Cardno
Shaping the Future

North Ryde Station Precinct Part 3A and SSS Application

Civil Engineering Investigation

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Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035
Level 3, 910 Pacific Highway
Gordon NSW 2072
Telephone: 02-9496 7700
Facsimile: 02 9499 3902
International: +61 2 9496 7700
sydney@syd.cardno.com.au
www.cardno.com.au

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Executive Summary

Cardno has been commissioned by the Transport Construction Authority (TCA) to undertake an engineering investigation into the proposed development at North Ryde. The primary purpose of the investigation was to determine constraints and opportunities relating to the site with respect to utility services, flooding and drainage, and to provide advice in relation to water cycle management opportunities.

This investigation has been prepared in support of a Preliminary Environmental Assessment for a Part 3A application for the North Ryde Station Precinct Masterplan including State Significant Site listing, a Concept Plan Application and Stage 1 Project Application.

The investigation considered the following issues:

- Flooding
- Site grades
- Potential riparian corridors and associated Asset Protection Zones (APZ) for bushfire protection
- Connection to the existing drainage system
- Stormwater detention requirements
- Water Sensitive Urban Design (WSUD) requirements and opportunities
- Servicing for potable water and sewer
- Electrical servicing
- Telecommunications servicing
- Servicing for natural gas

The following was concluded as a result of the investigation:

- Probable flood constraints were determined. The only significant flood constraint was found to be around Porters Creek, outside of the proposed main footprint of urban development.

- The section of Porters Creek fronting the site is *not* identified by the NSW Office of Water as a watercourse within the NSW Office of Water database, however we understand that some revegetation within the area is proposed, and have nominated typical requirements on a constraints map. Likely asset protection zone requirements associated with re-vegetation were also indicated on the constraints map.

- There is an existing Part 3A Permit to carry out crossing works at Porters Creek as part of the Epping to Chatswood Rail Link, however this would not cover any further works proposed as part of a new development application. It is likely that a new permit (now known as a Controlled Activity Permit) would be required.

- Development of the site will require the provision of stormwater detention storage. A hydrologic model of the site was developed and approximate volumes necessary to meet Council's requirements were calculated. For the catchment which drains north to Porters Creek, above ground storage within the vegetated area near the creek combined with water quality treatment would be suitable. For the remainder of the site, storage in below ground tanks would likely be the most practical solution.

- Opportunities to employ WSUD on the site include the collection of stormwater runoff for irrigation use and the treatment of discharge from the site via bio-retention areas, which in some cases can be co-located with above-ground detention storage areas. The exact combination and configuration of these systems will be subject to a detailed feasibility assessment during the detailed design process. A water quality model was constructed for the site and approximate areas of bio-retention areas calculated.

- Subject to the provision of stormwater detention storage in accordance with Council's requirements, connection to the existing stormwater system is likely to be feasible, with minimal upgrade requirements.

- Sydney Water has identified the area within its "Growth Servicing Plan", and has indicated that adequate water supply and sewer infrastructure exists in the area to service its development. Notwithstanding, some local upgrades to the system would likely be required, however these will probably be funded by Sydney Water.

- Electrical servicing will most likely require the construction of 3 x 11kV feeders to an existing zone substation on the corner of Waterloo Road and Eden Park Drive.

- The status of broadband service provision within new developments is currently in a state of flux, however broadband telecommunications servicing can currently be provided via Telstra, other suppliers or the National Broadband Network (NBN). While provision by the NBN is expected to be provided at no cost (except for the cost of pits and pipes within the development), timing of provision is not certain at this stage.

- Jemena has advised that natural gas is currently available to service the development from an existing high pressure main adjacent to the site, via a pressure reduction station.

In summary, servicing of the site for utilities does not appear to present any unusual difficulties, and constraints likely to impact on the development have been presented herein to inform the masterplanning process.

David Pitronaci
B.E. (Civil) MIEAust CPEng NPER

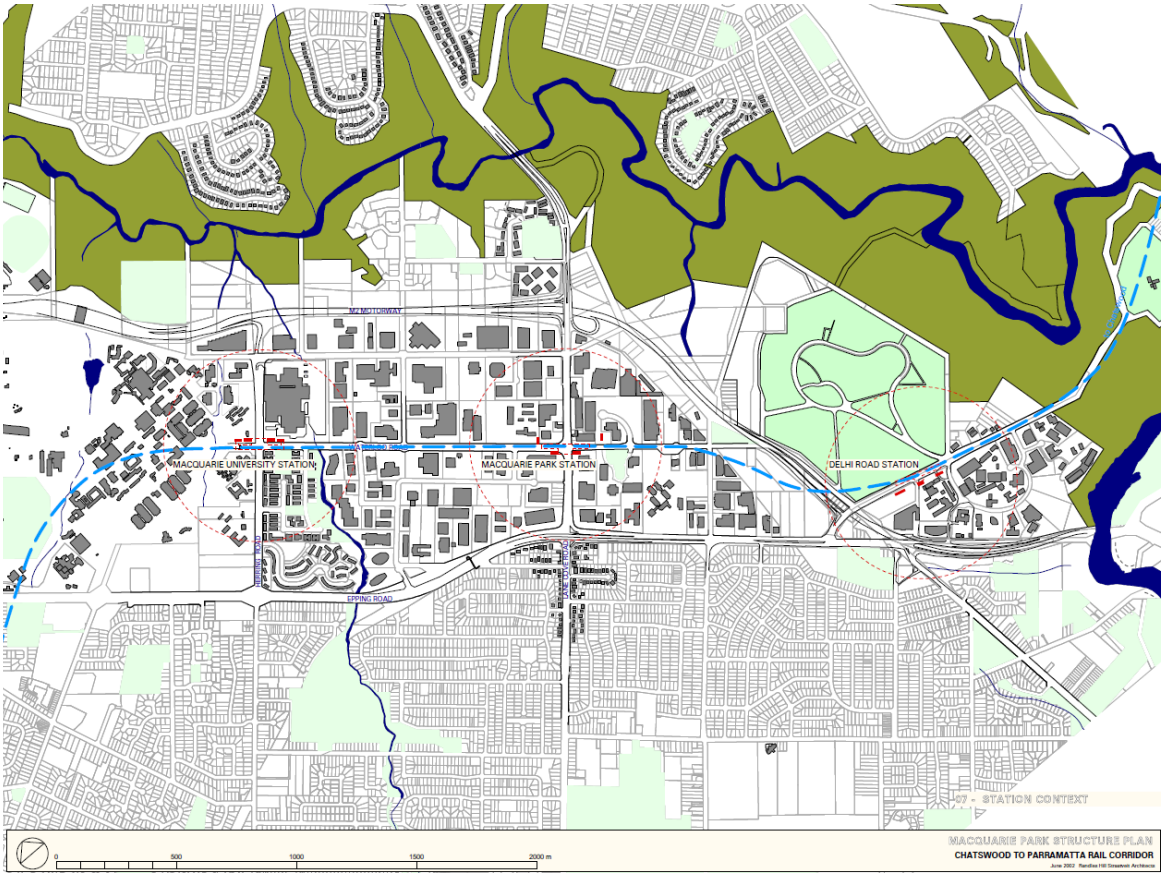
Table of Contents

Table of Figures

1 Introduction

The site is located within the Macquarie Park Development Corridor and falls within the Ryde City Council Local Government Area (LGA). Macquarie Park is a 340 hectare business precinct which is the fourth-largest employment centre in the Sydney metropolitan area. The corridor's development potential will make it an employment centre comparable with the Adelaide and Perth CBDs.

Figure 1: - The Macquarie Park Development Corridor



Cardno has been commissioned to undertake an engineering investigation in order to determine constraints and opportunities relating to the site with respect to utility services, flooding and drainage.

The Transport Construction Authority intends to lodge a Part 3A Application to the Minister for the declaration of the site as a State Significant Site. This investigation has been prepared in support of a Preliminary Environmental Assessment (PEA) for the Part 3A Application for the North Ryde Station Precinct Masterplan as well as to support the masterplanning process by preparing a series of constraints maps.

This report highlights the key issues in relation to servicing of the site, flooding constraints and specific requirements in relation to drainage, stormwater detention and water quality.

2 Site Description

The land forming the site of this investigation is described as:

- Lot 4 DP1131774;
- Lot 160 DP1136651;
- Lot 11 DP1017829;
- Lot E DP28507;
- Lot 11 &12 in DP27851;
- Lot 565 DP28914;
- Lot 100 & 101 DP1131776;
- Lot 20 & 21 DP1017829.

The site is wholly contained within the Ryde City Council Local Government Area (LGA). A Site Plan has been attached in Appendix A.

The subject lots cover a total land area of 14.06ha and are crossed by the M2 Motorway, Epping Road and Delhi Road.

Lot 101 in DP1131776 is the most northerly of the subject lots and is an irregular shaped parcel of 7.44 hectares. This lot is dissected by Lot 100 in DP1131776 which follows the alignment of the underground rail line. The lots collectively are known as the M2 Site. They are bounded by the M2 motorway to the east, Delhi Road and Epping Roads to the South and by an industrial estate and Wicks Road to the west and northwest respectively.

The site varies in elevation between reduced level (RL) 40m Australian Height Datum (AHD) in the north to RL 55m AHD at the highest point at the southern end. The lots are generally cleared, apart from an area in the north adjoining Porters Creek. The lots contain a substantial hardstand area, a sealed private access road from Wicks Road to the southern end of the site and a stormwater retention basin.

Lot 565 in DP28914 is a 1.48ha parcel located to the southwest of the Precinct. The site is owned by the Office of Strategic Land (OSL), is generally level and contains Tennis Courts and an associated clubhouse building. The site is bounded to the east by Epping Road, to the south by community open space and to the west by an approximate 15m strip of trees and vegetation stretch.

