

Tallawarra Lands Concept Plan
Approval Modification

APPENDIX

E

FLOOD RISK ASSESSMENT

Our Ref: 82014142-01:AD

Contact: Ali Djozan

10 August 2017

Department of Planning and Environment
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Dear Anthony,

PROPOSED MODIFICATIONS TO TALLAWARRA LANDS CONCEPT APPROVAL FLOOD RISK ASSESSMENT

Project Background

A Concept Approval under Part 3A of the Environmental Planning and Assessment Act 1979 has been issued for the proposed Tallawarra Lands development. The Concept Approval was informed by a flood risk assessment dated 16 December 2010 prepared by Bewsher which addressed the hydrology and flood risk issues as required by the State legislator.

The Flood Risk Assessment prepared by Bewsher has generally addressed the following requirements:

- Provision of an assessment of flood risk (in accordance with the provision of 2005 NSW Floodplain Development manual) including the potential effects of climate change, sea level rise, and an increase in rainfall intensity. The assessment is to include a flood study of existing conditions and a flood risk management assessment;
- An assessment of the changes in hydrology associated with the proposed development (i.e. runoff, tidal movement, flood flows and groundwater regime) on the environmental lands within and surrounding the development.

Refer to, "*Tallawarra Lands Flood Risk Assessment*" prepared by Bewsher dated 16 December 2010 for further information.

Current Project Description

Bridgehill Group have acquired some of the Tallawarra Lands in the Northern and Central Precincts from Energy Australia, and intends to develop new residential and light industrial development and tourism facilities on those lands and increase densities from those subject to the Concept Approval. Bridgehill is proposing to modify the current approval by increasing the footprint for the residential development in the Central and Northern Precincts and modify the overall approved residential yield from 1010 to 1480 lots.

Details of the Concept Approved super lot extents and proposed super lot extents are presented in **Appendix A**.

The proposed subdivision lot layout (including the proposed modifications) overlayed on the 100 year ARI flood extent is presented in Cardno's sketch provided in **Appendix B**.

Project Objectives

The objective for the current assessment is to address the SEARs for the modification, in particular the item 11 which is:

11. Flooding, The modification request shall:

- *provide an assessment of an additional flood risks associated with the proposal in accordance with the NSW Floodplain Development Manual (2005), including the impact of flooding on the development, the impact of the development on flood behaviour and the potential impacts of climate change, coastal processes, sea level rise and an increase in rainfall intensity; and*
- *address changes in hydrology from the proposed modification (runoff, tidal movement, flood flows and groundwater regime) and the impacts on environmental lands within and surrounding the site*

Methodology

The approved flood study (*Tallawarra Lands Flood Risk Assessment, Bewsher 2010*) has addressed the flooding issues for the currently approved Tallawarra Lands development concept.

The intention for the current assessment is to re-evaluate the items addressed in the approved flood study against the proposed modifications to Tallawarra Lands development layout and assess if the proposed modifications conform to the outcome of the approved flood study and ultimately address the flood related SEARs for the modification.

1. Flood Risk Assessment

1.1 Potential Encroachment into Flood Prone Areas

The proposed extensions to the development footprint in the Northern and Central Precincts are not within the flood extent. The modification will therefore not cause the project to be subject to any additional flood risk. The extensions will also have no additional impacts on the flooding extent, flood behaviour or storage within the floodplain. The proposed subdivision lot layout overlaid on the 100 year ARI flood extent are presented in **Appendix B**.

1.2 Flood-Time Access

The Section 5.2.4 of the approved flood study states that “based on current ground levels, the minimum ground level in the precinct is of the order of 6m AHD and therefore the whole of the [northern] precinct is some metres above the ‘high level’ potential climate change lake level (i.e. 3.04m AHD). All properties would also be well above the Lake Illawarra extreme flood level of RL 3.26m AHD.”

The proposed extension within the Northern Precinct is along the ridge on top of the catchment with the levels varying between RL 18.6m and 34.5m AHD. The lowest ground in the proposed extension area, RL 18.6m AHD, is significantly higher than the potential climate change flood level of RL 3.04m AHD and Lake Illawarra extreme flood level of RL 3.26m AHD. Furthermore, no alterations to the overall development access is proposed in the Northern Precinct as a result of the development layout modifications (extensions) and therefore, the flood-time access arrangement as stated in the approved flood study is still applicable to the proposed modified development in the Northern Precinct. Refer to approved flood study for estimation of the climate change flood levels and Lake Illawarra extreme flood levels. Refer to **Appendix C1** for details of the proposed lot layout for Northern Precinct and the elevation contours.

