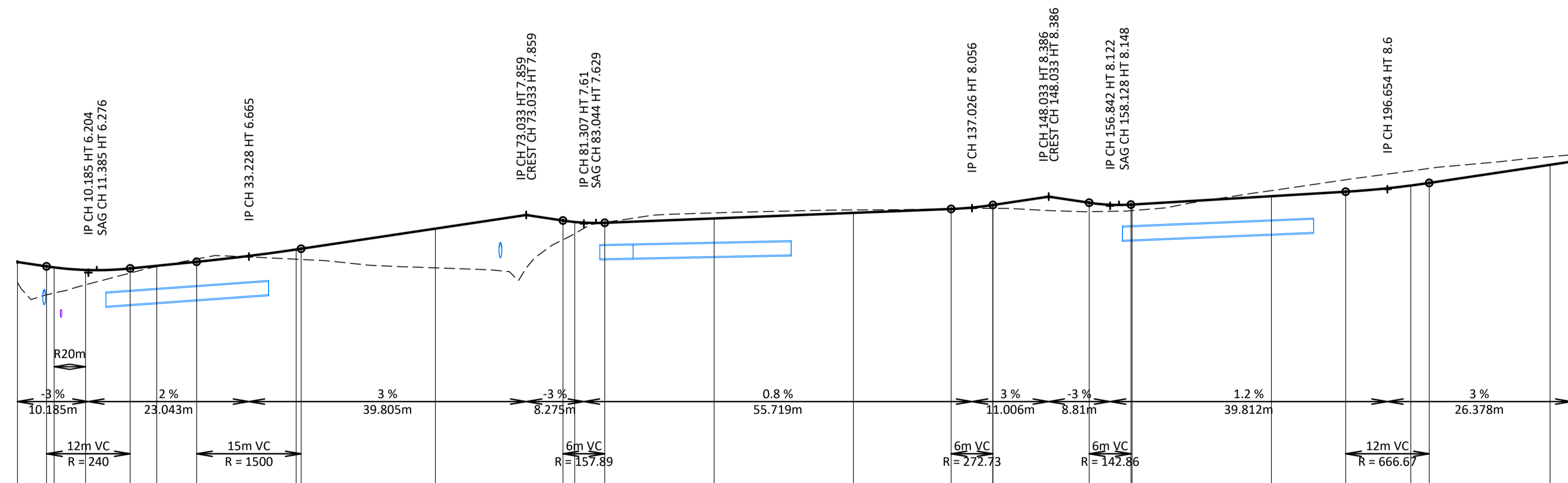
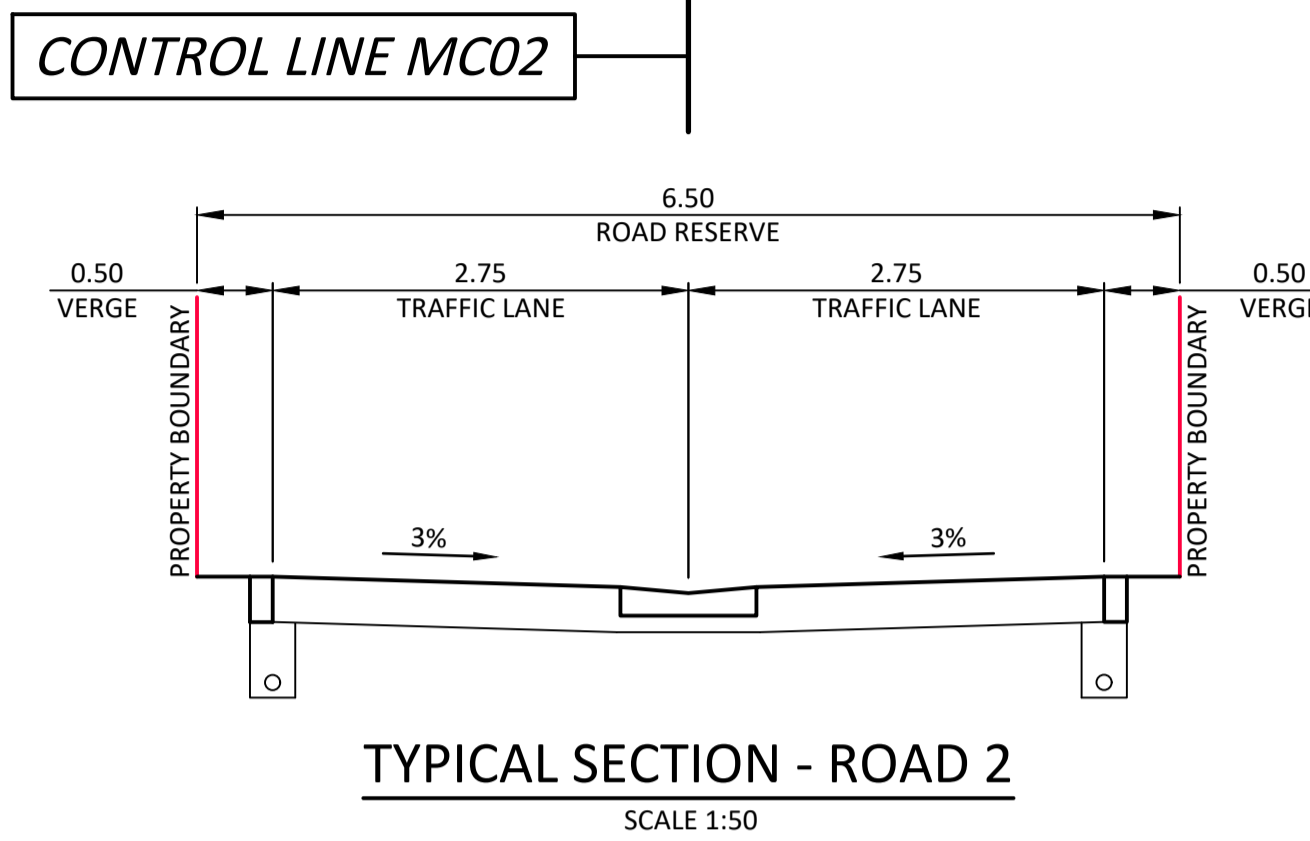
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Casino 100 Barker St. Casino 2470
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CLARENCE PROPERTY

EPIQ ESTATE - LENNOX HEAD, NSW, 2478
SUPER LOT 7
CIVIL WORKS
LONGITUDINAL SECTION - MC01

Reference No. 2014/351
DRAWING No. 14351-S7-DA-CI-12
REVISION A



Horiz Curve Data

Vertical Geometry Grade (%)

Vertical Grade Length

Vertical Curve Length (m)

Vertical Curve Radius (m)

DATUM R.L. -0.50

DEPTH TO EXISTING SURFACE	DESIGN HEIGHT	EXISTING SURFACE	CHAINAGE
0.589	6.509	5.921	0
0.819	6.384	5.565	4.185
0.737	6.354	5.617	5.269
0.426	6.281	5.855	9.774
0.131	6.324	6.193	16.185
0.025	6.400	6.375	20
-0.080	6.515	6.595	25.728
0.279	6.868	6.589	40
0.308	6.890	6.582	40.728
1.127	7.468	6.341	60
0.552	7.700	7.148	78.307
0.333	7.659	7.326	80
-0.011	7.634	7.646	84.307
-0.159	7.760	7.919	100
-0.085	7.920	8.005	120
-0.007	8.032	8.039	134.026
0.097	8.145	8.048	140
0.098	8.146	8.048	140.026
0.258	8.212	7.955	153.842
0.176	8.158	7.982	159.842
0.175	8.160	7.985	160
-0.159	8.400	8.559	180
-0.344	8.528	8.872	190.654
-0.419	8.706	9.125	200
-0.418	8.780	9.198	202.654
-0.234	9.300	9.534	220
-0.195	9.391	9.586	223.033

LONGITUDINAL SECTION MC02

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

FOR APPROVAL

SCALES SHOWN ARE FOR AN A1 SIZE ORIGINAL DRAWING



Full Size 1:500; Half Reduction 1:1000
SCALE (m)



Full Size 1:200; Half Reduction 1:400
SCALE (m)



Full Size 1:100; Half Reduction 1:200
SCALE (m)

HORIZ. DATUM	MGA
VERT. DATUM	AHD
SURVEY	NDC
DRAWN	DY
DESIGN	DY
APPROVED	CP
DATE	24.08.2018

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CLARENCE
PROPERTY

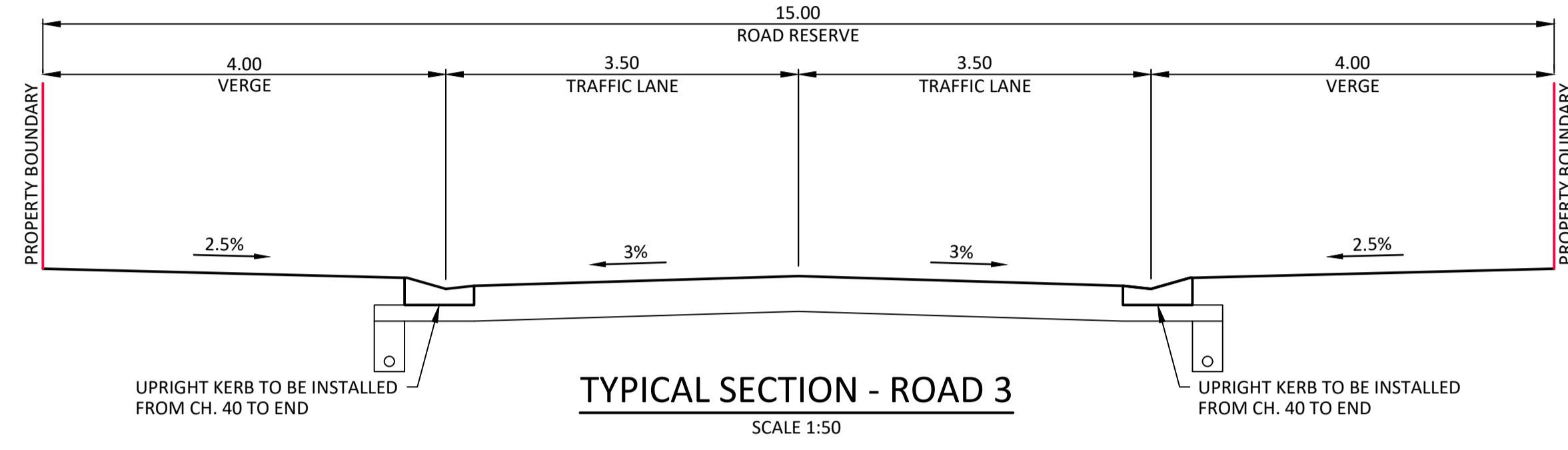
EPIQ ESTATE - LENNOX HEAD, NSW, 2478
SUPER LOT 7
CIVIL WORKS
LONGITUDINAL SECTION - MC02

Reference No. **2014/351** DRAWING No. **14351-S7-DA-CI-13**

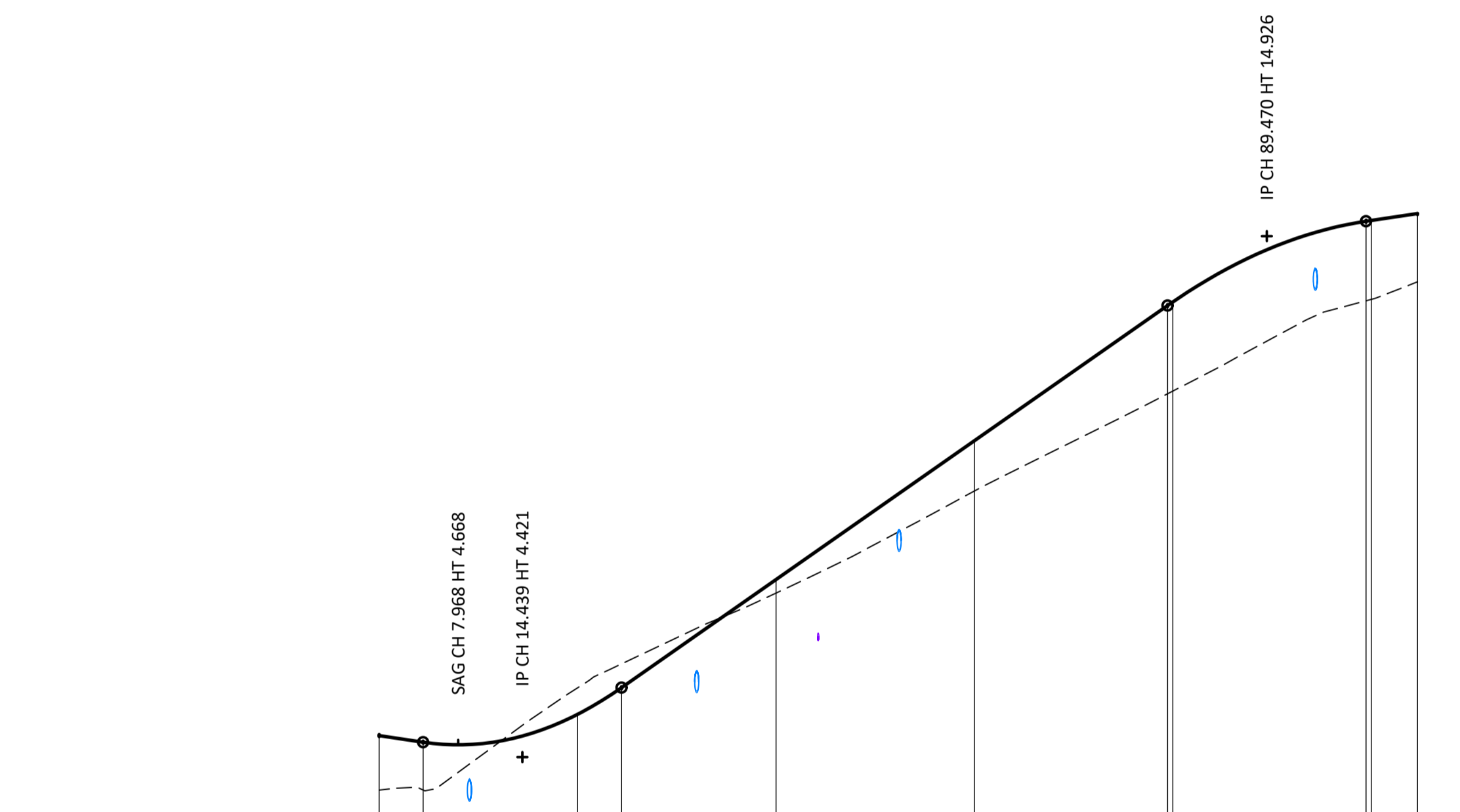
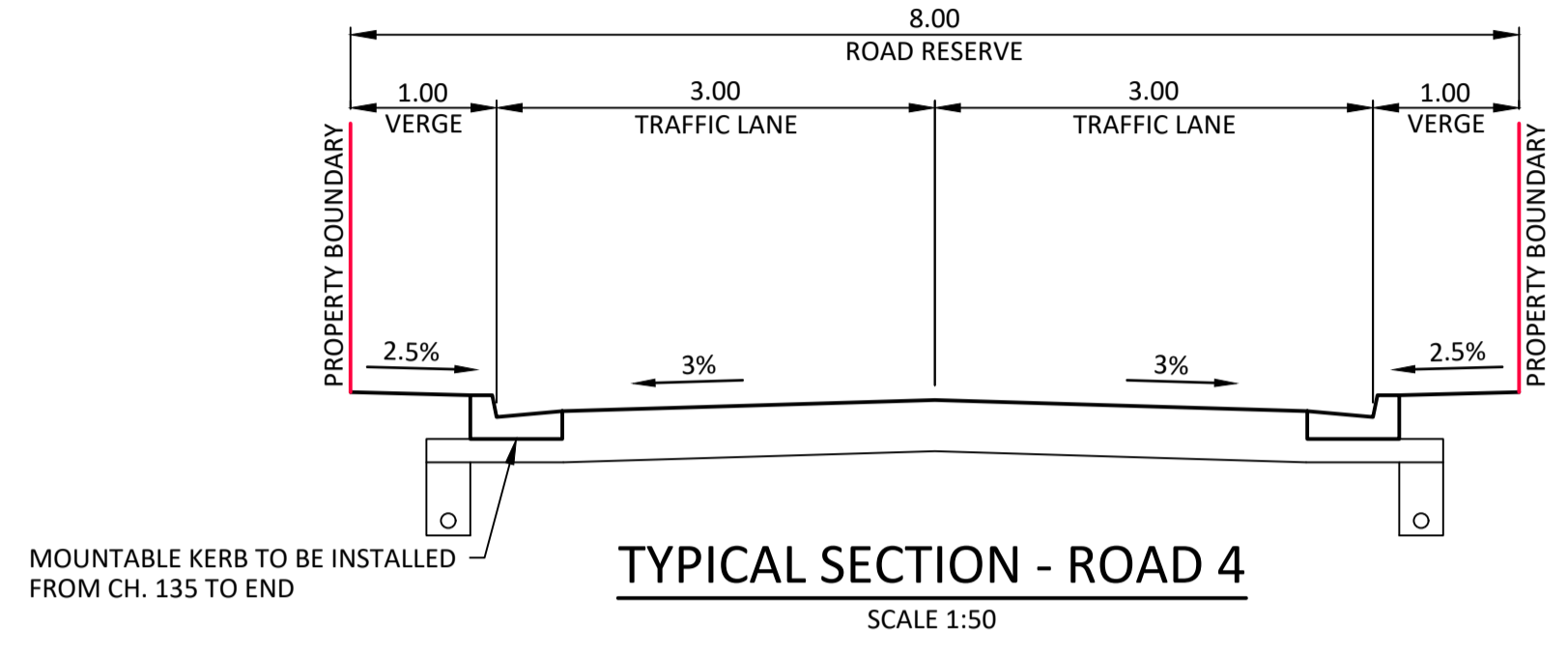
REVISION **A**