Lot 11 DP1017829, Lot E DP28507, Lots 11, 12 & 13 in DP27851 and Lots 20 & 21 in DP1017829 make up the central precinct and are collectively known as the RTA Site. The site is made up of a mix of residential lots and dense bushland. This central precinct is bounded to the east by the M2 Motorway, to the north by Delhi Road, and to the southwest by Epping Road.

Lot 4 DP1131774 & Lot 160 DP1136651 are 1.3ha and 1.76ha in area respectively. They are located in the southeast of the site and are collectively named the North Ryde Station Site. The lots vary in elevation between reduced level (RL) 60m Australian Height Datum (AHD) in the north to the steep decrease to RL 48m AHD at the lowest point at the southern end. The site surrounds the newly constructed North Ryde Train Station and service buildings.The southern end previously contained the former Global Studios buildings which are now cleared. The site is bounded to the north by Delhi Road, to the west by the M2 Motorway and to the East by commercial/office buildings.

3 Proposed Development

This investigation has been undertaken on the basis of the supplied documentation, namely the Concept Plan prepared by the Transport Infrastructure Development Corporation (15 September 2009), plans prepared for the ING site (privately owned lands) by Nettleton Tribe (July 2010) and supplementary GFA and cadastral data provided by TCA on 1 November 2010.

The development proposal is for a number of mixed used residential/commercial/retail/open space precincts. The total yield of the project is estimated at approximately 311,828m² of residential floor area and approximately 55,000m² of commercial/retail area.

4 Methodology of Investigation

The following methodology has been adopted for this investigation:

- Background information provided by TCA was reviewed.
- The site was inspected to identify any obvious constraints and to gain an appreciation for topography, drainage and potential flooding issues.
- A "Dial before you dig" services search was undertaken.
- Cardno's in-house GIS data sets and Sydney Water's Hydra information were reviewed in order to compile cadastral data, current zoning information, topographic data, aerial photography, services information and other constraints published by LPMA.
- Documents on Ryde City Council's website were downloaded and reviewed.
- A site plan was compiled showing the location and size of all major services within and around the site.
- A meeting was held with the City of Ryde Council in order to obtain any available information on flood level / extent data, piped drainage network location and size, and where possible, Council's hydraulic model of the stormwater drainage system.
- Council's Macquarie Park Floodplain Management Study and Plan by Bewsher Consulting (April 2010) was reviewed to ascertain its relevance to the site.
- An electrical consultant (Connect Infrastructure) was engaged to advise on likely electrical servicing scenarios.
- The relevant service authorities were contacted for preliminary advice on likely service capacities in the immediate area.
- Based on the available services information, preliminary advice obtained from the service authorities and Cardno's experience with similar investigations, the extent to which the existing services would be likely to have capacity to service the development and the likely upgrade requirements were estimated.
- The above data was compiled and a series of maps indicating flooding and drainage constraints was prepared.
- Council's DCP 2010 was reviewed in order to determine its policies with respect to stormwater detention and water quality.
- A hydraulic model was created in the "Drains" modelling software in order to determine the future discharges from the site and the likely stormwater detention requirement. Post developed site discharges were reviewed in comparison to the existing infrastructure to estimate whether it is likely to have sufficient capacity or whether upgrades may be necessary.
- Suitable locations have been nominated for on-site detention systems, based on Council requirements, catchment characteristics and the use of the abovementioned Drains model.
- A MUSIC model was created for the site in order to establish the likely requirement for water quality treatment facilities and to recommend water sensitive urban design initiatives that would be suitable to the site, such as bio-retention and stormwater harvesting.

- A series of plans have been produced indicating the various spatial information compiled through the above process. These are included in Appendices A-G.

5 Utility Servicing Infrastructure

5.1 Sydney Water Servicing

The site falls within Sydney Water's identified "Major Infill Sites" in its Growth Servicing Plan. The Plan states of the corridor that "*The development can be serviced by connection to existing infrastructure. Sydney Water will need to deliver works to its trunk system to cater for the cumulative effect of development in the medium term*." It also indicates that it anticipates development of the site post 2015. Sydney Water's current interim policy for "Funding of works to service growth" (February 2010), states that for development progressed "in sequence" "Sydney Water will fund all water, wastewater, stormwater and recycled water works except for minimum sized reticulation, where the works align with Sydney Water's and the NSW Government's land release and development timetable."

The above indicates that sufficient capacity is available in the existing network surrounding the site, and provided that development occurred post 2015, Sydney Water would fund any necessary lead-in works or upgrades external to the site. This would however be subject to confirmation with Sydney Water via a formal application. In the absence of formal advice, we undertook a review of Sydney Water services within the area, as detailed below. A map showing all existing services information collected from the various agencies, including Sydney Water main locations and sizes is included in Appendix B.

5.2 Wastewater Infrastructure

As can be seen from the Services Plan, there is a significant amount of sewer infrastructure surrounding and within the site. For most of the site areas, connection to mains close to or within the sites will be possible. While it cannot be determined with certainty without detailed modelling by Sydney Water, based on the sizes of the existing mains, the fact that much of the site has been developed and serviced in the past and an approximation by Cardno of the sewer flow rates generated from the proposed development, it is likely that the existing mains will have capacity to service the site without any significant upgrade.

The possible exception to this is likely to be the servicing of the northernmost parcel, which may necessitate the construction of a 250mm diameter main from the site to the existing 900mm carrier, approximately 300m west of the site. If required however, it is likely that the extension would be funded by Sydney Water. This possible extension is indicated on the Services Plan contained in Appendix B.

5.3 Potable Water Infrastructure

The services plan also shows a significant network of potable water services in and around the site with mains of between 100mm and 200mm fronting all lots. These will likely provide a large proportion of potable water supply. However it is likely based on the size of the development and the proposal for high-rise buildings, that a watermain extension of a larger size will be required to provide sufficient pressures to the site. A possible scenario which would most likely provide ample capacity is the provision of a 300mm diameter watermain extension from an existing 750mm diameter main in Cox's Road. We have indicated the approximate location of this extension. As with sewer lead-ins, presuming that the development staging occurs in line with Sydney Water's nominated sequence (as discussed under Section 5.1), it is likely that any such extension, if required, would be funded by Sydney Water.

5.4 Electricity Infrastructure

Cardno engaged an electrical design consultant, Connect Infrastructure, to provide advice on likely electrical servicing requirements for the site and available supply sources. Based on the Preliminary Structure Plan (15 September 2009), Connect estimated the following electrical load generation:

- Precincts 2,3,4 and 5, commercial 4.53MVA, residential 4.06MVA, total = 8.49 MVA;
- Precinct 1; commercial 930kVA: residential 635kVA total = 1.56MVA
- ING lands, residential 1985kVA total = 1.98MVA
- Precinct 6, residential 374kVA total = 0.374MVA
- Precinct 7, residential 8640kVA total = 0.64MVA

Total load all precincts = 13.044MVA. Assuming a diversity factor of 0.8 then maximum demand would be in the order of 10.44MVA. This estimated load will require up to three (3) new 11kV feeders from a zone substation plus a minimum eleven (11) x 1MVA kiosk or indoor type substations.

Connect Infrastructure contacted Energy Australia with respect to available supply in the grid. While Energy Australia was not able to provide firm advice without a formal application and assessment, it was able to advise as follows:

The closest Zone Substation (ZS) available for connection is the Macquarie Park ZS, located at the corner of Waterloo Road and Eden Park Drive, approximately 300 m away from the site. This ZS is rated at 114 MVA, with current usage at 100MVA. (Connect believes that the 100MVA usage figure probably already allows for some development within the proposed development sites). Given that there is a new ZS proposed at Top Ryde and at Epping, that the Macquarie Park ZS is able to be upgraded and that the proposed development is likely to be staged, Energy Australia advised that connection to the Macquarie Park ZS would most likely be feasible. This would of course be subject to a formal application being made and assessed by Energy Australia in detail.

5.5 Telecommunications Infrastructure

Telstra has released a public statement regarding the supply of telecommunications to new development areas. Telstra has confirmed that it will no longer be supplying copper telephone cable to green field development sites. From 1st June 2010 Telstra will offer high speed fibre optic cabling to all new developments through its 'Velocity Package.' The provision of high speed broadband by Telstra would be developer funded.

Other options exist for developers in the supply of high speed broadband services, most notably through the National Broadband Network (NBN). The NBN is committed to the provision of fibre optic to 90% of existing Australian dwellings over the next 8 years. Installation of this network is free to existing residential areas however new release areas will be subject to developer funded costs. This has been the subject of lobbying to the Commonwealth by the Urban Development Institute of Australia (UDIA), which has argued that costs for new development sites should be no greater than those to already developed areas, on the basis that the market would be unfairly skewed otherwise.

Based on our recent discussions with representatives from the UDIA, we understand that the Commonwealth's current advice is that the pit and pipe network within new developments is to be funded by the developer, while the fibre within the site and lead-in (backhaul) works would be provided by the NBN, however at this stage there is no confirmation from the Commonwealth on timing of works by the NBN.

Given the location of the site within an existing highly developed area, it is likely that telecommunications services would be readily available, with the only probable question being in relation to the nature of the service provided and the funding arrangements.

5.6 Natural Gas Infrastructure

Appendix B indicates location of existing natural gas infrastructure in the vicinity of the site. Jemena was contacted for its advice on servicing for natural gas. Jemena's Neale Hilton advised that the existing High Pressure Secondary (1050kPa) network adjacent to this site currently has capacity to supply the proposed development. Mr Hilton also advised that pressure reduction station(s) from this gas main would be required to reduce the pressure to acceptable residential/light commercial use prior to reticulation to individual sites.