The proposed modification within the Central Precinct involves extension of the proposed development further north-east towards the top of the hill. The levels in the proposed extended area vary between approx. RL 39m and 120m AHD. The ground level in the approved part of the Central Precinct varies between approx. RL 9m and 67m AHD. The lowest elevation in the proposed extension is higher than the lowest point in the previously approved area by approx. 30m. Also, the proposed modification to the Central Precinct development layout does not involve modifications to the overall access arrangement to the Central Precinct. Therefore, the proposed modifications to the Central Precinct development do not impair the validity of the

approved flood study regarding the Flood-Time Access. Refer to **Appendix C2** for details of the proposed lot layout for Central Precinct and the elevation contours.

No modification are proposed to the Southern Precinct.

Based on the evaluation of the Northern Precinct and the Central Precinct, it can be concluded that the proposed development modification to the Tallawarra Lands will not impact the approved flood study outcome in terms of the Flood-Time Access.

1.3 Implications of Potential Climate Change

The approved flood study (Section 5.3.1) has identified the increase in Lake Illawarra flood levels and/or increase in catchment runoff associated with potential increase in rainfall intensities as two potentially hazardous flood time conditions which could be resulted from the climate change effects.

1.3.1 Sea Level/Lake Level Rise

The approved flood study investigates the 100 year ARI flood levels and increased flood levels as a result of the climate change and summarize the results as shown in **table 1**.

Table 1: Lake Illawarra 100 year ARI flood levels at Tallawarra (extracted from the approved flood study)

Scenario	Lake 100 year ARI Level
2010	2.24m AHD
2050 (+0.4m Sea Level Rise)	2.49m AHD
2100 (+0.9m Sea Level Rise)	3.04m AHD

The approved flood study states that the flood levels presented in **table 1** do not have direct impact on the Tallawarra Lands project as development is not proposed below the flood levels predicted for the increased year 2100 lake levels (3.04m AHD).

The proposed extension to the Tallawarra Lands project are located in the areas that are either of similar height or higher than the areas of approved development and, therefore, are not expected to be impacted by the increased lake flood levels as a result of sea level rise.

The proposed modifications to the Tallawarra Lands does not include any modification to the access arrangement to the site and therefore, the approved flood study's findings with regard to the flood-time access and the potential impacts of the climate change on the flood-time access is unchanged and still valid for the proposed modifications.

1.3.2 Rainfall Intensity increases

The approved flood study (Section 5.3.2) states that an allowance has been made for a 500mm freeboard relative to Duck Creek 100 year ARI flood levels to cater for the increased flood levels as a result of the potential increase in the rainfall intensities (as a result of climate change) for assessing the minimum subdivisional fill levels in the central and southern Precincts.

The proposed modifications to the Central Precinct involves extension of the development to the higher parts of the site towards the north-eastern corner of the Central Precinct. As discussed above, the lowest point in the proposed extension is higher than the lowest point in the approved part by approx. 30 metres. Therefore,

the proposed extension to the Central Precinct is outside the potential influence of the increased rainfall intensities as a result of climate change.

Similarly, the proposed extension area in the Northern Precinct is significantly higher than the rest of the precinct and well outside of the potential impact zone as a result of the increased rainfall intensities as a result of the climate change. In addition to this, all of the proposed lots will still have 500mm of freeboard above the 100 year ARI flood level which allows for some increase in rainfall due to climate change.

2. Impact of Hydrologic changes on the Tallawarra Lands Site

2.1 Changes in Runoff and Associated Impacts

The approved flood study (Section 6.1) refers to BMT WBM Drainage Assessment report (BMT WBM 2010) which details the issues associated with site development runoff quality and quantities.

The report describes that the stormwater quality issues can be addressed by adopting a series of mitigation options in the design phase.

The report also identifies that Wollongong City Council does not require on-site detention basins as the site is located on the foreshore of Lake Illawarra. However, the report identifies the need for mitigation of the environmental flows (flows smaller than 1 year ARI design event) through achievement of specific retention targets as part of the WSUD measures.

With regard to the proposed modifications to the Tallawarra Lands, the proposed extension does not cover a substantial land compared to the approved development land. Also, the proposed measures for achieving the stormwater quality and quantity objectives can be achieved consistent with the measures proposed for the remainder of the development.

It is anticipated that the requirements for stormwater quality and environmental flow attenuation can be achieved consistent with the rest of the development as presented in the approved flood study. Additionally, the OSD will not be required due to the proximity of the development to Lake Illawarra.

2.2 Changes to Tidal Movements and Associated Impacts

The approved flood study indicates that the proposed development will have nil impact on the local tidal regime as the proposed development will not include any filling of lands within the tidal zone.

Accordingly, the proposed modifications to the Tallawarra Lands will have no impact on the local tidal regime as the proposed extensions are located in elevations higher than the rest of the development.

2.3 Changes to Flood Flows and Associated Impacts

The approved flood study (Section 6.2) indicates that the Central and Southern Precincts of the proposed development are located within the relatively large Duck Creek catchment. However, their associated footprint is located almost exclusively outside the 100 year ARI flood extent. The report indicates that the increase in the peak discharges as a result of the development will be extremely small compared to the peak discharges generated from the greater Duck Creek catchment and therefore the changes in the site hydrologic regime will be insignificant in the overall Duck Creek flood regime.