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CONTROL LINE MC03

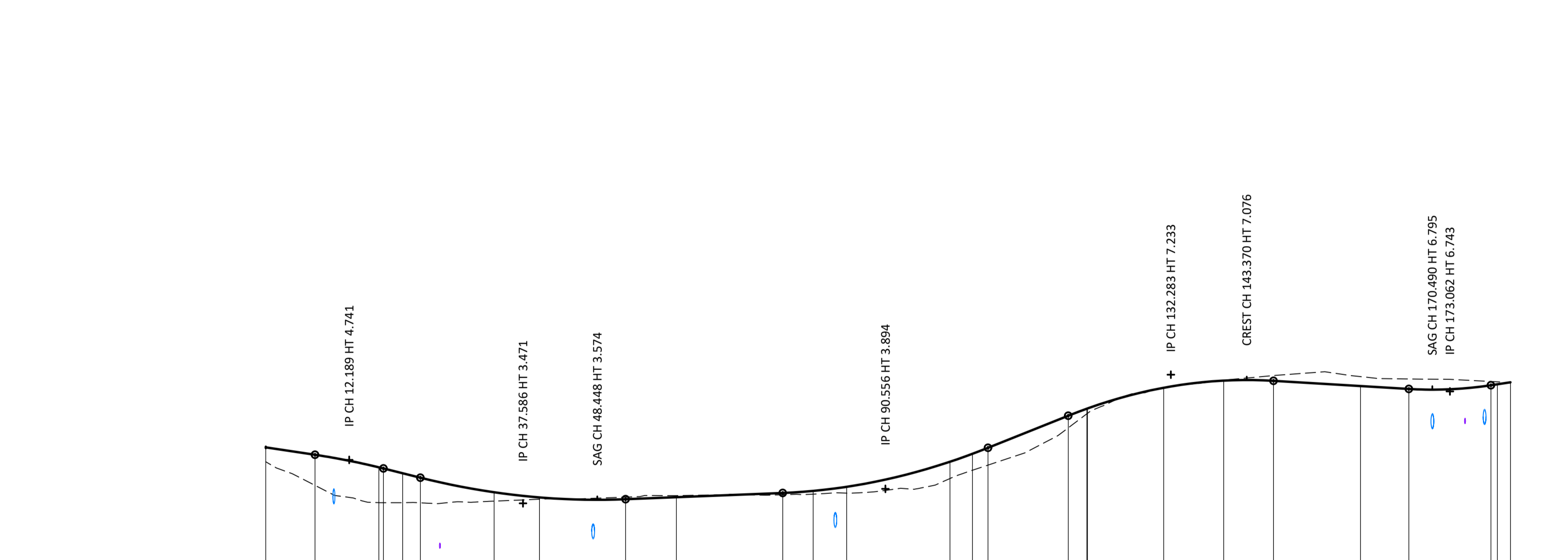


CONTROL LINE MC04



Horiz Curve Data
Vertical Geometry Grade (%)
Vertical Grade Length
Vertical Curve Length (m)
Vertical Curve Radius (m)
DATUM R.L. -1.50

DEPTH TO EXISTING SURFACE	DESIGN HEIGHT	EXISTING SURFACE	CHAINAGE
1.099	4.855	3.755	0
0.965	4.721	3.756	4.439
-0.534	5.284	5.817	20
-0.480	5.821	6.302	24.439
0.271	8.000	7.729	40
1.013	10.800	9.787	60
1.779	13.526	11.747	79.47
1.798	13.599	11.801	80
1.604	15.226	13.622	99.47
1.592	15.242	13.650	100
1.377	15.382	14.004	104.663

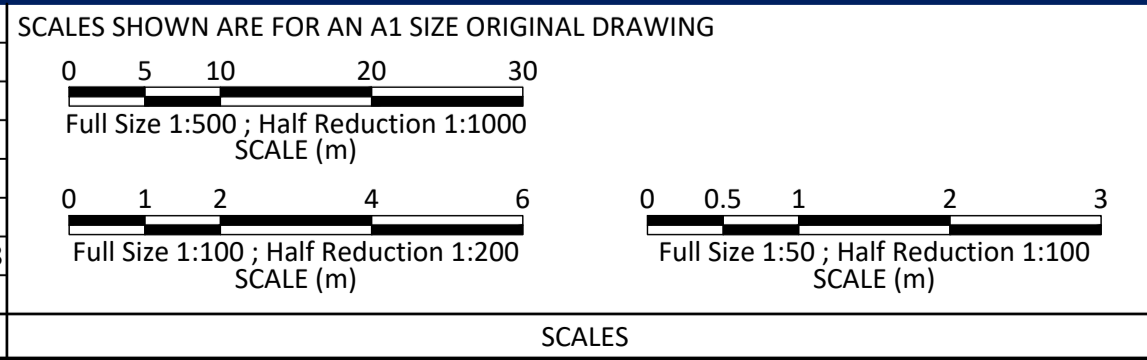


Horiz Curve Data
Vertical Geometry Grade (%)
Vertical Grade Length
Vertical Curve Length (m)
Vertical Curve Radius (m)
DATUM R.L. -3.00

DEPTH TO EXISTING SURFACE	DESIGN HEIGHT	EXISTING SURFACE	CHAINAGE
0.421	5.106	4.685	0
0.894	4.891	3.997	7.189
1.032	4.523	3.491	16.532
1.001	4.491	3.489	17.189
0.859	4.350	3.491	20
0.736	4.221	3.485	22.586
0.259	3.794	3.535	33.37
0.053	3.643	3.591	40
-0.062	3.591	3.652	52.586
-0.046	3.650	3.696	60
0.052	3.774	3.723	75.556
0.095	3.834	3.739	80
0.185	3.954	3.769	84.899
0.490	4.687	4.197	100
0.480	4.919	4.439	103.279
0.505	5.094	4.590	105.556
0.355	6.033	5.678	117.283
0.150	6.239	6.088	120
0.142	6.246	6.104	120.101
0.006	6.850	6.844	131.234
-0.015	7.059	7.074	140
-0.153	7.053	7.206	147.283
-0.276	6.900	7.176	160
-0.291	6.815	7.106	167.062
-0.110	6.923	7.033	179.062
-0.072	6.951	7.024	180
0.024	7.009	6.984	181.917

FOR APPROVAL

REVISIONS	DESCRIPTION	DY	CP	24.08.18
A	FOR APPROVAL			



HORIZ. DATUM	MGA
VERT. DATUM	AHD
SURVEY	NDC
DRAWN	DY
DESIGN	DY
APPROVED	CP
DATE	24.08.2018

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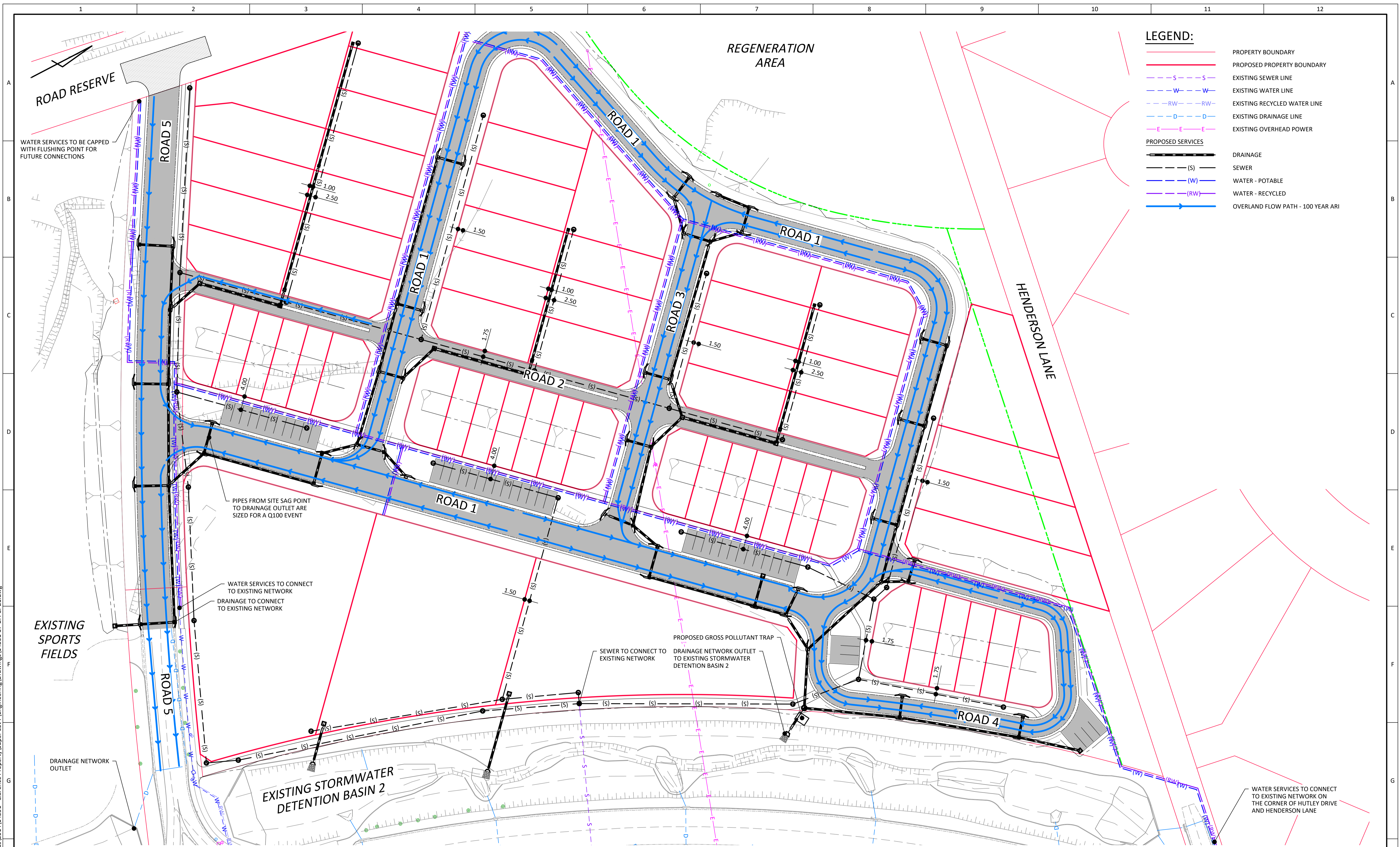
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EPIQ ESTATE - LENNOX HEAD, NSW, 2478
SUPER LOT 7
CIVIL WORKS
LONGITUDINAL SECTION - MC03 & MC04

Reference No. 2014/351
DRAWING No. 14351-S7-DA-CI-14
REVISION A

Plot Date: 24 Aug. 2018 CAD File Name: K:\Jobs\2014\14351 - Clarence Property\Super Lot 7\Engineering\Drawings\14351-S7-DA-CI-14.dwg



- LEGEND:**
- (Red solid line) — PROPERTY BOUNDARY
 - (Red dashed line) — PROPOSED PROPERTY BOUNDARY
 - - - S - S (Blue dashed line) - EXISTING SEWER LINE
 - - - W - W (Blue dashed line) - EXISTING WATER LINE
 - - - RW - RW (Blue dashed line) - EXISTING RECYCLED WATER LINE
 - - - D - D (Blue dashed line) - EXISTING DRAINAGE LINE
 - - - E - E (Pink dashed line) - EXISTING OVERHEAD POWER
- PROPOSED SERVICES**
- (Black solid line) — DRAINAGE
 - (S) (Black solid line) — SEWER
 - (W) (Blue solid line) — WATER - POTABLE
 - (RW) (Blue solid line) — WATER - RECYCLED
 - (Blue solid line with arrow) — OVERLAND FLOW PATH - 100 YEAR ARI

PLAN
SCALE 1:500

FOR APPROVAL

REV	DESCRIPTION	DY BY	CP APP	DATE
A	FOR APPROVAL	DY	CP	24.08.18

SCALES SHOWN ARE FOR AN A1 SIZE ORIGINAL DRAWING

SCALES
0 5 10 20 30
Full Size 1:500; Half Reduction 1:1000
SCALE (m)