The advice from Jemena is attached in Appendix H.

6 Stormwater Drainage and Detention Storage Requirements

Cardno met with Guna Veerasingham and Austin Morris of City of Ryde Council on 7 October 2010 in order to discuss the development site with respect to the surrounding drainage infrastructure and flooding constraints. Council was able to provide a map indicating the location of its piped network, and pipe size data was also purchased from Council. Council advised that it was not in a position to supply its Drains model of the area. Accordingly, a Drains model representing the site itself was prepared in order to determine the discharges which would be generated from the developed site and the detention storage requirements. The pipe sizes indicated on Council's data sets were reviewed with respect to their approximate existing catchments and to allow an estimation as to whether they would be likely to provide sufficient capacity for discharge from the site (after routing through detention storage), or whether extensions to the downstream system would be required.

Appendix C shows the location of the existing drainage infrastructure and pipe sizes. Based on our review, it is considered that after the provision of detention storage, the existing piped drainage network would have capacity to collect runoff from the development site, except for the westernmost parcels, which would require extension of drainage lines to the site. This would probably be achieved by extending the drainage system located within the RTA service road, south-west of the Microsoft building.

Council Stormwater Detention Requirements

Council's DCP 2010, Part 8.2 – Stormwater Management, requires that any development which involves demolition and replacement of existing structures must ensure that the runoff from the site post development does not exceed that of "state of nature" conditions, and that this would need to be determined by hydraulic modelling. It also states that storage may be below ground, or above ground to a maximum depth of 1.2m (beyond which pool type fencing would be required). Above ground detention storage areas can typically be combined with water quality treatment areas, as further discussed below under "Water Quality Requirements". Below ground detention storage systems would be able to be located below roads, open space areas, car-parking areas or within building basements. These would logically be combined with rainwater tanks, however the exact locations will be subject to the detailed design process.

Based on Council's detention storage requirements, and taking account of the site areas, slopes and approximate impervious areas post development (assumed conservatively to be 85%), a Drains hydraulic model was prepared to establish approximate detention storage volumes required. These were split into precincts, as referenced on the Preliminary Structure Plan (15 September 2009) and are summarised below:

Figure 2 - ***Approximate Detention Storage Volumes and Areas per Precinct Based on Drains Modelling***

Precinct	Catchment Area	Pre-developed Discharge (Q100)	Post Developed Discharge (Q100)	Required Detention Storage Volume (cu.m)	Detention Storage Area (m^2) Assuming Average Depth of 0.8m
North Ryde Station Site	3.2 Ha	715 L/s	1,920 L/s	1,250	1,570
M2 Site	9.16 Ha	1,320 L/s	4,390 L/s	4,200	5,250
RTA Site	0.72 Ha	230 L/s	435 L/s	200	250
OSL Site	1.48 Ha	360 L/s	883 L/s	535	670

7 Water Quality Requirements and WSUD Opportunities

Water quality and Water Sensitive Urban Design (WSUD) have become common practice in the urban development industry and are required by most Councils. WSUD involves the design of development in a manner that is sensitive to the water cycle, and includes initiatives such as the reduction in the use of potable water, the encouragement of infiltration to groundwater, the capturing of stormwater for non-potable uses, the management of runoff quantities and frequencies from the site in a manner which replicates pre-development conditions and the management of the quality of runoff, in order to minimise detrimental impact on downstream waterways. WSUD can be achieved in by a variety of methods, and the suitable selection of a suite of treatments is generally dependent upon the particular constraints and proposed land-uses of each individual site.

Stormwater Harvesting

In the case of this site, there is a considerable opportunity to harvest and re-use rainwater and stormwater from the hardstand areas. This would likely consist of the collection of roof water and surface runoff in tanks, either above or below round. Above ground open storage is also possible, but generally not suitable for a high density urban site such as this. While toilet flushing is a suitable use for collected rainwater, in our experience, high density residential areas typically demand significantly more water for toilet flushing than can be collected from the footprint of the development. While this does not rule out the use of collected stormwater for toilet flushing with top-up by potable supply, other uses for rainwater exist, such as car-washing and irrigation. The nature of re-use would need to be further analysed at the detailed design stage, however it is likely to be found that the most efficient uses for the rainwater are for irrigation.

The collection and re-use of runoff is also beneficial to water quality (as further discussed below) and to the downstream receiving waters, by reducing the frequency of high velocity flows which impact on streambanks. Treatment of collected stormwater will be required prior to its re-use. This would typically include source control, such as gross-pollutant traps, bio-retention and sedimentation sumps, as well as filtration and UV treatment, depending on the collection system and the intended use.

Water Quality Treatment

Council's DCP 2010, Part 8.2 – Stormwater Management, nominates that quality of runoff from development sites is to be managed so as not to result in an adverse impact on downstream receiving waters. The DCP does not nominate specific treatment criteria, so in order to estimate the appropriate requirements for water quality treatment, a MUSIC model was prepared and the commonly adopted pollutant load reduction criteria of 80% total suspended solids, 65% total phosphorous and 45% total nitrogen was used as a target. This was again based on a conservative assumption of 85% imperviousness within the developed site. It was assumed that the treatment train would consist of gross pollutant traps and bio-retention areas.

The resulting areas of bio-retention calculated are summarised in the table below.

Figure 3 - ***Approximate Water Quality Treatment Areas per Precinct Based on MUSIC Modelling***

Precinct	Catchment Area	Required Water Quality Treatment Area (m^2)	Opportunity for Combined Detention Storage
North Ryde Station Site	3.2 Ha	700	Y
M2 Site	9.16 Ha	1,800	Y
RTA Site	0.72 Ha	170	Y
OSL Site	1.48 Ha	300	Y

Water quality can also be provided by the use of infiltration areas, wetlands and gross pollutant traps, or a combination of the four. Collection and re-use of water also improves quality by taking runoff “out of the system”. The use of wetlands within this site is unlikely to be suitable, due to the need for occupy large areas and also require flat sites with large catchments in order to be viable.

The areas calculated above provide a guide to the likely areas of bio-retention that would be required as part of the site’s overall water quality treatment strategy. It would be recommended that for this site, the co-location of above-ground detention storage areas and bio-retention areas would be suitable in some of the areas, most notably, the low-lying area at the northern end of the site, near Wicks Road. This area is a suitable location for both of these uses due to it being located at the bottom end of one of the site’s most significant catchments. There is also an opportunity to combine the installation of water quality / quantity treatment areas with the rehabilitation of the heavily degraded vegetation surrounding Porters Creek.

8 Flooding

Cardno obtained from Council's website maps indicating the simulated flood events for November 1984 and February 1990 over the site and its surrounds. These indicated various flood affectation within the site, however in some cases did not appear to be consistent with expectations when viewed within the context of site topography. Council advised that these maps had not been rationalised and as such should not be used as a reliable source of flood data.

Council provided a flood map for the site indicating low, medium and high flood risk precincts determined from the Bewsher Macquarie Park Floodplain Management Study & Plan (April 2010). Council indicated that the low, medium and high flood precincts related to the Probable Maximum Flood (PMF), 1 in 10 year (or 1% AEP) flood and areas of high depth or velocity respectively. Council emphasised that this information was in a draft format at this stage. The flood data was digitised by Cardno and mapped over the site. The main areas of flood affectation can be seen to be within the vicinity of Porters Creek, adjacent to Wicks Road. This is consistent with our expectations, given the topography of the site.

This flood data has been added to the Constraints Map.

Council advised that it was not in a position to provide a copy of the full report as it was yet to be publically exhibited, however it is understood from discussions with Council that the key findings of the report were the establishment of flood extents discussed above.

There is also a small amount of flood affectation identified at the southern site of the North Ryde Station Site (Lot 160 DP1136651). While there may be some localised drainage issues in the area, given the significant drop to the M2 motorway directly south of the identified flooding, it is not considered that this identified flood affectation would pose a significant constraint, and would most likely be found to be of little consequence with more detailed flood modelling and the design of a drainage system suitable for the development.

9 Porters Creek and Riparian Corridor

Under existing legislation (the Water Management Act 2000), approval is required from the NSW Office of Water (NOW) to carry out works within 40m of a watercourse. Typically, NOW requires that any development around these watercourses would require the establishment of a riparian corridor and vegetation buffer around the watercourses to protect and enhance their environmental function. The width of these corridors is subject to the type of watercourse (broadly nominated as category 1, 2 or 3 streams) and varies between 20 and 80 metres on either side of the stream.

Porters Creek is cuts across the northern end of the site, adjacent to Wicks Road. The NOW database "NSW Stream Order Dataset (2009)" was reviewed over the site area. The database does not identify this section of Porters Creek as a watercourse. While the creek has defined banks, it appears from aerial photography that it is piped further downstream and its vegetation does not connect to upstream or downstream vegetation; both factors which would limit its ecological value and are consistent with its not being categorised.

It is understood however that TCA intends to retain and enhance existing vegetation around the creek, and as such, the NOW requirements for riparian corridor rehabilitation would serve as an appropriate guide. There is an existing Part 3A Permit (now known as a "Controlled Activity Permit") to carry out crossing works at Porters Creek as part of the Epping to Chatswood Rail Link, however this would not cover any further works proposed as part of a new development application.