Similarly, the proposed extension of the central precinct is not expected to increase the peak discharges significantly compared to the greater Duck Creek catchment and that no impacts are anticipated on the Duck Creek flood behaviour as a result of the proposed modifications to the Central Precinct development.

The approved flood study indicates that while there will be an increase in peak flows and flow volumes associated with the Northern Precinct runoff there will not be environmental impacts associated with major storm, with the increase in volume being insignificant compared to the greater Lake Illawarra catchment.

With regard to the proposed modification for the Northern Precinct, the small increase in the development area is not expected to result in changes in flood behaviour within Lake Illawarra.

2.4 Changes to Groundwater Regime and Associated Impacts

Section 6.4 of the approved flood study indicates that the runoff regime associated with the proposed development will not have any significant impact on the current groundwater regime or its quality since:

- The proposed development of some of the hilly portions (with associated minor changes in ground levels and formal stormwater conveyance system) will not change the slow vertical seepage regimes associated with substantially impervious clay-bedrock conditions
- With the singular exception of the Southern Precinct work, development is not proposed in the low lying areas where the groundwater and saltwater interface occurs

The proposed extensions to the Concept Approval of Tallawarra Lands development are proposed on equal or higher grounds (closer to the top of the hill) in the Northern and Central Precinct areas relative to the approved development. No modification is proposed in the Southern Precinct which is identified to have a higher risk of impacts on the groundwater regime due to the ground conditions around the former ash pond areas.

Based on the above points and consistent with the approved flood study, the proposed modifications are not expected to result in any changes to the groundwater regime.

Summary

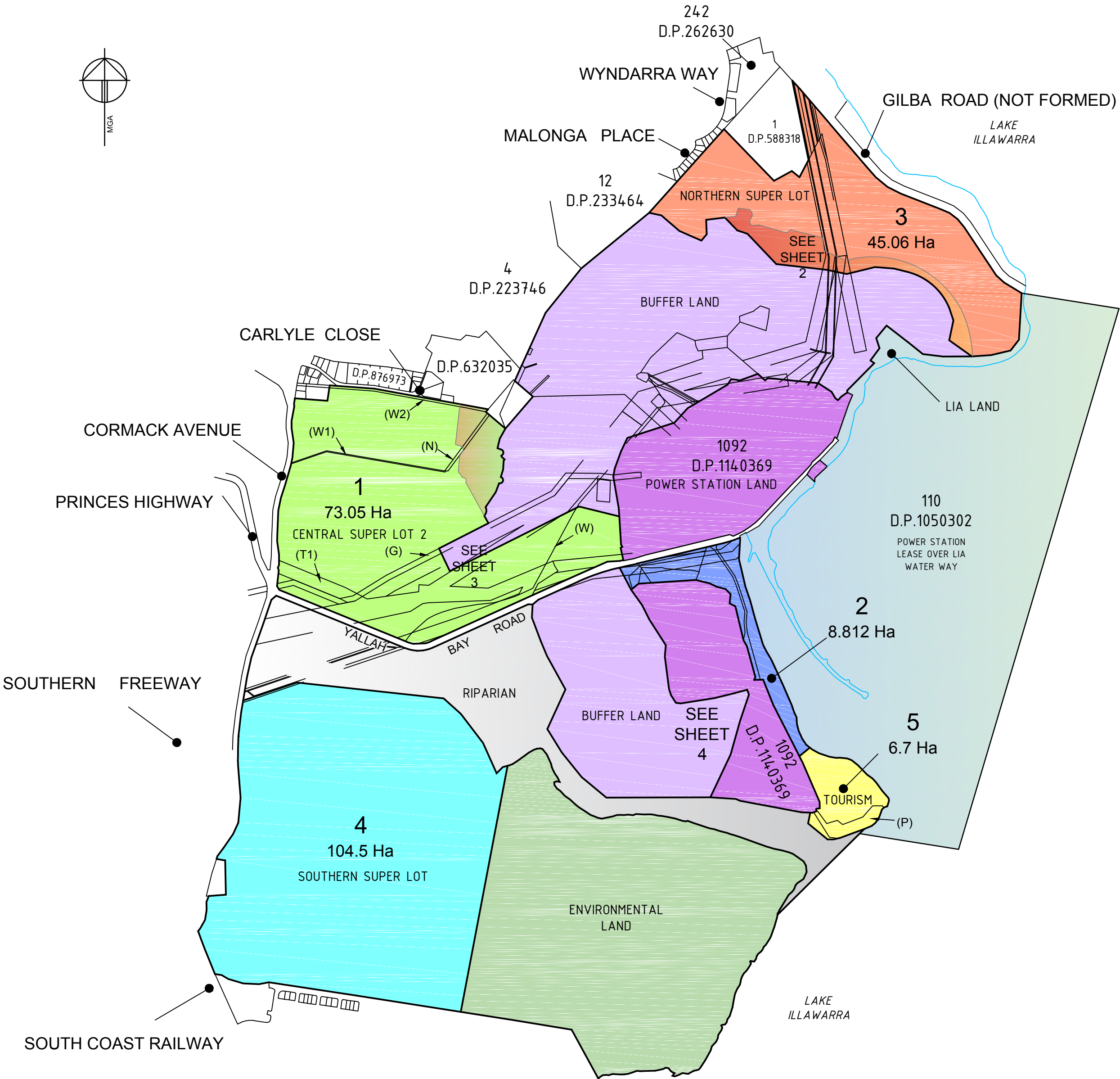
Based on the review of the proposed modification to the Tallawarra Lands, review of the SEARs and assessment against the approved flood study, it is concluded that the proposed modifications to the Tallawarra Lands (as shown on the layout plans included in **Appendix A**) is anticipated to meet the requirements of the SEARs flood items. Furthermore, the proposed modifications will not result in flood impacts beyond those identified within the approved flood study.