APPROVALS	
HORIZ. DATUM	MGA
VERT. DATUM	AHD
SURVEY	NDC
DRAWN	DY
DESIGN	DY
APPROVED DATE	CP 24.08.2018

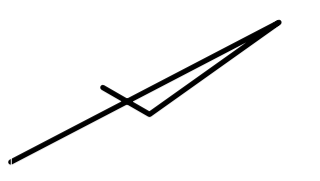
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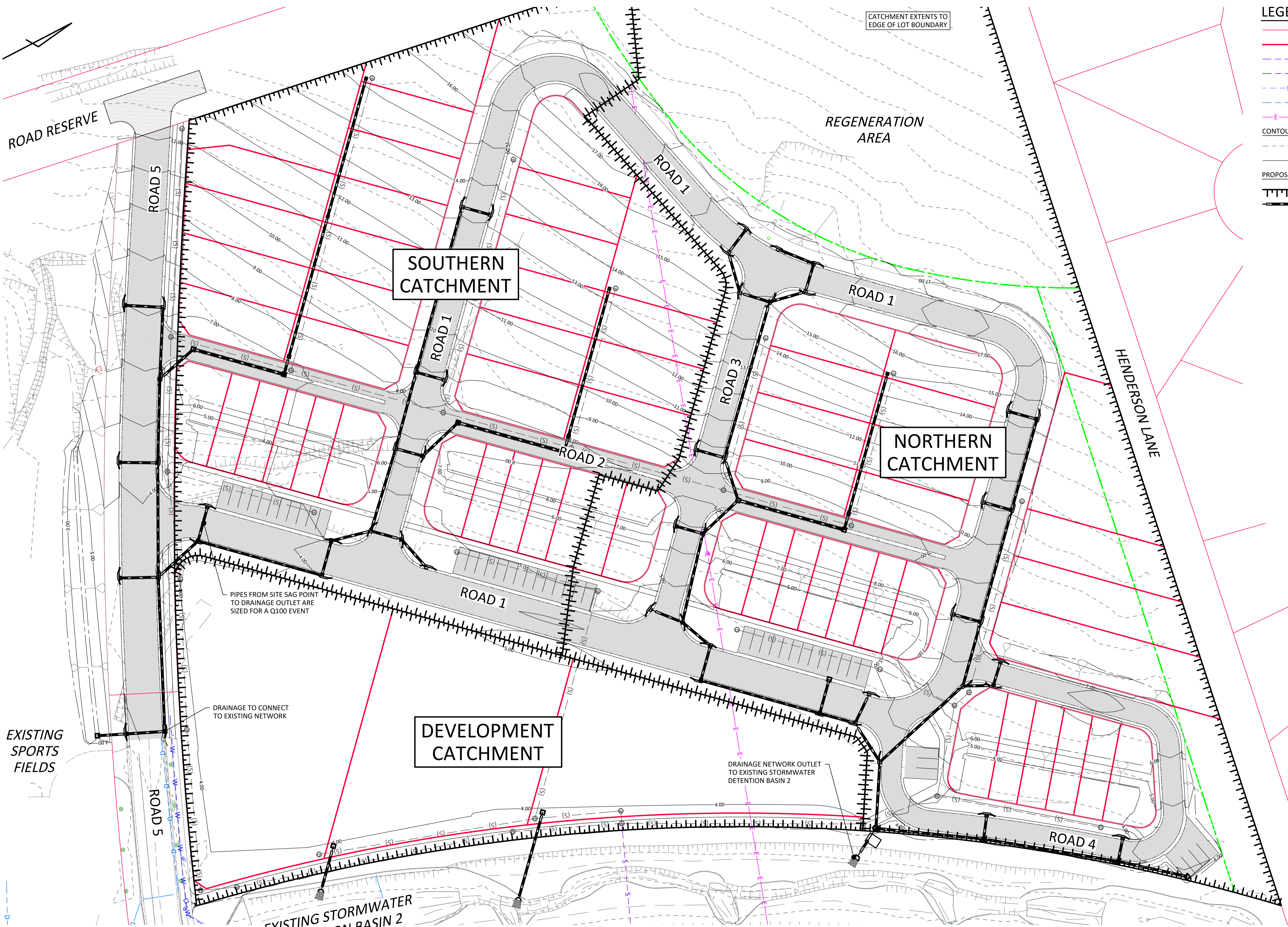
EPIQ ESTATE - LENNOX HEAD, NSW, 2478
SUPER LOT 7
CIVIL SERVICES PLAN

Reference No. 2014/351	DRAWING No. 14351-S7-DA-CI-21	REVISION A
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CATCHMENT EXTENTS TO
EDGE OF LOT BOUNDARY

- LEGEND:**
- PROPERTY BOUNDARY
 - - - PROPOSED PROPERTY BOUNDARY
 - S - S - EXISTING SEWER LINE
 - W - W - EXISTING WATER LINE
 - RW - RW - EXISTING RECYCLED WATER LINE
 - D - D - EXISTING DRAINAGE LINE
 - E - E - EXISTING OVERHEAD POWER
- CONTOURS**
- - - EXISTING (1m INTERVALS)
 - - - DESIGN (1m INTERVALS)
- PROPOSED DRAINAGE**
- CATCHMENT BOUNDARY
 - DRAINAGE



PIPES FROM SITE SAG POINT
TO DRAINAGE OUTLET ARE
SIZED FOR A Q100 EVENT

DRAINAGE TO CONNECT
TO EXISTING NETWORK

**DEVELOPMENT
CATCHMENT**

DRAINAGE NETWORK OUTLET
TO EXISTING STORMWATER
DETENTION BASIN 2

PLAN
SCALE 1:500

FOR APPROVAL

Plot Date: 24.Aug. 2018 CAD File Name: K:\Jobs\2014\14351 - Clarence Property\Super Lot 7\Engineering\Drawings\14351-S7-DA-CI-22.dwg

REV	DESCRIPTION	BY	CP	DATE
A	FOR APPROVAL	DY	CP	24.08.18

SCALES SHOWN ARE FOR AN A1 SIZE ORIGINAL DRAWING

SCALES
0 5 10 20 30
Full Size 1:500 ; Half Reduction 1:1000
SCALE (m)

HORIZ. DATUM	MGA
VERT. DATUM	AHD
SURVEY	NDC
DRAWN	DY
DESIGN	DY
APPROVED	CP
DATE	24.08.2018

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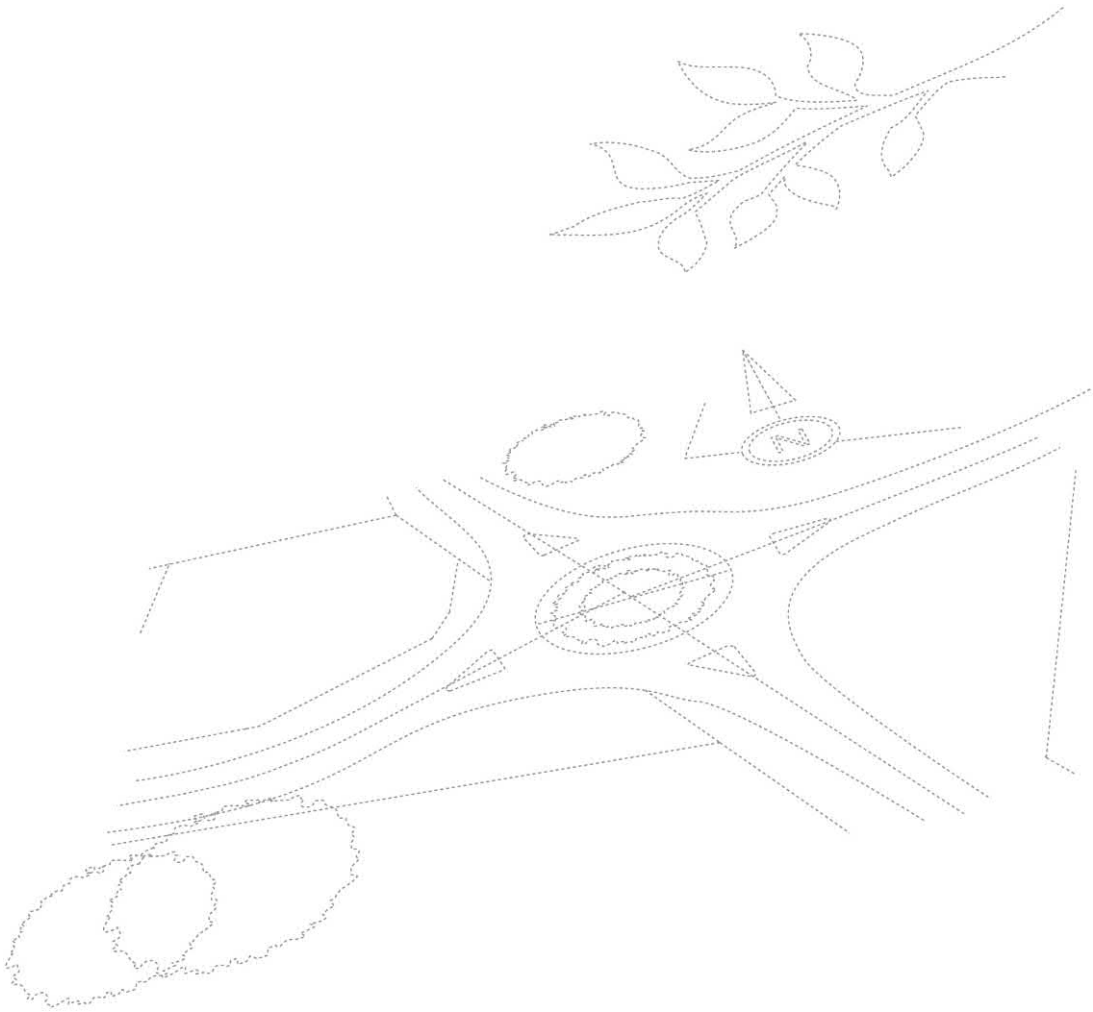


EPIQ ESTATE - LENNOX HEAD, NSW, 2478
SUPER LOT 7
DRAINAGE
CATCHMENT PLAN

Reference No. 2014/351 DRAWING No. 14351-S7-DA-CI-22

REVISION
A

Appendix B Acid Sulfate Soil Management Plan



Acid Sulfate Soil Management Plan Pacific Pines Stage 1B

Prepared for: Royal Bank of Scotland
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<i>UPR</i>	<i>Description</i>	<i>Date Issued</i>	<i>Issued By</i>
1675-1321	First issue	27/08/2014	DMT



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Background

1.1 Introduction

This Acid Sulfate Soil Management Plan (ASSMP) has been prepared by GeoLINK for the Royal Bank of Scotland and its development partner Lend Lease, for the approved residential development known as Pacific Pines, Lennox Head.

The ASSMP details strategies to mitigate potential environmental impacts associated with the disturbance of acid sulfate soils during construction of Stage 1B of the Pacific Pines development.

This Acid Sulfate Soil Management Plan specifically addresses Condition E3 of the Project Plan approval, which requires:

An Acid Sulfate Soil Management Plan shall be prepared by a suitably qualified person in accordance with the Acid Sulfate Soil Assessment Guidelines (Acid Sulfate Soil Management Advisory Committee, 1998). The Management Plan shall be submitted to and approved by the Certifying Authority prior to the issue of a Construction Certificate.

1.2 The Site

The Stage 1B residential subdivision is located at Montwood Drive, Lennox Head, on land known as Lot 234 DP 1104071. The whole of this property has an area of approximately 80.5 hectares, with Stage 1B occupying the lower western part of the lot.

1.3 The Approved Development

Stage 1B is part of a larger residential subdivision approved by the NSW State Government under MP_0026, which includes a *Concept Approval* for the whole of the Pacific Pines estate and a *Project Approval* for Stage 1.

The development subject to the Project Approval is described as:

A 61 lot residential subdivision comprising:

1. *Fifty one residential lots ranging in size from 600 m² to 900 m².*
2. *Seven super lots for future development as follows:*
 - a) *Super Lot 1 (1.44 ha).*
 - b) *Super Lot 3 (0.21 ha).*
 - c) *Super Lot 4 (0.18 ha).*
 - d) *Super Lot 5 (4.2 ha).*
 - e) *Super Lot 6 (0.24 ha).*
 - f) *Super Lot 7 (5.59 ha).*
 - g) *Super Lot 8 (4.98 ha).*
3. *Two open space lots of 910 m² and 641 m².*
4. *Earthworks.*
5. *Associated roads and civil works.*
6. *Landscaping.*

Stage 1B of the approved subdivision is described in Condition A2 of the project Approval as:

Stage 1B – Subdivision of Super Lots 1, 3, 4, 5, 6, 7 and 8, the extension of Montwood Drive, the construction of Main Street, construction of internal roads adjoining the east and north boundaries of Super Lot 1, the construction of Hutley Drive and the western link for the playing fields adjacent to the site and revegetation of the 100 metre buffer to littoral rainforest in the north west of the site.

1.4 Acid Sulfate Soil Assessment

Gilbert & Sutherland Pty Ltd (G&S) previously prepared *The Soil Survey, Acid Sulfate Assessment, Stormwater Management Plan, Surface Water Assessment and Environmental Management Plan Pacific Pines, Lennox Head* (G&S 2001).

The purpose of the assessment was to determine the presence, extent and nature of acid sulfate soils at the site. The assessment focused on the area of the water quality control pond, but is considered relevant to the adjacent Stage 1B.

Potential acid sulfate soils were identified at the site. These were generally of a moderate severity for coarse sands to fine silty sands and of high severity for silty clays.

G&S advised that “excavated material should be reinterred below the water table or treated with lime. This would involve sampling every 1,000 m³ of excavated material to determine appropriate liming rates.”

Management Plan

2.1 Acid Sulfate Sampling and Analysis

Person Responsible	Contractor's Site Manager, Environmental Consultant
Objective	To identify any ASS and PASS during Stage 1B earthworks at the site and determine their acid generating potential prior to treatment.
Performance Criteria	All AASS & PASS material is identified and appropriate treatment procedures are determined prior to excavation.
Implementation Strategy	<p>Initial acid sulfate soil investigations indicate that ASS and PASS are likely to be encountered during the Stage 1B works.</p> <p>Prior to excavation commencing, sampling and testing of material is to be undertaken in proposed excavation areas, where the depth of excavation will go below 5 mAHD, in accordance with the following protocol:</p> <p>Frequency: Chromium Suite analysis will be conducted for each soil colour or texture change encountered below 5 mAHD, with a minimum sample frequency of one test per 1000 m³ of material to be excavated.</p> <p>Sample size: Soil samples should be more than 0.3 kg in weight with a brief soil texture description accompanying each sample.</p> <p>Sampling: Soil samples will be collected in sealed containers that exclude air.</p> <p>Handling and storage: Samples to be sent to a laboratory for analysis ASAP. Samples to be frozen if storage is required.</p> <p>Laboratory analysis: Samples to be analysed using the Chromium Suite method, with the liming rate specified (where required).</p>
Monitoring	The sampling and analysis of material shall be tracked by the Environmental Consultant and Site Manager. Records shall be kept of volumes to be excavated, location of sampling and laboratory results.
Auditing	The Environmental Consultant to audit the sampling and analysis process every three months.
Reporting	ASS analytical results including interpretation and liming rates shall be reported to the Site Manager and kept on site.
Identification of Incident or Failure	Insufficient sampling or failure to sample as identified by material tracking records and/or test results and/or procedures.
Potential Corrective Actions	Undertake additional sampling as required to thoroughly identify the nature of the material to be disturbed. Consultation with an Environmental Consultant to determine appropriate rates for additional sampling.