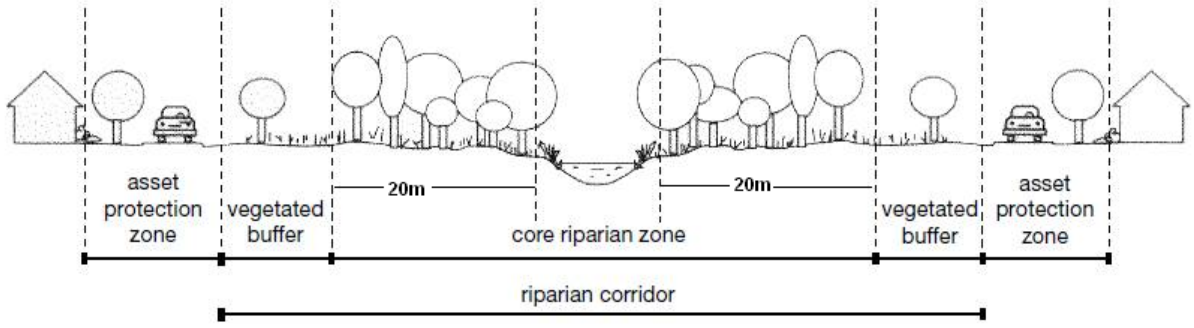
Two categories of first order streams exist, permanent and non-permanent. Based on our site inspection, the creek appears to be a perennial stream.

If the creek was categorised as a watercourse by NOW, a Controlled Activity Permit would be required for any works within 40m of its banks and NOW would typically impose the following requirements:

- a core riparian zone of 20m within which development works are precluded;
- a vegetated buffer of 10m beyond the core riparian zone;
- an asset protection zone (APZ) beyond these to manage bushfire risk. The APZ can contain roads and other infrastructure, but not residential buildings;

The figure below provides a schematic indication of these requirements.

Figure 4 - ***Figure 4. Riparian Corridor Guidelines DECCW***



The APZ width, based on our experience, is likely to be around 25-30m.

We have indicated the likely riparian corridor widths and associated APZ on the constraints maps. While the creek is not currently categorised by NOW as a watercourse, it is likely that a permit from NOW would still be required.

Because the creek is not identified as a watercourse, there is likely to be some flexibility in regards to constructing detention storage and water quality treatment areas within the corridor. As discussed under “Water Quality Requirements and WSUD Opportunities”, there is a significant opportunity to combine rehabilitation of the vegetated area around Porters Creek with water quality and quantity treatment areas, given its location within the catchment. The benefits of such an approach will be the ability to create a sustainable feature within the site which protects the downstream environment, is aesthetically pleasing, can be used by the community and enhances the ecological value of the currently degraded area.

10 Constraints Mapping

A constraints map was prepared which indicates the constraints identified through this investigation. These include:

- Flood extents
- Watercourses
- Riparian corridor requirements
- Asset protection zones
- Contour data
- Aerial photography

The constraints map is included in Appendix D.

11 Limitations of this Investigation

This investigation has been prepared in order to provide advice on the servicing of the site, to identify constraints and opportunities with respect to flooding and drainage issues. Additionally, other physical and planning constraints obtained from Cardno's in-house database were compiled in order to present an indicative constraints map. The investigation has been prepared for the following purposes:

- To confirm the availability of services to the site and to estimate the likely upgrade requirements.
- To support the application to the Minister for the declaration of the site as a State Significant Site by providing data and advise regarding civil engineering and servicing issues.
- To inform the masterplanning process by advising on constraints and opportunities.

The report is based on a review of various datasets, review of publically available documents and existing reports, preliminary advice from various servicing authorities and Council and our engineering judgement regarding likely development requirements. As the development investigation progresses, this information should be further investigated and confirmed via a detailed investigation, formal applications to the various service authorities and formal dialogue with Council. This report should not be used for the purposes or detailed design or construction cost estimates.

12 Conclusion

This investigation was undertaken in order to determine constraints and opportunities relating to the site with respect to utility services, flooding and drainage, as well as to provide advice on water cycle management requirements. The investigation has concluded the following:

- All major services, including water, sewer, gas, electrical and telecommunications are currently available at or close to the site and have the capacity to service the site without the need for major trunk upgrades.

- No significant engineering constraints were identified within the site, except for the presence of flood affectation associated with Porters Creek. It is understood that the masterplanning process has considered the flood affectation within the layout.

- Stormwater detention storage will be required in accordance with Council's DCP 2010. The detention storage can be accommodated within the site via a combination of above ground storage areas and below ground tanks. Detention storage volumes have been calculated as part of this investigation and the required volumes have been incorporated into the masterplanning process.

- There are opportunities to implement water sensitive urban design (WSUD) practices within the site. The elements of WSUD considered most appropriate for the site would consist of the capture and re-use of roof-water and runoff for irrigation purposes, and the use of bio-retention areas in conjunction with above ground detention storage areas, allowing for the integration of landscaping, water quality and water quality functions. Approximate areas of bio-retention treatment required to meet prescribed treatment levels have been calculated an incorporated into the masterplanning process.

- Porters Creek would most likely not require the provision of riparian corridors under legislation, however an opportunity exists to rehabilitate the vegetation around the creek and to integrate the revegetation with stormwater quality and quantity treatment facilities. This will be investigated further as part of the Concept Plan and the Environmental Assessment.

Appendix A

Site Plan

Lot and DP	Area (ha)
4//1131774	1.30
160//1136651	1.76
565//28914	1.48
E//28507	0.05
11//27851	0.05
12//27851	0.06
100//1131776	1.72
101//1131776	7.44
11//1017829	0.10
20//1017829	0.01
21//1017829	0.01

Transport Construction Authority
NSW GOVERNMENT

Site Plan

M2 & DELHI ROAD
NORTH RYDE PROJECT

Legend

- Precincts (13.98ha)
- Major Roads (LPMA)
- Watercourse (LPMA)
- 10m Contours (LPMA)
- Cadastre (LPMA)
- Waterbodies (LPMA)
- LGA Boundary (LPMA)

Note: Data shown on this map has been sourced from various agencies and other information available at the time of production. It should be used for general, high level and indicative purposes only. Cardno does not warrant that the data is complete or accurate. Cardno recommends that further investigations be carried out if the data is to be used for project feasibility purposes.

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Scale 1:5,000 (at A3)

Metres
0 50 100 150 200 250

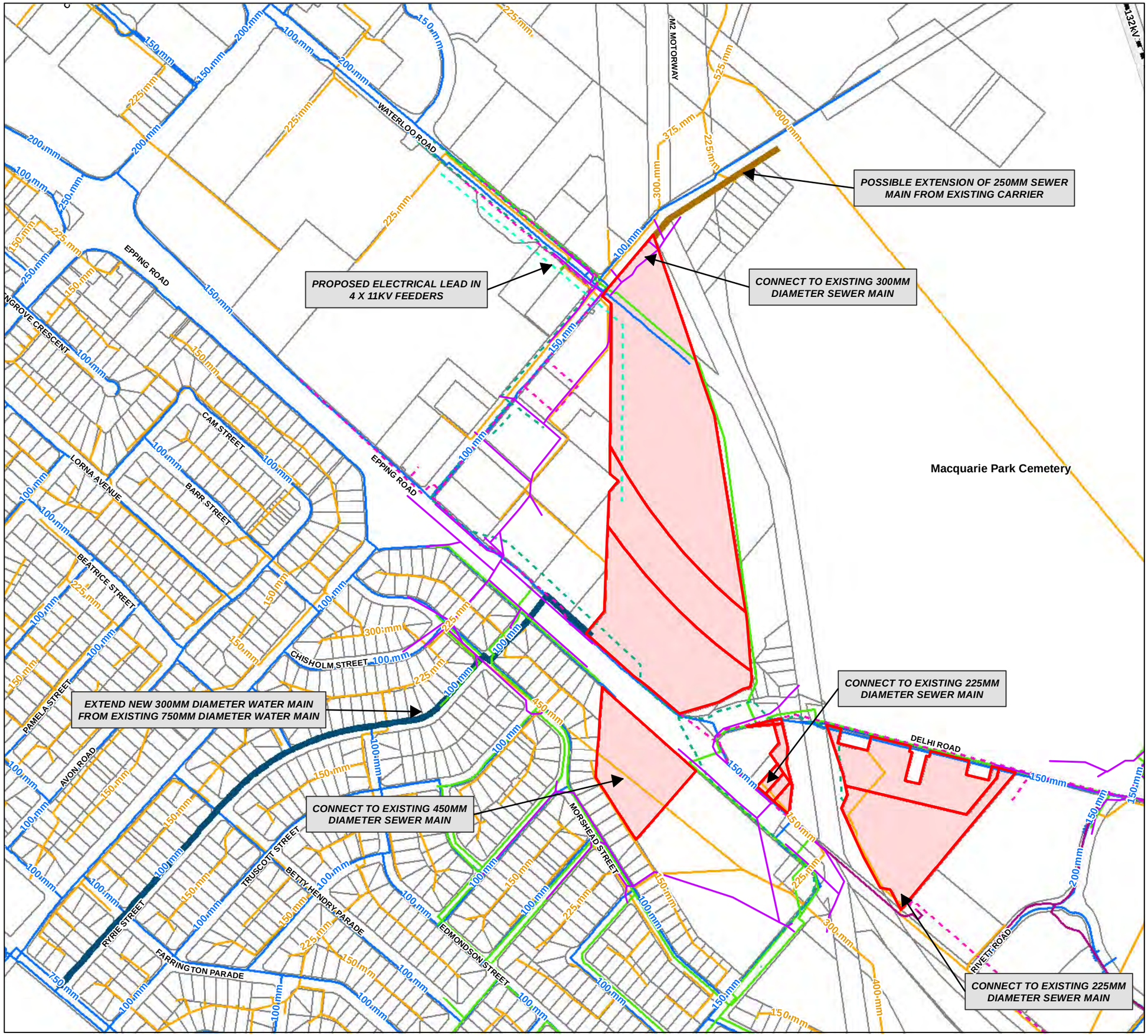
Cardno

Map Produced by Cardno Wollongong
Date: 26/11/2010
Coordinate System: GDA 1994 MGA Zone 56
Project: 211063-002
Map: 1801_SitePlan.mxd 12