Yours sincerely,



Ali Djozan
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for Cardno
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Email: ali.djozan@cardno.com.au

Enc: Appendix A
Appendix B
Appendix C



- GENERAL NOTES**
- SEE SHEET 2 FOR DETAIL ON LOT 3 (NORTHERN SUPER LOT).
 - SEE SHEET 3 FOR DETAIL ON LOT 1 (CENTRAL SUPER LOT 1).
 - SEE SHEET 4 FOR DETAIL ON LOT 2 (CENTRAL SUPER LOT 2).
 - THIS PLAN SHOWS AREAS AND DIMENSIONS WHICH MAY BE SUBJECT TO CHANGE, FOR EXAMPLE BY COUNCIL APPROVALS, SERVICES APPROVALS OR DEPARTMENT OF LAND AND PROPERTY APPROVALS AND REGISTRATION OF ANY FINAL SUBDIVISION PLAN.
 - THIS CONCEPT SALES PLAN HAS BEEN PREPARED FOR BRIDGEHILL (TALLAWARRA) PTY LTD.

LEGEND

- CENTRAL SUPER LOT 1
- CENTRAL SUPER LOT 2
- NORTHERN SUPER LOT
- SOUTHERN SUPER LOT
- TOURISM
- DUCK CREEK RIPARIAN LAND
- ENVIRONMENTAL LAND
- POWER STATION LAND
- POWER STATION BUFFER LAND
- POWER STATION LEASE OVER LIA WATER WAY

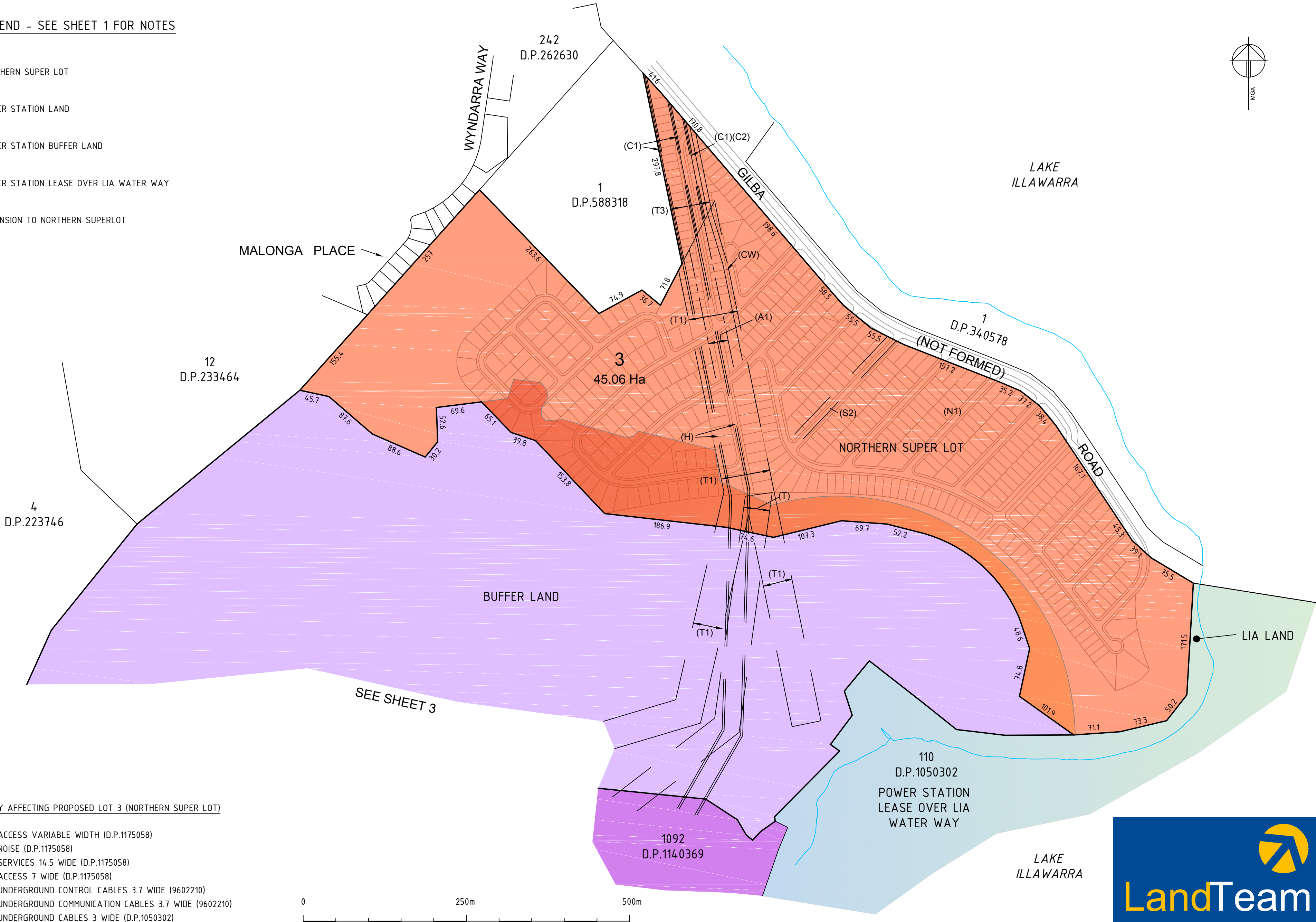
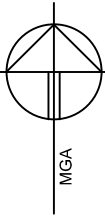
0 500m 1000m



