STORMWATER MANAGEMENT & TRUNK DRAINAGE STRATEGY LOT A BURLEY ROAD HORSLEY PARK EMPLOYMENT PRECINCT

August 2010

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Engineers & Managers

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STORMWATER MANAGEMENT & TRUNK DRAINAGE STRATEGY

LOT A BURLEY ROAD HORSLEY PARK EMPLOYMENT PRECINCT

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STORMWATER MANAGEMENT & TRUNK DRAINAGE STRATEGY

LOT A BURLEY ROAD HORSLEY PARK EMPLOYMENT PRECINCT

1 INTRODUCTION

This Stormwater Management and Trunk Drainage Strategy has been prepared by Brown Consulting (NSW) Pty Ltd for Jacfin Pty Ltd to support the Proposed Concept and Project Application for the Horsley Park Employment Precinct within Precinct 8 of the Western Sydney Employment Area (WSEA). The proposed development site is located within the Penrith local government area as shown in Figure 1.

The study specifically describes the proposed stormwater quantity and quality management system using Water Sensitive Urban Design (WSUD) principles.

1.1 SITE DESCRIPTION

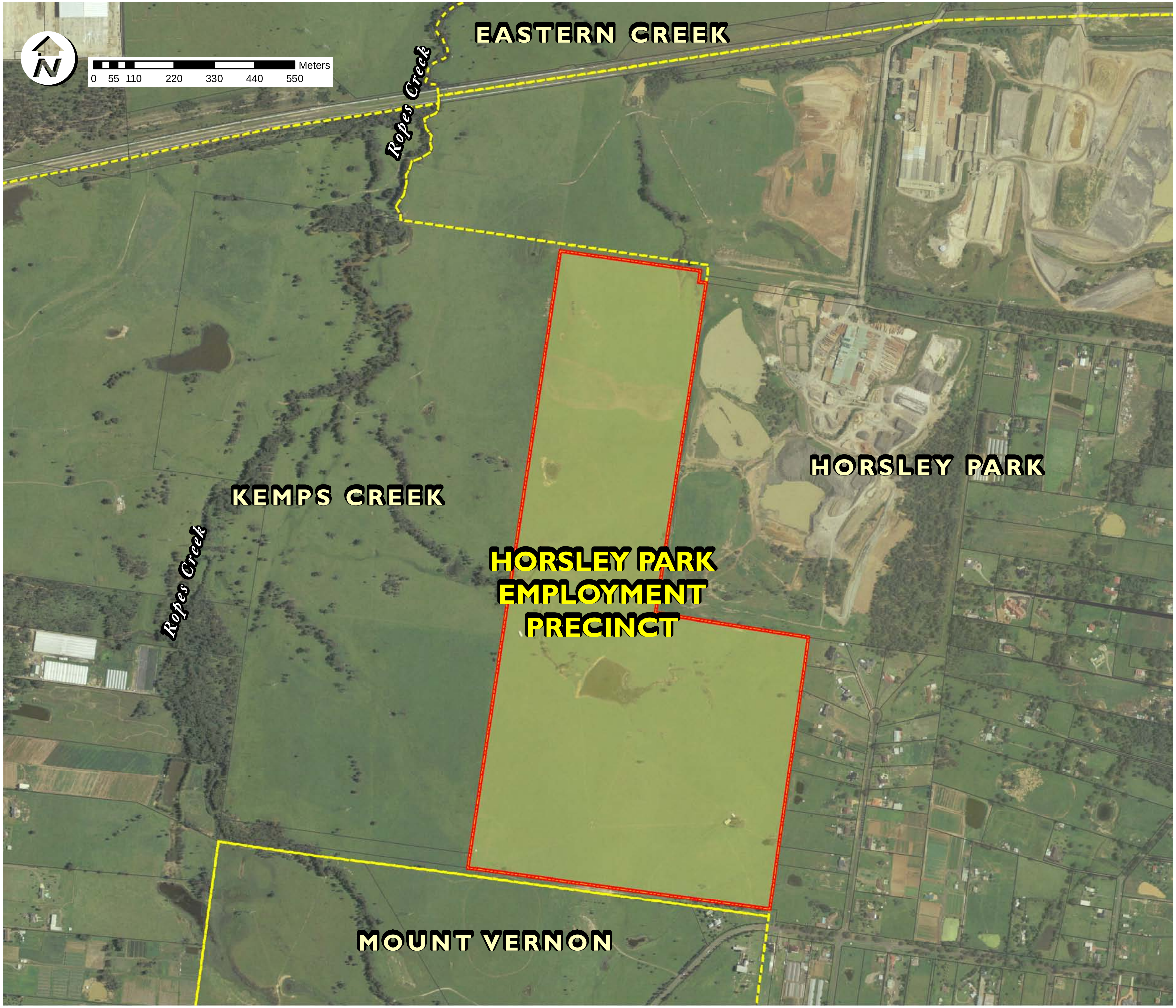
The site of Lot A Burley Road, shown on Figure 1, has historically been utilised as a rural farming area, showing evidence of tillage and soil improvements. The topography of the Site is gently sloping to the west, with gradients ranging from 1% to 7%. The main soil type is clay, originating from Wianamatta Shale, with approximately 200-300 millimetres of overlying topsoil. The site is devoid of significant vegetation (trees and shrubs) on the upper and lower slopes of the site, with the larger trees, including introduced species lining Ropes Creek and the E2 Conservation Area extending into the site.

The northern portion of the site falls to the north, draining to Ropes Creek through the Goodman development area located across Burley Road. The central of the site area falls to the E2 Conservation Area surrounding the small Ropes Creek tributary. A small section of approximately 8 hectares at the south eastern end of the site drains through private property to the south east.

The northern section of the site is bordered to the east by a PGH brickworks facility owned by CSR Limited. The southern section of the site is bordered to the east by large lot rural residential subdivisions. Land use to the south and west of the site is primarily rural farming land. Ropes Creek is located to the west of the site boundary.

1.1.1 Ropes Creek Catchment

Ropes Creek is a tributary of South Creek, part of the Hawkesbury Nepean River system, shown on Figure 2. Ropes Creek flows in a northerly direction to the confluence with South Creek approximately 13.5 kilometres north-north-west of the site in the suburb of Ropes Crossing. The catchment area of Ropes Creek at the location of Lot A Burley Road is 186.5 hectares. The land use catchment consists mainly of grassed paddocks and large lot rural subdivisions.



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Legend

- SITE
- CADASTRE
- SUBURB BOUNDARY

Details

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A	CLIENT REVIEW	JULY 2010

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Drawing Title

FIGURE 1
SITE OVERVIEW

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Drawing No.	FIGURE 01
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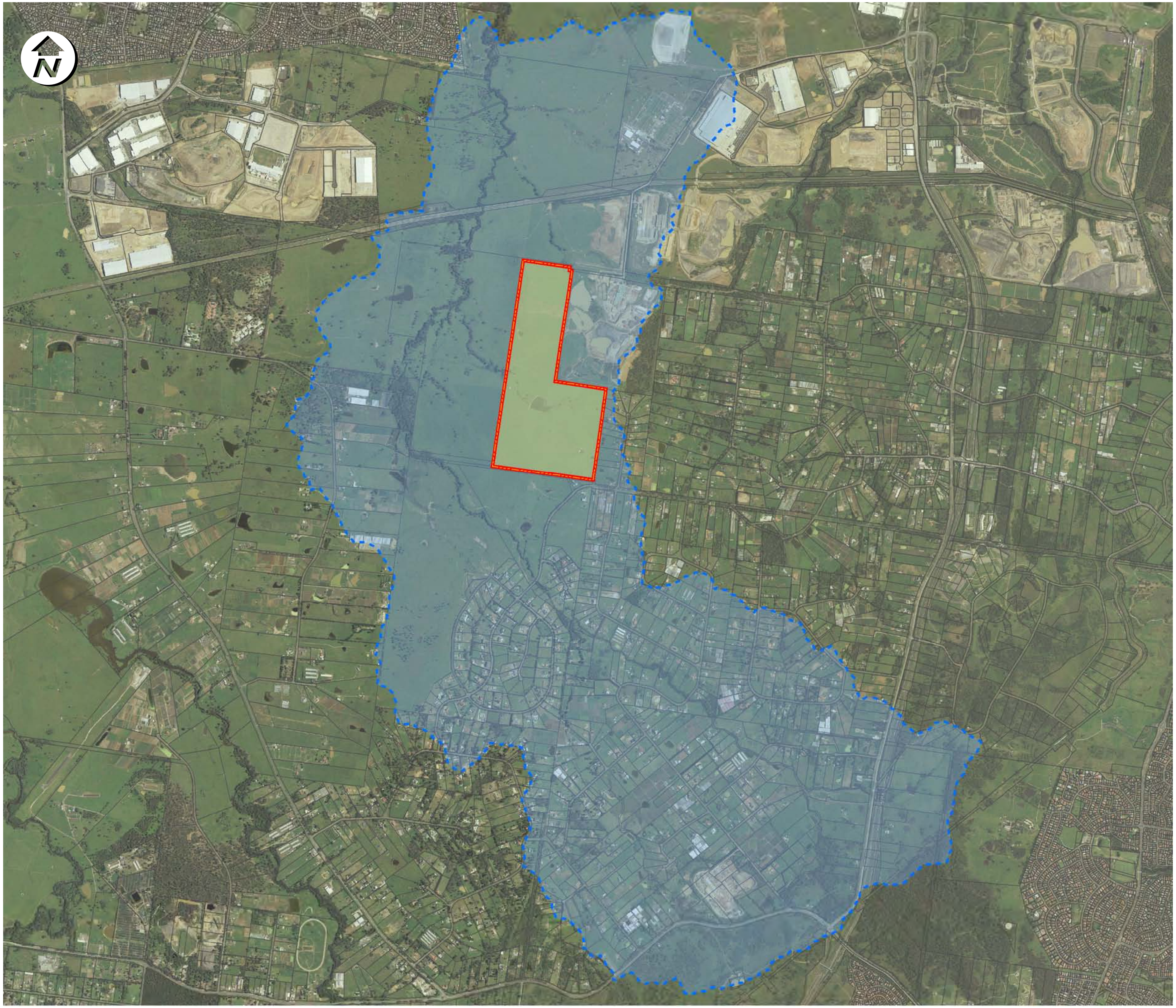

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Legend

- CATCHMENTE EXTENTS
- SITE EXTENTS
- CADASTRE

Details

Issue	Amendment	Date
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Drawing Title

FIGURE 2 CATCHMENT PLAN

Scale	NTS
Drawn	TWC
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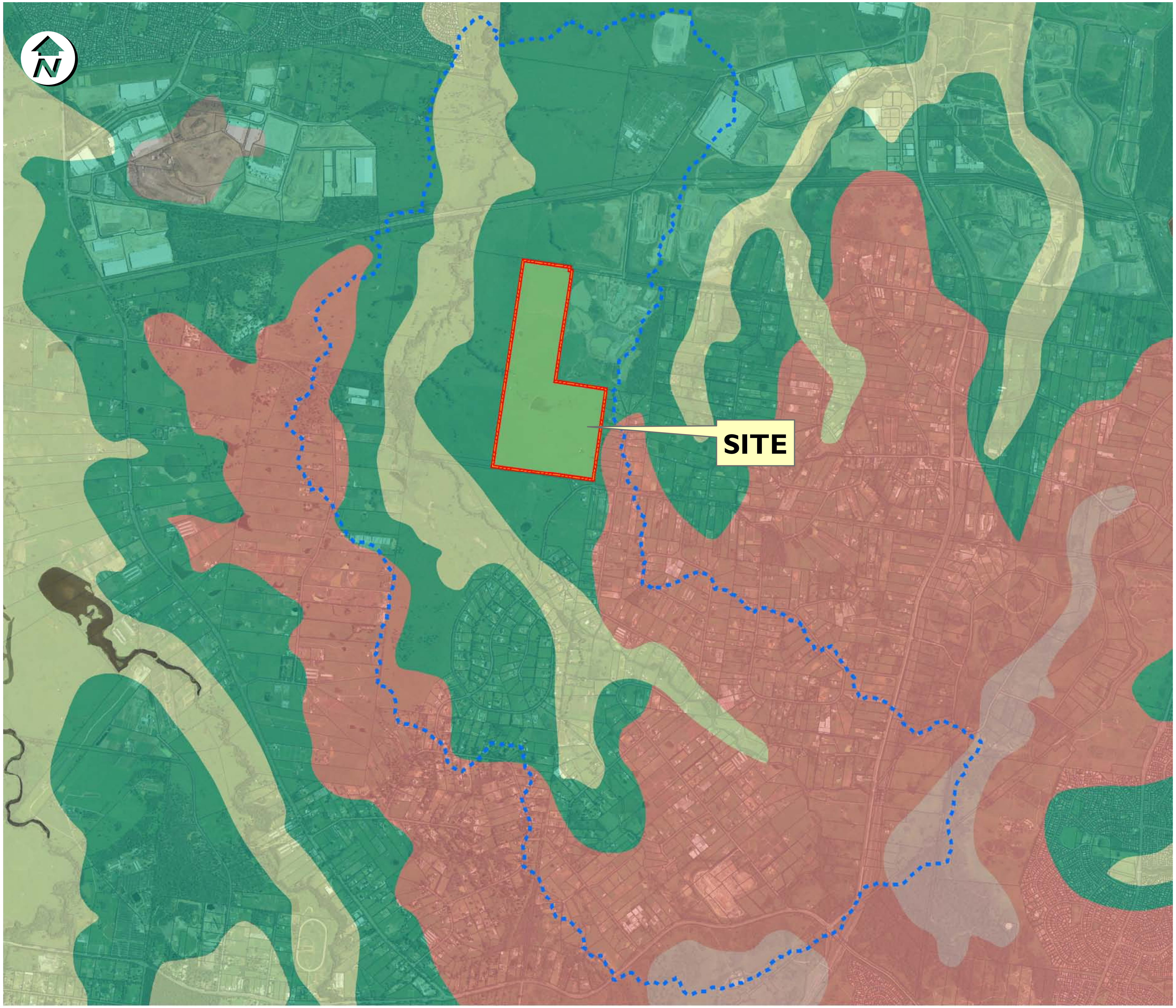
Job No.	X10135
Drawing No.	FIGURE 02
Issue	A

1.1.2 Soil Types

Soil types in the Ropes Creek catchment were mapped from the *Soil Landscapes of the Penrith 1:100,000 Sheet*, shown on Figure 3. The three main soil landscapes present on the site are:

- **South Creek Soil Landscape (sc)** – a fluvial soil landscape developed in floodplains, valley flats and drainage depressions with erosion channels. The South Creek soils are developed on alluvium derived from Wianamatta Group shales and are often very deep-layered sediments over bedrock or relict soils. Landscape limitations include flood hazard, waterlogging (seasonal or localised), permanently high water tables (localised) and high erosion hazard.
- **Blacktown Soil Landscape (bt)** – a residual soil landscape developed on gently undulating rises with local releif to 30 metres and slopes of less than 5% gradient. The Blacktown soils are derived from Wianamatta and Hawkesbury shales and are shallow to moderately deep. Crests, upper slopes and well drained areas are typically red and brown podzolic soils, with deep yellow podzolic soils located on lower areas of poor drainage. Limitation of these soils are that they are highly plastic, moderately reactive, of low fertility, poor soil drainage, localised salinity and moderate erodibility.
- **Luddenham Soil Landscape (lu)** – an erosional soil landscape developed on undulating to rolling hills with local releif of 50 to 80 metres with slopes of 10 to 20%. Luddenham soils are shallow and derived from Wianamatta Group shales, often associated with resistant sandstone beds. Crests and upper slopes are typically dark podzols and massive earthy clays, with lower slopes and drainage lines moderately deep yellow podzols. Limitations are the highly plastic subsoils of moderate reactivity, low to moderate shrink-swell potential, low to moderate soil fertility and moderate erodibility.



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Legend

- SITE EXTENTS
- CADASTRE
- CATCHMENT EXTENTS

SOIL LANDSCAPE

- BLACKTOWN
- SOUTH CREEK
- LUDDENHAM
- DISTURBED TERRAIN
- PICTON
- BERKSHIRE PARK

Details

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Drawing Title

FIGURE 3
SOIL LANDSCAPE PLAN

Scale	NTS
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Drawing No.	FIGURE 03
Issue	A

1.2 STORMWATER OBJECTIVES OVERVIEW

The aim of this study is to establish a stormwater & trunk drainage strategy based on WSUD principles. The key objectives of this study include:

- Potential impact from the development with respect to stormwater quantity, quality and flooding on-site and downstream of the site;
- Linking water infrastructure effectively to minimise the impacts of development upon runoff;
- Protecting downstream receiving waters (e.g. riparian corridors) from increased flow rates and water quality degradation; and
- Protect assets and the subdivision from flooding.

The specific objectives of the Concept/Project Plan with regards to stormwater quantity management include:

- Attenuate peak storm flows for the 20 and 100 year ARI to existing flow rates
- Incorporate safety considerations into the design of batter slopes, ponding depths and other design requirements
- Minimise potential for damages resulting from flooding

1.3 BACKGROUND – STATE ENVIRONMENTAL PLANNING POLICY (WESTERN SYDNEY EMPLOYMENT AREA) 2009

This Policy aims to protect and enhance the Western Sydney Employment Area for employment purposes. The Policy aims to ensure that development occurs in a logical, environmentally sensitive and cost-effective manner and only after a development control plan (including specific development controls) has been prepared for the land concerned.

This Stormwater Management and Trunk Drainage Strategy furthers the provisions of SEPP 59 by developing design criteria, indicative layouts and diagrams relating to the development of land within the Horsley Park Employment Precinct. This Strategy incorporates the provisions of relevant Penrith City Council planning policies into the concept design, integrating the aims, objectives and controls to achieve the outcomes required for consideration in the determination of the development application.

1.4 PROJECT OVERVIEW

The proposal involves the development of Lot A Burley Road for industrial and employment purposes, including the subdivision of the lot, construction of roads and drainage infrastructure and the construction of industrial and employment buildings. An indicative lot and road layout is shown in Figure 4.

Figure 4 - Indicative Layout Plan

2 DRAINAGE DESIGN CRITERIA

This section outlines the planning context and design criteria relevant to the Horsley Park Employment Precinct. The section provides a brief description of relevant Western Sydney Employment Area and Penrith City Council publications and concludes with a table that summarises the applicable design criteria. All the documents listed in this section address the key issues of the Director-General's requirements for the project relevant to Stormwater Management and Drainage Strategy.

2.1 STATE ENVIRONMENTAL PLANNING POLICY (WESTERN SYDNEY EMPLOYMENT AREA) 2009

Part 5 of the State Environmental Planning Policy (SEPP59 - WSEA) 2009 specifies the principal development standards. Section 5 of Schedule 4 outlines provisions for flooding.