2.2 Acid Sulfate Soil Treatment

Person Responsible	Contractor's Site Manager, Environmental Consultant.
Objective	No acidic or potentially acidic soils are to be disturbed or excavated without appropriate testing and/or treatment by neutralisation of the acid generation potential of the material.
Performance Criteria	All ASS material has been appropriately neutralised and verified prior to final placement.
Implementation Strategy	<p>Acid sulfate soil excavation to be conducted according to the following treatment measures.</p> <p>Lime treatment</p> <p>Soils requiring treatment will be placed in spatially tracked lots within bunded areas that have an impermeable base. Materials used to construct the bund areas will be free from acid sulfate soils. The bunded areas will be prepared with surface liming at the rate of 0.2 x average net acid generating potential per square metre or at the minimum rate of 1 kg/m².</p> <p>The bunded areas shall have a leachate collection system. Any water discharged from the bunded areas must comply with the water quality criteria listed in the Stormwater Works Process Strategy.</p> <p>Soils selected for treatment will be treated with lime at the rate specified by the laboratory, including a mixing factor of safety of 1.5. Uniform mixing must be achieved. A potential approach is to spread material to a depth of <300 mm, apply lime at the determined rate and mix with a rotary hoe or disc plough.</p> <p>Stockpiling of untreated ASS material within the bunded areas should be kept to a minimum and in general accordance with the requirements for Short Term Stockpiling as per the ASSMAC guidelines.</p> <p>A layer of lime slurry shall be applied to exposed cut faces immediately following the excavation to the maximum depth to neutralise the soils exposed to oxidation.</p> <p>Validation testing</p> <p>Following lime treatment, verification testing shall be performed at the rate of one sample per 250 m³ of treated material.</p> <p>Any material that exceeds TAA thresholds but does not exceed oxidisable sulfur concentrations (e.g. material that is high in organic matter or iron oxides) shall be treated with lime at the appropriate application rate, but will not require validation testing to be undertaken.</p> <p>Excavation works and timing of stockpiling/treatment</p> <p>All excavation works and stockpiling of untreated acid sulfate materials shall be carried out in such a manner that:</p> <ul style="list-style-type: none"> ▪ The surface area of materials exposed to oxidation is minimised. ▪ The length of time the untreated materials are exposed to air is minimised. ▪ Provides for a system of suitable diversion drains or embankments to divert surface waters away from the stockpiles and the excavation area. ▪ Ensures that any unforeseen groundwater seepage and/or leachate and/or stormwater runoff within the excavation area is collected and not released from the site, untreated and untreated to any stormwater drain or waters (including groundwater). ▪ Ensures that any leachate and/or stormwater runoff which has been in contact with acid sulfate materials or contaminants is collected and not released from the site, untreated and untreated to any stormwater drain or waters (including groundwater).

	<p>Supply of neutralising agent</p> <p>A supply of neutralising agent or agricultural lime shall be kept onsite at all times for treatment of acid sulfate soils. The supply shall be stored in a covered and bunded area to prevent accidental release to the environment.</p> <p>A supply of hydrated lime shall be kept onsite at all times for treatment of acidic waters (if encountered). Storage requirements for hydrated lime shall be as specified for a neutralising agent or agricultural lime and in accordance with the manufacturer's MSDS.</p>
Monitoring	The treatment of ASS material shall be tracked by the Environmental Consultant and Site Manager. Records shall be kept of actual volumes excavated, liming rates applied, and validation testing results.
Auditing	<p>The Environmental Consultant to audit the ASS treatment process every three months. Alternatively, auditing may be carried out by an independent consultant.</p> <p>The audit should include an inspection of site activities, complaints, corrective actions and reporting to assess compliance with the provisions outlined within the ASSMP.</p>
Reporting	Records including testing results and material tracking are to be kept on site during the construction phase and should be available for inspection at all times.
Identification of Incident or Failure	<p>Further investigation would only be required if:</p> <ul style="list-style-type: none"> ▪ Verification sampling tests fail, indicating the insufficient application of lime. ▪ The formation of jarosite in exposed or excavated soils was observed. ▪ Areas of green-blue water or extremely clear water occurred. ▪ Rust-coloured deposits on plants and on the banks of drains or water bodies were noted. ▪ A sulfurous odour was detected. ▪ The pH of related water bodies dropped substantially below background levels.
Potential Corrective Actions	<p>Retesting of materials in the vicinity of excavation.</p> <p>Any need for additional lime in specific lots would be assessed and applied with thorough mixing.</p>



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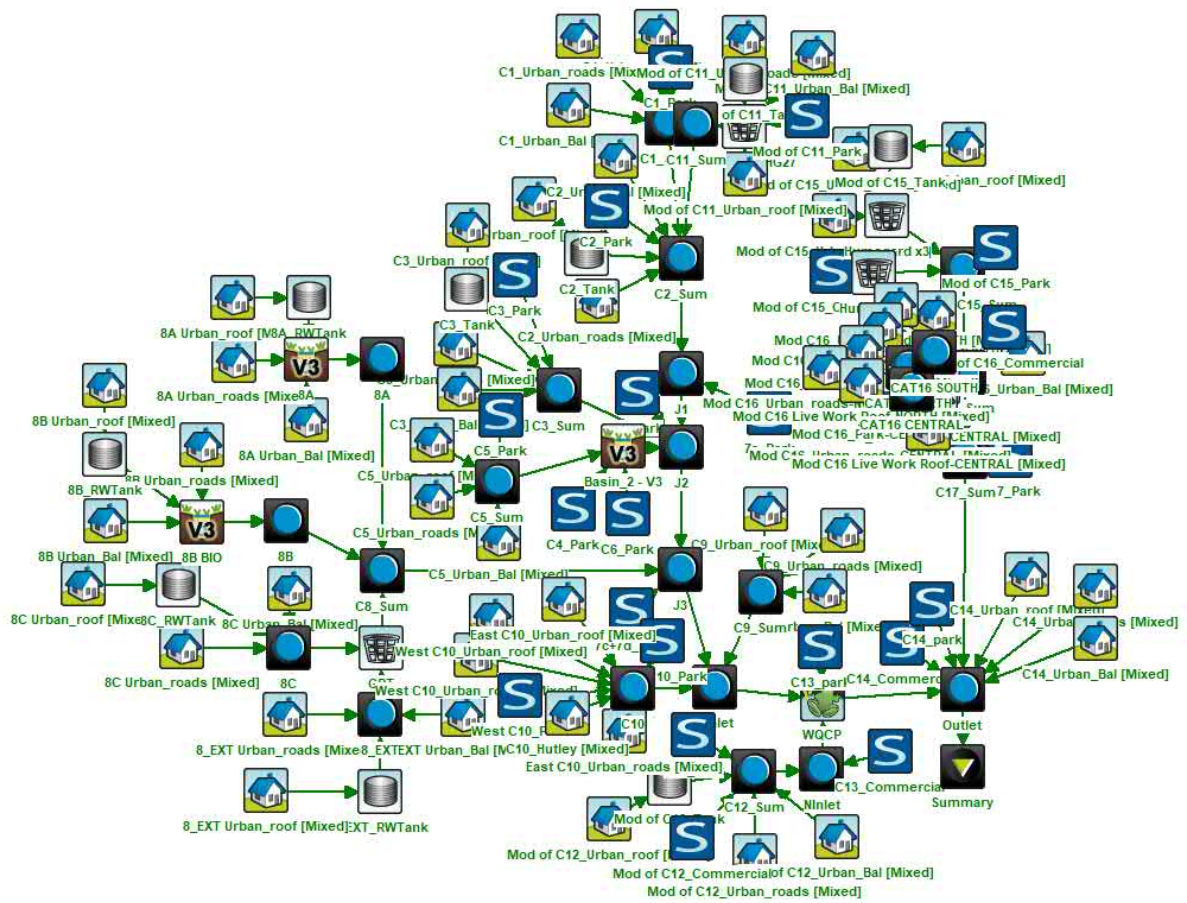
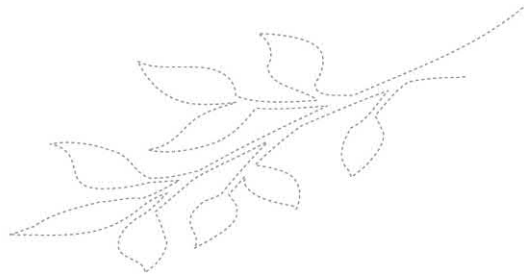
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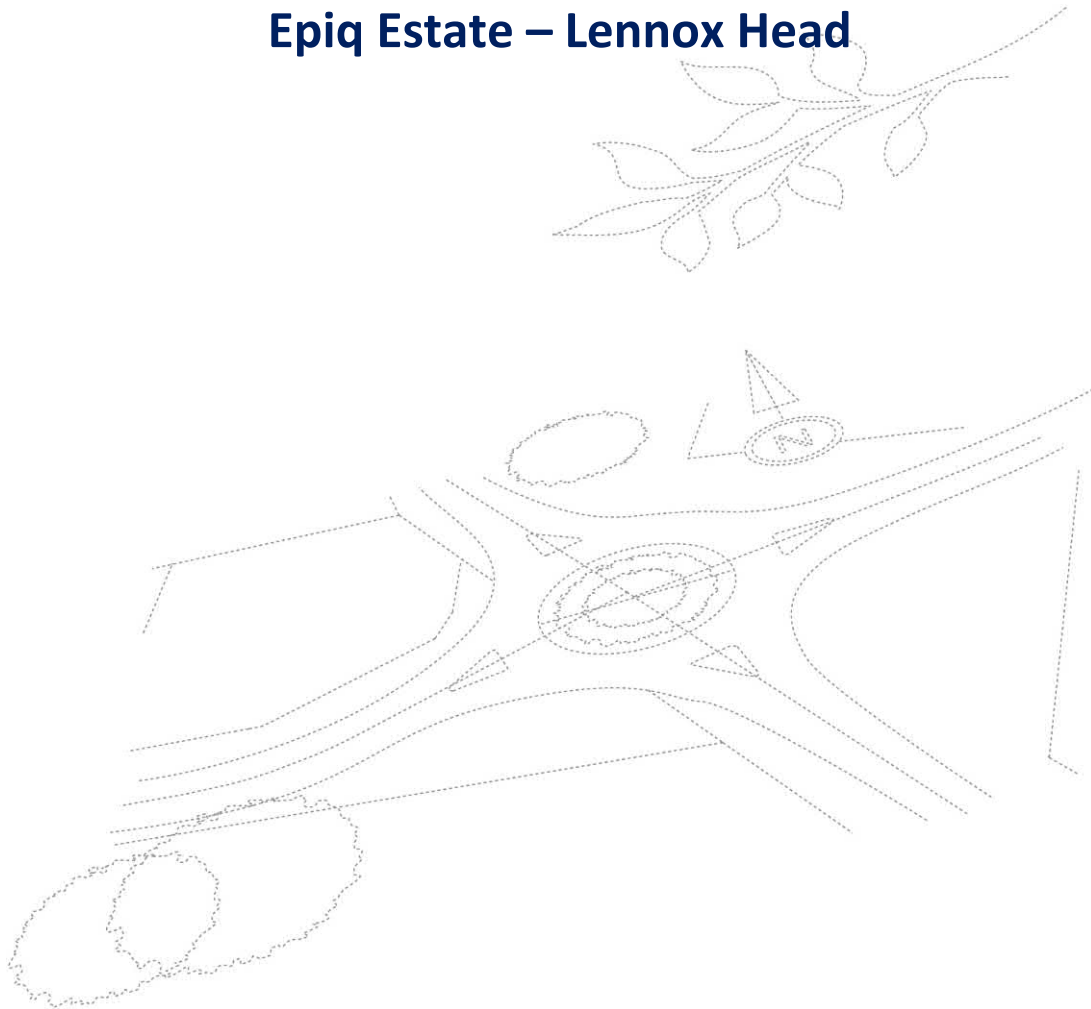
Appendix C

MUSIC Model



Appendix D

H2One - Hydraulic Assessment of the Dual Reticulation Water Supply Network Epiq Estate – Lennox Head





**EPIQ Estate All Stages
Lennox Head NSW 2478**

**Hydraulic Assessment of the Dual Reticulation
Water Supply Network**

For Ballina Shire Council Approval

FINAL Report V2 - 12 May, 2017



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Version	Date	Author	Reviewer
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FINAL - V1	10 May, 2017	D Colledge	J May
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1 INTRODUCTION

1.1 Background

EPIQ Estate is a Master Planned urban development located in Lennox Head, NSW, approximately 30 km's south of Byron Bay. The site has an estimated land area of 80 hectares and is proposed for residential, commercial, retail, open space and conservation land use. The development is scheduled for completion via a number of stages, with ultimate development projected within the next three - five years. Stage 1A, comprising of 51 residential freehold lots, has been constructed with Stage 1B and Super Lot 8 (Release 2) currently under construction. All remaining stages are currently in the planning or Development Application (DA) phase. The remaining development stages (including those currently under construction) are expected to consist of the following.

- 503 x residential freehold allotments
- 27 x medium density dwellings
- 4.4 x Ha community sporting field with community centre
- Child care centre
- 5,500 m² Gross Floor Area (GFA) of commercial and retail precinct
- Park, conservation area and open space throughout the site.

A potable water and recycled water service strategy has previously been developed for EPIQ Estate, with connection to Ballina Shire Council's (BSC) existing network at the southern and northern site boundaries. To confirm the proposed strategy and associated infrastructure sizing, H2One Pty Ltd was engaged to complete a hydraulic modelling analysis of the dual reticulation system, in accordance with BSC's adopted Design Standards; *New South Wales Development Design Specification, D11, Water Supply* (2009).

The results of the assessment and confirmed reticulation layout plans are presented in this report.

1.2 Objectives

The key objectives of the project were as follows:

1. Estimate ultimate potable water and recycled water demands for EPIQ Estate.
2. Develop potable water and recycled water hydraulic models for the proposed distribution systems.
3. Complete a standard flow and fire flow hydraulic analysis to confirm infrastructure sizing/layout, in accordance to BSC's Design Standards.
4. Issue an RPEQ certified hydraulic assessment report and associated concept design layout plans.

1.3 Potable Water Supply Strategy

The potable water supply service strategy for EPIQ Estate consists of a High Level Zone (HLZ) and Low Level Zone (LLZ) supply regime, with the ultimate construction of a 1.5 ML storage tank at the northern end of the development site. The construction of this storage tank will be undertaken by BSC sometime after the completion of the EPIQ Lennox Estate, as the demand in the greater Lennox Head area increases. In the interim, a pressure reducing valve will be installed at this location to reduce the pressures to acceptable levels for the LLZ. This was previously developed in liaison with BSC as a long-term strategy to rectify storage deficiencies in the region.

The HLZ will be located at the northern end of the site and is directly serviced by BSC's existing Basalt Court tank (RL 73.4 m AHD), via an encircled trunk system of DN450 and DN300 mains along North Creek Road, Henderson Lane and Montwood Drive. The HLZ will service approximately 167 residential allotments with elevated ground levels west and south of the proposed tank.

The LLZ water tank will be constructed on elevated ground levels to the north-east of the site (RL 48 m AHD), with upstream supply from the Basalt Court tank via an existing DN200 trunk main along Stoneyhurst Drive. The LLZ tank will service majority of the development and neighbouring properties to the north and south.

Note BSC's hydraulic model was not available for the project and the LLZ boundary has yet to be determined. For these reasons, the proposed storage volume of the tank (1.5 ML) could not be assessed with the information available. It is therefore recommended BSC confirm the LLZ boundary and tank storage volume prior to detailed design.

1.4 Recycled Water Supply Strategy

EPIQ Estate's recycled water network will be serviced from the south, via BSC's future proposed storage tank and DN250/200 trunk mains along Montwood Drive. The development's internal trunk infrastructure will be sized to provide adequate service to downstream customers, north of the site.