Surveyor: DAVID ANTHONY LOFBERG of LandTeam 42967055 Date of Survey: - Surveyor's Ref: 209393	PLAN OF SUBDIVISION OF LOT 30 & 31 DP1175058, LOT 7 & 8 DP1049520, LOT1 DP1146409, LOT 15 DP1050255, LOT 1 DP551658, LOT102 DP716727, LOT1 DP543285, LOT 1 & 2 DP792664, LOT 11 DP552933, LOT 151 DP628980, LOT 1 & 3 DP109795, LOT 20 DP633211, LOT 10 DP552933	LGA: WOLLONGONG Locality: KOONAWARRA DAPTO & YALLAH Subdivision No: Lengths are in metres. Reduction Ratio 1 : 12500	Registered	
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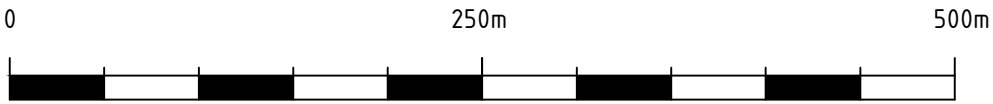
LEGEND - SEE SHEET 1 FOR NOTES

- NORTHERN SUPER LOT
- POWER STATION LAND
- POWER STATION BUFFER LAND
- POWER STATION LEASE OVER LIA WATER WAY
- EXTENSION TO NORTHERN SUPERLOT