2.2 *PENRITH DEVELOPMENT CONTROL PLAN 2006*

Part 2, Section 2.10 of the Penrith DCP outlines aims and objectives to reduce the impact of flooding and flood liability on individual owners and occupiers. Part B of this DCP provides guidance for development within land designated by Penrith Council as being "Flood liable land". Relevant sections of Section 3 of Part B are:

3.4 Industrial Commercial New Development
3.9 Subdivision
3.11 Filling of Flood Liable Land

2.3 *PENRITH CITY COUNCIL – ERSKINE PARK EMPLOYMENT AREA DEVELOPMENT CONTROL PLAN 2002*

This DCP relates to land in the Erskine Park Employment Area, located to the west of the site, across Ropes Creek. This DCP does not directly relate to the Horsley Park Employment Precinct but has been assessed as part of this investigation for completeness and in order to provide guidance as to Penrith Council's requirements.

2.4 GROWTH CENTRES DEVELOPMENT CODE (DEC 2006)

The Development Code by the then Department of Environment and Conservation (DEC) provides the basis for the planning and design of precincts and neighbourhoods. It is intended to be a reference work, to stimulate ideas and provide a guide to best practice.

The Code is a guide for Precinct Planning in the Growth Centres. It is the link to the State Environmental Planning Policy (SEPP) and the Structure Plan principles and design elements set at the high level to improve the built environment. Sections of the Development Code specifically relevant to the design of the Horsley Park Employment Precinct are:

- B-2 Water Sensitive Urban Design and Stormwater Management (pg B-16); and
- B-3 Riparian Corridors (pg B-31).

2.5 PENRITH CITY COUNCIL GUIDELINES FOR ENGINEERING WORKS FOR SUBDIVISIONS AND DEVELOPMENTS – PART 1 – DESIGN (1997)

This document outlines Penrith City Council's recommended practice for drainage design. Section 3 of these guidelines specifies drainage design procedures and sets relevant design criteria for design of drainage infrastructure.

2.6 PENRITH CITY COUNCIL STORMWATER MANAGEMENT FOR DEVELOPMENTS 2009 (DRAFT)

This specification contains technical design data for the calculation of flows, flood elevations and velocities along with technical standards for the design of drainage structures. The hydrologic parameters include rainfall intensity charts and runoff parameters for flow estimation. The handbook also outlines hydraulic parameters and design requirements for pits, culverts and pipes.

2.7 OTHER RELEVANT SPECIFICATIONS

The documents outlined above are to be read in conjunction with the following.

- AS/NZ3500.3 ‘Plumbing and Drainage - Stormwater Drainage;
- Australian Rainfall & Runoff (Engineers Australia);
- Australian Runoff Quality (Engineers Australia);
- ‘Technical Note: Interim Recommended Parameters for Stormwater Modelling – North-West and South-West Growth Centres’;

- Building Code of Australia Housing Provisions (current edition);
- Penrith City Council's Local Environmental Plan;
- Relevant Penrith City Council Development Control Plans;
- Managing Urban Stormwater - Soils and Construction (current edition);
- Water Sensitive Urban Design in the Sydney Region Resource Kit (2003);
- Water Sensitive Urban Design Technical Guidelines for Western Sydney (2004);
- NSW Floodplain Development Manual (2005);
- Floodplain Risk Management Guideline – Practical Consideration of Climate Change (DECC) and
- Designing Safer Subdivisions – Guidance on Subdivision Design in Flood Prone Areas - Hawkesbury-Nepean Floodplain Management Strategy Steering Committee, Parramatta, (June 2006)

Table 1 summarises the design criteria applicable to development of the Horsley Park Employment Precinct, outlines the source of the criteria and provides any comments or departures from the criteria where applicable.

Table 1 Design Criteria

Parameter	Requirement			Source/Reference	Comments/ Departures
IFD data	2 year 1 hour		29.4	Appendix 5 PCC 1997	Nil
	2 year 12 hour		6.6		
	2 year 72 hour		1.9		
	50 year 1 hour		59.8		
	50 year 12 hour		12.8		
	50 year 72 hour		4.3		
	F2		4.29		
	F50		15.79		
	skew		0		
Recurrence interval year (% AEP)	Minor	20 year (5% AEP)		Section 3.3 PCC 1997	All roads to be above 100 year level
	Major	100 year(1% AEP)			
	Main Roads	10 year (10% AEP)			
	Building pad levels	500 year (0.2% AEP)		Industrial insurance requirement	
XP RAFTS hydrologic modelling parameters	Initial Loss	Pervious	25 mm		Nil
		impervious	1 mm		
	Continuing	Pervious	2.5 mm		
		impervious	0 mm		
	Roughness	Pervious	0.035		
		impervious	0.015		
DRAINS hydrologic modelling parameters	Paved initial storage		1 mm		Not used in this report – parameters are set for detailed design stage
	Paved continuing storage		0mm/hr		
	Grassed initial storage		5-10mm		
	Grassed continuing storage		2-5mm/hr		
	Soil Type		3		
	MAC		3		
	Kinematic Roughness coefficient n*			Table 1 Section 3.5.2 PCC 1997	
	Road/Paved Area		0.01		
	Parkland/grassed		0.15		
Rational Method hydrologic parameters	Region B			Section 3.3 PCC 1997 ARR 1987	C_{10} calculated according to Section 3.5.3
	C_{10}		0.845		
	FF_1		0.80		
	FF_2		0.85		
	FF_5		0.95		
	FF_{10}		1.00		
	FF_{20}		1.05		
	FF_{50}		1.15		
	FF_{100}		1.20		

Table 1 (cont) Design Criteria

Parameter	Requirement	Source/Reference	Comments/ Departures
HGL	< 150mm below Kerb level for minor (5 year) peak	Section 3.6 PCC 1997	Nil
Impervious Percentages	90% for Industrial Area	Table 3 Section 3.5.3 PCC 1997	Nil
Blockage factor	Pipe inlet 50% headwall 50% lowpoint 100%		Nil
Minimum Pipe size	300 mm within commercial or industrial lots 375 mm within roadways	Section 5.4 PCC2009 Section 3.9.1a PCC1997	Nil
Minimum gradient (pipe)	1:100 (desirable) 1:200	Section 3.9.1e PCC1997 Section 5.4 PCC 2007	1:100 to be used
Pit spacing	Maximum spacing 75 metres	Section 3.7.1.4 PCC 1997	Nil
Velocity depth product	< 0.4 m^2/s in road gutter for the 20 year event < 0.4 m^2/s in road gutter for the 100 year event	Section 3.7.1.2 PCC 1997 NSW Floodplain Development Manual	Nil
Gutter flow width	< 2.5m for 20 year event (or < 80 litres/second)	Section 3.7.1.1 PCC 1997	Nil
Pipe Cover	RCP 0.6m to collar		RCP 1.0m to be used
Minimum Pavement Grade	1:100 concrete 1:50 brick paved 1:30 bitumen seal	Section 6.2 PCC 2009	Nil
Inlet pit location - Intersection	Gutter flows < 1m width or 20 l/s (20 year) adjacent to upstream kerb return tangent point	Section 3.7.1.5 PCC 1997	Nil
Freeboard	500mm above 100 year flood 200mm for 100 year flood level to basin embankment Building pad levels above 500 year (0.2% AEP)	Section 3.4 PCC DCP 2006 Section 5.4.2 PCC 2009 Industrial insurance requirement	Nil

Table 1 (cont) Design Criteria

Parameter	Requirement		Source/Reference	Comments/ Departures
Batter slopes (grassed)	1V:6H for retention/detention basins		Section 6.3 PCC 2009	Nil
Basin slope (minimum)	floor 2%		Section 6.3 PCC 2009	Nil
Basin Fencing	Childproof fencing with lockable gate		Section 6.3 PCC 2009	Nil
MUSIC water quality modelling parameters				
Water Quality Pollutant Removal Targets (% removal)	Gross Pollutants Total Suspended Solids Total Phosphorous Total Nitrogen	90 85 65 45	GCC 2006	PCC do not have parameters set
Rainwater Tanks	Required for development to be approved by the Director-General		Part 5 Section 22 SEPP	Nil

3 PRE-DEVELOPMENT FLOW RATES

3.1 METHODOLOGY

The hydrologic modelling software *XP-RAFTS* (Version 9) was used for hydrological analysis of the site, including the wider Ropes Creek catchment. An *XP-RAFTS* model was developed of the existing catchment to obtain pre-development flows in order to set discharge limits for the developed catchment.

3.1.1 Ropes Creek XP-RAFTS Hydrological Model

The *XP-RAFTS* hydrological model of the entire Ropes Creek catchment was used to develop flow rates for existing conditions and for analysis of developed conditions. The layout of the model is presented on Figure 5.

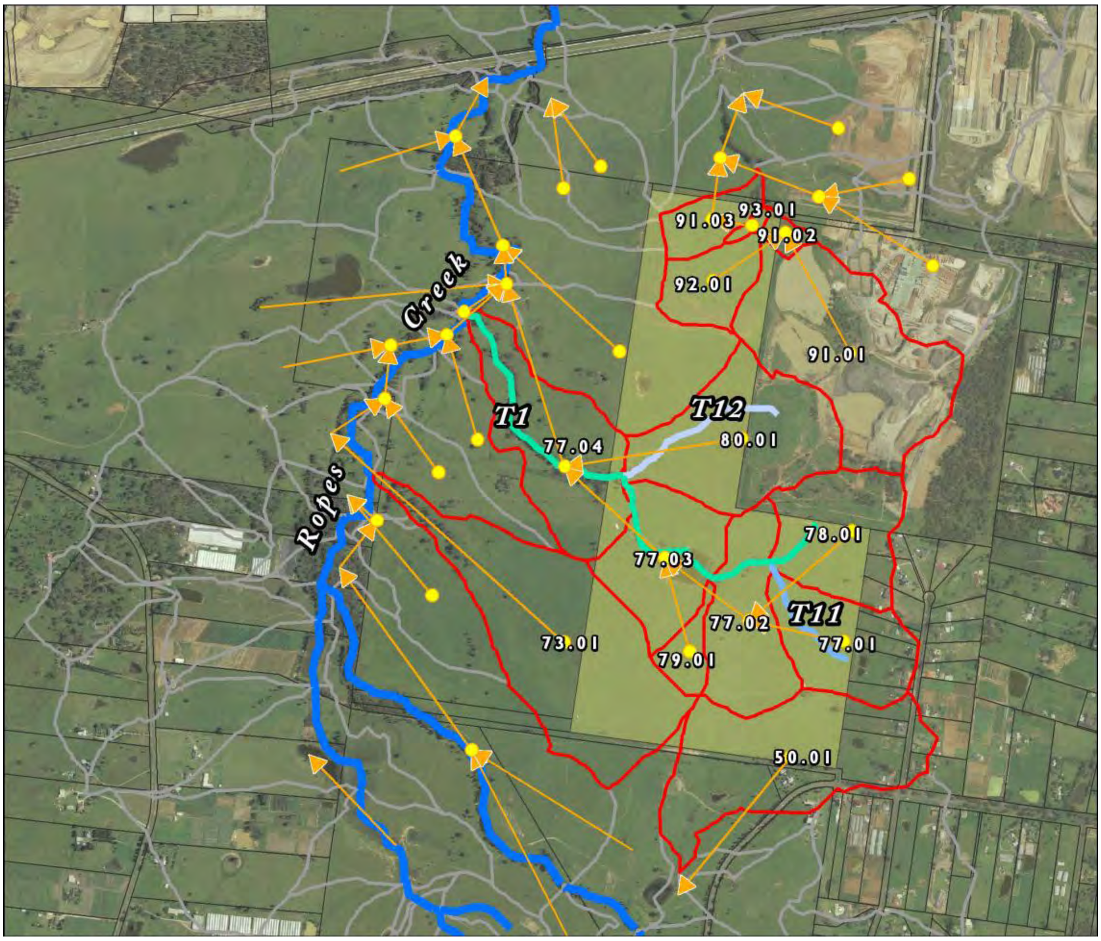


Figure 5 – *XP-RAFTS* Model Layout Plan

The Horsley Park Employment Precinct is located within this catchment wide model and contains three small subcatchments, one draining the area to the north of the site, one to the west and a third to the south eastern corner.

3.1.2 Hydrological Model Parameters

The parameters used in the modelling of Ropes Creek and the catchment including the Horsley Park Employment Precinct are provided in Table 1. These parameters have been determined by Brown Consulting in accordance with the procedures contained within Australian Rainfall and Runoff. Brown Consulting has used these parameters in *XP-RAFTS* models developed for catchments within Western Sydney and specifically within the Western Sydney Employment Area that have been approved by the Growth Centres Commission.

Manning values used in the catchments were 0.015 for the impervious fraction and 0.035 for the pervious fraction, representing urban and well grazed pasture landuses. The impervious fractions used for each landuse included 5% for open space areas and 90% for industrial/commercial areas.

3.1.3 Hydrological Survey Sources

A digital elevation model was developed for the Ropes Creek catchment, including the Horsley Park Employment Precinct, using 5 metre grided LIDAR data provided by the NSW Department of Lands.

3.1.4 Pre-developed Flow Rates

Flow rates for existing conditions were developed in the *XP-RAFTS* hydrologic modelling program using the parameters specified in Table 1. Storm durations from 5 minutes to 72 hours were analysed, with the results of total runoff from the Horsley Park Employment Precinct for the 20 and 100 year recurrence interval presented in Table 2.

Table 2 Existing Condition Peak Flows and Total Catchment Areas

Node	***Total Catch. Area (ha)***	***Peak Flow*** *(m^3/s)*	
		20 year	***100 year***
T11 - East Boundary (Node **77.01**)	12.6	1.5	2.1
T1 – Nort East Boundary (Node **78.01**)	14.2	1.8	2.7
T1 – u/s of the dam (Node **77.02**)	39.5	4.8	7
T1 – d/s of the dam (Node **77.03**)	56.2	6.6	9.9
South Boundary (Node **50.01**)	25.7	2.5	3.4
South West Boundary (Node **73.01**)	33.1	3.1	4
T12 - East Boundary (Node **80.01**)	20.9	2.2	3.1
North Boundary (Node **91.03)**	74.6	4.2	5.8
T1 – West Boundary (Outlet Node **77.04**)	95.7	10.2	14.8

The results in Table 2 show that the pre-development critical storm for the 20 year ARI storms are 18 and 4.5 hour durations and for the 100 year ARI storms 2 and 4.5 hour durations, within the Horsley Park site. These peak flow rates in Tables 2 will be used as the permissible site discharge rate for the design of the stormwater management system for the Horsley Park Employment Precinct.

3.1.5 Calibration/Validation

The runoff parameters specified by Brown Consulting were applied to the *XP-RAFTS* model to estimate flows from the catchment for the 20 and 100 year ARI peak storm events. For the calibration, the Probabilistic Rational Method was used to estimate the flow for comparison to flows calculated using the *XP-RAFTS* model. The results of the flow calculations for the peak storm events for the total 95.7 hectare area at node 77.04 of the Horsley Park Employment Precinct are presented in Table 3.

Table 3 Horsley Park Employment Precinct *XP-RAFTS* & PRM Runoff Calculations

Average Recurrence Interval (years)	*XP-RAFTS Hydrologic Model Flow (m^3/s)*	*Probabilistic Rational Method Flow (m^3/s)*
20	10.2	2.7
100	14.8	11.5

The results in Table 3 indicate that using the runoff parameters specified by Brown Consulting in the *XP-RAFTS* model generates larger flow estimates as using the Probabilistic Rational Method with Penrith City Council specified parameters, for the same time of concentration (2 hour for the 100 year and 18 hour for the 20 year ARI storm events). Therefore at this stage, as a conservative approach, it is appropriate to use the *XP-RAFTS* results, for all hydrologic calculations undertaken in the design of drainage and detention infrastructure for the Horsley Park Employment Precinct.

3.1.6 Post-developed Flow Rates

Flow rates for developed conditions were calculated in the *XP-RAFTS* hydrologic modelling program and are based on the Concept Plan. Sub-catchments were modelled using imperviousness between 40% and 90%. Storm durations from 5 minutes to 72 hours were analysed, with the results of total runoff from the Ropes Creek Employment Precinct for the 100 year recurrence interval presented in Table 4.

Table 4 Developed Conditions Peak Flows

Node	***Peak Flow*** *(m³/s)*	
	20 year	***100 year***
T11 - East Boundary (Node **77.01**)	4.9	6
T1 – Nort East Boundary (Node **78.01**)	2.5	5.1
T1 – u/s of the dam (Node **77.02**)	12	16.9
T1 – d/s of the dam (Node **77.03**)	17.6	21.7
South Boundary (Node **50.01**)	4.6	6
South West Boundary (Node **73.01**)	4.9	6.4
T12 - East Boundary (Node **80.01**)	4.3	5.6
North Boundary (Node **91.03)**	4.9	7
T1 – West Boundary (Outlet Node **77.04**)	21	27

The results in Table 4 show that post-development peak flows for both 20 and 100 ARI storm event are from 1.5 hour and 2 hour critical duration storms. From the results presented in Table 2 and 4, detention is required to bring the post development flows to pre development levels. This is discussed in section 6.1 of this report.

4 FLOODING ANALYSIS

An analysis of flooding in the Horsley Park Employment Precinct and Ropes Creek was undertaken to assess the constraints caused by flooding and to develop flood planning levels (FPL) and road levels. Flow rates in Ropes Creek and tributaries were developed utilising parameters from modelling undertaken for investigations that have previously been submitted to the Growth Centres Commission, as discussed in Section 3.1.2. The hydraulic modelling software *SOBEK* was used to map flood extents for the 100 year ARI storm event.

4.1 METHODOLOGY

The hydraulic modelling the local tributaries of Ropes Creek through the Horsley Park Employment Precinct has been undertaken in *SOBEK* (Version 2.11.002) developed by Delft Hydraulics. This model enables efficient integration between river hydraulics, where flow can be considered 1D, and the floodplain where flows and associated storage effects are best described by a 2D model. Figure 6 shows the river and floodplain elements as treated by *SOBEK*. The 1D element is represented by a cross section which bisects the 2D surface, which is represented by a raster surface (often referred to as a Digital Elevation Model – DEM). *SOBEK* allows stacked raster grids of varying resolution to derive a surface detailed with the required accuracy.