Aerial imagery supplied by Near Maps
(Sept 2010) and associated third party suppliers

Appendix B

Services Plan



Transport Construction Authority

NSW GOVERNMENT

Services Plan

M2 & DELHI ROAD
NORTH RYDE PROJECT

Legend

- Precincts
- Sewer Pumping Station (Sydney Water)
- UECOMM
- Non AAPT/PowerTel Asset
- AAPT/PowerTel Asset
- Gas Main (Jemena)
- Stormwater (Ryde City Council)
- Watermain (Sydney Water)
- Sewermain (Sydney Water)
- Possible Water Extension
- Possible Sewer Extension
- Proposed Electrical Lead In 4x11kV Feeders
- Electricity Transmission Line (LPMA)
- Easement (LPMA)
- Cadastre (LPMA)
- Waterbodies (LPMA)
- LGA Boundary (LPMA)

UECOMM and AAPT/PowerTel services information from Dial Before You Dig Request (27-9-2010) Sequence Number 19578298

Note: Data shown on this map has been sourced from various agencies and other information available at the time of production. It should be used for general, high level and indicative purposes only. Cardno does not warrant that the data is complete or accurate. Cardno recommends that further investigations be carried out if the data is to be used for project feasibility purposes.

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Scale 1:5,000 (at A3)

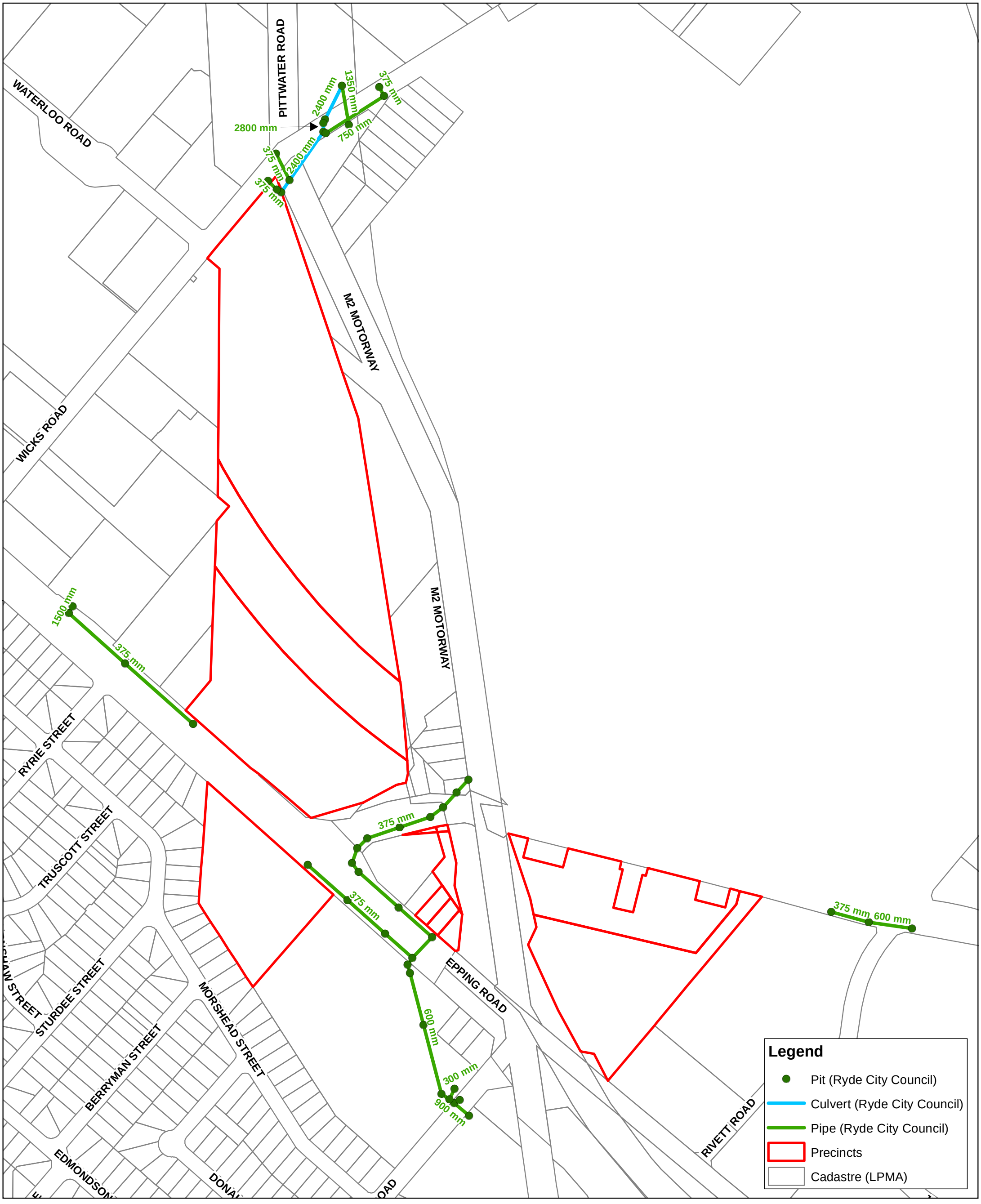
Metres
0 50 100 150 200 250

Cardno

Map Produced by Cardno Wollongong
Date: 26/11/2010
Coordinate System: GDA 1994 MGA Zone 56
Project: 211063-002
Map: 1803_ServicesPlan.mxd 12

Appendix C

Council Pipe Size Data



Transport Construction Authority
NSW GOVERNMENT

Scale 1:3,500 (at A3)

Metres
0 50 100 150 200

Pipe Locations

M2 & DELHI ROAD
NORTH RYDE PROJECT

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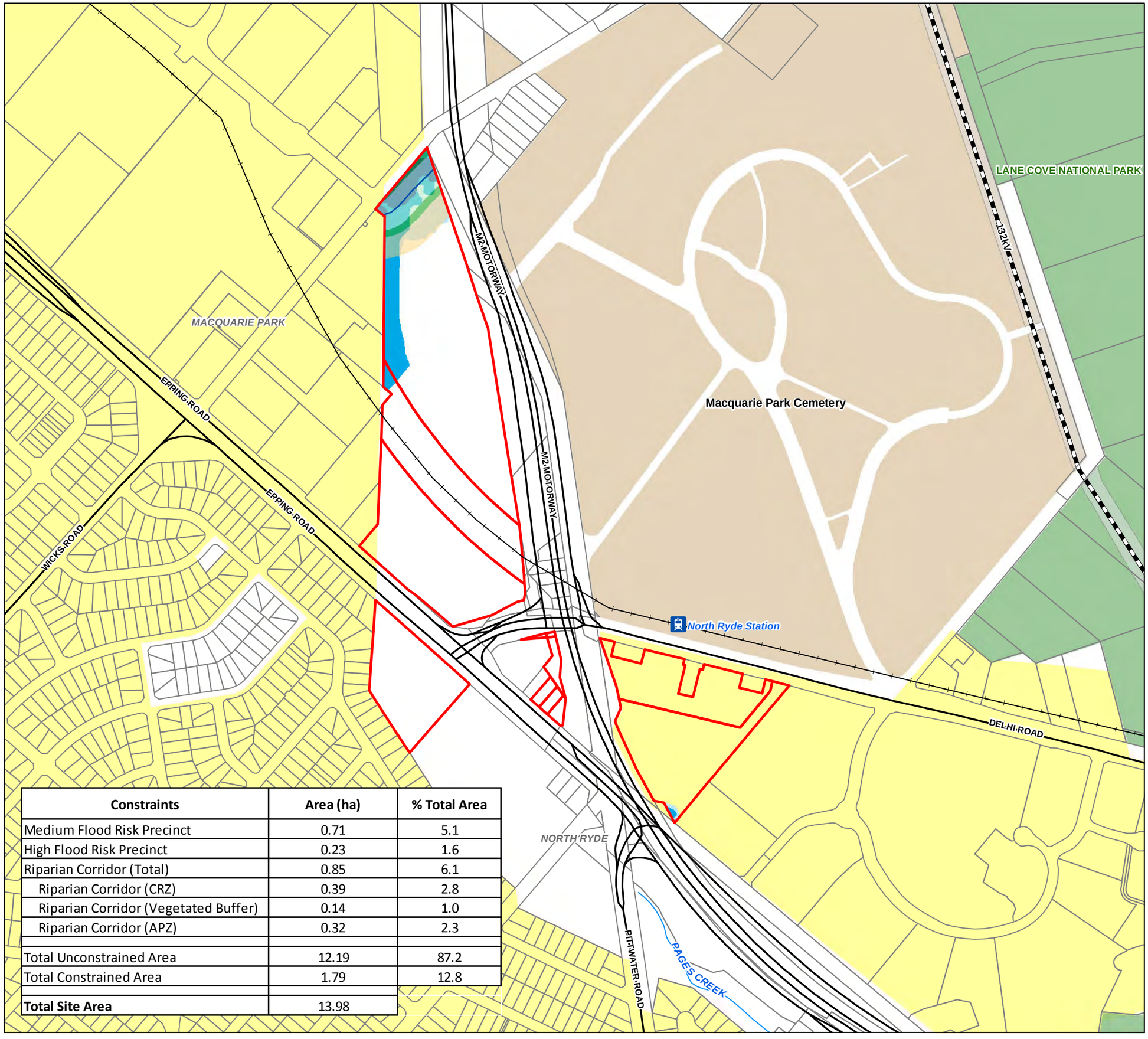
Cardno

Map Produced by Cardno Wollongong
Date: 26/11/2010
Coordinate System: GDA 1994 MGA Zone 56
Project: 211063-002 Map: 1807_PipeLocations.mxd 06

Note: Data shown on this map has been sourced from various agencies and other information available at the time of production. It should be used for general, high level and indicative purposes only. Cardno does not warrant that the data is complete or accurate. Cardno recommends that further investigations be carried out if the data is to be used for project feasibility purposes.