2 METHODOLOGY

2.1 Desired Standards of Service

The Design Standards of BSC's *New South Wales Development Design Specification, D11, Water Supply* (2009) were adopted for the project. Where assessment criteria was not available within BSC's Design Standards, the Water Services Association of Australia (WSAA) *Water Supply Code of Australia, WSA 03* (2011) was assumed. A summary of relevant provisions are presented in Table 1 below.

Table 1. Design specifications adopted for the analysis

Provision	Specification
Residential peak instantaneous potable demand	0.12 L/s/ET
Residential peak instantaneous recycled demand	0.03 L/s/ET
Minimum standard flow network pressure	20 m
Maximum standard flow network pressure	78 m
Maximum pipe velocity	3.0 m/s
Maximum head loss	5 m head/km for <=DN150 3 m head/km >=DN200
Minimum fire flow network pressure	12 m at peak demand
Fire flow at hydrant	11 L/s
Hazen Williams pipe friction co-efficient	<= 150 diameter, 100 >150 <300 diameter, 110

2.2 Demand Assessment

A demand assessment of the development was undertaken to estimate peak flows attributed to the proposed land use type and density, for both potable and recycled water supply. This was calculated using BSC's adopted peak instantaneous unit rates for potable water (0.12 L/s/ET) and recycled water (0.03 L/s/ET), in conjunction with demand rates adopted from Water Directorate's *Section 64, Determinations of Equivalent Tenements Guidelines* (2009).

Refer below for a summary of the demand estimation for the EPIQ Estate, at ultimate development.

Table 2. Demand estimation for the proposed development

Site Land Use and Density	Demand Rate	ET	Potable Peak Flow (L/s)	Recycled Peak Flow (L/s)
503 + 51 x residential freehold lots	1 ET/Lot	554.0	66.5	16.6
25 x medium density dwellings (west of Hutley Dr)	1 ET/dwelling	25.0	3.0	0.8
Commercial precinct (5,500 m ² GFA)	0.6 ET/100m ²	33.0	4.0	1.0
Child care centre (90 children)	0.06 ET/child	5.4	0.7	0.2
5 x park/open space	1 ET/lot	5.0	0.6	0.2
Community Centre (23 flushing units)	1.1 ET/flushing unit	25.3	3.0	NA
Sports fields (4.4 Ha)	20 ET/Ha	88.0	NA	2.6
TOTAL		735.7	77.8	21.4

Note: The 5 park allotments were allocated 1 ET to account for potential water usage from public toilets, taps, wash down etc.

2.3 Hydraulic Model Assessment

The methodology adopted for the hydraulic assessment is as follows.

1. An InfoWater dual reticulation hydraulic model was developed for EPIQ Estate, based on the service supply strategies determined from previous consultant studies, refer Appendix 1. The pipe layouts were introduced to a base model as a background layer, and model node/hydrant elements drawn manually.
2. All pipes were initially allocated the minimum allowable size (DN100) and assigned the relevant Hazen Williams Roughness co-efficient.
3. The following data was subsequently introduced to the hydraulic model.
 - a. Potable water valve and tank arrangement for the proposed LLZ and HLZ systems
 - b. Potable water boundary conditions:
 - i. HLZ standard flow and fire flow, peak hour: 71.0 m head at both Henderson Lane (north-east) and Fieldcrest Drive (south-east), assuming Fieldcrest Drive will be directly serviced from the Basalt Court reservoir.
 - ii. LLZ standard flow and fire flow, peak hour: 50.0 m head, based on the Minimum Operating Level (MOL) of the proposed supply tank with a ground level of RL 48 m AHD.
 - c. Recycled water boundary conditions:
 - i. Standard flow, peak hour: 74.0 m head at Montwood Drive. The development's network was also required to meet downstream boundary conditions of 70.0 m head @ 10.6 L/s and 69.0 m head @ 21.5 L/s, for Henderson Lane and Hutley Drive respectively. This was to ensure adequate service is achieved for downstream connections.
4. A standard flow and fire flow hydraulic analysis was undertaken on the potable water reticulation layout, where pipe sizes were systematically increased and/or connections adjusted to achieve relevant Design Standards.
5. A standard flow hydraulic analysis was undertaken on the recycled water reticulation layout, where pipe sizes were systematically increased and/or connections adjusted to achieve relevant Design Standards. Note a fire flow analysis was not completed on the recycled water network, as BSC has allocated this service to the potable system only.
6. Modelling results were then verified and deliverables prepared.

3 RESULTS

3.1 Potable Water

As per the methodology described in Section 2.3 of this report, a standard flow and fire flow hydraulic analysis was undertaken on the proposed potable water service strategy. The analysis identified that the infrastructure presented in Table 3 and Appendix 2 achieved BSC's Design Standards. Refer to Appendices 2 through 7 for detailed modelling results.

Table 3. Summary of potable water infrastructure

Description	Location	Diameter (DN)	Length (m)
Potable water reticulation pipe	Throughout site	100	6,420
Potable water reticulation pipe	Throughout site	150	1,390
Potable water reticulation pipe	Montwood Dr and Stoneyhurst Dr	200	2,460
Potable water trunk pipe	Centre of the site	300	420
Potable water tank (1.5 ML)	Northern end of site	NA	NA

Note: Potable water tank volume to be confirmed by BSC

A summary of the hydraulic modelling results is as follows.

- The HLZ presented a standard flow and fire flow minimum pressure of 22.5 m and 19.6 m respectively, at node J112.
- The HLZ presented a standard flow maximum pressure of 55 m (node J168), at the eastern boundary of the site.
- The LLZ presented a standard flow and fire flow minimum pressure of 26.0 m and 19.5 m respectively, at node J64.
- The LLZ presented a standard flow maximum pressure of 46 m (node J198).

In summary, the service strategy provided adequate supply to the potable network receiving an average network pressure of 38 m. Due to varied elevations across the site, isolated areas received pressures marginally above and below 22 m and 70 m, respectively.

3.2 Recycled Water

As per the methodology described in Section 2.3 of this report, a standard flow hydraulic analysis was undertaken on the proposed recycled water service strategy. The analysis identified that the infrastructure presented in Table 4 and Appendix 4 achieved BSC's Design Standards. Refer to Appendices 4 through 7 for detailed modelling results.

Table 4. Summary of recycled water infrastructure

Description	Location	Diameter (DN)	Length (m)
Recycled water reticulation pipe	Throughout site	100	7,800
Recycled water reticulation pipe	Southern end of site	150	50
Recycled water reticulation pipe	Throughout site	200	2,145
Recycled water trunk pipe	Montwood Dr	250	520

A summary of the hydraulic modelling results is as follows.

- The network presented a standard flow minimum pressure of 22.5 m, at node J112.
- The network presented a standard flow maximum pressure of 69 m, at node J216.
- A pressure differential was unable to be maintained in favour of the potable system, to reduce the risk of potential cross-contamination.

Similarly to the potable water system, the service strategy provided adequate supply to the recycled water network receiving an average network pressure of 54 m. Due to varied elevations across the site, isolated areas received pressures marginally above and below 22 m and 70 m, respectively.

4 CONCLUSION

EPIQ Estate is a Master Planned urban development located in Lennox Head, NSW, approximately 30 km's south of Byron Bay. The development is scheduled for completion via a number of stages, with ultimate development projected within the next three - five years. The remaining development stages will consist of the following.

- 503 x residential freehold allotments
- 27 x medium density dwellings
- 4.4 x Ha community sporting field with community centre
- Child care centre
- 5,500 m² Gross Floor Area (GFA) of commercial and retail precinct
- Park, conservation area and open space throughout the site.

H2One Pty Ltd was engaged to confirm the proposed potable water and recycled water service strategy, in accordance with Ballina Shire Council's (BSC) adopted Design Standards; *New South Wales Development Design Specification, D11, Water Supply* (2009), to service EPIQ Estate at ultimate development.

The hydraulic analysis determined that the dual reticulation service strategy presented in Appendices 2 and 4 satisfies the minimum Design Standards and is therefore recommended for BSC approval. Detailed modelling results can be observed in Appendices 2 through 7.

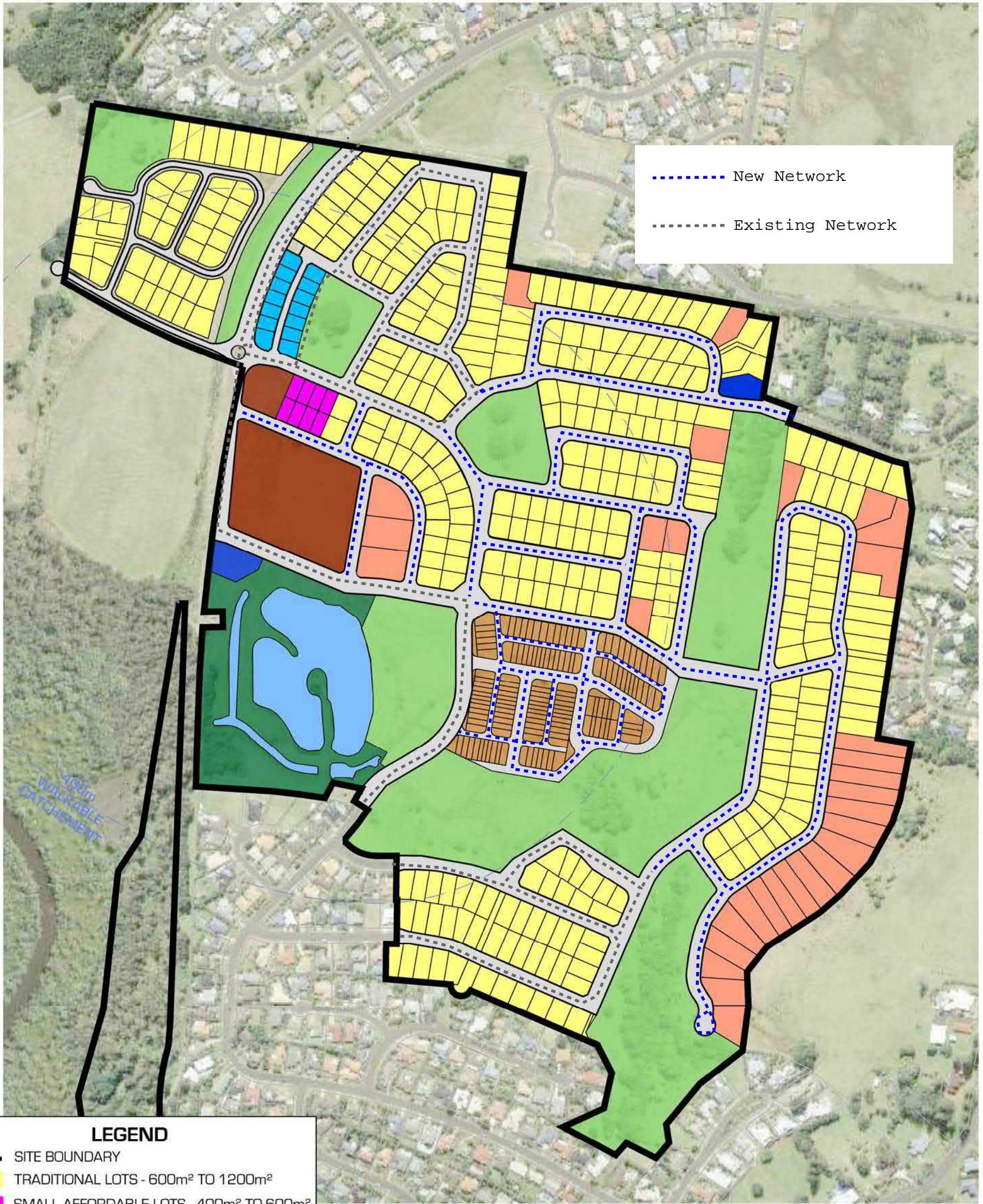
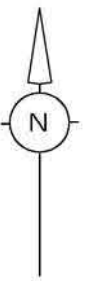
5 REFERENCES

Water Directorate (2009) *“Section 64, Determinations of Equivalent Tenements Guidelines”*

Ballina Shire Council (2009) *“New South Wales Development Design Specification, D11, Water Supply”*

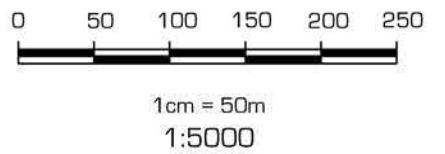
6 APPENDICES

Appendix 1. EPIQ Estate Site Layout



..... New Network
 Existing Network

LEGEND	
	SITE BOUNDARY
	TRADITIONAL LOTS - 600m ² TO 1200m ²
	SMALL AFFORDABLE LOTS - 400m ² TO 600m ²
	LARGE LOTS - >1200m ²
	INDEPENDENT / ASSISTED UNITS AND RETIREMENT COURT YARD LOTS
	PARK COURT LOTS - 400m ² - 600m ²
	CONSERVATION / PARK / OPEN SPACE
	DRAINAGE RESERVE
	COMMUNITY USE
	NEIGHBOURHOOD CENTRE



SOURCE:
 Plans prepared by geolink - Pacific Pines Estate - Lennox Head 1675 - 1028
 Illustration C6 - Movement Network Dated: August 2012.

NOTE:
 This preliminary layout has been completed in accordance with the instructions provided by Epiq Lennox Head. In this respect preliminary desktop data has been used to form this layout. The final layout is subject to the completion of a detailed survey & engineering plans. Accordingly, the conclusions reached within this report may be modified by the author upon the completion of the final design plans & site inspection. Newton Denny Chapelle accepts no responsibility for any loss or damage suffered, however so arising, to any person or corporation who may use or rely on this report.