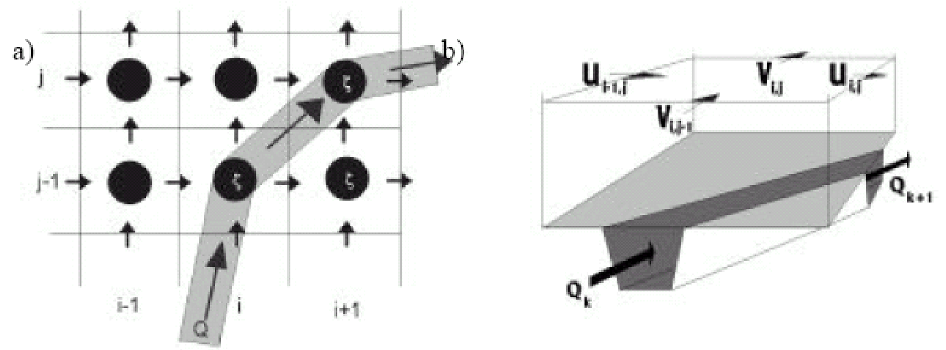


Figure 6 - Schematic Representations of the Integrated 1D/2D SOBEK Hydraulic Model

4.1.1 Survey Sources

Survey for the study area included ground survey from RPS which was used to form a TIN (triangular irregular network) from which a digital elevation model with 5 metre grid spacing was imported into *SOBEK* using the *12d* software package. The survey included spot levels taken across the floodplain along with relevant hydraulic features such as embankments, changes in bank and bed levels, and floodplain elevation.

4.1.2 Roughness

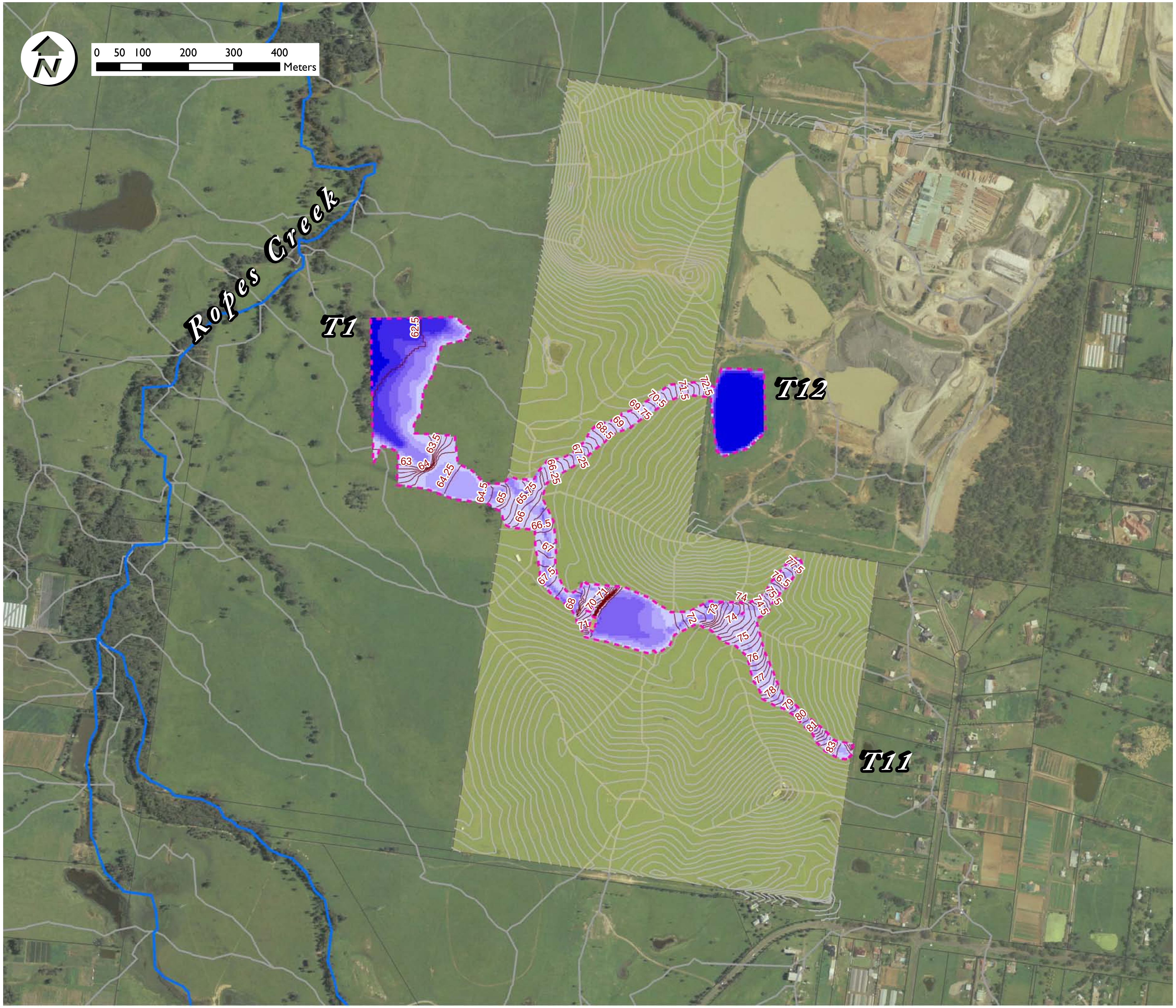
A uniform Manning's roughness value was described across the entire Horsley Park Employment Precinct model for the flood estimation. This coefficient of 0.035 for overbank/floodplain roughness and channel roughness was used based on values presented in Table 1.

4.2 EXISTING FLOOD EXTENTS

The existing 100 year flood extents, flood depth and flood surface elevations were calculated using *SOBEK* hydraulic modelling program. The 100 year flood extents of the tributaries of Ropes Creek within the Horsley Park Employment Precinct are presented in Figure 7, with preliminary flood hazard mapped on Figure 8.

The *SOBEK* modelling has shown that the 100 year ARI flood levels vary from RL 71.5 m AHD in the location of the existing farm dam, to RL 65 m AHD at the downstream western boundary of the site. Flood depths in the area of the Horsley Park Employment Precinct for pre-development conditions range over the site.

The results show that the 100 year flood within the Ropes Creek tributaries extends onto the proposed location of the lots in the Horsley Park Employment Precinct.



Legend

- CATCHMENTS
- CADASTRE
- 100Y ARI PEAK EXTENTS

100Y ARI PEAK FLOOD DEPTH

Depth in Metres

- 0.00 - 0.20
- 0.21 - 0.50
- 0.51 - 1.00
- 1.01 - 1.50
- 1.51 - 2.00
- 2.01 - 3.00
- 3.01 - 13.21
- PEAK WSEL CONTOUR .25m

Details

Issue	Amendment	Date
A	CLIENT REVIEW	JULY 2010

Project

HORSLEY PARK INDUSTRIAL SUBDIVISION

Drawing Title

FIGURE 8
100YEAR ARI PEAK FLOOD EXTENTS EXISTING CONDITIONS

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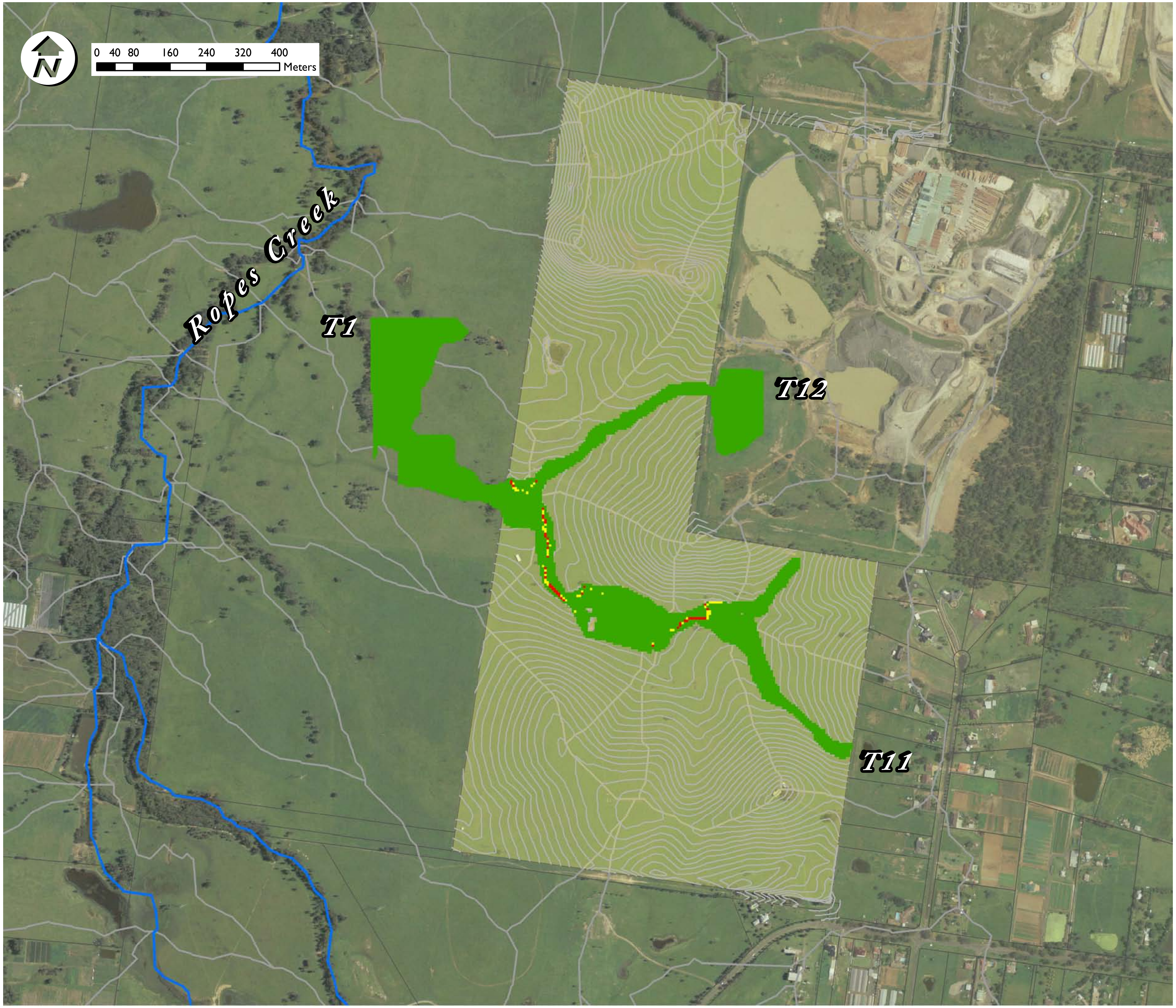
Drawing No.	FIGURE 07

Issue **A**



Legend

CATCHMENTS

CADASTRE

100Y ARI PEAK HAZARD

Velocity Depth Product

- < 0.40
- 0.41 - 0.60
- 0.61 - 2.45

Details

Issue	Amendment	Date
A	CLIENT REVIEW	JULY 2010

Project

HORSLEY PARK
INDUSTRIAL SUBDIVISION

Drawing Title

FIGURE 8
100YEAR ARI PEAK
FLOOD HAZARD
EXISTING CONDITIONS

Scale	1:8000@A3
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Checked	SC
Job No.	X10135
Drawing No.	FIGURE 08
Issue	**A**

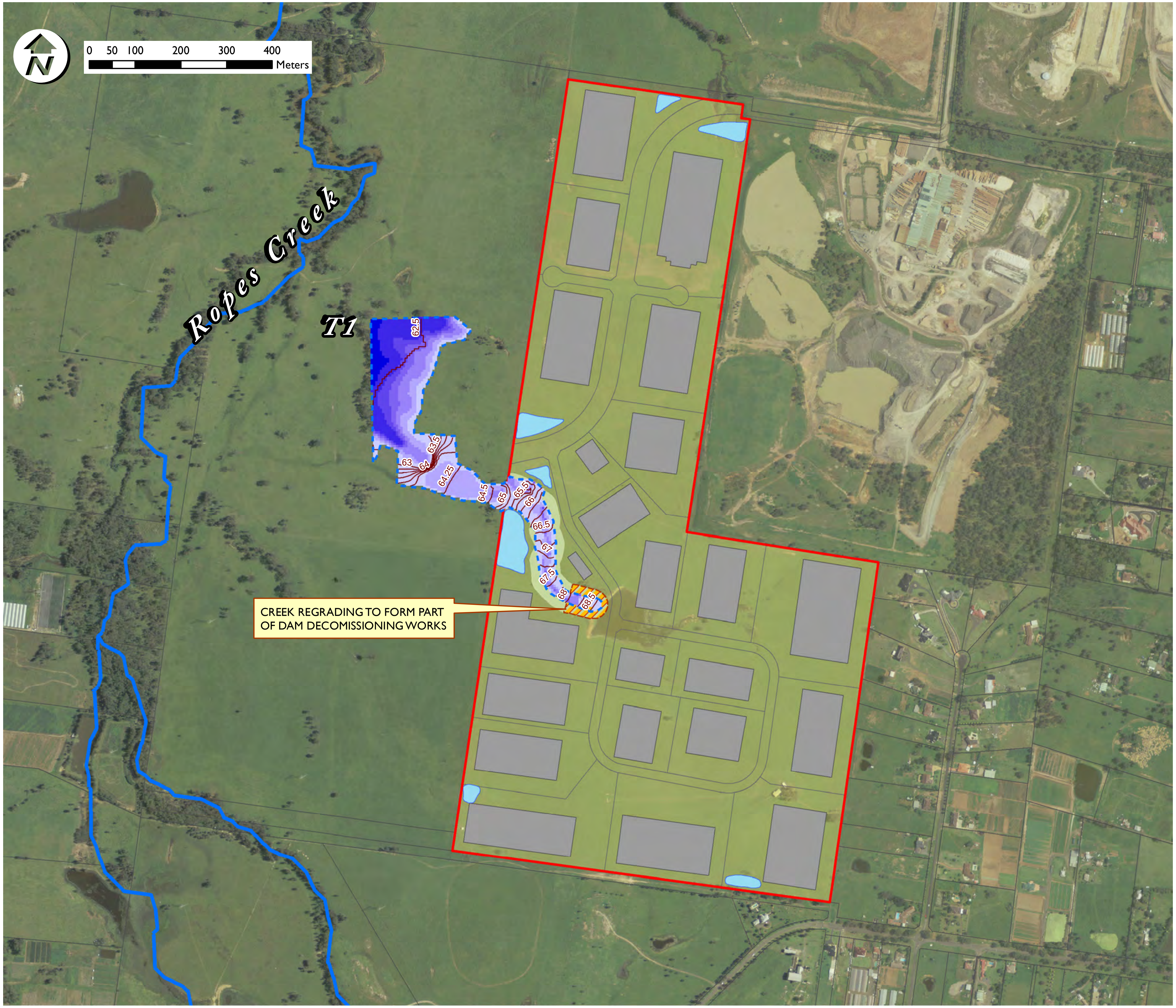
4.3 PRELIMINARY DEVELOPED FLOOD EXTENTS

The 100 year flood extents of the tributary of Ropes Creek within the Horsley Park Employment Precinct are presented in Figure 9, with preliminary flood hazard mapped on Figure 10.

The flood extents are contained within the E2 Conservation zone, with the 100 year ARI flood levels same as for the existing conditions. The area of the creek next to the existing farm dam will be regraded to form part of the proposed dam de-commissioning works.

4.4 FLOOD PLANNING LEVELS & ROAD LEVELS

The minimum habitable floor level of buildings will be 500 millimetres above the 100 year ARI flood level. All roads will be located above the 100 year ARI flood level. Preliminary road levels are presented on drawing set X10135.000-402.



BROWN CONSULTING

Legend

- CREEK REGRADING AREA
- BASIN
- FUTURE ROAD
- LOTS
- BUILDINGS
- RIPARIAN ZONE
- CREEK - Ropes
- 100Y ARI PEAK EXTENTS

100Y ARI PEAK FLOOD DEPTH

- 0.00 - 0.20
- 0.21 - 0.50
- 0.51 - 1.00
- 1.01 - 1.50
- 1.51 - 2.00
- 2.01 - 3.00
- 3.01 - 4.53 max
- PEAK WSEL CONTOUR .25m

Details

Issue	Amendment	Date
A	CLIENT REVIEW	JULY 2010
A	CLIENT REVIEW	NOV 2010

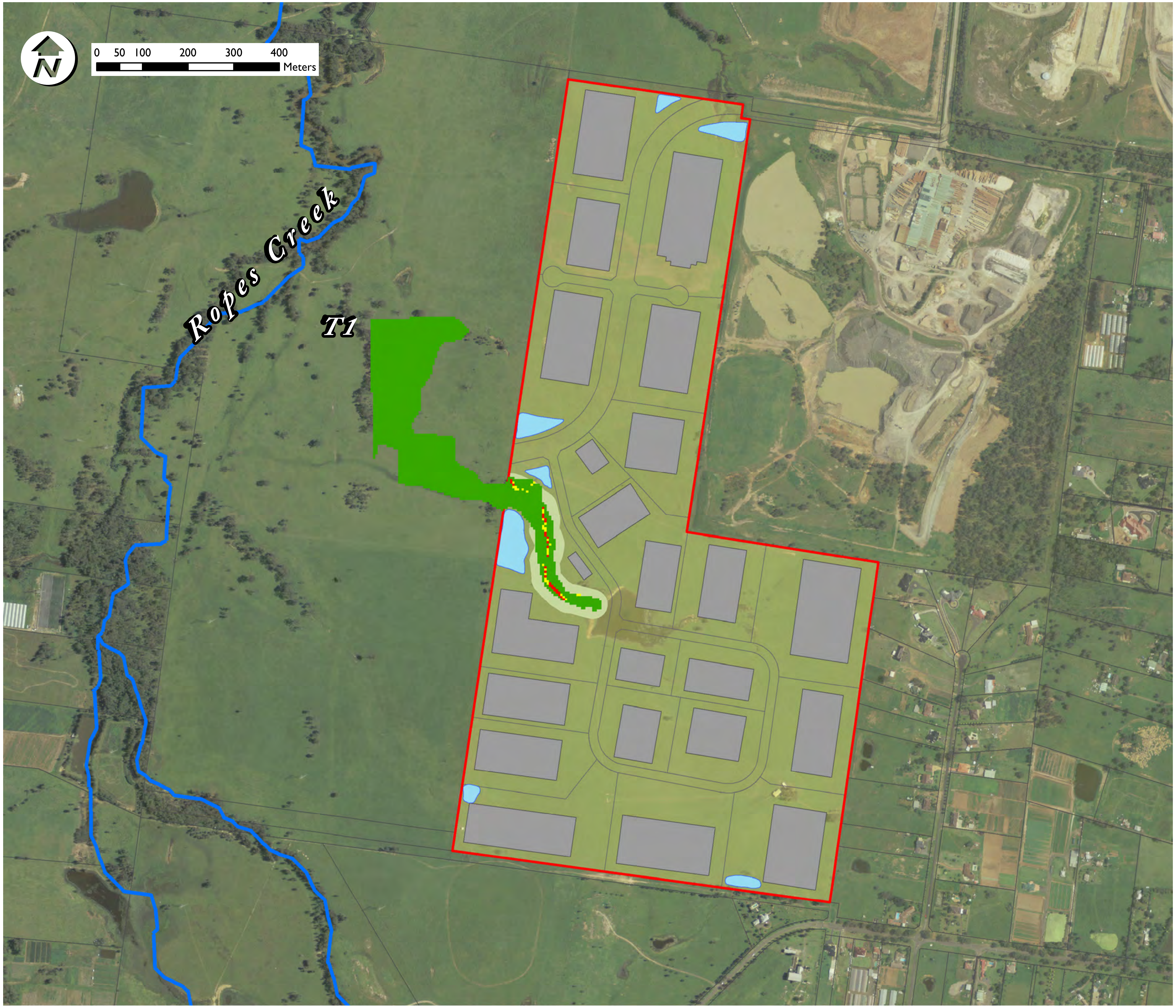
Project

HORSLEY PARK INDUSTRIAL SUBDIVISION

Drawing Title

FIGURE 9
100YEAR ARI PEAK FLOOD EXTENTS DEVELOPED CONDITIONS

Scale	1:8000@A3
Drawn	TWC
Checked	SC
Job No.	X10135
Drawing No.	FIGURE 09
Issue	B



BROWN
CONSULTING

Legend

- BASIN
- FUTURE ROAD
- LOTS
- BUILDINGS
- RIPARIAN ZONE
- CREEK - Ropes

100Y ARI PEAK HAZARD

- < 0.40
- 0.41 - 0.60
- 0.61 - 1.03 max

Details

Issue	Amendment	Date
A	CLIENT REVIEW	JULY 2010
B	CLIENT REVIEW	NOV 2010

Project

HORSLEY PARK
INDUSTRIAL SUBDIVISION

Drawing Title

FIGURE 10
100YEAR ARI PEAK
FLOOD HAZARD
DEVELOPED CONDITIONS

Scale	1:8000@A3
Drawn	TWC
Checked	SC
Job No.	X10135
Drawing No.	FIGURE 10
Issue	**B**

5 CONCEPT DRAINAGE DESIGN

5.1 LOT DRAINAGE DESIGN

Runoff from the development area for storms up to the 20 year ARI will be collected by the following systems:

- For the car and truck parking/manoeuvring areas, a combination pit and pipe and swale system discharging to a number of bioretention basins around the site. This water is then discharged into swale drains and then into the creek around the site.
- The roof water will be directed to detention basins and from there will be discharged to the creek system.