Appendix D

Constraints Map



Constraints	Area (ha)	% Total Area
Medium Flood Risk Precinct	0.71	5.1
High Flood Risk Precinct	0.23	1.6
Riparian Corridor (Total)	0.85	6.1
Riparian Corridor (CRZ)	0.39	2.8
Riparian Corridor (Vegetated Buffer)	0.14	1.0
Riparian Corridor (APZ)	0.32	2.3
Total Unconstrained Area	12.19	87.2
Total Constrained Area	1.79	12.8
Total Site Area	13.98	

Transport Construction Authority

Constraints Plan

M2 & DELHI ROAD
NORTH RYDE PROJECT

Legend

- Precincts
- Railway Station (Epping to Chatswood Line)
- Major Roads (LPMA)
- Watercourse (LPMA)
- Indicative Drainage Line
- Approximate Railway Tunnel Alignment
- Electricity Transmission Line (LPMA)
- Cadastre (LPMA)
- Easement (LPMA)
- LGA Boundary (LPMA)
- Built Up Areas (LPMA)
- NPWS Reserve (LPMA)

Crown Land (LPMA)

- Crown Parcel

Drainage Line Riparian

- 20m Core Riparian Zone
- 10m Vegetated Buffer
- 30m APZ

Macquarie Park FRMS (April 2010)

- Low Risk
- Medium Risk
- High Risk

Note: Data shown on this map has been sourced from various agencies and other information available at the time of production. It should be used for general, high level and indicative purposes only. Cardno does not warrant that the data is complete or accurate. Cardno recommends that further investigations be carried out if the data is to be used for project feasibility purposes.

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Scale 1:5,000 (at A3)

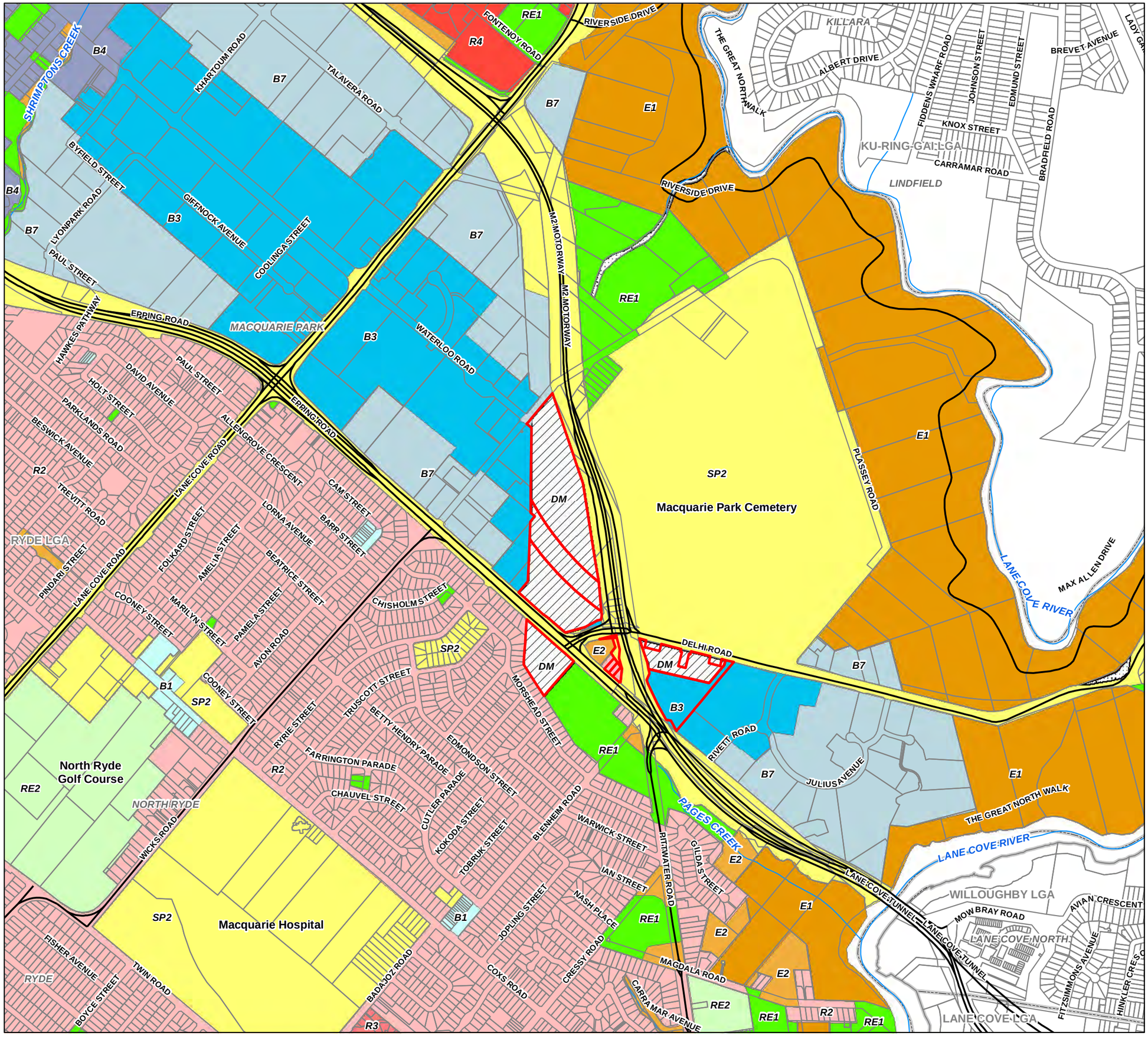
Metres
0 50 100 150 200 250

Cardno

Map Produced by Cardno Wollongong
Date: 26/11/2010
Coordinate System: GDA 1994 MGA Zone 56
Project: 211063-002
Map: 1804_ConstraintsPlan.mxd 10

Appendix E

Zoning Plan



Current Zoning Plan

M2 & DELHI ROAD
NORTH RYDE PROJECT

Legend

- Precincts
- Major Roads (LPMA)
- Watercourse (LPMA)
- Cadastre (LPMA)
- LGA Boundary (LPMA)

Ryde LEP (2010)

- Deferred Matters (Subject to Ryde PSO)
- UL - Unzoned Land
- B1 - Neighbourhood Centre
- B3 - Commercial Core
- B4 - Mixed Use
- B7 - Business Park
- E1 - National Parks and Nature Reserves
- E2 - Environmental Conservation
- R2 - Low Density Residential
- R3 - Medium Density Residential
- R4 - High Density Residential
- RE1 - Public Recreation
- RE2 - Private Recreation
- SP2 - Infrastructure

Note: Data shown on this map has been sourced from various agencies and other information available at the time of production. It should be used for general, high level and indicative purposes only. Cardno does not warrant that the data is complete or accurate. Cardno recommends that further investigations be carried out if the data is to be used for project feasibility purposes.

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Scale 1:10,000 (at A3)