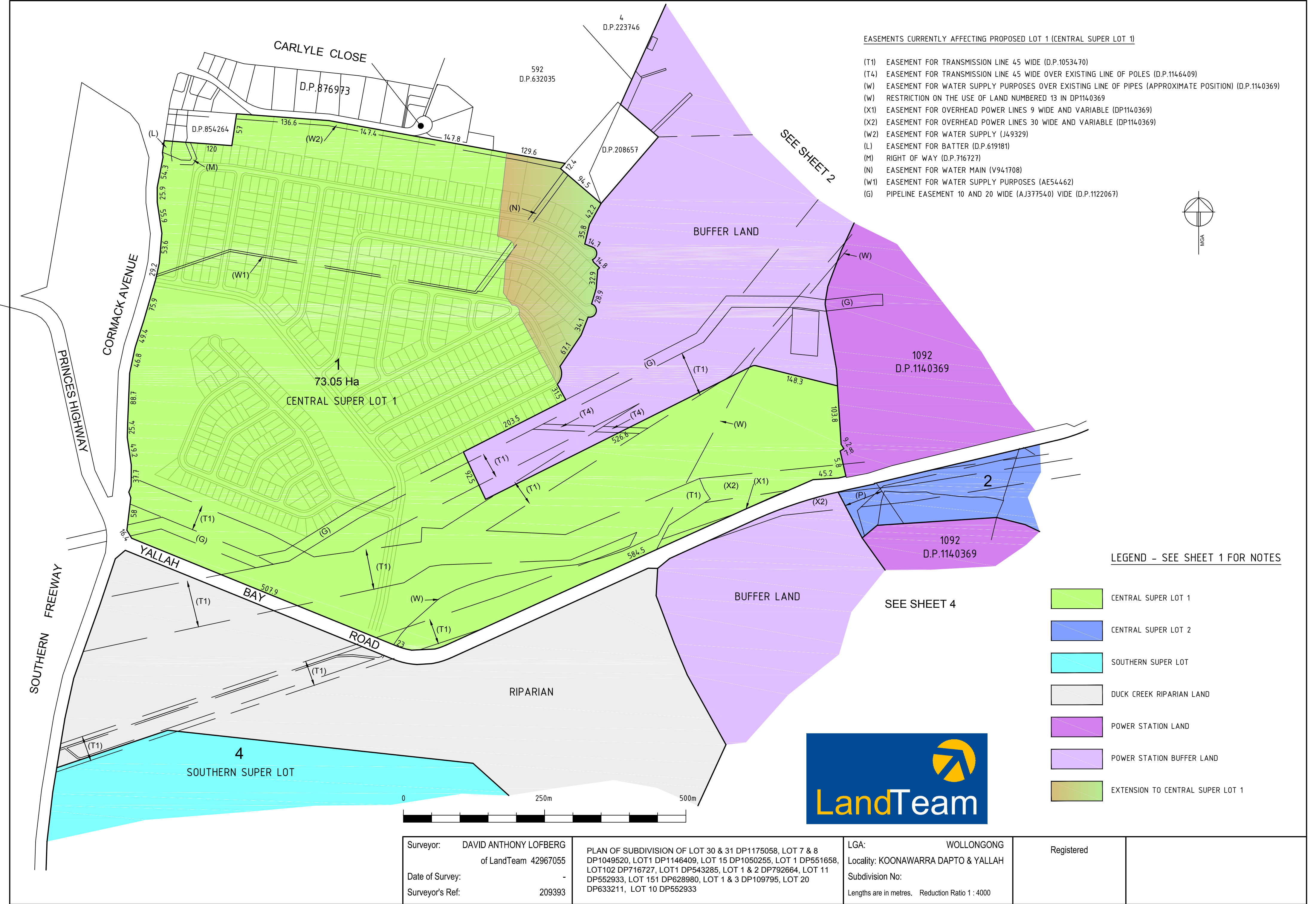
EASEMENTS CURRENTLY AFFECTING PROPOSED LOT 3 (NORTHERN SUPER LOT)