5.2 TRUNK DRAINAGE DESIGN

Major flows are considered those flows in excess of the 20 year ARI peak flow, in accordance with Penrith City Council Guidelines for Engineering Works for Subdivisions and Developments (1997), presented in Table 1. Such flows from the parking and manoeuvring areas will be directed overland using the internal access-ways and swales (where appropriate). From here the flows are conveyed to the bioretention basins, where detention is provided to reduce the peak flows to pre development levels.

Stormwater flows from the roof areas will be directed to the detention basin within the site. The downpipes and drainage network for this system need to be sized to convey the 100 year ARI flows to the basin.

It is proposed to provide an overland flowpath for the upstream site along the northern section of the eastern boundary of the site. This system will consist of a pipe system sized to convey the 20 year ARI flow and a swale to convey additional flows up to the 100 year ARI to the creek system.

The floor levels of the buildings will be set a minimum of 500 mm above the 100 year ARI flood level.

6 STORMWATER BASIN DESIGN

Section 4 of this report has determined that stormwater detention basins are required to mitigate the floods from the proposed development. The basins have been designed with a bioretention system in the base, with extended detention above, and the base detention basin storage volume above the extended detention., This arrangement minimises space requirements of the basin while meeting pollutant removal performance targets. Bioretention basin and the pollutant removal performance is discussed in more details in Section 6.3. The basins were designed to treat flow from 100 hectares of area of the Horlsey Park Employment Precinct.

6.1 DETENTION REQUIREMENTS

The detention strategy requires that individual lot detention basins manage 2 year ARI flows, with large scale community basins with managing 100 year ARI flows to pre-development rates from the catchment. This arrangement ensures no increase in peak flows at Ropes Creek upstream or downstream of the Horlsey Park Employment Precinct. The design requirements of the basins are required to limit flows to peak flow rates for the 100 year events as presented in Table 1.

The master stormwater layout for the Horsley Park Employment Precinct incorporates seven basins. The concept basin detentions are modelled in *DRAINS* to determine the effectiveness of the basins to limit flows to pre-development levels of this development. The DRAINS outputs are detailed in Table 5 and Table 6.

Table 5 100 year ARI Peak Flows at Detention Basin locations

Basin No.	*Exs.Con.* (m^3/s)	*Dev.Con.* (m^3/s)	*Dev.with Basin* (m^3/s)
Basin 1	2.46	3.05	2.18
Basin 2	4.84	5.90	4.66
Basin 3	12.60	15.40	12.20
Basin 4	8.46	10.40	7.40
Basin 5	7.19	8.82	7.06
Basin 6	3.66	4.49	3.59
Basin 7	3.97	4.87	3.96

Table 6 Detention Basins requirements

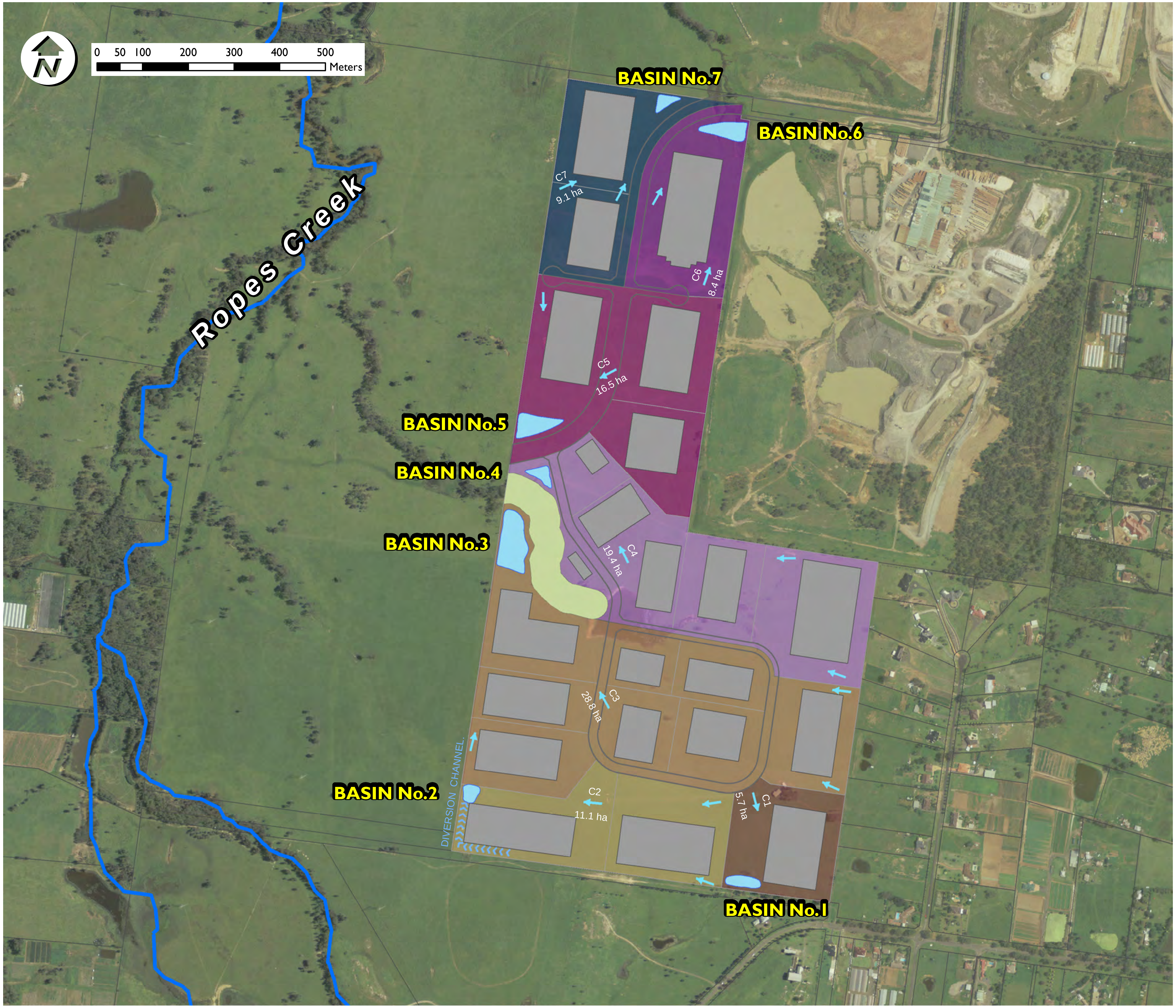
Basin No.	*Surf.Area (m2)*	*Bioret.Area (m2)*	*Catch.Area (ha)*	*Volume (m3)*
Basin 1	2,150	1,040	5.7	840
Basin 2	3,400	2,000	11.1	1,500
Basin 3	7,600	5,250	*28.8*	*3,900*
Basin 4	5,500	3,540	19.4	3,350
Basin 5	5,000	3,000	16.5	2,200
Basin 6	2,500	1,500	8.4	1,200
Basin 7	2,800	1,700	9.1	1,300

Indicative size of surface area of bioretention filter media for seven detention basins, presented in Table 6 has been determined to meet the water quality targets outlined in Table 1 from the Growth Centres Development Code (DEC 2006). These areas would be readily incorporated in the base of the proposed larger basin areas as presented in Table 6.

6.2 DETENTION BASIN DESIGN

The detention basins havel been designed to maximise the storage volume available within the constraints of the road, the riparian buffer zone and the location of the sewage pumping station. A batter slope of 1V:6H and maximum ponding depth of 1.0 metres above the extended detention will be required for the basin.

The outlet of the basin was sized to meet Penrith Council design requirements of attenuating the 100 year flows. This outlet will be sized using the *DRAINS* hydrologic modelling program using parameters specified in Table 1. Preliminary basin locations are presented on Figure 11 and sizing in Section 6.1 of this report.



BROWN CONSULTING

Legend

- CREEK - Ropes
- FLOW DIRECTION
- DIVERSION CHANNEL
- BASIN
- FUTURE ROAD
- LOTS
- BUILDINGS
- RIPARIAN ZONE

STORMWATER COLLECTION AREAS

- Basin 1 - 5.7ha
- Basin 2 - 11.1ha
- Basin 3 - 28.8ha
- Basin 4 - 19.4ha
- Basin 5 - 16.5ha
- Basin 6 - 8.4ha
- Basin 7 - 9.1ha

Details

Issue	Amendment	Date
A	CLIENT REVIEW	JULY 2010
B	CLIENT REVIEW	NOV 2010

Project

HORSLEY PARK INDUSTRIAL SUBDIVISION

Drawing Title

FIGURE 11 PRELIMINARY BASIN LOCATIONS & STORMWATER MASTERPLAN

Scale	1:8000@A3
Drawn	TWC
Checked	SC
Job No.	X10135
Drawing No.	FIGURE 11
Issue	B

6.3 WATER QUALITY REQUIREMENTS

The then Department of Environment and Conservation (DEC), now the NSW Office of Water under the Department of Environment, Climate Change and Water (DECCW) has established stormwater management targets as part of the Development Code under the State Environmental Planning Policy "Growth Centres". The targets are outlined in Table 1 and are slightly different to those commonly that have been adopted throughout NSW. The targets in Table 1 are in-line with current best practice nutrient level reductions.

6.3.1 Gross Pollutant Traps

Gross pollutant traps (GPT) are typically placed in-line with the drainage system prior to discharge into a bioretention basin. These capture litter, debris, coarse sediment, oils and greases. While the pollutant capture efficiency of various traps may vary, as a conservative measure for modelling purposes the GPT is assumed to be capable of removing the following annual load:

- Gross Pollutants 90%
- Suspended Sediments 0%
- Total Phosphorous 0%
- Total Nitrogen 0%

It is proposed to install GPTs at the inlets of the detention basins for litter control.

6.3.2 Bioretention Basins

Bioretention basins will be utilised to perform the majority of the water treatment from the site. Bioretention basins consist of shallow areas over most of their surface area to incorporate macrophytes for nutrient uptake.

The bioretention basins have been conceptually designed on the basis of a 1m deep filter medium with a maximum depth of ponding of 0.55m and a 48 hour drawdown.

Suitable wetland macrophyte species for the bioretention basin, would include species such as; *baumea articulata*, *carex appressa*, *cyperus difformis, cyperus polystachyos, eleocharis sphacelata*, *eleocharis cylindrostachys, cyperus flaccidus, juncus prisatocarpus, juncus remotiflourus, juncus usitatus, lomandra longifolia, phragmites australis and phragmites lanuginosum.* All these species exhibit good nutrient removal rates and are hardy. Landscape drawings will be provided at Project Plan stage to detail the actual species mix to be used in the basin.

Plantings within the bioretention basins must be complementary to the adjacent local native plant communities of the riparian corridor and be able to withstand periods of inundation and some long dry periods between rain events. Suitable littoral or transitional plant species (DLWC 1998) for the bioretention basin would include species such as: *Baumea juncea, Carex appressa, Carex fascicularis, Cyperus exaltatus, Carex polystachyus, Gahnia sieberana, Juncus prismatocarpus, Juncus usitatus, Lomandra longifolia, Paspalum distichum,* and *Schoenus brevifolius*. This is subject to further detailed landscape desugn.

It is recommended that the bioretention basin filter media be installed after 80% of development is completed within the catchment in order to prevent the filter from being clogged prematurely from construction run off. Prior to installation of the filter media, the bioretention basin will be turfed with *Paspalum distichum*.

Sizing of the bioretention basins has been undertaken using the WSUD Technical Guidelines for Western Sydney and results are presented in Section 6.1.

7 STAGE 1 PROJECT APPLICATION

The proposed developed area and general site layout of Stage 1 of the development of Horsley Park Employment Precinct are presented on drawings X10135-000 and X10135-001. The layout of the drainage infrastructure of Stage 1 of the development of Horsley Park Employment Precinct is presented on drawing X10135-102.

7.1 DETENTION REQUIREMENTS

The implementation of the large scale community basins will be staged with each project application to ensure the detention and water quality objectives are met with each development. This arrangement ensures no increase in peak flows at Ropes Creek upstream or downstream of the Horsley Park Employment Precinct.

The concept basin detention of Basin No.6 for Stage 1 was modelled in *DRAINS* to determine the size and effectiveness of the basins to limit flows to pre-development levels of this Stage 1 development. The DRAINS outputs are detailed in Table 5 and Table 6 in Section 6.1.

7.2 WATER QUALITY REQUIREMENTS

The then Department of Environment and Conservation (DEC), now the NSW Office of Water under the Department of Environment, Climate Change and Water (DECCW) has established stormwater management targets as part of the Development Code under the State Environmental Planning Policy "Growth Centres". The targets are outlined in Table 1 and are slightly different to those commonly adopted throughout NSW. The targets in Table 1 are in-line with current best practice nutrient level reductions and will be used for the design of the Stage 1 detention basin.

Providing the surface area of bioretention filter media as presented in Table 6 in Section 6.1 for Basin No.6 for the Stage 1, will ensure that the treated water meets the required GCC water quality requirements.

7.3 RAINWATER HARVESTING REQUIREMENTS

The roof water will be directed to rainwater harvesting tanks, to detention basins and from there will be discharged to the creek system. These rainwater tanks will be designed to accommodate the non-potable water used within the development. The size of rainwater tank required for the proposed Stage 1 development have been calculated to be 25 kL.

8 SOIL & WATER MANAGEMENT DURING CONSTRUCTION

8.1 SOIL AND WATER MANAGEMENT PLAN

A Soil and Water Management Plan (SWMP) will be prepared and implemented to minimise potential impacts on hydrology and water quality during the construction period. This plan will incorporate the design and installation of erosion controls in accordance with the requirements *Managing Urban Stormwater: Soils and Construction* published by Landcom (colloquially known as the *"Blue Book"*).

The plan will include the following:

- At the vegetation clearing stage, cleared vegetation will be mulched and spread over disturbed area to provide a natural erosion barrier
- Prior to commencement of earthworks, a range of measures will be put in place including:
    - Construction of cut-off drains to prevent clean water from upstream of the corridor flowing onto and eroding disturbed areas
    - The diversion of site discharge points to erosion control measures such as silt fences and sedimentation basins in order to control dirty water areas
    - The stabilisation of exposed areas as soon as practical following the construction of each section of works
- Controls outside the specific work area would be put in place including:
    - Refuelling of plant and machinery within bunded areas or off site in appropriate locations
    - Minimisation of disturbed areas so that the potential export of sediment is minimised
    - The establishment and maintenance of stabilised construction compounds to reduce the overall disturbance area for the Project.
- Temporary sediment basins will be constructed to capture water and sediment before it can leave the site or enter the receiving water bodies. Conceptual design of the temporary sediment basins will be included in the SWMP and follow the methodology outlined in the "*Blue Book*" with the following features:
    - Sediment basins are to be located at points near where dirty water would discharge to receiving waters or leave the site
    - Basins are to be designed for Type F/D soils, as outlined in Section 6.3.4 of the Blue Book, in accordance with the soil type classifications
    - The minimum depth of the basins will be 0.6 metres with an average depth of 1 metre.

A surface water quality monitoring program for the construction period will be developed to monitor water quality upstream and downstream of the construction areas. Construction period monitoring will be carried out periodically and after rainfall events as part of the assessment of the operation of water quality mitigation measures. Monitoring during the construction phase of the project would examine the following indicators:

- pH
- Electrical conductivity
- Turbidity
- Dissolved oxygen

8.2 DUST MANAGEMENT PLAN

A Dust Management Plan will be prepared and implemented to provide best management strategies for dust control and an approved monitoring program for identified key issues and areas of concern, to achieve target dust deposition and minimise adverse impacts and complaints relating to dust emissions.