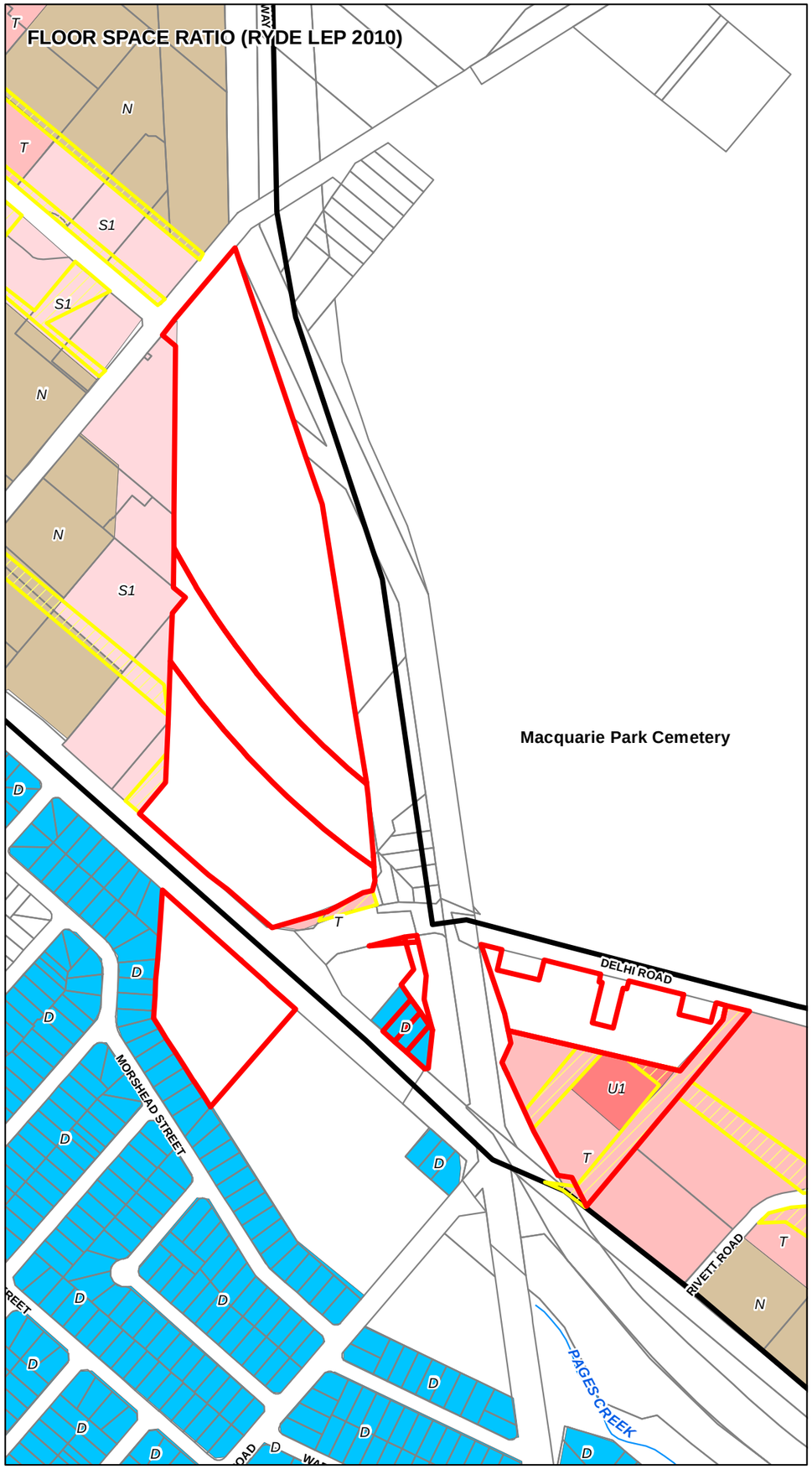
Metres
0 100 200 300 400 500

Map Produced by Cardno Wollongong
Date: 26/11/2010
Coordinate System: GDA 1994 MGA Zone 56
Project: 211063-002
Map: 1802_ZoningPlan.mxd 10

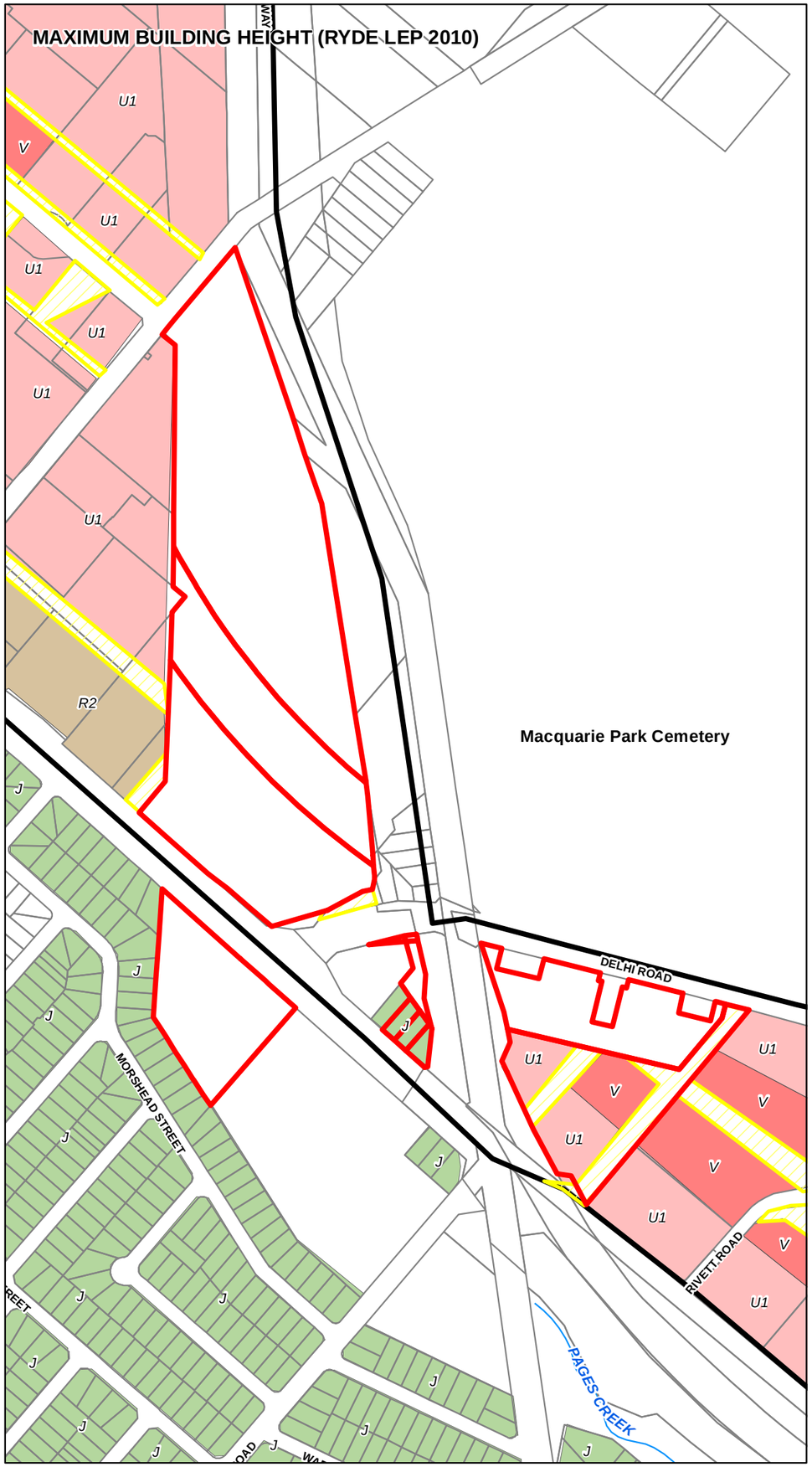
Appendix F

Ryde LEP Information

FLOOR SPACE RATIO (RYDE LEP 2010)



MAXIMUM BUILDING HEIGHT (RYDE LEP 2010)



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Additional LEP Information

M2 & DELHI ROAD
NORTH RYDE PRECINCT

Legend

- Precincts
- Cadastre (LPMA)
- Watercourse (LPMA)
- LGA Boundary (LPMA)

Macquarie Park Access

- Macquarie Park Corridor
- Proposed Access

Floor Space Ratio (n:1)

- D - 0.5
- N - 1
- S1 - 1.5
- T - 2
- U1 - 2.5

Maximum Building Height

- J - 9.5m
- R2 - 22m
- U1 - 30m
- V - 37m

Note: Data shown on this map has been sourced from various agencies and other information available at the time of production. It should be used for general, high level and indicative purposes only. Cardno does not warrant that the data is complete or accurate. Cardno recommends that further investigations be carried out if the data is to be used for project feasibility purposes.

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Scale 1:5,000 (at A3)

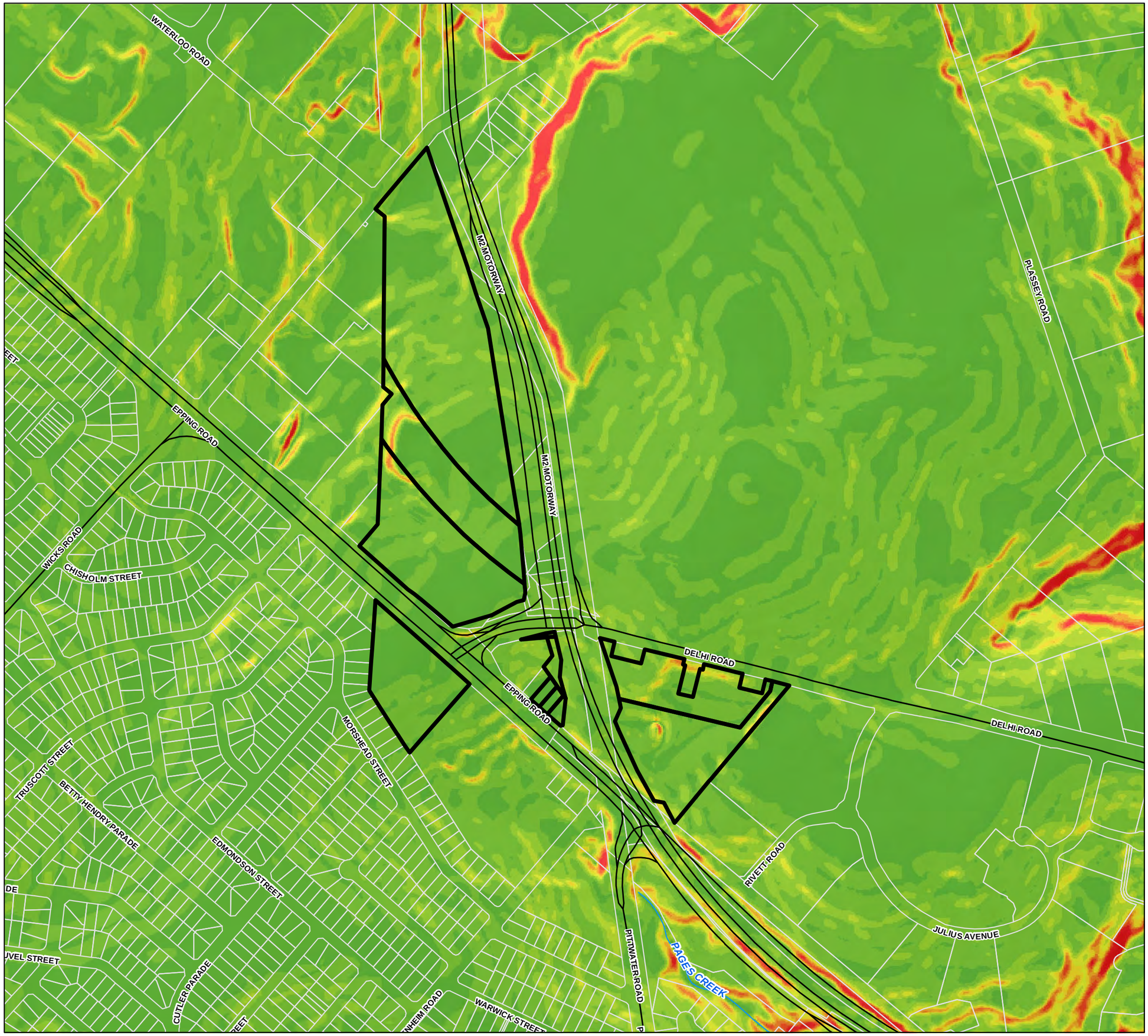
Metres
0 50 100 150 200 250

Cardno

Map Produced by Cardno Wollongong
Date: 26/11/2010
Coordinate System: GDA 1994 MGA Zone 56
Project: 211063-002
Map: 1806_RydeLEP_Information.mxd 07