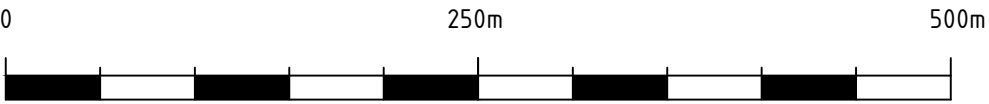
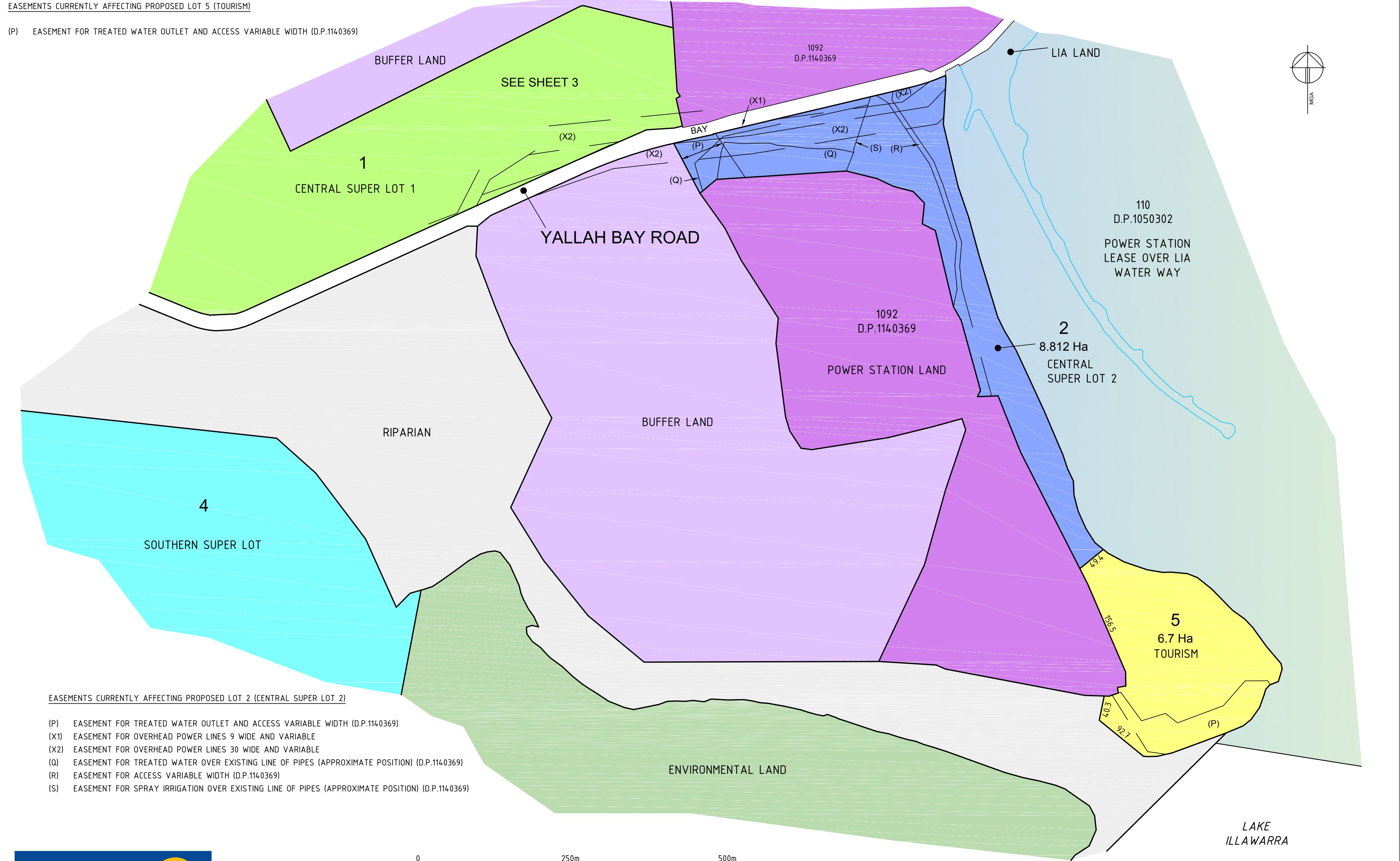
- A1) EASEMENT FOR ACCESS VARIABLE WIDTH (D.P.1175058)
- N1) EASEMENT FOR NOISE (D.P.1175058)
- S2) EASEMENT FOR SERVICES 14.5 WIDE (D.P.1175058)
- CW) EASEMENT FOR ACCESS 7 WIDE (D.P.1175058)
- (C1) EASEMENT FOR UNDERGROUND CONTROL CABLES 3.7 WIDE (9602210)
- (C2) EASEMENT FOR UNDERGROUND COMMUNICATION CABLES 3.7 WIDE (9602210)
- (H) EASEMENT FOR UNDERGROUND CABLES 3 WIDE (D.P.1050302)
- (T1) EASEMENT FOR TRANSMISSION LINE 4.5 WIDE (D.P.1053470)
- (T3) EASEMENT FOR TRANSMISSION LINE (9602210)
- (T) EASEMENT FOR OVERHEAD POWER LINES 40 WIDE AND VARIABLE (D.P.1135295)



Surveyor: DAVID ANTHONY LOFBERG of LandTeam 42967055	PLAN OF SUBDIVISION OF LOT 30 & 31 DP1175058, LOT 7 & 8 DP1049520, LOT1 DP1146409, LOT 15 DP1050255, LOT 1 DP551658, LOT102 DP716727, LOT1 DP543285, LOT 1 & 2 DP792664, LOT 11 DP552933, LOT 151 DP628980, LOT 1 & 3 DP109795, LOT 20 DP633211, LOT 10 DP552933	LGA: WOLLONGONG	Registered	
Date of Survey: -		Locality: KOONAWARRA DAPTO & YALLAH		
Surveyor's Ref: 209393		Subdivision No:		
		Lengths are in metres. Reduction Ratio 1 : 4000		







Surveyor: DAVID ANTHONY LOFBERG of LandTeam 42967055 Date of Survey: - Surveyor's Ref: 209393	PLAN OF SUBDIVISION OF LOT 30 & 31 DP1175058, LOT 7 & 8 DP1049520, LOT1 DP1146409, LOT 15 DP1050255, LOT 1 DP551658, LOT102 DP716727, LOT1 DP543285, LOT 1 & 2 DP792664, LOT 11 DP552933, LOT 151 DP628980, LOT 1 & 3 DP109795, LOT 20 DP633211, LOT 10 DP552933	LGA: WOLLONGONG Locality: KOONAWARRA DAPTO & YALLAH Subdivision No: Lengths are in metres. Reduction Ratio 1 : 4000	Registered	
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100 year ARI Flood Extent - Existing Conditions

TALLAWARRA LANDS

Legend

- Concept Plan Boundary
- Lot Layout
- Watercourses (LPI)
- 1m Flood Height Contour (mAHD)
- Cadastre (DFSI-SS, 2017)

Flood Depth (m)

- 0 - 0.25
- 0.25 - 0.5
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- > 3

1:9,500 Scale at A3



Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2017-07-21
Coordinate System: GDA 1994 MGA Zone 56
Project: 82017142
Map: 82017142-01-GS-019-100yr_Existing.mxd 02
Aerial imagery supplied by LPI (2015)