The sources of dust and emissions during construction include the following:

- Wind-blown sand and dust due to large exposed areas during reclamation
- Earthworks activities
- Stockpiling sand on reclamation
- Loading and unloading materials
- Transport of sand and other spoil
- Use of haul roads

Dust Control Measures include:

- Dust monitoring conducted both prior and during construction activities (installing dust deposition gauges at identified locations; daily and weekly visual surveillance of dust emissions, dust controls, plant emissions; meteorological daily data collection such as wind speed, rain, temperature, humidity etc.)
- Where possible, minimise disturbed and exposed areas
- Locate stockpiles as far away from public and residential areas as possible

- Dust control on short-term stockpiles (≤ 3 months) will be controlled using water sprays, drift fencing and daily inspections and long-term (≥ 3 months) progressive vegetation and bitumen emulsions
- Construct wind-breaks or drift fences made of geo-fabric screens at regular intervals around stockpiles and erodible areas
- Apply a thin layer of bitumen or grass in completed reclamation areas
- Inspect equipment and vehicles exhaust emissions at start up and during construction and do not leave machinery and vehicles running when not in use
- Cement will be delivered to site in sealed tankers and pumped to silos, providing a closed system to prevent dust emissions
- Restrict construction traffic to defined areas and speed limits
- Wherever possible, seal internal construction-related roads
- Cover unsealed roads with road base rock and gravel and keep moist
- Operate a water spray system over any gravel stockpiles
- During dry and windy conditions spray water over the road surfaces to prevent wind erosion

The volume of water required for dust suppression will vary according to prevailing climatic conditions, the extent of haul road development and the usage of the haul roads. It is considered that on days that the daily rainfall exceeds evaporation it is unlikely that dust suppression will be required. As such the yearly rate for haul road watering has been calculated using the effective evaporation for the site multiplied by the area of haul road to be watered (assumed width of 30 m) and multiplied by a factor of 1.4 to allow for increased evaporation due to vehicle movements on the haul road. Based on this calculation, the typical annual water demand for haul dust suppression will range from 13 ML/km to 16 ML/km of haul road for a wet rainfall year and dry rainfall year respectively.

9 CONCLUSION

The hydrological and hydraulic modelling has shown that the proposed subdivision and supporting roads of the Horsley Park Employment Precinct can be constructed while meeting Penrith City Council, DECCW and NSW Office of Water requirements for stormwater quantity and quality management.

The objectives and performance targets (quantity and quality) are achieved by using a mix of water sensitive urban design (WSUD) components throughout the subdivision, including rainwater tanks and bio-retention basins with detention storage.

10 REFERENCES

Faculty for Advancing Water Biofiltration (FAWB) (2009). *Adoption Guidelines for Stormwater Biofiltration Systems*, Facility for Advancing Water Biofiltration, Monash University, June 2009.

Institution of Engineers Australia 2001. *Australian Rainfall & Runoff*.

NSW Department of Environment and Conservation (DEC, now DECCW) 2006, *Growth Centres Development Code*

NSW Department of Land and Water Conservation 1998*, The Constructed Wetland Manual*

Penrith Council 2009, Engineering Design Specification

Penrith Development Control Plan 2006

Penrith City Council – Erskine Park Employment Area Development Control Plan 2002

Penrith City Council Guidelines for Engineering Works for Subdivisions and Developments – Part 1 – Design (1997)

Penrith City Council Stormwater Management for Developments 2009 (DRAFT)

11 GLOSSARY OF TERMS

Afflux	The rise in water level upstream of a hydraulic structure such as a bridge or culvert, caused by losses incurred from the hydraulic structure.
Australian Height Datum	National survey datum corresponding approximately to mean sea level.
Annual Exceedance Probability	The chance of a flood of a given size or larger occurring in any one year, generally expressed as percentage probability. For example, a 100 year ARI flood is a 1% AEP flood. An important implication is that when a 1% AEP flood occurs, there is still a 1% probability that it could occur the following year.
Average Recurrence Interval	Is the long term average number of years between the occurrence of a flood as big as, or larger than the selected flood event.
Catchment	The catchment at a particular point is the area of land which drains to that point.
Design floor level	The minimum (lowest) floor level specified for a building.
Design flood	A hypothetical flood representing a specific likelihood of occurrence (for example the 100 year or 1% probability flood). The design flood may comprise two or more single source dominated floods.
Development	Existing or proposed works which may or may not impact upon flooding. Typical works are filling of land, and the construction of roads, floodways and buildings.
Discharge	The rate of flow of water measured in terms of volume over time. It is not the velocity of flow which is a measure of how fast the water is moving rather than how much is moving. Discharge and flow are interchangeable.
Digital Terrain Model	A three-dimensional model of the ground surface that can be represented as a series of grids with each cell representing an elevation (DEM) or a series of interconnected triangles with elevations (TIN).
Effective warning time	The available time that a community has from receiving a flood warning to when the flood reaches their location.
Flood	Above average river or creek flows which overtop banks and inundate floodplains.
Flood awareness	An appreciation of the likely threats and consequences of flooding and an understanding of any flood warning and evacuation procedures. Communities with a high degree of flood awareness respond to flood warnings promptly and efficiently, greatly reducing the potential for damage and loss of life and limb. Communities with a low degree of flood awareness may not fully appreciate the importance of flood warnings and

	flood preparedness and consequently suffer greater personal and economic losses.
Flood behaviour	The pattern / characteristics / nature of a flood.
Flooding	The State Emergency Service uses the following definitions in flood warnings: *Minor flooding:* causes inconvenience such as closing of minor roads and the submergence of low level bridges *Moderate flooding:* low-lying areas inundated requiring removal of stock and/or evacuation of some houses. Main traffic bridges may be covered. *Major flooding:* extensive rural areas are flooded with properties, villages and towns isolated and/or appreciable urban areas are flooded.
Flood frequency analysis	An analysis of historical flood records to determine estimates of design flood flows.
Flood fringe	Land which may be affected by flooding but is not designated as a floodway or flood storage.
Flood hazard	The potential threat to property or persons due to flooding.
Flood level	The height or elevation of flood waters relative to a datum (typically the Australian Height Datum). Also referred to as “stage”.
Flood liable land	Land inundated up to the probable maximum flood – flood prone land.
Floodplain	Land adjacent to a river or creek which is inundated by floods up to the probable maximum flood that is designated as flood prone land.
Flood Planning Levels	Are the combinations of flood levels and freeboards selected for planning purposes to account for uncertainty in the estimate of the flood level.
Flood proofing	Measures taken to improve or modify the design, construction and alteration of buildings to minimise or eliminate flood damages and threats to life and limb.
Floodplain Management	The coordinated management of activities which occur on flood liable land.
Floodplain Management Manual	A document by the NSW Government (2001) that provides a guideline for the management of flood liable land. This document describes the process of a floodplain risk management study.
Flood source	The source of the flood waters.
Floodplain Management Standard	A set of conditions and policies which define the benchmark from which floodplain management options are compared and assessed.
Flood standard	The flood selected for planning and floodplain management activities. The flood may be an historical or design flood. It should be based on an understanding of the flood behaviour and the associated flood hazard. It should also take into account social, economic and ecological considerations.

Flood storages	Floodplain areas which are important for the temporary storage of flood waters during a flood.
Floodways	Those areas of the floodplain where a significant discharge of flow occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if they are partially blocked, would cause significant redistribution of flood flows, or a significant increase in flood levels.
Freeboard	A factor of safety usually expressed as a height above the flood standard. Freeboard tends to compensate for the factors such as wave action, localised hydraulic effects and uncertainties in the design flood levels.
Geographical Information System	A form of computer software developed for mapping applications and data storage. Useful for generating terrain models and processing data for input into flood estimation models.
High hazard	Danger to life and limb; evacuation difficult; potential for structural damage, high social disruption and economic losses. High hazard areas are those areas subject to a combination of flood depth and flow velocity that are deemed to cause the above issues to persons or property.
Historical flood	A flood which has actually occurred – Flood of Record.
Hydraulic	The term given to the study of water flow in rivers, estuaries with coastal systems.
Hydrograph	A graph showing how a river or creek's discharge changes with time.
Hydrology	The term given to the study of the rain-runoff process in catchments.
Low hazard	Flood depths and velocities are sufficiently low that people and their possessions can be evacuated.
Management plan	A clear and concise document, normally containing diagrams and maps, describing a series of actions that will allow an area to be managed in a coordinated manner to achieve defined objectives.
Map Grid Australia	A national coordinate system used for the mapping of features on a representation of the earths surface. Based on the geographic coordinate system 'Geodetic Datum of Australia 1994'.
Peak flood level, flow or velocity	The maximum flood level, flow or velocity occurring during a flood event.
Probable Maximum Flood	An extreme flood deemed to be the maximum flood likely to occur at a particular location.
Probable Maximum Precipitation	The greatest depth of rainfall for a given duration meteorologically possible over a particular location. Used to estimate the probable maximum flood.
Probability	A statistical measure of the likely frequency or occurrence of flooding.

Riparian Zone	Areas that are located adjacent to watercourses. Their definition is vague and can be characterised by landform, vegetation, legislation or their function.
Runoff	The amount of rainfall from a catchment which actually ends up as flowing water in the river of creek.
Stage hydrograph	A graph of water level over time.
Velocity	The speed at which the flood waters are moving. Typically, modelled velocities in a river or creek are quoted as the depth and width averaged velocity, i.e. the average velocity across the whole river or creek section.
Water Sensitive Urban Design	An approach to planning and design of urban development that aims to minimise the negative impacts on the natural water cycle. This design philosophy aims to protect the health of aquatic ecosystems by integrating "natural" features into the stormwater, water supply and sewage management of a development.

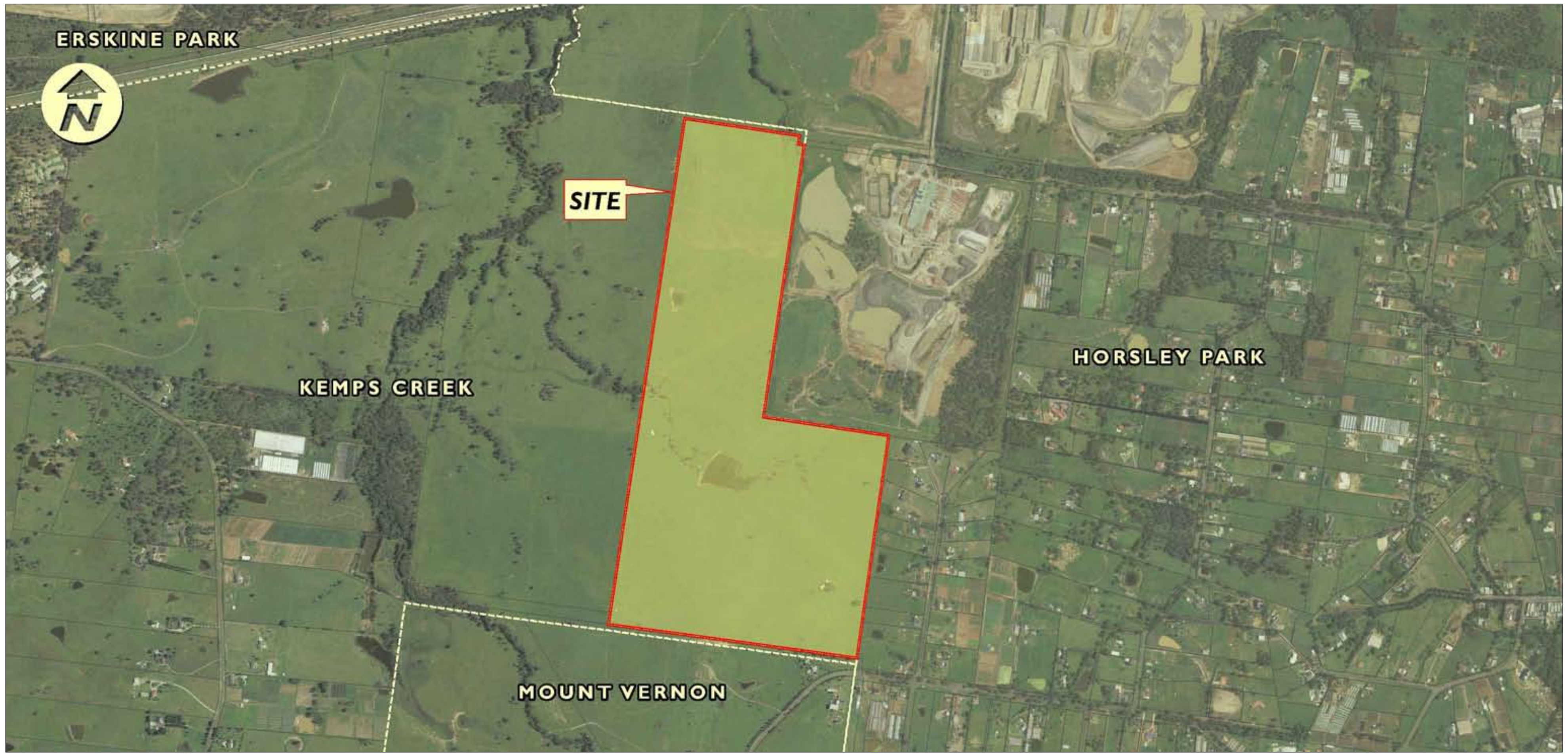
12 APPENDICES

APPENDIX A

DRAWINGS

LOT A BURLEY ROAD, HORSLEY PARK EMPLOYMENT PRECINCT

ROAD AND BULK EARTHWORK CONCEPT STAGE 1



LOCALITY PLAN
N.T.S.

LGA BLACKTOWN COUNCIL

JACFIN PTY LTD

DRAWING LIST

BROWN

LOT A BURLEY ROAD, HORSLEY PARK EMPLOYMENT PRECINCT
ROAD AND BULK EARTHWORK CONCEPT STAGE 1
JOB No: X10135

Brown Consulting (NSW) Pty Ltd

Level 2, 2 Burbank Place, Norwest Business Park
Baulkham Hills NSW Australia 2153
Telephone: 02 8808 5000 Facsimile: 02 8808 5099

DRAWING	REVISION
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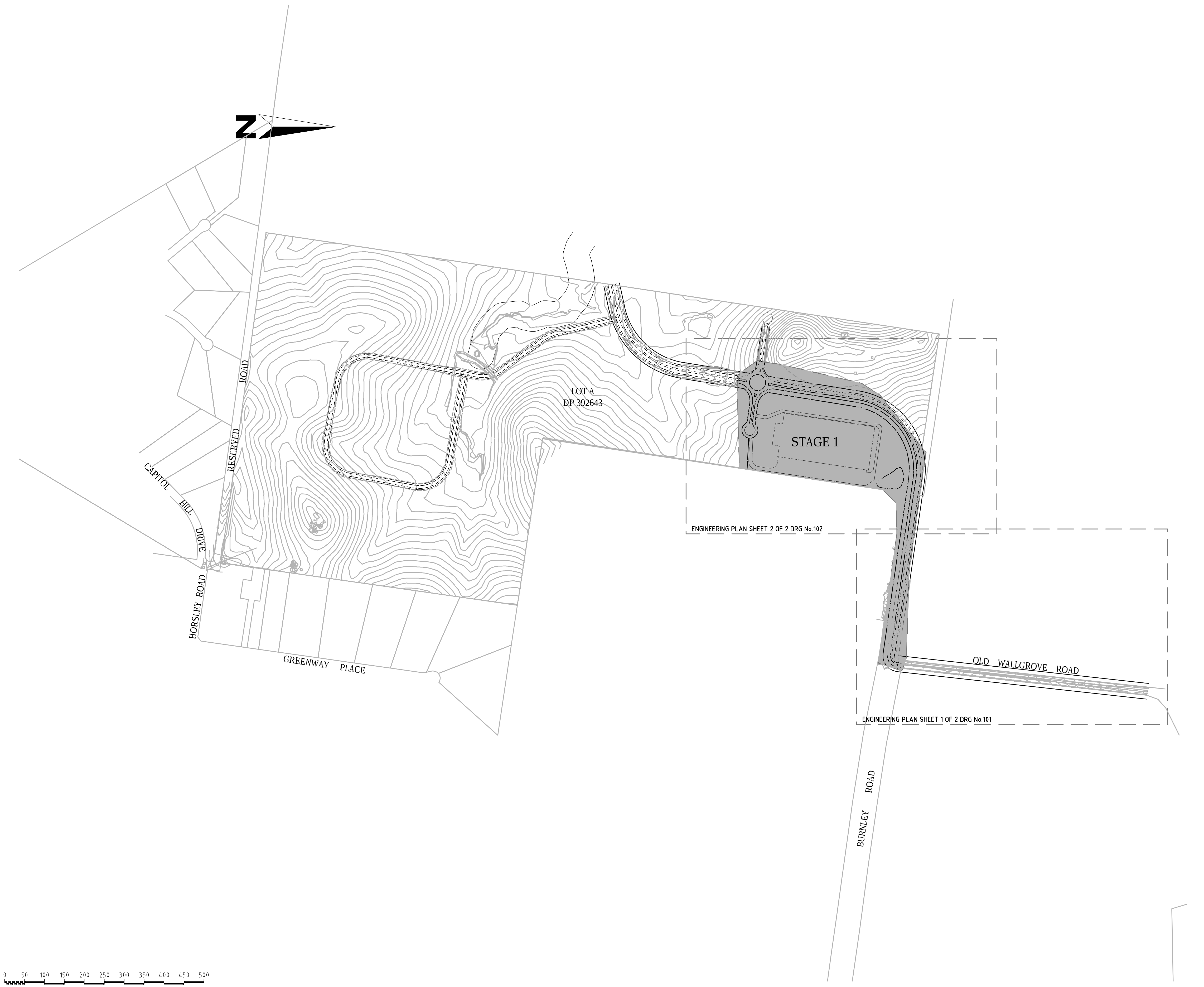

LEGEND

PROPOSED	DESCRIPTION	EXISTING	FUTURE
L3 375ø	STORMWATER PIPELINE	375ø	
LA 150ø	COMMON DRAINAGE LINE, PIT & SLOPE JUNCTION		
	STORMWATER DRAINAGE PIT		
3/17	DRAINAGE LINE No. 3 DRAINAGE PIT No. 17		
	CONCRETE HEADWALL		
	SLOPE JUNCTION		
SS	SUBSOIL DRAIN		
K&G	STANDARD 150mm KERB & GUTTER	EXIST. K&G	FUT. K&G
RK	STANDARD ROLL KERB & GUTTER	EXIST. RK	FUT. RK
KO	STANDARD KERB ONLY	EXIST. KO	FUT. KO
ES	STANDARD EDGE STRIP	EXIST. ES	FUT. ES
MK	STANDARD MOUNTABLE KERB	EXIST. MK	FUT. MK
VC	VEHICULAR CROSSING	VC	VC
PR	STANDARD PEDESTRIAN RAMP	PR	PR
DC	STANDARD DISH CROSSING	DC	DC
EOB	EDGE OF BITUMEN	EXIST. EOB	FUT. EOB
	ROAD PAVEMENT		
P42.50	FINISHED PAVEMENT LEVEL		
	CONCRETE PATHWAY		
	STANDARD GUIDE POSTS		
	STREET NAME SIGN		
150	CONTOURS	50	61
CUT FILL	SITE REGRADING AREA		
	BENCHMARK	BM RL....	
	SEWER MAIN, ACCESS CHAMBER	S AC S	
	TELECOM LINE, POLE, PIT	T TP	
	WATER MAIN, HYDRANT STOP VALVE, AIR VALVE	W H SV AV	
	GAS MAIN	G G	
	ELECTRICITY LINE, POLE	E PP	
	LIMIT OF CONSTRUCTION		
	LIMIT OF STAGE		
	TREES TO BE REMOVED		
	POST & RAIL FENCE		

0 50 100 150 200 250 300 350 400 450 500

SCALE 1:5000 (A1) SCALE 1:10000 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
A	12/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

REVISIONS

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Quality System Quality Endorsed Company

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APPROVAL

BY: TOBY TAMES
BE (Hons) GradDlpMgt CPESC CPEng MIEAust
Director

SIGN:

DATE: 12/08/2010

Client: JACFIN PTY LTD

Project: LOT A BURLEY ROAD, HORSLEY PARK EMPLOYMENT PRECINCT ROAD AND BULK EARTHWORK CONCEPT STAGE 1

Drawing: GENERAL LAYOUT PLAN

Drawn by: A.Mc

Design by: M.N.