Appendix G

Slope Analysis



Transport Construction Authority
NSW GOVERNMENT

Slope Analysis

M2 & DELHI ROAD
NORTH RYDE PROJECT

Legend

- Precincts
- Major Roads (LPMA)
- Watercourse (LPMA)
- Cadastre (LPMA)

Slope (Percent) from 2m Contours (LPMA)

- 0 - 5 %
- 5 - 10 %
- 10 - 15 %
- 15 - 20 %
- 20 - 25 %
- 25 - 30 %
- 30 - 35 %
- 35 - 40 %
- 40 - 45 %
- > 45 %

Note: Data shown on this map has been sourced from various agencies and other information available at the time of production. It should be used for general, high level and indicative purposes only. Cardno does not warrant that the data is complete or accurate. Cardno recommends that further investigations be carried out if the data is to be used for project feasibility purposes.

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Scale 1:5,000 (at A3)

Metres
0 50 100 150 200 250

Cardno

Map Produced by Cardno Wollongong
Date: 26/11/2010
Coordinate System: GDA 1994 MGA Zone 56
Project: 211002_03
Map: 1805_SlopeAnalysis.mxd 08

Appendix H

Jemena Advice

David Pitronaci (Sydney)

From: Hilton, Neale [Neale.Hilton@jemena.com.au]
Sent: Monday, 11 October 2010 5:24 PM
To: David Pitronaci (Sydney)
Subject: RE: North Ryde

Thanks David,
I am aware of this site as previous enquiries have come specifically relating to the areas 2,3,4,5 beside the M2. The existing High Pressure Secondary (1050kPa) network adjacent to this project currently has capacity to supply this proposal. Pressure reduction station(s) from this gas main would be required to reduce the pressure to acceptable residential/light commercial use prior to reticulation to individual sites. Costs are not available at this early stage until known gas loads and specific connection locations are determined. Please note that capacity is not reserved for any individual project.

Neale Hilton
Network Development Manager
Sydney

Jemena Gas Networks (NSW) Limited
Address Level 20, 111 Pacific Highway North Sydney NSW 2060
Postal Address Locked Box 2/159 Ridgecrop Drive Castle Hill 2154
Mobile 0402 060 151 Fax (02) 9899 3571 Email neale.hilton@jemena.com.au

thenaturalchoice.com.au

From: David Pitronaci (Sydney) [mailto:David.Pitronaci@cardno.com.au]
Sent: Monday, 11 October 2010 1:33 PM
To: Hilton, Neale
Subject: North Ryde

Level 3, Cardno Building
910 Pacific Highway Gordon NSW 2072
Tel:+61 2 9496 7700 Fax:+61 2 9499 3902

Neale

As discussed, please see attached site plan along with possible densities. I have also attached the DBYD info we received.

If you could call me to discuss when you have had a look it would be appreciated.

Please also note that the project is still confidential at this stage.

Thanks

David Pitronaci
Manager - Urban and Transport

Phone: +61 2 9496 7700
Fax: +61 2 9499 3902
Email: David.Pitronaci@cardno.com.au
Web: www.cardno.com.au

Appendix I

Drains Modelling Results

M2 AND DELHI ROAD - NORTH RYDE PROJECT

DRAINS DATA AND RESULTS

DETENTION BASIN DETAILS

Name	Volume (cu.m)	MaxVol (cu.m)	Max Q (cu.m/s)
Basin 1 + ING	1250	1139.4	0.709
Basin 2-5	4200	4107.9	1.228
Basin 6 & 8	200	185.7	0.21
Basin 7	535	446.5	0.357

SUB-CATCHMENT DETAILS - DATA

Name	Total Area (ha)	Paved Area %	Grass Area %	Paved Length (m)	Grass Length (m)	Paved Slope (%)	Grass Slope (%)	Paved Roughness	Grass Roughness
PRE Site 1 + ING	3.32	0	100	280	280	3.6	3.6	0.015	0.3
POST Site 1 + ING	3.32	85	15	280	280	3.6	3.6	0.015	0.3
PRE Site 2-5	9.16	0	100	660	660	3.3	3.3	0.015	0.3
POST Site 2-5	9.16	85	15	660	660	3.3	3.3	0.015	0.3
PRE Site 6 & 8	0.72	0	100	130	130	5.3	5.3	0.015	0.3
POST Site 6 & 8	0.72	85	15	130	130	5.3	5.3	0.015	0.3
PRE Site 7	1.48	0	100	140	140	1.5	1.5	0.015	0.3
POST Site 7	1.48	85	15	140	140	1.5	1.5	0.015	0.3

SUB-CATCHMENT DETAILS - RESULTS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Due to Storm
PRE Site 1 + ING	0.712	0	0.712	8.31	50.14	AR&R 100 year, 1.5 hours storm, average 66.4 mm/h, Zone 1
POST Site 1 + ING	1.916	1.879	0.036	4.91	29.63	AR&R 100 year, 5 minutes storm, average 247.4 mm/h, Zone 1
PRE Site 2-5	1.324	0	1.324	15.22	91.83	AR&R 100 year, 2 hours storm, average 56.5 mm/h, Zone 1
POST Site 2-5	4.394	4.28	0.124	10.46	63.14	AR&R 100 year, 20 minutes storm, average 144.1 mm/h, Zone 1
PRE Site 6 & 8	0.228	0	0.228	4.27	25.78	AR&R 100 year, 1 hour storm, average 82.9 mm/h, Zone 1
POST Site 6 & 8	0.435	0.421	0.014	2.76	16.65	AR&R 100 year, 5 minutes storm, average 247.4 mm/h, Zone 1
PRE Site 7	0.358	0	0.358	6.52	39.36	AR&R 100 year, 1 hour storm, average 82.9 mm/h, Zone 1
POST Site 7	0.883	0.865	0.019	4.21	25.42	AR&R 100 year, 5 minutes storm, average 247.4 mm/h, Zone 1

PIPE DETAILS

From	Slope (%)	Dia (mm)	Max Q (cu.m/s)	Max V (m/s)	Due to Storm
Basin 1 + ING	1	525	0.709	3.3	AR&R 100 year, 2 hours storm, average 56.5 mm/h, Zone 1
Basin 2-5	1	600	1.228	4.3	AR&R 100 year, 2 hours storm, average 56.5 mm/h, Zone 1
Basin 6 & 8	1	300	0.21	3	AR&R 100 year, 1.5 hours storm, average 66.4 mm/h, Zone 1
Basin 7	1	375	0.357	3.2	AR&R 100 year, 2 hours storm, average 56.5 mm/h, Zone 1

Appendix J

MUSIC Modelling Results

M2 AND DELHI ROAD - NORTH RYDE PROJECT

MUSIC DATA AND RESULTS

Site 1 + ING

	sources	resid load	% reduction
Flow (ML/yr)	31.1	31.1	0
Total Suspended Solids (kg/yr)	6.15E+03	614	90
Total Phosphorus (kg/yr)	12.6	3.07	75.7
Total Nitrogen (kg/yr)	89.6	48.4	45.9
Gross Pollutants (kg/yr)	752	0	100

Bio-Retention

Surface Area	700	sqm
Filter Area	550	sqm

Site 2-5

	sources	resid load	% reduction
Flow (ML/yr)	85.8	85.9	0
Total Suspended Solids (kg/yr)	1.70E+04	1.66E+03	90.3
Total Phosphorus (kg/yr)	34.9	8.45	75.8
Total Nitrogen (kg/yr)	245	132	46.2
Gross Pollutants (kg/yr)	2.07E+03	0	100

Bio-Retention

Surface Area	1800	sqm
Filter Area	1550	sqm

Site 6 & 8

	sources	resid load	% reduction
Flow (ML/yr)	6.75	6.75	0
Total Suspended Solids (kg/yr)	1.37E+03	149	89.2
Total Phosphorus (kg/yr)	2.8	0.681	75.7
Total Nitrogen (kg/yr)	19.3	10.5	45.4
Gross Pollutants (kg/yr)	163	0	100

Bio-Retention

Surface Area	170	sqm
Filter Area	100	sqm

Site 7

	sources	resid load	% reduction
Flow (ML/yr)	13.9	13.9	0
Total Suspended Solids (kg/yr)	2.80E+03	301	89.2
Total Phosphorus (kg/yr)	5.72	1.42	75.2
Total Nitrogen (kg/yr)	39.7	21.7	45.3
Gross Pollutants (kg/yr)	335	0	100

Bio-Retention

Surface Area	300	sqm
Filter Area	220	sqm

TOTAL Bio-Retention

Total Surface Area	2970	sqm
Total Filter Area	2420	sqm