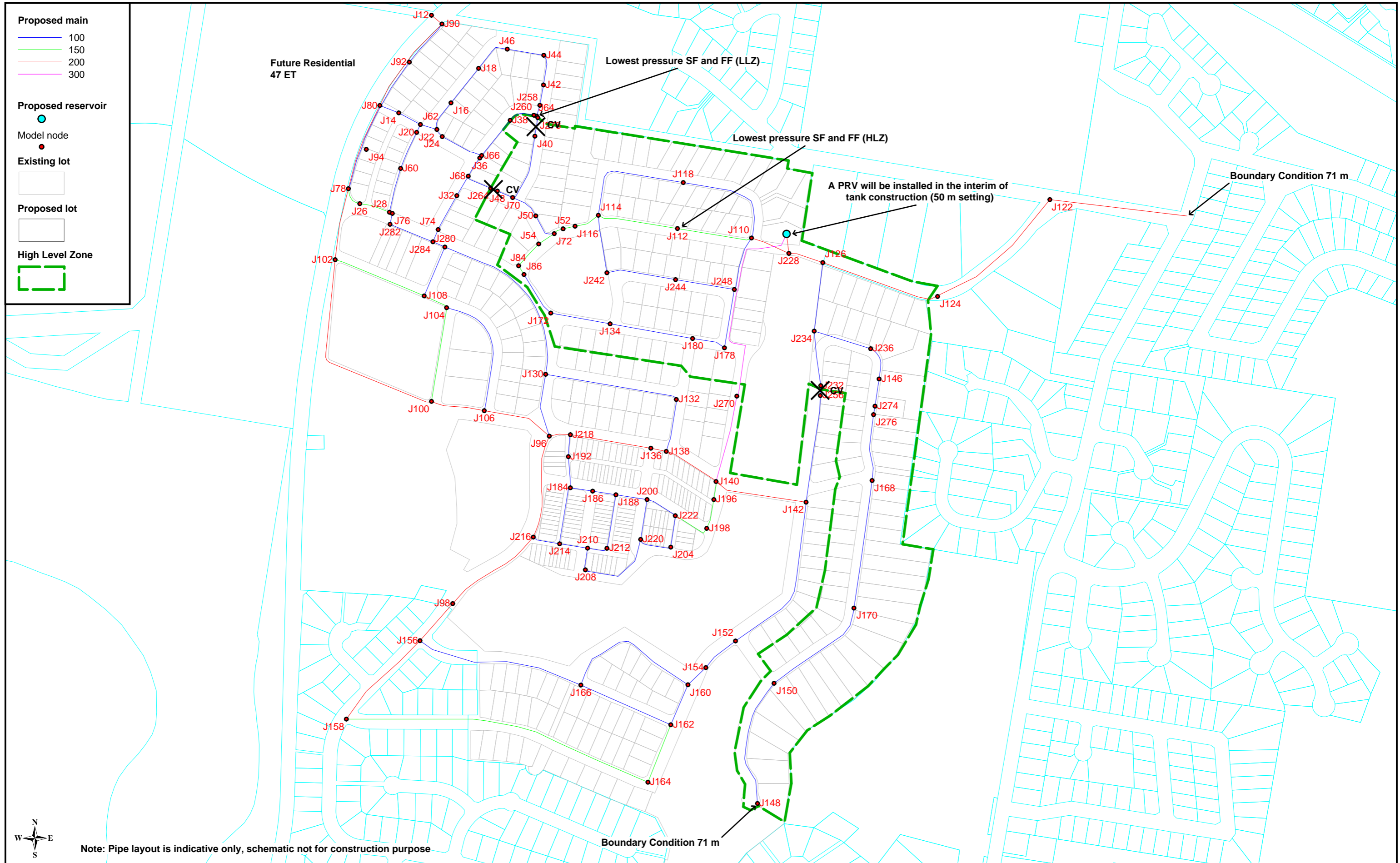
REV	DATE	AMENDMENT
A		
B		
C		
D		
E		

SOURCE PLAN: www.maps.six.nsw.gov.au - accessed 14.11.16

\\job\2014\14351-clarence.property_masterfile_planning\planning plans_rdc plans\out files\geolink update\geolink plan\setcdwg_c8-lot topographies

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 Surveyors Planners Engineers
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 LISMORE 31 Carrington St. Lismore 2480 PH: 6622 1011
 CASINO 100 Barker St. Casino 2470 PH: 6662 5000
 ABN: 86 220 045 469

EPIQ LENNOX HEAD
ILLUSTRATION
C8 - LOT TOPOGRAPHIES
 CLIENT: CLARENCE PROPERTY CORPORATION
 LOCATION: LOT 234 DP1104071
 LENNOX HEAD NSW
 DATE: 16.11.16 REF: 14/351
 SCALE: 1 : 4000 @ A3 DRAWN: bk



Note: Pipe layout is indicative only, schematic not for construction purpose



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DESIGNED: D Colledge	NOTE: DESIGN NOT TO BE AMENDED WITHOUT H2ONE PTY LTD ACCEPTANCE		DATUM: HORIZ: MGA94 (ZONE 56) HEIGHT: AHD
DRAWN: D Colledge			SCALE: 0 100 200 Metres
CHECKED: J May			
APPROVED: J May	C	REVISED ISSUE - 11 MAY 2017	
CLIENT PM:	B	REVISED ISSUE - 03 MAY 2017	
	A	ORIGINAL ISSUE - 28 APR 2017	
H2ONE PM: J May	No.	REVISION	APPROVED

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PROJECT NO: 1611162	
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EPIQ Estate All Stages
 Lennox Head NSW 2478

Appendix 2. Potable Water Supply
 Pipe Reticulation Layout (Node Labels)

ORIGINAL ISSUE DATE: APR, 2017
DATE SCANNED:
DRG No:
REV:

Important Notice!
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Proposed main

- 100
- 150
- 200
- 300

Proposed reservoir

- Model node
- Existing lot
- Proposed lot

High Level Zone

Future Residential
47 ET

Boundary Condition 71 m

Boundary Condition 71 m



Note: Pipe layout is indicative only, schematic not for construction purpose

H2ONE

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DESIGNED:
D Colledge
DRAWN:
D Colledge
CHECKED:
J May
APPROVED:
J May
CLIENT PM:
A
H2ONE PM:
J May

NOTE: DESIGN NOT TO BE AMENDED WITHOUT H2ONE PTY LTD ACCEPTANCE

No.	REVISION	APPROVED
C	REVISED ISSUE - 11 MAY 2017	
B	REVISED ISSUE - 03 MAY 2017	
A	ORIGINAL ISSUE - 28 APR 2017	

DATUM:
HORIZ: MGA94 (ZONE 56)
HEIGHT: AHD
SCALE:
0 100 200
Metres
SURVEYED BY / DATE: SURVEY CHECKED:

H2ONE REFERENCES
PROJECT NO:
1611162
FILE REFERENCE:
CAD FILE:



NEWTON DENNY CHAPELLE
PO BOX 1138
LISMORE NSW 2480

EPIQ Estate All Stages
Lennox Head NSW 2478

Appendix 3. Potable Water Supply
Pipe Reticulation Layout (Pipe Labels)

ORIGINAL ISSUE DATE:
APR, 2017
DATE SCANNED:
DRG No: REV:

Important Notice!
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Proposed pipe

- 100
- 150
- 200
- 250

Model node

Existing lot

Proposed lot

DS Boundary Condition 69 m @ 21.5 L/s

Future Residential
47 ET

DS Boundary Condition 70 m @ 10L/s

Boundary Condition 74 m



Note: Pipe alignments are indicative only, schematic not for construction purpose

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CHECKED: J May		
APPROVED: J May		
CLIENT PM:	B	REVISED ISSUE - 03 MAY 2017
	A	ORIGINAL ISSUE - 28 APR 2017
H2ONE PM: J May	No.	REVISION
		APPROVED

DATUM: HORIZ: MGA94 (ZONE 56) HEIGHT: AHD	
SCALE: 0 100 200 Metres	
SURVEYED BY / DATE:	SURVEY CHECKED:

H2ONE REFERENCES	
PROJECT NO: 1611162	
FILE REFERENCE:	
CAD FILE:	

Newton Denny Chapelle
SURVEYORS PLANNERS ENGINEERS

NEWTON DENNY CHAPPELLE
PO BOX 1138
LISMORE NSW 2480

**EPIQ Estate All Stages
Lennox Head NSW 2478**

Appendix 4. Recycled Water Supply
Pipe Reticulation Layout (Node Labels)

ORIGINAL ISSUE DATE: APR, 2017
DATE SCANNED:
DRG No:
REV:

Proposed pipe

- 100
- 150
- 200
- 250

Model node

-

Existing lot

-

Proposed lot

-

DS Boundary Condition 69 m @ 21.5 L/s

Future Residential
47 ET

DS Boundary Condition 70 m @ 10L/s

Boundary Condition 74 m



Note: Pipe alignments are indicative only, schematic not for construction purpose

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DESIGNED: D Colledge	NOTE: DESIGN NOT TO BE AMENDED WITHOUT H2ONE PTY LTD ACCEPTANCE		
DRAWN: D Colledge			
CHECKED: J May			
APPROVED: J May			
CLIENT PM:	B	REVISED ISSUE - 03 MAY 2017	
	A	ORIGINAL ISSUE - 28 APR 2017	
H2ONE PM: J May	No.	REVISION	APPROVED

DATUM:
HORIZ: MGA94 (ZONE 56)
HEIGHT: AHD

SCALE:
0 100 200
Metres

SURVEYED BY / DATE: SURVEY CHECKED:

H2ONE REFERENCES	
PROJECT NO: 1611162	
FILE REFERENCE:	
CAD FILE:	

Newton Denny Chapelle
SURVEYORS PLANNERS ENGINEERS

NEWTON DENNY CHAPELLE
PO BOX 1138
LISMORE NSW 2480

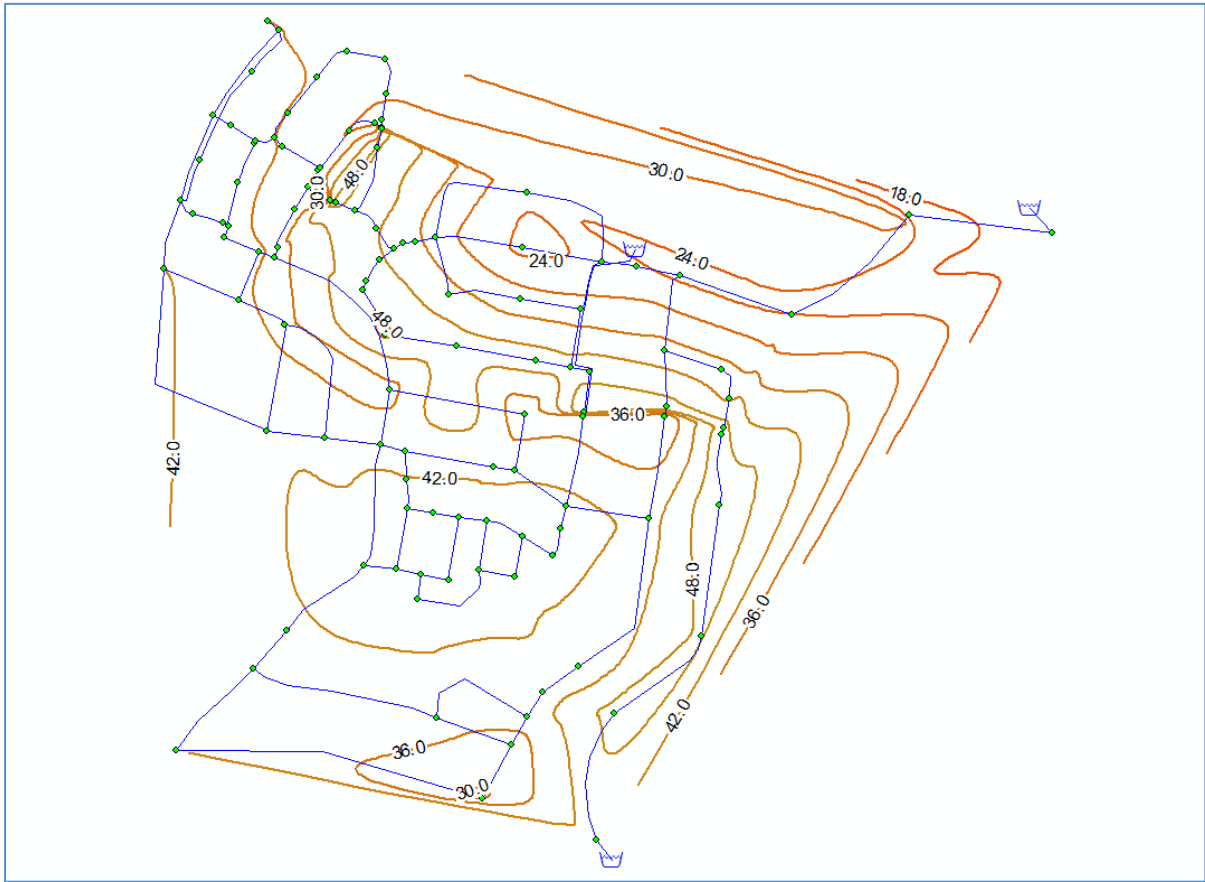
**EPIQ Estate All Stages
Lennox Head NSW 2478**

Appendix 5. Recycled Water Supply
Pipe Reticulation Layout (Pipe Labels)

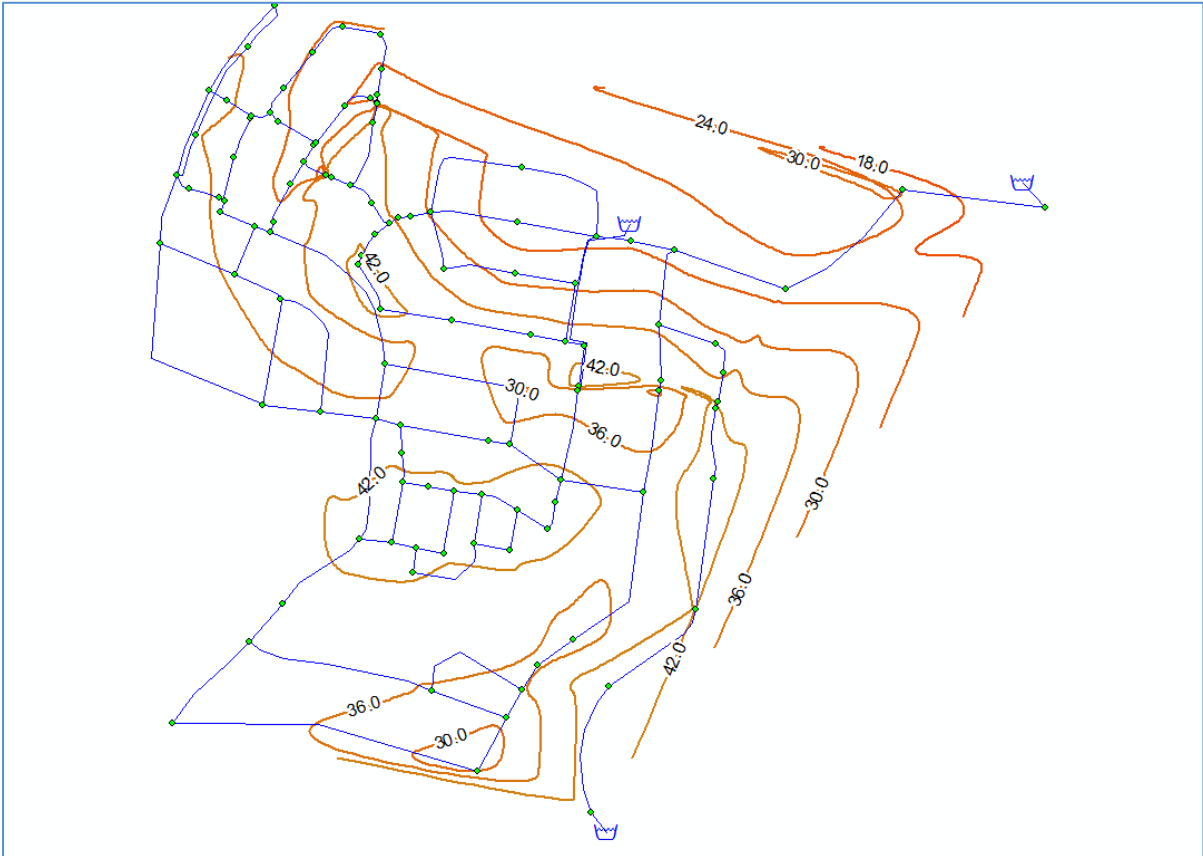
ORIGINAL ISSUE DATE: APR, 2017	
DATE SCANNED:	
DRG No:	REV:

Appendix 6. Screenshot of Hydraulic Modelling Results

POTABLE WATER – Standard Flow Peak hour (pressure, m)



POTABLE WATER - Fire Flow Peak hour (pressure, m)



RECYCLED WATER - Standard Flow Peak hour (pressure, m)