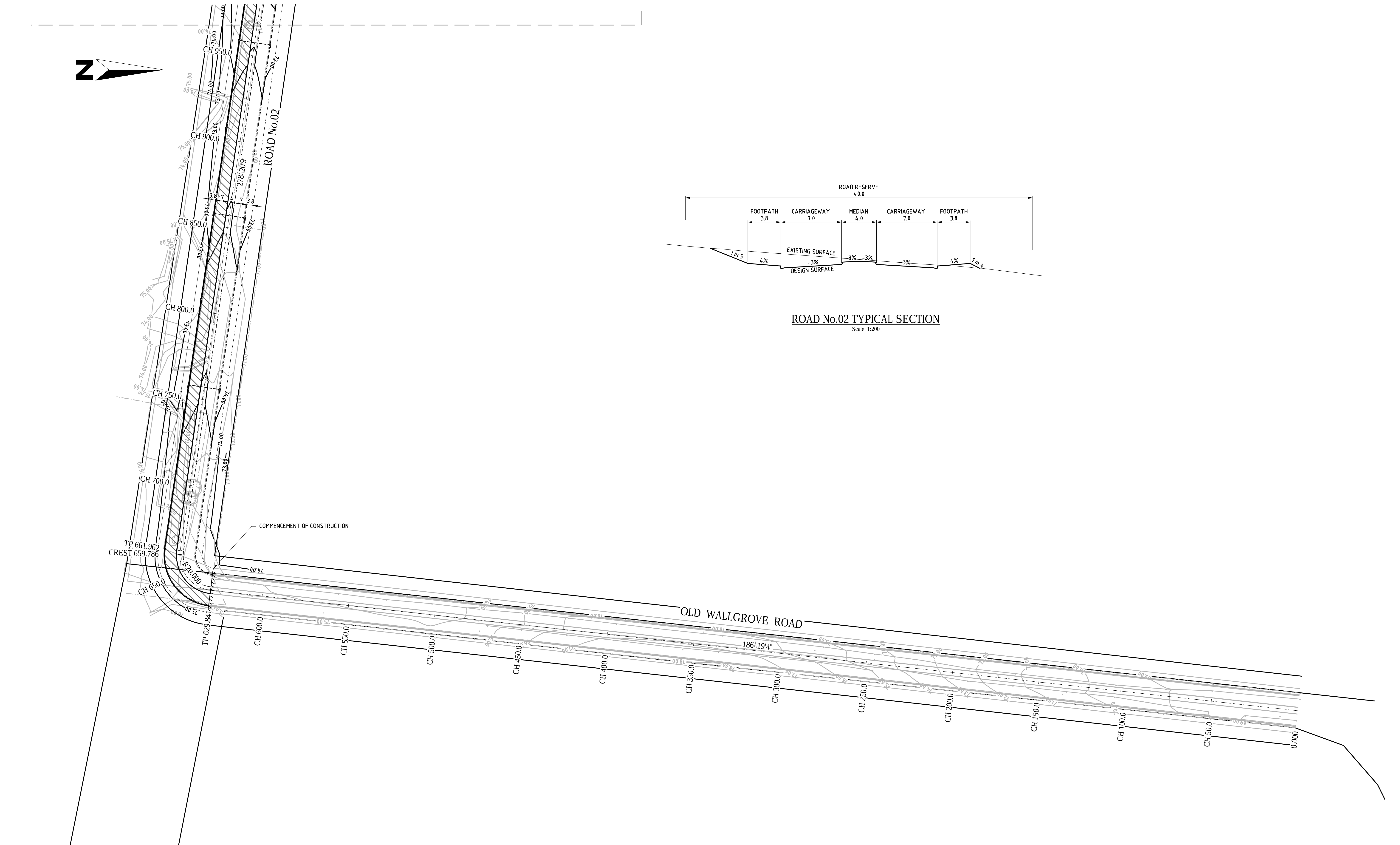
Project No: X10135

Scale(A1): 1:5000

Drawing No: 001

Revision: A

FOR CONTINUATION REFER TO DRAWING No. 102



ROAD No.02 TYPICAL SECTION
Scale: 1:200

SCALE 1:1000 (A1) SCALE 1:2000 (A3)

SCALE 1:200 (A1) SCALE 1:400 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
A	12/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

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Director
SIGN:
DATE: 12/08/2010

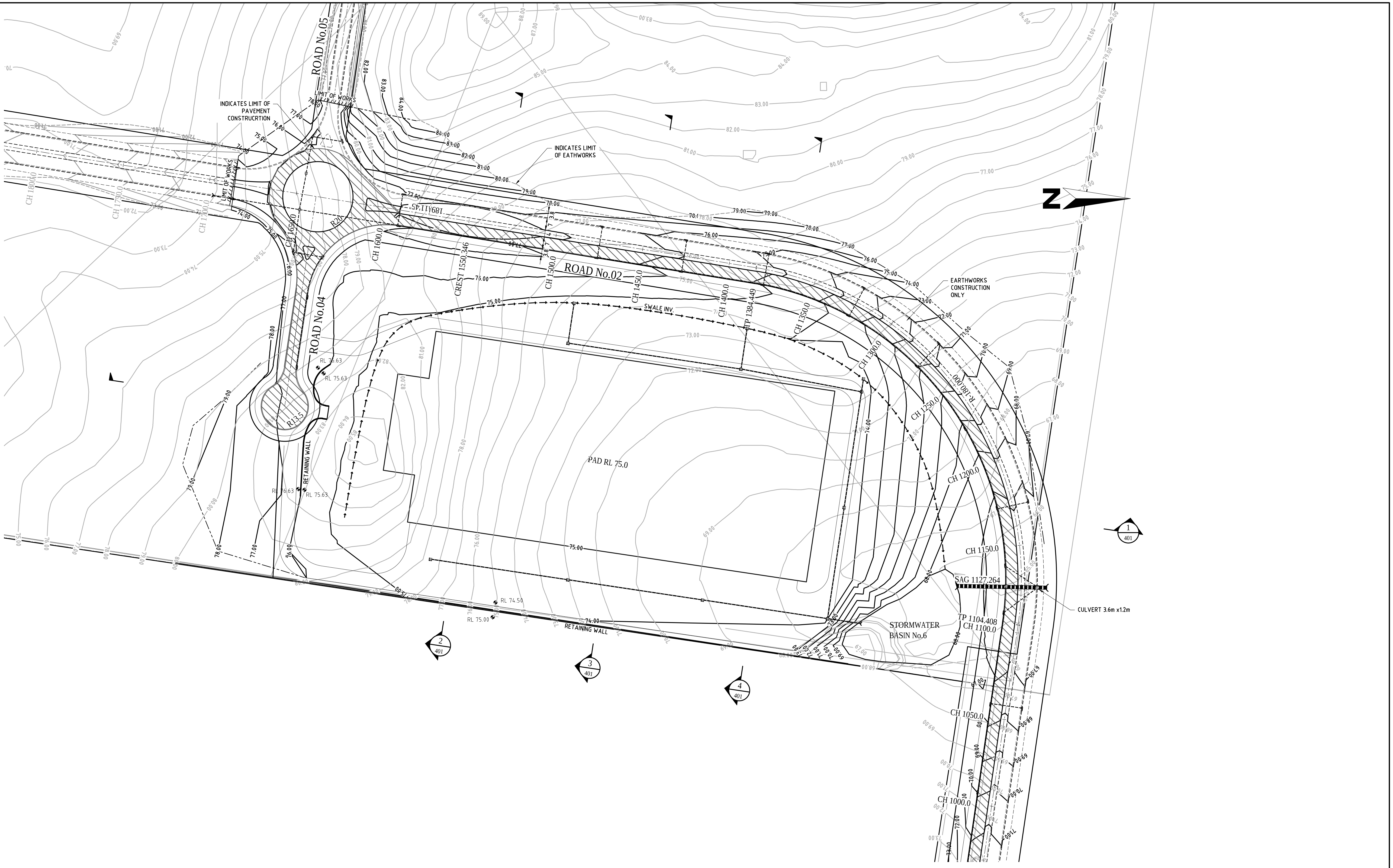
Client: JACFIN PTY LTD

Project: LOT A BURLEY ROAD, HORSLEY PARK EMPLOYMENT PRECINCT
ROAD AND BULK EARTHWORK CONCEPT STAGE 1

Drawing: ENGINEERING PLAN
SHEET 1 OF 2

Drawn by: A.Mc
Design by: M.N.
Scale(A1): 1:1000
Project No: X10135
Drawing No: 101
Revision: A

Saved: 12.08.2010, By: michael noonan



FOR CONTINUATION REFER TO DRAWING No. 101

0 10 20 30 40 50 60 70 80 90 100
SCALE 1:1000 (A1) SCALE 1:2000 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
A	12/08/2010	PROJECT DESIGN PLAN	MN	PF	TT

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BY: TOBY TAMES
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Director
SIGN:
DATE: 12/08/2010

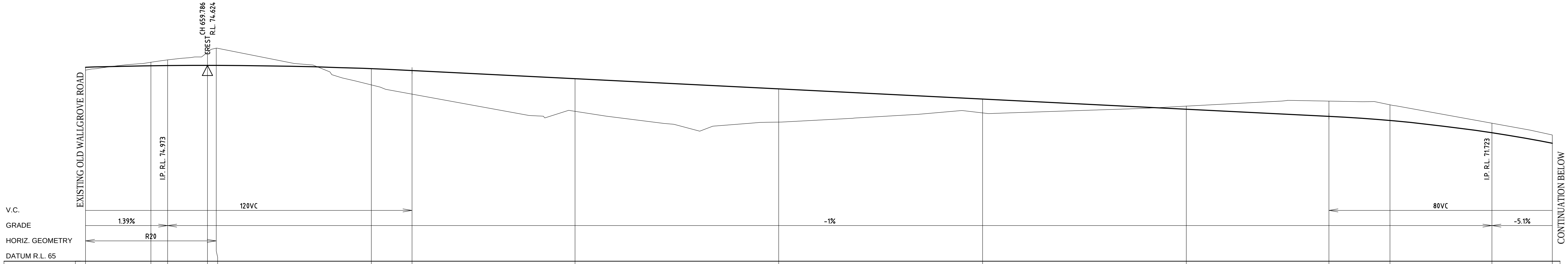
Client: JACFIN PTY LTD

Project: LOT A BURLEY ROAD, HORSLEY PARK EMPLOYMENT PRECINCT
ROAD AND BULK EARTHWORK CONCEPT STAGE 1

Drawing: ENGINEERING PLAN SHEET 2 OF 2

Drawn by: A.Mc
Design by: M.N.
Project No: X10135
Scale(A1): 1:1000
Drawing No: 102
Revision: A

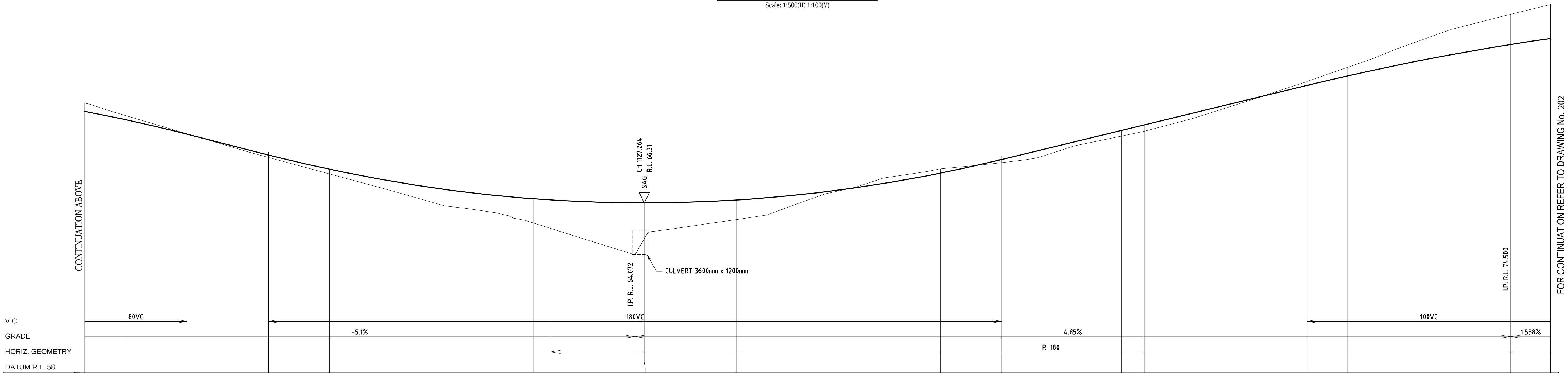
Saved: 12.08.2010 , By: michael noonan
\\sydnas01\projects\X10\X10135 - Horsley Park Industrial Subdivision\Drawings\Civil\X10135-102.dwg



DESIGN LEVEL	74.535	74.605	74.615	74.624	74.624	74.463	74.373	73.973	73.473	72.973	72.473	72.123	71.915	71.313	70.804
EXISTING LEVEL	74.393	74.783	74.9	75.272	75.469	73.667	73.21	72.367	71.842	72.294	72.625	72.87	72.691	71.784	71.208
CHAINAGE	629.841	645.901	650	659.786	661.962	700	710	750	800	850	900	935	950	975	989.841

LONGSECTION ROAD NO.02

Scale: 1:500(H) 1:100(V)



DESIGN LEVEL	70.804	70.39	69.683	68.663	67.96	66.515	66.454	66.311	66.31	66.453	67.772	68.438	69.865	70.135	72.075	72.543	74.086	74.384
EXISTING LEVEL	71.208	70.589	69.704	68.545	67.734	65.33	65.05	63.779	64.535	65.497	67.986	68.283	69.587	69.824	72.267	72.971	75.57	76.047
CHAINAGE	989.841	1000	1015	1035	1050	1100	1104.408	1125	1127.264	1150	1200	1215	1244.429	1250	1290	1300	1340	1349.841

LONGSECTION ROAD NO.02 CONT'D

Scale: 1:500(H) 1:100(V)

SCALE 1:500 (A1) SCALE 1:1000 (A3)

SCALE 1:100 (A1) SCALE 1:200 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
A	12/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

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Sydney Canberra Brisbane Melbourne Singapore

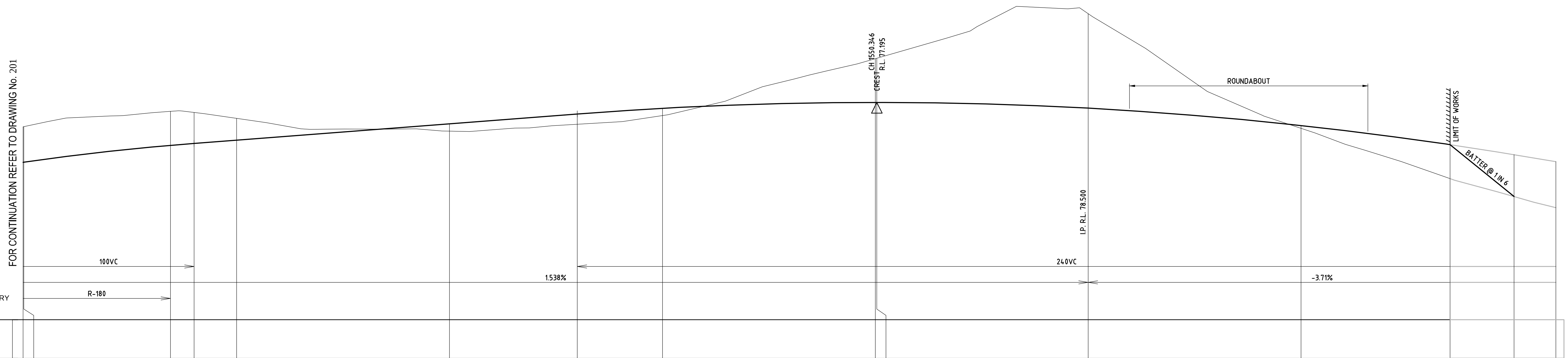
APPROVAL
BY: TOBY TAMES
BE (Hons) GradDipMgt CPESC CPEng MIEAust Director
SIGN:
DATE: 12/08/2010

Client: JACFIN PTY LTD

Project: LOT A BURLEY ROAD, HORSLEY PARK EMPLOYMENT PRECINCT
ROAD AND BULK EARTHWORK CONCEPT STAGE 1

Drawing: ROAD No.02 LONGSECTION SHEET 1 OF 2

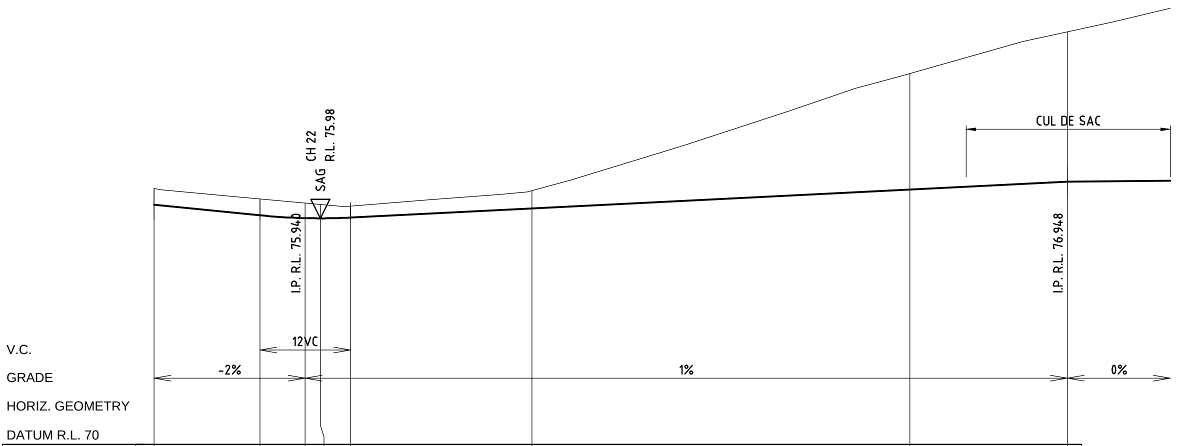
Drawn by: A.Mc
Design by: M.N.
Scale(A1): AS NOTED
Project No: X10135
Drawing No: 201
Revision: A