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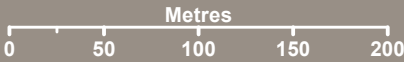
Contour Plan Northern
Precinct

TALLAWARRA LANDS

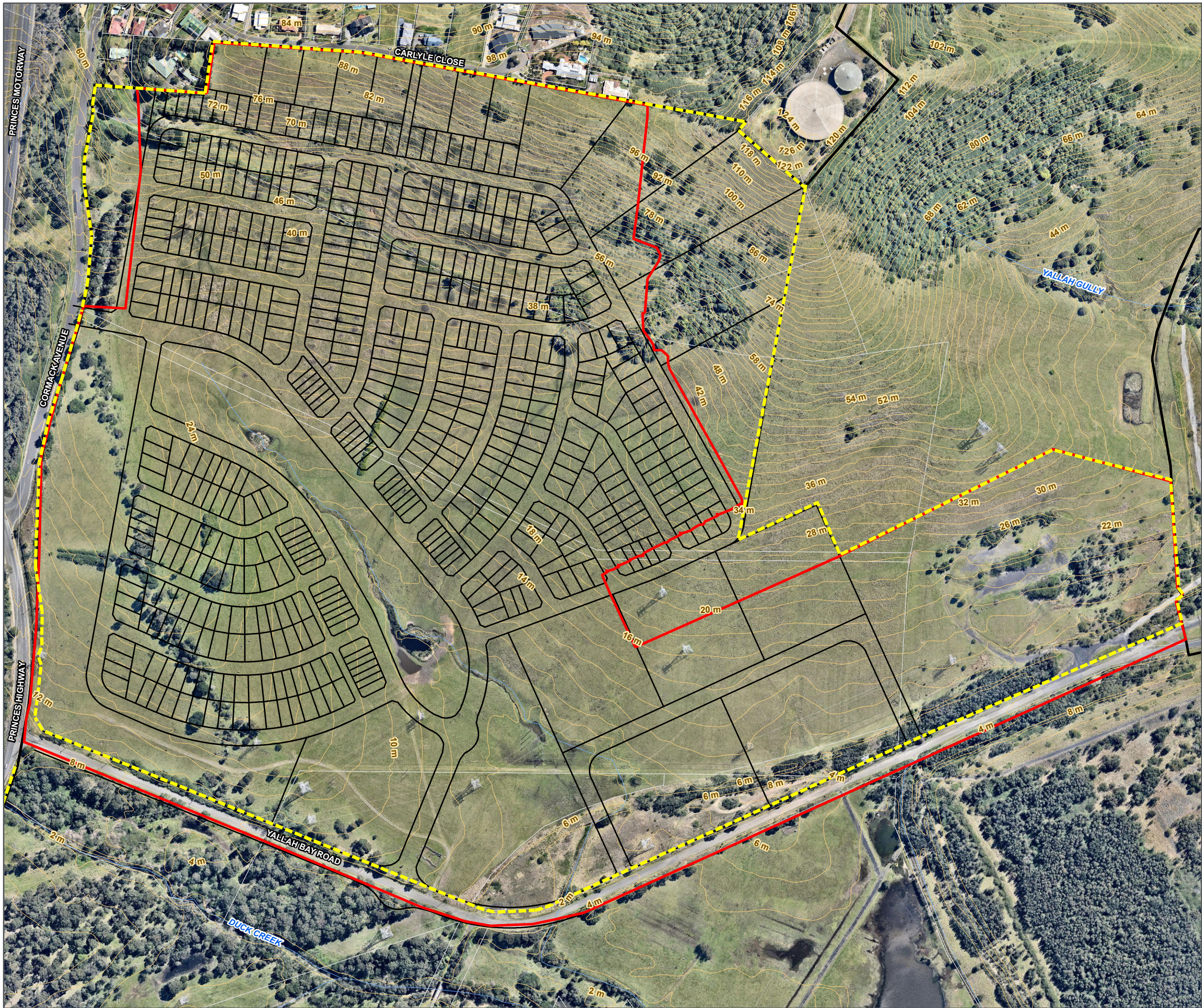
Legend

- Concept Plan Boundary
- Proposed Superlot Boundary
- Lot Layout
- Watercourses (LPI)
- 2m Contours (LPI)
- Concept Approval
- Cadastre (DFS-I-SS, 2017)

1:4,000 Scale at A3




Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2017-08-01
Coordinate System: GDA 1994 MGA Zone 56
Project: 82017142
Map: 82017142-01-GS-022-Contour_Plan_Northern.mxd 01
Aerial imagery supplied by nearmap (October, 2016)



Contour Plan Central Precinct

TALLAWARRA LANDS

Legend

- Concept Plan Boundary
- Proposed Superlot Boundary
- Lot Layout
- Watercourses (LPI)
- 2m Contours (LPI)
- Concept Approval
- Cadastre (DFSI-SS, 2017)

1:4,000 Scale at A3