Appendix 7. Raw Modelling Results

Pipes - Potable Water

Pipe ID	Pipe DN (mm)	HW Co-efficient	Length (m)	SF PH Flow Rate (L/s)	SF PH Velocity (m/s)	SF PH Head loss (m/km)
P101	200	110	144.5	0.5	0.02	0.0
P103	100	100	71.4	0.5	0.07	0.1
P109	100	100	64.8	1.2	0.15	0.6
P111	100	100	141.2	0.3	0.04	0.0
P115	200	110	79.4	18.3	0.58	2.7
P117	200	110	320.5	10.2	0.33	0.9
P119	200	110	95.3	7.0	0.22	0.5
P121	150	110	146.5	5.7	0.32	1.3
P123	150	110	72.3	5.6	0.32	1.2
P125	200	110	75.9	23.0	0.73	4.2
P127	150	110	109.9	2.2	0.13	0.2
P131	100	100	191.6	2.3	0.30	2.1
P135	200	110	167.2	1.6	0.05	0.0
P137	100	100	168.7	2.2	0.27	1.8
P139	100	100	182.9	0.4	0.05	0.1
P141	150	110	28.7	3.3	0.19	0.5
P143	150	110	109.0	6.9	0.39	1.8
P145	150	110	118.4	5.1	0.29	1.1
P147	200	110	194.4	16.8	0.54	2.3
P149	200	110	211.0	16.8	0.54	2.3
P15	100	100	39.6	1.7	0.22	1.2
P151	200	110	160.1	16.8	0.54	2.3
P153	200	110	60.2	12.4	0.39	1.3
P159	100	100	74.2	0.1	0.02	0.0
P163	150	110	82.8	0.3	0.02	0.0
P165	100	100	107.9	0.2	0.02	0.1
P167	200	110	151.3	1.9	0.06	0.0
P169	150	110	422.9	1.9	0.10	0.2
P17	100	100	4.4	1.0	0.13	0.5
P171	100	100	259.6	0.7	0.10	0.2
P173	100	100	173.1	0.6	0.08	0.1
P175	100	100	42.6	1.4	0.18	0.8
P177	100	100	39.6	3.5	0.45	4.5
P179	100	100	59.2	3.5	0.45	4.5
P183	100	100	182.6	3.0	0.38	3.3
P185	100	100	239.7	4.3	0.54	6.4
P187	200	110	33.8	24.5	0.78	4.7
P189	200	110	28.7	30.4	0.97	7.0
P19	100	100	28.2	2.8	0.35	2.8
P191	200	110	85.0	36.1	1.15	9.6
P199	100	100	180.0	1.2	0.16	0.6
P201	100	100	160.8	2.1	0.26	1.7
P203	100	100	68.0	1.4	0.17	0.8
P207	100	100	98.1	1.2	0.16	0.6
P209	100	100	108.6	0.5	0.06	0.1
P21	100	100	39.8	2.1	0.26	1.7
P219	100	100	186.3	3.1	0.39	3.4
P221	100	100	77.0	4.4	0.56	6.7
P223	100	100	48.2	0.5	0.06	0.1
P227	100	100	28.1	0.0	0.00	0.0
P23	100	100	61.9	1.1	0.14	0.5
P235	200	110	138.4	2.6	0.08	0.1
P237	100	100	35.6	1.7	0.21	1.1
P239	100	100	35.7	1.7	0.21	1.1
P247	150	100	39.8	12.8	0.72	6.7
P249	150	100	48.8	11.4	0.65	5.5
P25	100	100	57.0	0.5	0.06	0.1
P251	100	100	67.2	0.4	0.05	0.1
P257	100	100	39.1	0.6	0.08	0.2
P259	100	100	86.6	1.8	0.24	1.3

P263	100	100	33.8	1.1	0.13	0.4
P265	100	100	84.0	1.3	0.17	0.7
P267	100	100	44.5	1.1	0.14	0.5
P269	100	100	40.5	0.9	0.11	0.3
P27	100	100	51.7	0.1	0.02	0.0
P273	200	110	122.4	29.2	0.93	6.4
P275	100	100	38.1	2.1	0.27	1.8
P281	100	100	53.2	6.4	0.81	13.5
P283	100	100	55.5	5.0	0.64	8.6
P285	100	100	49.1	3.8	0.48	5.1
P287	100	100	37.6	4.8	0.61	7.8
P29	100	100	49.3	0.1	0.02	0.0
P293	200	110	69.3	2.6	0.08	0.1
P299	200	110	48.2	12.4	0.39	1.3
P307	100	100	108.2	3.7	0.47	4.8
P309	100	100	82.2	2.0	0.26	1.6
P31	100	100	35.2	0.7	0.09	0.2
P311	100	100	44.8	1.2	0.15	0.6
P319	100	100	79.8	0.6	0.07	0.2
P321	100	100	98.2	0.6	0.07	0.2
P325	100	100	83.4	1.1	0.15	0.6
P327	100	100	74.2	3.3	0.43	4.1
P343	100	100	140.4	0.8	0.10	0.3
P345	100	100	75.8	0.8	0.10	0.3
P35	100	100	16.2	0.7	0.09	0.2
P351	100	100	41.2	0.9	0.12	0.4
P361	300	120	122.3	57.2	0.81	2.6
P365	150	110	16.0	3.3	0.19	0.5
P367	100	100	79.8	2.2	0.28	1.9
P369	100	100	54.4	0.0	0.00	0.0
P37	100	100	57.7	0.2	0.03	0.0
P373	150	100	31.5	14.0	0.79	8.0
P375	100	100	13.9	0.0	0.00	0.0
P377	100	100	39.5	0.4	0.05	0.1
P379	100	100	95.0	0.4	0.05	0.1
P381	100	100	10.4	0.4	0.05	0.1
P383	100	100	7.4	0.0	0.00	0.0
P385	100	100	7.8	0.0	0.00	0.0
P387	100	100	11.6	0.7	0.09	0.2
P389	100	100	10.0	0.7	0.09	0.2
P39	100	100	3.9	1.4	0.18	0.9
P393	100	100	25.4	0.0	0.00	0.0
P395	200	110	112.3	5.8	0.18	0.3
P397	100	100	71.9	1.0	0.12	0.3
P399	100	100	22.1	0.3	0.04	0.0
P401	300	120	295.3	57.2	0.81	2.6
P405	100	100	17.3	1.3	0.16	0.6
P407	100	100	51.5	1.3	0.16	0.6
P409	100	100	257.3	2.9	0.37	3.2
P41	100	100	63.6	1.7	0.21	1.1
P411	100	100	15.4	2.6	0.32	2.4
P413	100	100	33.4	1.7	0.21	1.1
P415	100	100	117.6	2.9	0.37	3.2
P43	100	100	1.2	0.0	0.00	0.0
P47	100	100	27.2	1.7	0.22	1.2
P49	200	110	124.8	5.3	0.17	0.3
P51	150	100	25.8	0.6	0.03	0.0
P53	150	110	43.9	0.6	0.03	0.0
P55	150	110	8.5	0.6	0.03	0.0
P57	100	100	61.5	1.9	0.24	1.4
P59	100	100	56.2	1.0	0.13	0.5
P65	100	100	57.6	2.6	0.34	2.6
P67	100	100	34.2	2.2	0.28	1.8
P69	100	100	27.3	1.4	0.18	0.9
P71	100	100	35.5	0.0	0.00	0.0
P73	100	100	27.5	0.4	0.05	0.1
P75	100	100	93.8	0.8	0.11	0.3

P77	100	100	39.4	1.4	0.18	0.9
P79	100	100	39.1	1.9	0.24	1.5
P81	150	110	14.3	3.3	0.19	0.5
P83	150	110	24.5	1.4	0.08	0.1
P85	150	110	34.4	1.4	0.08	0.1
P87	150	110	14.1	1.4	0.08	0.1
P97	200	110	19.1	0.0	0.00	0.0

Note 1: “SF” is “standard flow”, “PH” is “peak hour” and “HW” is “Hazen-Williams”

Note 2: A small number of pipes presented minimum head loss (m/km) failures while remaining well below the 3 m/s maximum flow velocity standard. Further investigation revealed that upsizing these pipes didn’t significantly improve system pressures as the pipe lengths were too low to have a meaningful impact on head loss. As a result, the head loss (m/km) “failures” were disregarded.

Pipes - Recycled Water

Pipe ID	Pipe DN (mm)	HW Co-efficient	Length (m)	SF PH Flow Rate (L/s)	SF PH Velocity (m/s)	SF PH Head loss (m/km)
P101	200	110	144.5	19.3	0.6	3.0
P103	100	100	71.4	2.4	0.3	2.2
P109	100	100	64.8	2.7	0.3	2.6
P111	100	100	141.2	2.7	0.3	2.6
P115	200	110	79.4	21.2	0.7	3.6
P117	200	110	320.5	18.4	0.6	2.7
P119	200	110	95.3	17.2	0.5	2.4
P121	100	100	146.5	2.2	0.3	1.8
P123	100	100	72.3	4.3	0.6	6.6
P125	200	110	75.9	24.5	0.8	4.7
P127	100	110	100.0	2.0	0.3	1.4
P131	100	100	191.6	2.8	0.4	2.9
P135	250	110	167.2	39.1	0.8	3.7
P137	100	100	168.7	1.1	0.1	0.5
P139	100	100	182.9	0.6	0.1	0.2
P141	100	100	28.7	2.0	0.3	1.6
P143	100	100	109.0	1.3	0.2	0.7
P145	100	100	118.4	0.9	0.1	0.3
P147	200	110	194.4	0	0.0	0.0
P149	200	110	211.0	10.6	0.3	1.0
P15	100	100	39.6	3.4	0.4	4.1
P151	200	110	160.1	10.6	0.3	1.0
P153	100	100	60.2	1.5	0.2	1.0
P159	100	100	74.2	3.5	0.4	4.5
P163	100	100	82.8	2.8	0.4	2.8
P165	100	100	107.9	0.9	0.1	0.3
P167	250	110	151.3	50.3	1.0	6.0
P169	100	100	422.9	3.1	0.4	3.6
P17	100	100	4.4	0.9	0.1	0.4
P171	100	100	259.6	3.0	0.4	3.2
P173	100	100	173.1	1.7	0.2	1.1
P175	100	100	42.6	3.3	0.4	3.9
P177	100	100	39.6	4.6	0.6	7.2
P179	100	100	59.2	4.6	0.6	7.2
P183	100	100	182.6	0.2	0.0	0.0
P185	100	100	239.7	2.1	0.3	1.7
P187	200	110	33.8	11.0	0.4	1.1
P189	200	110	28.7	12.3	0.4	1.3
P19	100	100	28.2	2.5	0.3	2.2
P191	200	110	85.0	10.8	0.3	1.0
P199	100	100	180.0	1.6	0.2	0.7
P201	100	100	160.8	1.8	0.2	1.0
P203	100	100	66.6	3.8	0.5	5.1
P207	100	100	98.1	0.5	0.1	0.1
P209	100	100	108.6	0.1	0.0	0.0
P21	100	100	39.8	0.5	0.1	0.1
P219	100	100	186.3	0.8	0.1	0.3
P221	100	100	77.0	1.2	0.1	0.5

P223	100	100	48.2	0.1	0.0	0.0
P227	100	100	28.1	2.5	0.3	2.4
P23	100	100	61.9	0.8	0.1	0.2
P235	250	110	138.4	47.3	1.0	5.3
P237	100	100	35.6	0.7	0.1	0.2
P239	100	100	35.7	0.7	0.1	0.2
P247	100	100	39.8	2.6	0.3	2.5
P249	100	100	48.8	2.9	0.4	3.1
P25	100	100	57.0	0.9	0.1	0.3
P251	100	100	67.2	0.1	0.0	0.0
P257	100	100	39.1	1.9	0.2	1.5
P259	100	100	86.6	1.6	0.2	1.1
P263	100	100	33.8	4.4	0.6	6.7
P265	100	100	84.0	3.5	0.4	4.4
P267	150	100	44.5	8.2	0.5	3.0
P269	100	100	40.5	2.5	0.3	2.3
P27	100	100	51.7	1.0	0.1	0.4
P273	200	110	122.4	12.6	0.4	1.4
P275	100	100	38.1	2.2	0.3	1.8
P281	100	100	53.2	1.8	0.2	1.3
P283	100	100	55.5	1.1	0.1	0.5
P285	100	100	49.1	1.4	0.2	0.8
P287	100	100	37.6	2.0	0.3	1.6
P29	100	100	49.3	1.1	0.1	0.5
P293	250	110	69.3	47.3	1.0	5.3
P299	100	100	48.2	1.5	0.2	1.0
P307	200	100	108.2	12.3	0.4	1.6
P309	100	100	82.2	1.4	0.2	0.7
P31	100	100	35.2	1.2	0.2	0.6
P311	100	100	44.8	1.6	0.2	0.9
P319	100	100	79.8	0.9	0.1	0.4
P321	100	100	98.2	0.9	0.1	0.4
P325	100	100	83.4	1.4	0.2	0.8
P327	100	100	74.2	0.8	0.1	0.3
P343	200	100	140.4	11.5	0.4	1.4
P345	200	100	75.8	11.1	0.4	1.3
P35	100	100	16.2	1.9	0.2	1.5
P351	100	100	41.2	0.3	0.0	0.1
P361	100	100	122.3	2.5	0.3	2.4
P365	100	100	16.0	2.0	0.3	1.6
P367	100	100	79.8	2.2	0.3	1.9
P369	100	100	54.4	2.5	0.3	2.4
P37	100	100	57.7	2.1	0.3	1.7
P373	100	100	31.5	2.3	0.3	1.9
P375	200	100	13.9	11.3	0.4	1.3
P377	100	100	39.5	1.8	0.2	1.2
P379	100	100	95.0	2.0	0.3	1.5
P381	100	100	10.4	1.8	0.2	1.2
P383	100	100	7.4	2.5	0.3	2.4
P385	100	100	7.8	1.2	0.2	0.6
P387	100	100	11.6	1.2	0.2	0.6
P389	100	100	10.0	0.4	0.1	0.1
P39	100	100	3.9	2.0	0.3	1.5
P393	100	100	25.4	1.8	0.2	0.9
P395	200	110	112.3	10.2	0.3	0.9
P397	100	100	71.9	1.7	0.2	1.1
P399	100	100	22.1	1.3	0.2	0.7
P405	100	100	17.3	3.0	0.4	3.3
P407	100	100	51.5	3.0	0.4	3.3
P409	100	100	117.9	2.5	0.3	2.4
P41	100	100	63.6	0.1	0.0	0.2
P411	100	100	15.4	1.2	0.1	0.6
P413	100	100	33.4	2.1	0.3	1.8
P415	100	100	117.6	1.8	0.2	1.3
P429	100	100	7.2	0.6	0.1	0.1
P43	100	100	1.2	1.8	0.2	0.9
P431	100	100	74.1	4.4	0.6	6.6

P433	100	100	98.3	0.6	0.1	0.1
P435	100	100	80.3	2.3	0.3	1.7
P437	100	100	32.1	1.2	0.2	0.5
P47	100	100	27.2	3.4	0.4	4.1
P49	200	110	124.8	15.9	0.5	2.1
P51	100	100	25.8	1.3	0.2	0.7
P53	100	100	43.9	1.3	0.2	0.7
P55	100	100	8.5	1.3	0.2	0.7
P57	100	100	61.5	0.9	0.1	0.4
P59	100	100	56.2	0.9	0.1	0.4
P65	100	100	57.6	1.2	0.1	0.6
P67	100	100	34.2	1.0	0.1	0.4
P69	100	100	27.3	2.2	0.3	1.8
P71	100	100	35.5	1.2	0.2	0.6
P73	100	100	27.5	1.2	0.2	0.6
P75	100	100	93.8	1.8	0.2	0.9
P77	100	100	39.4	3.0	0.4	3.1
P79	100	100	39.1	3.0	0.4	3.1
P81	100	100	14.3	1.8	0.2	1.3
P83	100	100	24.5	1.2	0.2	0.5
P85	100	100	34.4	1.2	0.2	0.5
P97	200	110	19.1	21.5	0.7	3.7