DESIGN LEVEL	74.384	74.389	75.179	75.269	75.423	76.192	76.654	76.918	77.195	77.195	76.925	76.109	75.211	74.746	74.413
EXISTING LEVEL	76.047	76.054	76.777	76.721	76.445	75.845	76.173	76.577	79.247	79.267	81.358	75.981	73.620	72.78	72.254
CHAINAGE	1349.841	1350	1384.449	1390	1400	1450	1480	1500	1550	1550.346	1600	1650	1685	1700	1709.841

LONGSECTION ROAD NO.02 CONT'D

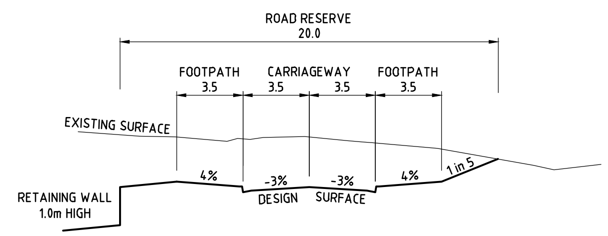
Scale: 1:500(H) 1:100(V)



DESIGN LEVEL	76.34	76.06	75.985	75.98	76	76.24	76.74	76.948
EXISTING LEVEL	76.776	76.491	76.385	76.349	76.305	76.716	79.812	80.913
CHAINAGE	0	14	20	22	26	50	100	120.812

LONGSECTION ROAD NO.04

Scale: 1:500(H) 1:100(V)



ROAD NO.04 TYPICAL SECTION

Scale: 1:200

0 5 10 15 20 25 30 35 40 45 50
SCALE 1:500 (A1) SCALE 1:1000 (A3)

0 1 2 3 4 5 6 7 8 9 10
SCALE 1:100 (A1) SCALE 1:200 (A3)

0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0
SCALE 1:200 (A1) SCALE 1:400 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
A	12/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

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BY: TOBY TAMES
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Director
SIGN:
DATE: 12/08/2010

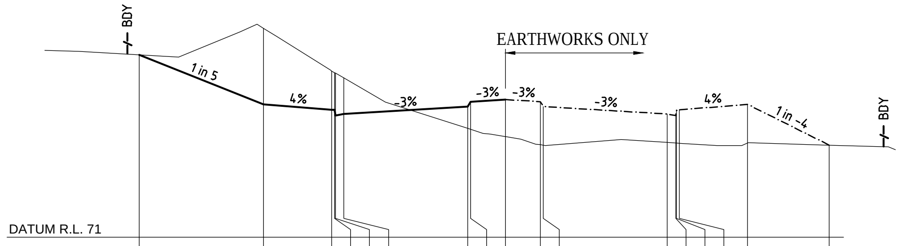
Client:
JACFIN PTY LTD

Project:
LOT A BURLEY ROAD, HORSLEY PARK EMPLOYMENT PRECINCT
ROAD AND BULK EARTHWORK CONCEPT STAGE 1

Drawing:
ROAD No.02 LONGSECTION
SHEET 2 OF 2

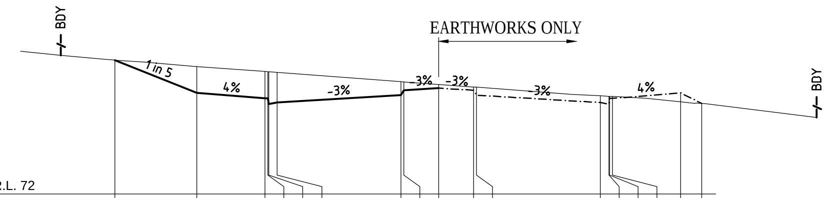
Drawn by: A.Mc
Design by: M.N.
Scale(A1): AS NOTED
Project No: X10135
Drawing No: 202
Revision: A

REPRESENTS EARTHWORKS ONLY



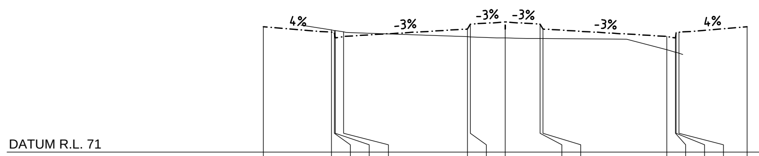
DESIGN LEVEL	75.835	74.522	74.377	74.377	74.227	74.267	74.464	74.594	74.463	74.594	74.464	74.267	74.227	74.377	74.377	74.522	73.441
EXISTING LEVEL	75.835	76.541	75.407	75.363	75.352	75.221	73.884	73.859	73.667	73.452	73.442	73.513	73.498	73.497	73.492	73.497	73.441
OFFSET	-19.367	-12.8	-9.19	-9.04	-9	-8.55	-2	-1.85	0	1.85	2	8.55	9	9.04	9.19	12.8	17.121

CH 700



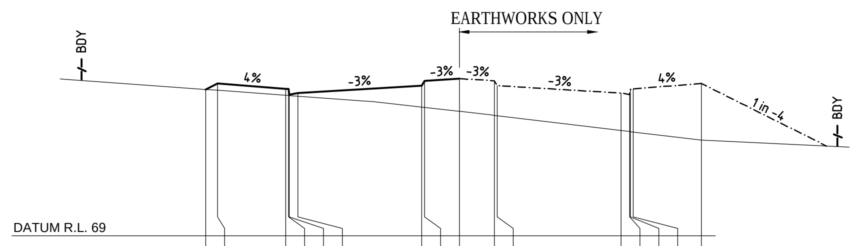
DESIGN LEVEL	75.54	74.673	74.529	74.529	74.379	74.419	74.615	74.745	74.615	74.745	74.615	74.419	74.379	74.529	74.529	74.673	74.396
EXISTING LEVEL	75.54	75.374	75.24	75.235	75.233	75.216	74.974	74.968	74.9	74.831	74.825	74.597	74.585	74.584	74.579	74.439	74.396
OFFSET	-17.137	-12.8	-9.19	-9.04	-9	-8.55	-2	-1.85	0	1.85	2	8.55	9	9.04	9.19	12.8	13.91

CH 650



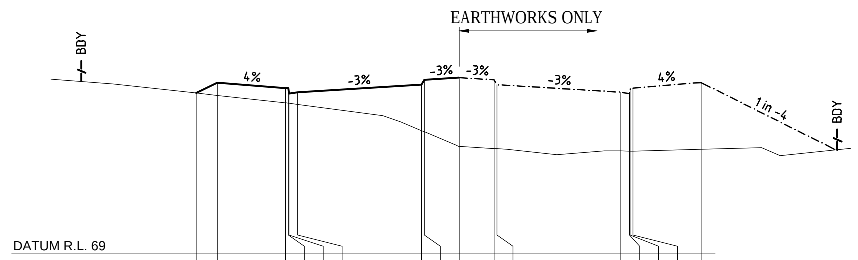
DESIGN LEVEL	74.327	74.182	74.182	74.032	74.072	74.269	74.399	74.268	74.399	74.269	74.072	74.032	74.182	74.182	74.327
EXISTING LEVEL		74.242	74.23	74.227	74.191	74.064	74.062	74.032	74.017	74.017	73.722	73.657	73.651	73.628	
OFFSET	-12.8	-9.19	-9.04	-9	-8.55	-2	-1.85	0	1.85	2	8.55	9	9.04	9.19	12.8

CH 600



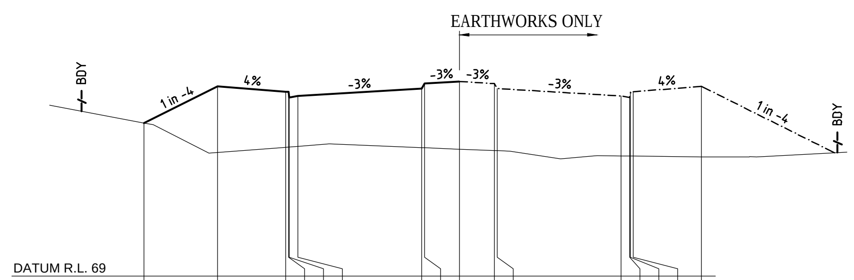
DESIGN LEVEL	72.875	73.032	72.887	72.887	72.737	72.777	72.974	73.104	72.973	73.104	72.974	72.777	72.737	72.887	72.887	73.032
EXISTING LEVEL	72.875	72.852	72.721	72.715	72.714	72.698	72.406	72.398	72.294	72.189	72.18	71.786	71.759	71.756	71.747	71.53
OFFSET	-13.428	-12.8	-9.19	-9.04	-9	-8.55	-2	-1.85	0	1.85	2	8.55	9	9.04	9.19	12.8

CH 850



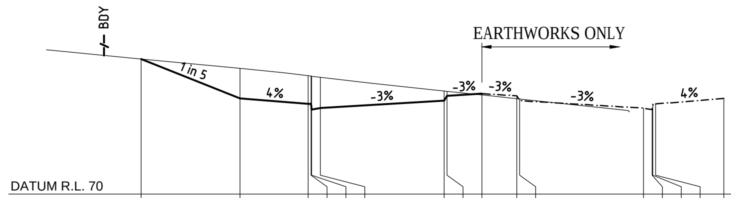
DESIGN LEVEL	73.253	73.532	73.387	73.387	73.237	73.277	73.474	73.604	73.473	73.604	73.474	73.277	73.237	73.387	73.387	73.532
EXISTING LEVEL	73.253	73.192	72.997	72.987	72.985	72.955	72.26	72.229	71.842	71.787	71.782	71.721	71.719	71.718	71.719	71.768
OFFSET	-13.916	-12.8	-9.19	-9.04	-9	-8.55	-2	-1.85	0	1.85	2	8.55	9	9.04	9.19	12.8

CH 800



DESIGN LEVEL	73.059	74.032	73.887	73.887	73.737	73.777	73.974	74.104	73.973	74.104	73.974	73.777	73.737	73.887	73.887	74.032
EXISTING LEVEL	73.059	72.279	72.417	72.423	72.424	72.441	72.407	72.404	72.367	72.33	72.327	72.187	72.184	72.184	72.183	72.163
OFFSET	-16.693	-12.8	-9.19	-9.04	-9	-8.55	-2	-1.85	0	1.85	2	8.55	9	9.04	9.19	12.8

CH 750



DESIGN LEVEL	73.579	72.532	72.387	72.387	72.237	72.277	72.474	72.604	72.473	72.604	72.474	72.277	72.237	72.387	72.387	72.532
EXISTING LEVEL	73.579	73.327	73.132	73.123	73.121	73.094	72.73	72.722	72.625	72.527	72.519					
OFFSET	-18.036	-12.8	-9.19	-9.04	-9	-8.55	-2	-1.85	0	1.85	2	8.55	9	9.04	9.19	12.8

CH 900

0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0

SCALE 1:200 (A1) SCALE 1:400 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
A	12/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

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BE (Hons) GradDipMgt CPESC CPEng MIEAust
Director
SIGN:
DATE: 12/08/2010

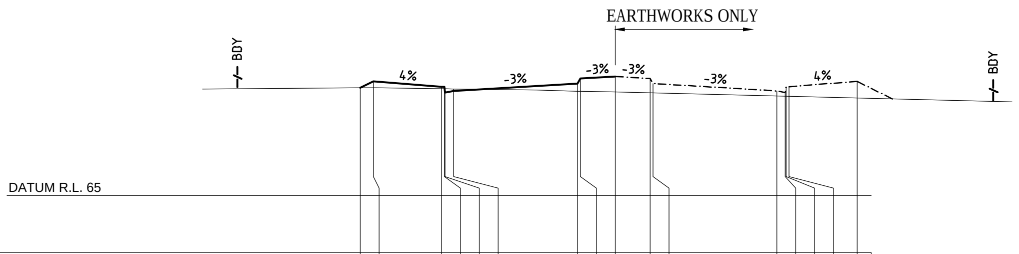
Client: JACFIN PTY LTD

Project: LOT A BURLEY ROAD, HORSLEY PARK EMPLOYMENT PRECINCT
ROAD AND BULK EARTHWORK CONCEPT STAGE 1

Drawing: ROAD No.02 CROSS SECTIONS
SHEET 1 0F 3

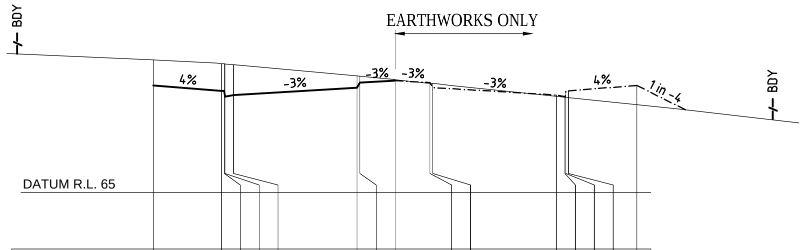
Drawn by: A.Mc
Design by: M.N.
Project No: X10135
Drawing No: 301
Scale(A1): 1:200
Revision: A

REPRESENTS EARTHWORKS ONLY



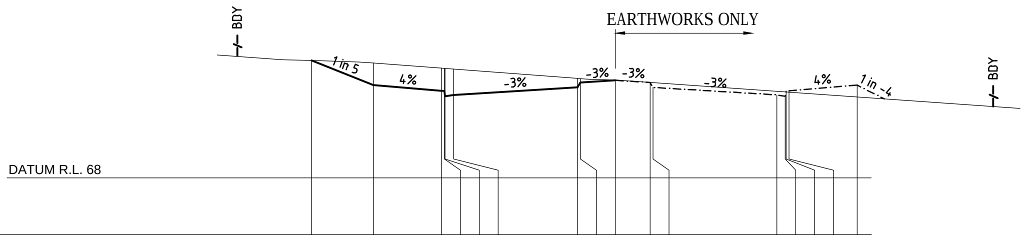
OFFSET	DESIGN LEVEL	EXISTING LEVEL
-13.496	67.845	67.845
-12.8	68.019	67.847
-9.19	67.874	67.822
-9.04	67.874	67.821
-9	67.724	67.821
-8.55	67.764	67.818
-2	67.961	67.759
-1.85	68.091	67.757
0	67.96	67.734
1.85	68.091	
2	67.961	
8.55	67.764	
9	67.724	
9.04	67.874	
9.19	67.874	
12.8	68.019	

CH 1050



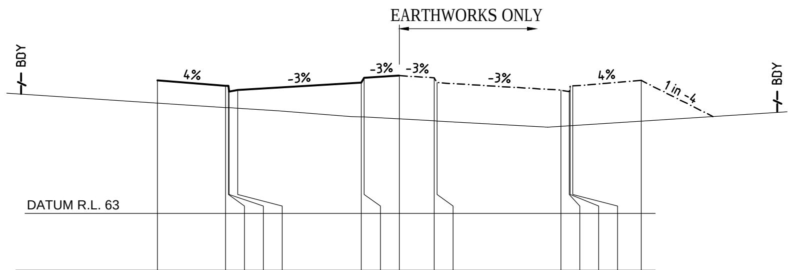
OFFSET	DESIGN LEVEL	EXISTING LEVEL
-12.8	67.831	68.508
-9.19	67.686	68.408
-9.04	67.686	68.401
-9	67.536	68.399
-8.55	67.576	68.379
-2	67.773	68.081
-1.85	67.903	68.074
0	67.772	67.986
1.85	67.903	67.887
2	67.773	67.882
8.55	67.576	67.539
9	67.536	67.516
9.04	67.686	67.514
9.19	67.686	67.507
12.8	67.831	67.321

CH 1200



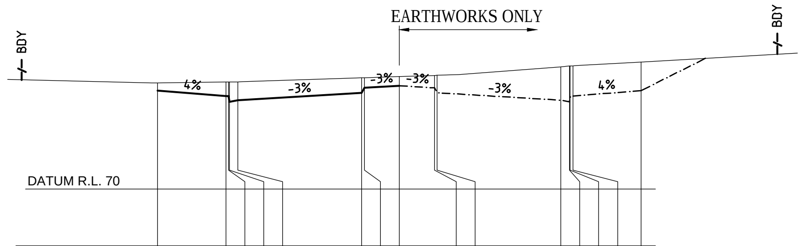
OFFSET	DESIGN LEVEL	EXISTING LEVEL
-16.063	71.101	71.101
-12.8	70.449	71.038
-9.19	70.305	70.901
-9.04	70.305	70.896
-9	70.155	70.894
-8.55	70.195	70.877
-2	70.391	70.63
-1.85	70.521	70.624
0	70.39	70.589
1.85	70.521	
2	70.391	
8.55	70.195	
9	70.155	
9.04	70.305	
9.19	70.305	
12.8	70.449	

CH 1000



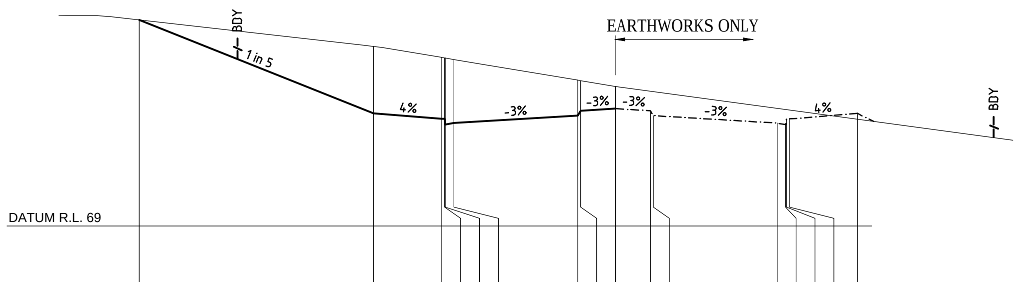
OFFSET	DESIGN LEVEL	EXISTING LEVEL
-12.8	66.511	65.915
-9.19	66.367	65.799
-9.04	66.367	65.794
-9	66.217	65.793
-8.55	66.257	65.778
-2	66.454	65.551
-1.85	66.584	65.548
0	66.453	65.497
1.85	66.584	65.445
2	66.454	65.441
8.55	66.257	
9	66.217	
9.04	66.367	
9.19	66.367	
12.8	66.511	

CH 1150



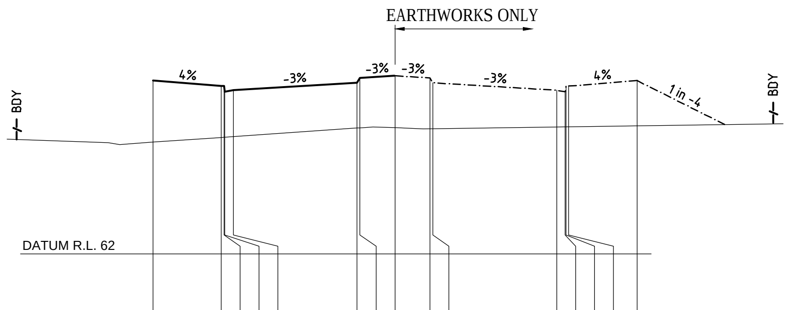
OFFSET	DESIGN LEVEL	EXISTING LEVEL
-12.8	72.602	72.806
-9.19	72.458	72.829
-9.04	72.458	72.83
-9	72.308	72.831
-8.55	72.348	72.833
-2	72.544	72.938
-1.85	72.674	72.94
0	72.543	72.971
1.85	72.674	73.001
2	72.544	73.003
8.55	72.348	73.231
9	72.308	73.249
9.04	72.458	73.25
9.19	72.458	73.256
12.8	72.602	73.358

CH 1300



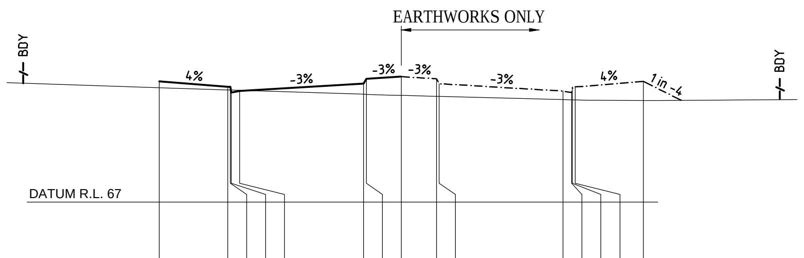
OFFSET	DESIGN LEVEL	EXISTING LEVEL
-25.191	74.452	74.452
-12.8	71.974	73.75
-9.19	71.83	73.455
-9.04	71.83	73.442
-9	71.68	73.439
-8.55	71.72	73.401
-2	71.916	72.856
-1.85	72.046	72.844
0	71.915	72.691
1.85	72.046	
2	71.916	
8.55	71.72	
9	71.68	
9.04	71.83	
9.19	71.83	
12.8	71.974	

CH 950



OFFSET	DESIGN LEVEL	EXISTING LEVEL
-12.8	66.574	64.949
-9.19	66.43	65.073
-9.04	66.43	65.078
-9	66.28	65.08
-8.55	66.32	65.095
-2	66.516	65.321
-1.85	66.646	65.326
0	66.515	65.33
1.85	66.646	
2	66.516	
8.55	66.32	
9	66.28	
9.04	66.43	
9.19	66.43	
12.8	66.574	

CH 1100



OFFSET	DESIGN LEVEL	EXISTING LEVEL
-12.8	70.194	70.03
-9.19	70.049	69.972
-9.04	70.049	69.969
-9	69.899	69.969
-8.55	69.939	69.961
-2	70.136	69.856
-1.85	70.266	69.853
0	70.135	69.824
1.85	70.266	69.8
2	70.136	69.798
8.55	69.939	69.714
9	69.899	69.708
9.04	70.049	69.708
9.19	70.049	69.706
12.8	70.194	69.693

CH 1250

0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0
SCALE 1:200 (A1) SCALE 1:400 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
A	12/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

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BY: TOBY TAMES
BE (Hons) GradDipMgt CPESC CPEng MIEAust
Director
SIGN:
DATE: 12/08/2010

Client:
JACFIN PTY LTD

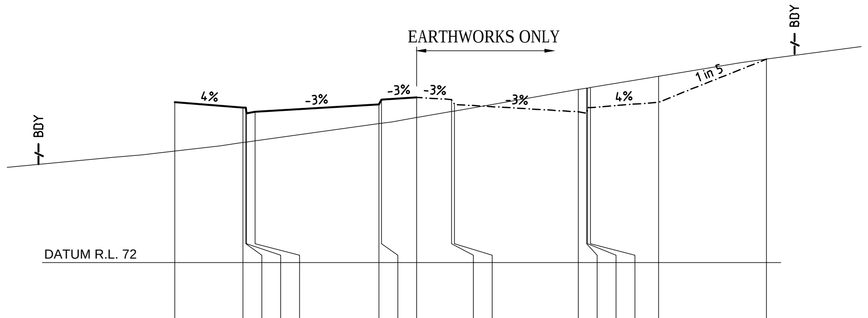
Project:
LOT A BURLEY ROAD, HORSLEY PARK EMPLOYMENT PRECINCT
ROAD AND BULK EARTHWORK CONCEPT STAGE 1

Drawing:
ROAD No.02 CROSS SECTIONS
SHEET 2 0F 3

Drawn by: A.Mc
Design by: M.N.
Scale(A1): 1:200
Project No: X10135
Drawing No: 302
Revision: A

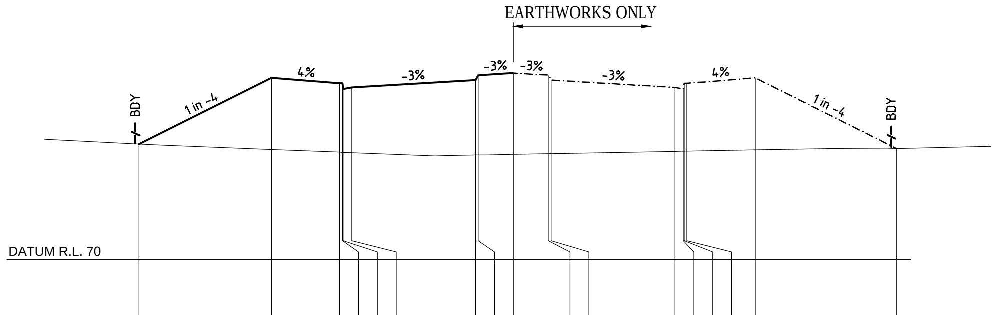
Saved: 12.08.2010, By: michael noonan
B:\X10135 - Horsley Park Industrial Subdivision\Drawings\Civil\X10135-302.dwg

REPRESENTS EARTHWORKS ONLY



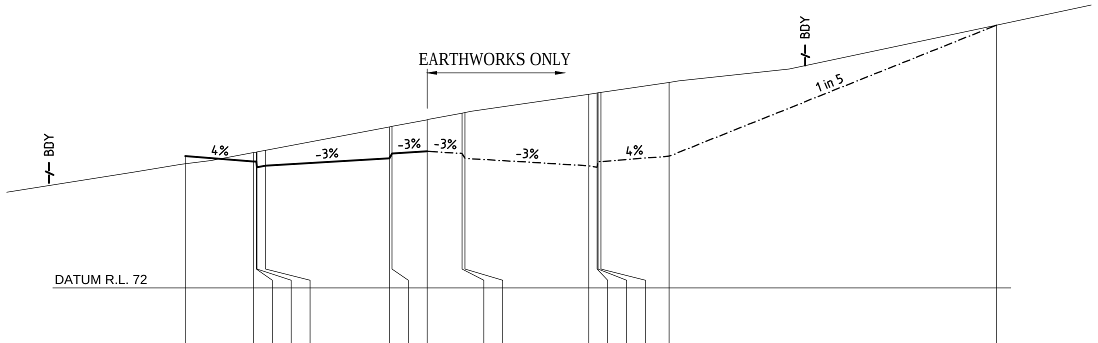
DESIGN LEVEL	76.251	76.107	76.107	75.957	75.997	76.193	76.323	76.192	76.323	76.193	75.997	75.957	76.107	76.107	76.251	77.394
EXISTING LEVEL	74.956	75.183	75.193	75.196	75.227	75.683	75.694	75.845	76.006	76.019	76.587	76.625	76.629	76.641	76.941	77.394
OFFSET	-12.8	-9.19	-9.04	-9	-8.55	-2	-1.85	0	1.85	2	8.55	9	9.04	9.19	12.8	18.513

CH 1450



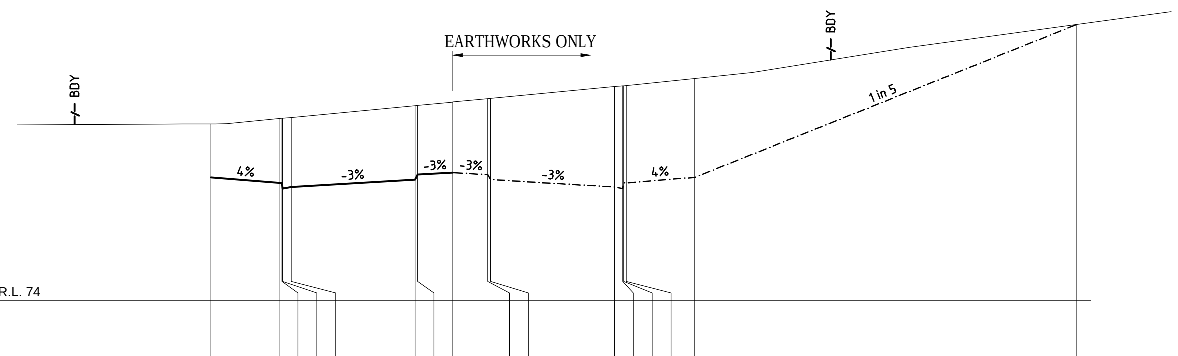
DESIGN LEVEL	73.054	74.805	74.66	74.66	74.51	74.55	74.747	74.877	74.746	74.877	74.747	74.55	74.51	74.66	74.66	74.805	72.935
EXISTING LEVEL	73.054	72.909	72.839	72.836	72.835	72.827	72.762	72.763	72.78	72.797	72.799	72.859	72.863	72.863	72.865	72.898	72.935
OFFSET	-19.804	-12.8	-9.19	-9.04	-9	-8.55	-2	-1.85	0	1.85	2	8.55	9	9.04	9.19	12.8	20.277

CH 1700



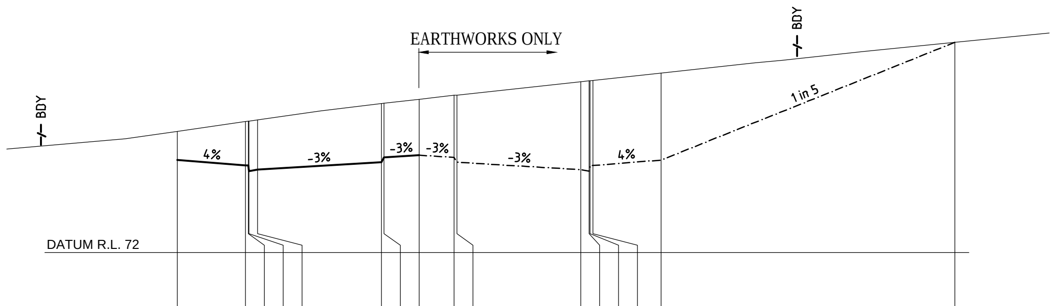
DESIGN LEVEL	75.482	75.337	75.337	75.187	75.227	75.424	75.554	75.423	75.554	75.424	75.227	75.187	75.337	75.337	75.482	78.948
EXISTING LEVEL	75.28	75.575	75.589	75.593	75.636	76.256	76.27	76.445	76.62	76.634	77.121	77.154	77.157	77.168	77.433	78.948
OFFSET	-12.8	-9.19	-9.04	-9	-8.55	-2	-1.85	0	1.85	2	8.55	9	9.04	9.19	12.8	30.129

CH 1400



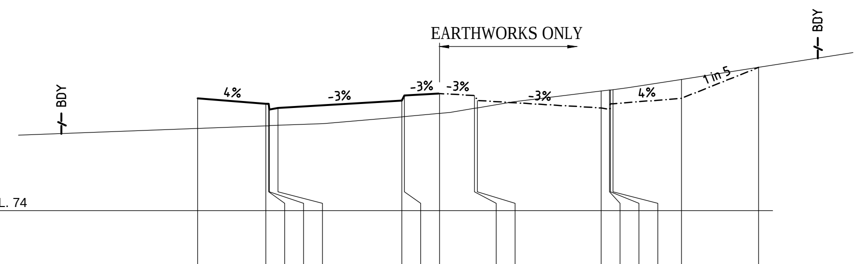
DESIGN LEVEL	77.254	77.109	77.109	76.959	76.999	77.196	77.326	77.195	77.326	77.196	76.999	76.959	77.109	77.109	77.254	81.297
EXISTING LEVEL	78.668	78.809	78.816	78.818	78.839	79.152	79.159	79.247	79.335	79.342	79.655	79.676	79.678	79.685	79.869	81.297
OFFSET	-12.8	-9.19	-9.04	-9	-8.55	-2	-1.85	0	1.85	2	8.55	9	9.04	9.19	12.8	33.019

CH 1550



DESIGN LEVEL	74.448	74.303	74.303	74.153	74.193	74.39	74.52	74.389	74.52	74.39	74.193	74.153	74.303	74.303	74.448	77.556
EXISTING LEVEL	75.204	75.464	75.474	75.477	75.51	75.937	75.946	76.054	76.157	76.165	76.517	76.541	76.543	76.551	76.745	77.556
OFFSET	-12.8	-9.19	-9.04	-9	-8.55	-2	-1.85	0	1.85	2	8.55	9	9.04	9.19	12.8	28.343

CH 1350



DESIGN LEVEL	76.976	76.832	76.832	76.682	76.722	76.919	77.049	76.918	77.049	76.919	76.722	76.682	76.832	76.832	76.976	77.793
EXISTING LEVEL	76.18	76.249	76.252	76.252	76.261	76.489	76.495	76.577	76.71	76.723	77.167	77.195	77.197	77.206	77.475	77.793
OFFSET	-12.8	-9.19	-9.04	-9	-8.55	-2	-1.85	0	1.85	2	8.55	9	9.04	9.19	12.8	16.882

CH 1500

0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0

SCALE 1:200 (A1) SCALE 1:400 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
A	12/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

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Director

SIGN:

DATE: 12/08/2010

Client: JACFIN PTY LTD

Project: LOT A BURLEY ROAD, HORSLEY PARK EMPLOYMENT PRECINCT
ROAD AND BULK EARTHWORK CONCEPT STAGE 1

Drawing: ROAD No.02 CROSS SECTIONS
SHEET 3 0F 3

Drawn by: A.Mc

Design by: M.N.

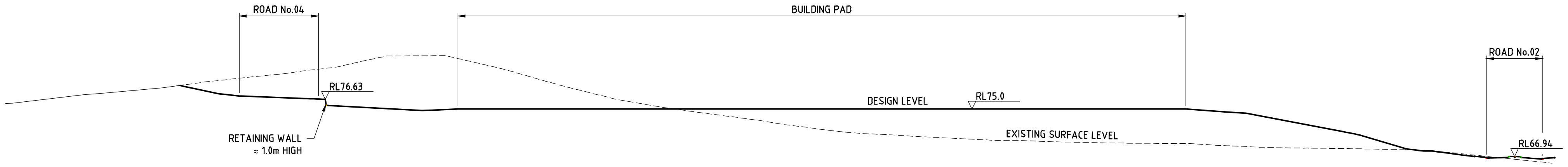
Project No: X10135

Scale(A1): 1:200

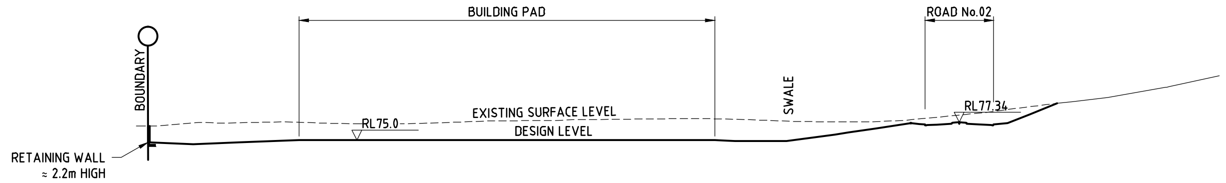
Drawing No: 303

Revision: A

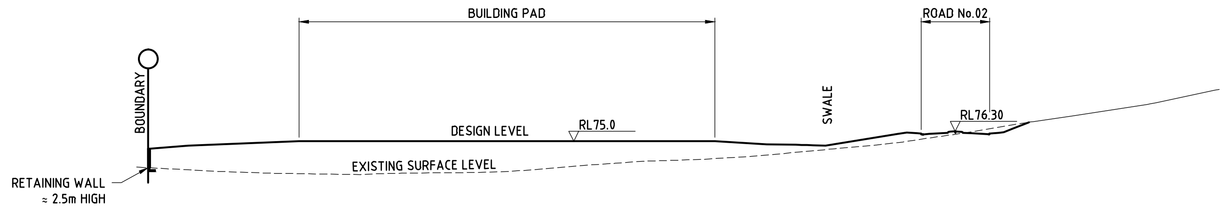
Saved: 12.08.2010, By: michael noonan



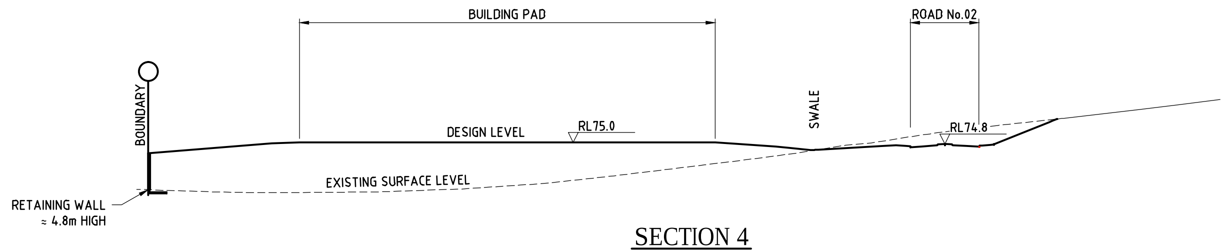
SECTION 1
Scale: 1:1000(H) 1:500(V)



SECTION 2
Scale: 1:1000(H) 1:500(V)



SECTION 3
Scale: 1:1000(H) 1:500(V)



SECTION 4
Scale: 1:1000(H) 1:500(V)

0 10 20 30 40 50 60 70 80 90 100
SCALE 1:1000 (A1) SCALE 1:2000 (A3)

0 5 10 15 20 25 30 35 40 45 50
SCALE 1:500 (A1) SCALE 1:1000 (A3)

PRELIMINARY

REV	DATE	DESCRIPTION	BY	VER	APP
A	12/08/2010	PROJECT PLAN DESIGN	MN	PF	TT

REVISIONS

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Quality System Quality Endorsed Company

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Director
SIGN:
DATE: 12/08/2010

Client: JACFIN PTY LTD

Project: LOT A BURLEY ROAD, HORSLEY PARK EMPLOYMENT PRECINCT
ROAD AND BULK EARTHWORK CONCEPT STAGE 1

Drawing: SITE REGRADING SECTIONS

Drawn by: A.Mc	Scale(A1): 1:1000 (H) 1:500 (V)
Design by: M.N.	
Project No: X10135	
Drawing No: 401	Revision: A