Note: A small number of pipes presented minimum head loss (m/km) failures while remaining well below the 3 m/s maximum flow velocity standard. Further investigation revealed that upsizing these pipes didn't significantly improve system pressures as the pipe lengths were too low to have a meaningful impact on head loss. As a result, the head loss (m/km) "failures" were disregarded

Nodes - Potable Water

Node ID	Demand (ET)	RL AHD (m)	SF PH Demand (L/s)	SF PH Pressure (m)	Fire Flow (L/s)	FF PH Pressure (m)
J100	20.0	5.0	2.40	40.9	11	38.8
J102	45.3	4.0	5.44	41.6	11	39.1
J104	20.0	12.0	2.40	33.7	11	31.3
J106	20.0	7.0	2.40	39.1	11	37.3
J108	20.0	9.0	2.40	36.6	11	34.2
J110	0.0	46.0	0.00	24.5	11	22.5
J112	14.3	48.0	1.72	22.3	11	19.6
J114	14.3	38.0	1.72	32.2	11	29.2
J116	0.0	33.0	0.00	37.2	11	34.1
J118	14.3	46.0	1.72	24.2	11	19.7
J12	0.0	10.0	0.00	35.5	11	32.6
J122	0.0	40.0	0.00	31.5	11	31.0
J124	0.0	48.0	0.00	23.1	11	22.0
J126	6.8	48.0	0.82	22.7	11	21.3
J130	0.0	13.0	0.00	33.5	11	31.0
J132	11.0	16.0	1.32	31.3	11	28.7
J134	14.3	25.0	1.72	45.1	11	39.2
J136	10.3	7.0	1.24	40.6	11	39.7
J138	11.0	7.0	1.32	40.9	11	40.0
J14	0.0	6.0	0.00	39.5	11	36.3
J140	10.3	5.0	1.24	43.9	11	43.5
J142	6.3	9.0	0.76	39.9	11	39.3
J146	6.8	29.0	0.82	41.0	11	34.0
J148	6.8	26.0	0.82	45.0	11	45.0
J150	7.8	20.0	0.94	50.4	11	47.4
J152	6.3	11.0	0.76	36.0	11	32.4
J154	0.0	8.0	0.00	38.6	11	35.2
J156	0.0	5.0	0.00	41.4	11	39.5
J158	0.0	5.0	0.00	41.4	11	39.4
J16	8.0	10.0	0.96	35.3	11	30.1
J160	12.6	8.0	1.51	38.4	11	35.3
J162	12.8	14.0	1.54	32.4	11	29.4
J164	12.8	18.0	1.54	28.4	11	25.5

J166	12.8	8.0	1.54	38.4	11	35.0
J168	6.8	16.0	0.82	54.0	11	46.4
J170	6.8	21.0	0.82	49.1	11	42.2
J172	0.0	21.0	0.00	49.1	11	44.3
J178	14.3	26.0	1.72	44.1	11	38.9
J18	5.0	10.0	0.60	35.3	11	29.1
J180	0.0	25.0	0.00	45.1	11	39.5
J184	10.3	2.0	1.24	44.4	11	42.0
J186	0.0	2.0	0.00	44.3	11	41.7
J188	10.3	3.0	1.24	43.3	11	40.6
J192	10.3	5.0	1.24	41.4	11	39.2
J196	10.3	3.0	1.24	45.1	11	43.2
J198	11.3	2.0	1.36	45.3	11	42.5
J20	0.0	8.0	0.00	37.5	11	33.9
J200	10.3	3.0	1.24	43.4	11	40.7
J204	10.3	2.0	1.24	44.4	11	41.1
J208	10.3	2.0	1.24	44.3	11	41.1
J210	10.3	2.0	1.24	44.3	11	41.5
J212	10.3	2.0	1.24	44.3	11	41.1
J214	10.3	2.0	1.24	44.3	11	42.0
J216	1.0	2.0	0.12	44.4	11	42.7
J218	21.3	6.0	2.56	40.6	11	39.2
J22	0.0	10.0	0.00	35.4	11	31.3
J220	10.3	2.0	1.24	44.4	11	41.3
J222	0.0	2.0	0.00	44.6	11	41.9
J228	0.0	46.0	0.00	24.6	11	23.0
J232	6.8	20.0	0.82	50.1	11	41.9
J234	6.8	32.0	0.82	38.2	11	35.0
J236	6.8	32.0	0.82	38.0	11	31.6
J238	0.0	24.0	0.00	46.1	11	39.8
J24	4.0	10.0	0.48	35.4	11	31.1
J242	0.0	32.0	0.00	38.2	11	34.0
J244	14.3	38.0	1.72	32.2	11	27.6
J248	0.0	38.0	0.00	32.2	11	28.6
J256	6.3	18.0	0.76	30.8	11	29.3
J258	0.0	18.0	0.00	27.3	11	20.8
J26	0.0	6.0	0.00	39.6	11	36.9
J260	2.0	18.0	0.24	27.3	11	21.0
J264	0.0	18.0	0.00	27.4	11	21.8
J270	0.0	16.0	0.00	33.2	11	32.9
J272	0.0	17.0	0.00	53.1	11	44.8
J274	0.0	20.0	0.00	50.0	11	42.7
J276	6.8	18.0	0.82	52.0	11	44.6
J278	0.0	20.0	0.00	50.1	11	38.2
J28	0.0	8.0	0.00	37.6	11	34.8
J280	0.0	9.0	0.00	36.6	11	33.8
J282	0.0	8.0	0.00	37.6	11	34.6
J284	0.1	12.0	0.12	33.6	11	30.6
J32	4.0	14.0	0.48	31.5	11	27.4
J36	0.0	15.0	0.00	30.4	11	26.0
J38	6.0	16.0	0.72	29.3	11	23.5
J40	7.0	22.0	0.84	48.1	11	37.2
J42	7.0	16.0	0.84	29.3	11	22.6
J44	0.0	11.0	0.00	34.3	11	27.5
J46	3.0	10.0	0.36	35.3	11	28.6
J48	3.0	20.0	0.36	50.1	11	42.1
J50	4.0	28.0	0.48	42.1	11	37.0
J52	0.0	32.0	0.00	38.2	11	35.0
J54	0.0	28.0	0.00	42.2	11	38.8
J60	7.0	8.0	0.84	37.5	11	33.9
J62	0.0	8.0	0.00	37.5	11	34.0
J64	0.0	20.0	0.00	25.3	11	18.9
J66	0.0	15.0	0.00	30.4	11	26.0
J68	6.0	15.0	0.72	30.4	11	26.1
J70	2.0	24.0	0.24	46.1	11	39.1
J72	0.0	30.0	0.00	40.2	11	36.9
J74	0.0	12.0	0.00	33.6	11	30.6

J76	0.0	8.0	0.00	37.6	11	34.8
J78	0.0	6.0	0.00	39.6	11	37.0
J80	25.0	6.0	3.00	39.5	11	36.8
J84	0.0	24.0	0.00	46.2	11	42.7
J86	0.0	23.0	0.00	47.2	11	43.7
J90	0.0	10.0	0.00	35.5	11	32.6
J92	7.0	6.0	0.84	39.5	11	35.5
J94	7.0	6.0	0.84	39.5	11	35.6
J96	0.0	7.0	0.00	39.5	11	37.9
J98	0.0	5.0	0.00	41.4	11	39.6

Nodes - Recycled Water

Node ID	Demand (ET)	RL AHD (m)	SF PH Demand (L/s)	SF PH Pressure (m)	Fire Flow (L/s)	FF PH Pressure (m)
J100	20.0	5.0	0.60	65.7	N/A	N/A
J102	108.0	4.0	3.24	65.8	N/A	N/A
J104	20.0	12.0	0.60	58.4	N/A	N/A
J106	20.0	7.0	0.60	64.0	N/A	N/A
J108	20.0	9.0	0.60	60.9	N/A	N/A
J110	0.0	46.0	0.00	24.3	N/A	N/A
J112	14.3	48.0	0.43	22.2	N/A	N/A
J114	14.3	38.0	0.43	32.2	N/A	N/A
J116	0.0	33.0	0.00	37.1	N/A	N/A
J118	14.3	46.0	0.43	24.2	N/A	N/A
J12	716.7	10.0	21.50	58.8	N/A	N/A
J122	353.3	40.0	10.60	30.0	N/A	N/A
J124	0.0	48.0	0.00	22.2	N/A	N/A
J126	6.7	48.0	0.20	22.4	N/A	N/A
J130	0.0	13.0	0.00	58.0	N/A	N/A
J132	11.0	16.0	0.33	55.0	N/A	N/A
J134	14.3	25.0	0.43	45.5	N/A	N/A
J136	10.3	7.0	0.31	64.1	N/A	N/A
J138	11.0	7.0	0.33	64.0	N/A	N/A
J14	0.0	6.0	0.00	63.4	N/A	N/A
J140	10.3	5.0	0.31	66.0	N/A	N/A
J142	6.3	9.0	0.19	61.9	N/A	N/A
J146	6.7	29.0	0.20	41.6	N/A	N/A
J148	6.7	26.0	0.20	45.1	N/A	N/A
J150	7.7	20.0	0.23	51.1	N/A	N/A
J152	6.3	11.0	0.19	60.3	N/A	N/A
J154	0.0	8.0	0.00	63.7	N/A	N/A
J156	0.0	5.0	0.00	68.1	N/A	N/A
J158	0.0	5.0	0.00	69.0	N/A	N/A
J16	8.0	10.0	0.24	59.6	N/A	N/A
J160	12.7	8.0	0.38	64.0	N/A	N/A
J162	12.7	14.0	0.38	58.2	N/A	N/A
J164	12.7	18.0	0.38	54.4	N/A	N/A
J166	12.7	8.0	0.38	64.2	N/A	N/A
J168	6.7	16.0	0.20	54.8	N/A	N/A
J170	6.7	21.0	0.20	50.0	N/A	N/A
J172	1.0	21.0	0.03	49.5	N/A	N/A
J178	14.3	26.0	0.43	44.5	N/A	N/A
J18	5.0	10.0	0.15	59.6	N/A	N/A
J180	0.0	25.0	0.00	45.5	N/A	N/A
J184	10.3	2.0	0.31	69.3	N/A	N/A
J186	0.0	2.0	0.00	69.3	N/A	N/A
J188	10.3	3.0	0.31	68.2	N/A	N/A
J192	10.3	5.0	0.31	66.3	N/A	N/A
J196	10.3	3.0	0.31	68.0	N/A	N/A
J198	11.3	2.0	0.34	69.0	N/A	N/A
J20	0.0	8.0	0.00	61.6	N/A	N/A
J200	10.3	3.0	0.31	68.2	N/A	N/A
J204	10.3	2.0	0.31	69.2	N/A	N/A
J208	10.3	2.0	0.31	69.3	N/A	N/A
J210	10.3	2.0	0.31	69.3	N/A	N/A

J212	10.3	2.0	0.31	69.3	N/A	N/A
J214	10.3	2.0	0.31	69.5	N/A	N/A
J216	1.0	2.0	0.03	70.0	N/A	N/A
J218	21.3	6.0	0.64	65.3	N/A	N/A
J22	0.0	10.0	0.00	59.6	N/A	N/A
J220	10.3	2.0	0.31	69.2	N/A	N/A
J222	0.0	2.0	0.00	69.1	N/A	N/A
J228	0.0	46.0	0.00	24.3	N/A	N/A
J232	6.7	20.0	0.20	50.6	N/A	N/A
J234	6.7	32.0	0.20	38.5	N/A	N/A
J236	6.7	32.0	0.20	38.6	N/A	N/A
J238	0.0	24.0	0.00	46.5	N/A	N/A
J24	4.0	10.0	0.12	59.6	N/A	N/A
J242	0.0	32.0	0.00	38.2	N/A	N/A
J244	14.3	38.0	0.43	32.2	N/A	N/A
J248	0.0	38.0	0.00	32.3	N/A	N/A
J256	6.3	18.0	0.19	52.7	N/A	N/A
J258	0.0	18.0	0.00	51.7	N/A	N/A
J26	0.0	6.0	0.00	63.6	N/A	N/A
J260	2.0	18.0	0.06	51.7	N/A	N/A
J264	0.0	18.0	0.00	51.8	N/A	N/A
J270	0.0	16.0	0.00	54.7	N/A	N/A
J272	0.0	17.0	0.00	53.6	N/A	N/A
J274	0.0	20.0	0.00	50.7	N/A	N/A
J276	6.7	18.0	0.20	52.7	N/A	N/A
J278	0.0	20.0	0.00	49.7	N/A	N/A
J28	0.0	8.0	0.00	61.6	N/A	N/A
J280	0.0	9.0	0.00	60.8	N/A	N/A
J282	0.0	8.0	0.00	61.7	N/A	N/A
J284	0.0	12.0	0.00	57.9	N/A	N/A
J286	4.0	22.0	0.12	48.1	N/A	N/A
J288	0.0	20.0	0.00	50.5	N/A	N/A
J32	6.0	14.0	0.18	55.8	N/A	N/A
J36	7.0	15.0	0.21	54.7	N/A	N/A
J38	7.0	16.0	0.21	53.7	N/A	N/A
J40	0.0	22.0	0.00	47.8	N/A	N/A
J42	3.0	16.0	0.09	53.7	N/A	N/A
J44	3.0	11.0	0.09	58.7	N/A	N/A
J46	4.0	10.0	0.12	59.7	N/A	N/A
J48	0.0	20.0	0.00	49.8	N/A	N/A
J50	0.0	28.0	0.00	42.0	N/A	N/A
J52	7.0	32.0	0.21	38.1	N/A	N/A
J54	0.0	28.0	0.00	42.1	N/A	N/A
J60	0.0	8.0	0.00	61.6	N/A	N/A
J62	0.0	8.0	0.00	61.6	N/A	N/A
J64	6.0	20.0	0.18	49.7	N/A	N/A
J66	2.0	15.0	0.06	54.7	N/A	N/A
J68	0.0	15.0	0.00	54.8	N/A	N/A
J70	0.0	24.0	0.00	45.8	N/A	N/A
J72	0.0	30.0	0.00	40.1	N/A	N/A
J74	0.0	12.0	0.00	57.8	N/A	N/A
J76	25.0	8.0	0.75	61.6	N/A	N/A
J78	0.0	6.0	0.00	63.6	N/A	N/A
J80	25.0	6.0	0.00	63.3	N/A	N/A
J84	0.0	24.0	0.00	46.1	N/A	N/A
J90	7.0	10.0	0.21	58.9	N/A	N/A
J92	7.0	6.0	0.21	63.0	N/A	N/A
J94	0.0	6.0	0.00	63.4	N/A	N/A
J96	0.0	7.0	0.00	64.3	N/A	N/A
J98	0.0	5.0	0.00	67.7	N/A	N/A